

CLOUD COMPUTING: A TOOL FOR EFFECTIVE TEACHING AND LEARNING PROCESS IN UNPRECEDENTED CONDITIONS

By

ELA DISEPH

*Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt
Department of Curriculum Studies/Instructional Technology Educational
Technology Option*

Abstract

In a world of uncertainties, where organizations, institutions and individuals are threatened with challenges of insecurity, rape, kidnap, and diseases like covid-19, both teachers and students tend to teach and learn in fear. The advent of covid-19 made institutions adopt more pragmatic approaches to teaching and learning. Therefore, this paper examines cloud computing: a tool for effective teaching and learning process in unprecedented conditions. It is concluded that the major benefits derived from the use of cloud computing in Nigerian Universities include enhanced availability, which is the most important factor driving most Universities in Nigeria to adopt cloud computing, followed by cost efficiency, reduced IT complexities, low environmental impact, scalability, mobility, and reduced investment in physical assets in a cloud environment increased operability. However, it is recommended that cloud service providers increase their public awareness campaigns aimed at informing the public about the advantages and hazards of cloud adoption by Nigerian businesses.

Key words: Cloud computing, Unprecedented Conditions, Cloud Computing Integration

Introduction

Cloud computing, facilitated by information and communication technology (ICT), is a powerful enabler of educational change and reform, allowing for the introduction of new teaching and research methods as well as the provision of educational facilities for online learning, teaching, and research collaboration (Fagbola, 2015). Cloud computing is a conformable tool that can solve the challenges of uncertainties of insecurity and pandemic diseases like covid-19 that have posed a threat to the conventional way of teaching/learning. Since 2012, from the Global Peace Index (GPI), Nigeria has dramatically experienced a consistent ranking of low peace. According to

Adagba, et al. (2012), Uhumwuangho, and Aluforo (2011), the government's attempts to reduce insecurity have not achieved enough beneficial results.

The covid-19 disease has constituted a major Public Health Challenge not just in Nigeria but in the whole world resulting in lockdowns and closure of education institutions across the globe. Insecurity and covid-19 have caused real interferences in the Nigerian education system. Therefore, this paper presents Cloud-Computing as a tool for effective teaching and learning in an unprecedented situation as a lasting solution to these challenges.

Review of Literature

Origin of cloud computing

Cloud computing, which sprang from the Internet and the web, ushers in a new age of computing by altering the way we work, think, do business, and connect throughout the world. It is a practical innovation that comprises cloud computing service providers renting common business apps or services online to customers on a pay-as-you-go or subscription basis (Nnadozie, 2013).

Computing as we know it began in the 1960s with mainframe data centre computing (pay-per-use method). This was quickly followed by personal/minicomputer computing, at which time computers were widely available and inexpensive. Following that, we entered the Client-Server computing era, which was characterized by distributed network computing. The origins of cloud computing may be traced back to August 24, 2006, when Amazon publicly tested its Elastic Computing Cloud (EC2) with the goal of providing developers with an infrastructure that could be rented to suit their IT requirements (T-Systems, 2011).

The phrase cloud computing, on the other hand, gained widespread in 2007 when it was first used in the English Wikipedia on March 3, 2007. Today, network virtualization has aided the emergence of cloud computing by allowing a dynamic data centre to offer a pool of resources that customers may use as required to match their workloads and changing business needs.

Concept of cloud computing

After the personal computer (PC) and the internet, the third (3rd) technological revolution, known as cloud computing, was born as a result of logical, architectural developments and conceptual, in grid computing, internet, networking, and (Mehmet and Serhat, 2011). Cloud computing may be defined

as a three-tiered platform for delivery, development, and application (Anjali & Pandey, 2013; Sclater, 2010).

1. **Delivery Platform:** A delivery platform, such as Amazon Elastic Cloud, employs on-demand cloud-based infrastructure to install infrastructure or applications.
2. **On-Demand:** A general-purpose programming language is provided by the on-demand cloud-based development environment (for example, Google sites, Coghead, Bungee Labs).
3. **Application platform:** It is used to create and deliver end-user applications as an application platform (for example, Google docs, NetSuite, Cisco-WebEx and Salesforce.com,).

The phrase "**cloud computing**," on the other hand, has become a prominent marketing phrase that requires clarification via appropriate definitions. Only four will be examined in this paper out of numerous. Cloud computing, according to Olabiyisi et al. (2012), is a ubiquitous, flexible, on-demand network access to a shared pool of customizable computing resources (for example, data centres, servers, applications, networks, and services) that may be promptly delivered and released with minimum engagement from the service provider or administration. It is in tremendous demand as it provides dynamic, self-service, shared infrastructure, and virtualized pay-per-use platforms. "Computing via the Internet, is opposed to computing on a desktop. This definition only succeeds in admitting cloud computing's dependency on the Internet. Cloud computing, according to (Cisco 2009), is "IT resources and services abstracted from the underlying infrastructure and offered "on-demand" and "at scale" in a multitenant environment." This statement emphasizes three (3) basic aspects of cloud computing: on-demand, at scale, and multi-tenancy. Cloud computing, according to Accenture (2011), is "the dynamic provision of IT capabilities (services, software, or hardware,) from third parties over a network." Cloud computing's on-demand, multitenant and at-scale, qualities is represented in this statement.

However, the US National Institute of Standards and Technology (NIST, 2016) defined cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. servers, services, networks, applications, and storage) that can be rapidly released and provisioned with minimal management effort or serendipity" in 2011. Among all of these definitions, most authors agree that cloud computing

is an internet-based on-demand service based on the notion of resource sharing.

During each time interval, some customers commence access, demanding the cloud provider's service, while others terminate access, releasing previously held resources. Other customers, on the other hand, may be fully involved with the services they demand from the service provider. The service provider has a variety of gear that allows it to successfully handle peak client service demand. Hardware that is not in use is switched off to save energy and money and improve resource efficiency. Furthermore, in the event of hardware failure, the cloud may abandon the usage of failed hardware in favour of functional hardware, while the provider replaces the old failing hardware with new ones in due course, ensuring consistent service delivery despite service failures and service life expirations (Nnadozie, 2013).

Characteristics of cloud computing

NIST established fundamental qualities, service models, and deployment models (Nnadozie, 2013). These five key traits are listed below:

On-demand self-service refers to a client's capacity to sign up for and get services from any cloud provider at any time.

Broad network access: This refers to a client's capacity to use any standard computer device, such as a desktop, laptop, or smartphone, to access the cloud provider's services through internet connections.

Resource pooling: The cloud provider's computer resources are readily accessible and each customer may utilize them as needed to satisfy their requirements. Regardless matter where the customer is located,

Rapid elasticity: Because various customers have various workload demands, cloud computing may scale up and down to match each client's needs.

Client resource usages are openly recorded to indicate the real rate of utilization by each client in a measured service.

In terms of on-demand SaaS, PaaS, and IaaS, Katz (2010) highlighted nine key characteristics of cloud computing in higher education:

- i. Improving access to limited IT skills and knowledge.
- ii. Increasing the size of IT services and resources.
- iii. Encouraging even more IT standardization.
- iv. Shortening time to market by reducing IT supply bottlenecks.
- v. Controlling or preventing ad hoc consumerization of company IT services.
- vi. Streamlining the matching of IT expenses, demand, and finance.

Cloud computing service and deployment models

According to numerous scholars, there are three basic service models. They are as follows:

- **Software as a service (SaaS):** Applications created for end users and supplied through web browser as services that may be shared to many clients on demand. Google Applications, Google Maps for Business, and salesforce.com are some examples.
- **Platform as a service (PaaS):** This service offers the tools you need to make the creation, deployment, and maintenance of applications easier. Google App Engine, Amazon Simple Storage Service, Amazon Map Reduce, and Microsoft Azure platform are other examples.
- **Infrastructure as a service (IaaS):** This is the supply of computer infrastructure as a service, including operating systems, network connection, virtualization technologies, servers, and data centre space. Cloud, Google Infrastructure cloud, Microsoft Azure, and Rackspace are some examples (Badger &Grance, 2011, Kepes, 2011, Landis &Blacharski, 2010).

Cloud Computing Deployment Models

According to Sun Microsystems (2010), cloud computing is divided into three deployment models:

1. the use of public clouds 2. Personal clouds 3. clouds that are hybrids.

Ahmed and Manal, (2014), said that cloud computing is categorized into four groups and this view was supported by (CSRC, "Cloud computing", 2014). They include:

Private Cloud: Is a computing model that offers a sole proprietary environment for a business entity. It is possible that the organization owns, manages, and operates it. Like-minded education or research groups may employ a shared cloud infrastructure thanks to shared services models and private clouds. Oracle (Oracle, 2011).

Community Cloud: It is a combined distributed resource provision from Green computing (Harris 2008), Grid computing distributed control from sdigital ecosystem (Briscoe & Wilde, 2006)) sustainability from autonomic computing (Kephart et al 2003) computing and cloud computing. It is a multi-lease platform that enables different enterprises to collaborate on the same platform since their demands and concerns are similar.

Public Cloud:It's a multi-tenant platform that lets many firms collaborate on the same platform if their demands and concerns are comparable.

A cloud service provider makes its cloud infrastructure accessible to the public on a commercial basis. On comparison to other deployment choices, this allows a customer to design and launch a service in the cloud with relatively minimal cost investment.

Hybrid cloud: A hybrid cloud architecture consists of two or more independent, autonomous cloud infrastructures, yet connected by standardized or proprietary technology which enables data and application mobility (for example: cloud bursting for load balancing between clouds).

Reasons for Integrating Cloud Computing in Education

The reasons why integration of cloud computing could be carried out in Nigeria Institution include:

Learning Disruptions: Uncertainties like insecurity (incessant killings, rape and kidnap) and epidemics and pandemics diseases had often disrupted the educational system in Nigeria. The coronavirus pandemic lockdowns is a clear example. However, with the adoption of Cloud Computing e-learning, students can stay in their comfort zone to learn without necessarily converging together.

Limited Facilities for research: Education and Research are paramount keys sectors targeted as visions of Millennium Development Goal (MGDS) for all institutions. Cloud Computer implementation together with e-learning and a research portal connected to on-line libraries will fast-track the educational research process in this sector and thereafter attain the MDGs.

Limited Education Opportunities: Educational opportunities are those that allow people to gain information and skills, as well as build the capacity to live a comfortable and independent life. Lack of applicable skills, on the other hand, means lower lifetime wages and a greater probability of unemployment. Individuals with low educational attainment have less possibilities to expand their knowledge and cognitive, social, and emotional capabilities (OECD, 2010d). Education is a significant instrument for fostering social development and improving social outcomes (Woessmann, 2008). Indeed, poor levels of educational achievement and skills are connected to a variety of economic and social issues, such as adolescent pregnancies and unhealthy behaviours (Cunha and Heckman, 2007; Heckman, 2008). As a result, it is practical to deploy cloud computing via ICT, which offers a wide range of skills and career prospects to everyone regardless of time or location.

Constraints on Student Performance: This has been seen at both public and private secondary and postsecondary institutions. In many places of the globe, it is also a topic of attention and concern (Asuru, 2002).

Benefits of adopting cloud computing

- i. **As a change agent for teaching and learning collaboration:** Information and communication technologies (ICT) are influencing and transforming every area of our lives (Adebayo, 2019). Introducing online learning, teaching, and research cooperation might be a technique for developing nations to become more equitable (Fagbola, 2016).
- ii. **Scale Economics, No Capital Expenditures, and On-Demand:** Kshetri (2010) outlined the several advantages of cloud computing. Higher education institutions should adopt cloud computing for three key reasons, according to Skiba (2011): economies of scale, no capital expenditures, and on-demand services.
- iii. **Sharing Capacity:**It includes the capacity to share papers, collaborate on editing, and efficiently manage versions of papers, media sources for online courses, presentations, publications, research datasets and syllabi (Skiba 2011).
- iv. **Increment of Data Execution Time:** Another compelling argument for businesses to use the cloud is the opportunity to boost data execution time. The case of the Washington Post processing 17,481 pages of data (account of Hilary Clinton as first lady) over 200 Amazon (EC2) cloud networks were used to enable searchable text and photographs is an example of the cloud model's capacity.
- v. **Data storage management (backups):** Arutyunov (2012) mentioned a kind of new model in addition to the main ones proposed by NIST namely Data-as-a-Service (DaaS).

Challenges to cloud computing adoption

1. **Organizational risks (OGR):** Cloud adoption might have a substantial influence on a company's IT governance, compliance with industry rules, in-house IT expertise, and IT strategy. Organizational concerns, according to Okai (2014), include the security and confidentiality of data stored in the cloud.

2. **Operational risks (OPR):** Non-transparent cloud operating models may result in rising hidden expenses, and cloud applications may become momentarily unavailable or out-of-service.
3. **Technical risks (TR):** This results from the complexity of Cloud infrastructure. Cloud users experience security threats both from outside and inside the cloud (Arm burst, 2010).
1. **Legal risks (LR):** Okai, (2014) raised the point clearly that legal issues of
 2. an organization could find itself in an unwanted legal disputes that can run into years due to laws surrounding location where data are stored.

Problems of implementing cloud computing in Nigeria

Nnadozie (2013) highlighted the following as some of the addressable problems of implementing cloud computing in Nigeria.

- i. **Unreliable Power Supply:** Nigeria's unreliable power supply has been a key hindrance to the adoption of cloud computing in the nation (Omo-Ettu, 2011).
- ii. **Lack of political will for true ICT growth:** According to the president of the Institute of Software Practitioners of Nigeria (ISPON), promoting indigenous software and infrastructure firms would assure the country's ICT growth and development (Uwaje, 2013). In related news, the Director-General of Nigeria's National Information Technology Growth Agency (NITDA) remarked that a key impediment to ICT development in the country is a lack of political will (Anyaye, 2010).
- iii. **Corruption:** According to Oruame (2008), "... details are surfacing on how ICT initiatives have just ended up as conduit pipes via which billions of dollars from the public purse have been stolen into private bank accounts."
- iv. **Poor internet service persistence:** This has been linked to the high cost of delivering network services (Opeke, 2013).

Conclusion

This paper introduced Cloud Computing as a tool that can salvage the educational system from all forms of uncertainties and highlighted the major benefits as being cost efficiency, enhanced availability, low environmental impact etc. while the constrains include data insecurity among others.

Suggestions

The following recommendations are made from this paper presentation on challenges and prospects of implementing cloud computing in Nigeria:

- i. The country's unreliability of power supply must be treated seriously and addressed as soon as feasible. This is due to the fact that power is critical in the operation of data centres.
- ii. Cloud service providers should ramp up their public awareness campaigns to educate the public about the advantages and hazards of cloud adoption by Nigerian businesses.
- iii. More cloud service providers are required in the nation to stimulate competition, which would lower the cost of cloud services. This would increase the technology's attractiveness to businesses.
- iv. More data centres should be built in the nation to enhance access to cloud computing resources, lower access prices, boost security monitoring, and safeguard local content.
- v. A solid legislative framework for data protection should be in place, and it should follow worldwide best practices.

References

- Accenture (2011). Application deployment Guide version 1.0.
- Asuru, V.A. (2002). Examination Malpractice: Implication for Sustainable Development in Nigeria. *Eastern COEASU Journal of Teachers Education*
- Adagba, O., Ugwu, S. C. and Eme, O. I. (2012). Activities of Boko Haram and insecurity question in Nigeria. *Arabian Journal of Business and Management Review*, 1.
- Adebayo, S. (2019). Perceived impacts of Cloud Computing adoption on the role of an IT department of a higher institution in a developing country. A Master thesis in Informatics, submitted to the department of Informatics, Linnaeus University, Sweden.

Anyaye, C. O. (2010) Lack of political will militates against ICT development. <http://www.dailytrust.com.ng/index.php/it-world/36513-lack-of-political-will-militates-against-ict-development>

Ahmed E. Youssef and Manal Alageel (2012). A framework for secure cloud computing", *International Journal of Computer Science Issues(IJCSI)*, 9 (4), 3. pp.487, July 2012.

Anjali J. & Pandey U.S. (2013). Role of cloud computing in higher education. *International Journal of Advanced Research in Computer Science and Software Engineering*, 3(7), 966-972.

Arm burst,(2010). A View of Cloud Computing. *Communications of the ACM*, [e-journal] 53(4), 50-58.

Arutyunov, V.V. (2012). Cloud computing: Its history of development, modern state, and future considerations.

Badger, L., &Grance, T. (2011) Cloud computing synopsis and recommendations. <http://csrc.nist.gov/publications/nistpubs/800-146/sp800-146.pdf>.

Briscoe, G & De Wilde, P. (2006). Digital Ecosystems: Evolving service-oriented architectures,in Conference on Bio Inspired Models of Network, Information and Computing Systems. IEEE Press, 2006. [Online]. Available: <http://arxiv.org/abs/0712.4102>.

CSRC, (2014) "Cloud computing", Accessed online at <http://www.csrc.nist.gov/groups/SNS/cloud-computing/index.html>.

Cisco (2009) Cisco cloud computing – Data centre strategy, architecture, and solutions. *Point of view white paper for U.S. public sector, 1st edition*.

Cunha, F. and Heckman (2007). The Evolution of inequality, Heterogeneity, and Uncertainty in the Labor Earnings in US Economy” NBER Working Paper No.13526, National Bureau of Economic Research, Cambridge. www.nber.org/papers/w13526

Fagbola, T.M. (2015). Cloud computing in education – A study of trends, challenges and an archetype for effective adoption in Nigerian Universities. In the book, *Information Communication Technology (ICT) Integration to Educational Curricula: A New Direction for Africa*. University Press of America.

Harris, J. G. (2008) Computing and Green It Best Practices on Regulations and Industry. Lulu.com

Heckman, J. (2008). The case of investing in disadvantage young children, big ideas for children: Investing in our nation's future, first Focus. Washington, DC.

Katz, (2010) Cloud Computing in Higher Education. https://net.educause.edu/section_params/conf/CCW

Kepes, B. (2011). *Understanding the cloud computing stack SaaS, PaaS, IaaS*. http://broadcast.rackspace.com/hosting_knowledge/whitepapers/Understanding-the-Cloud-Computing-Stack.pdf.

Kephart, Chess, D., Center, I & Hawthorne, N. (2003). The vision of autonomic computing. *Computer*, 36 (1), 41–50.

Kshetri, N. (2010). Cloud computing in developing economies. *Computer*. [e-journal] 43(10), 47 -55.

Landis, C. & Blacharski, D. (2010). *Cloud computing made easy*. <http://www.slideshare.net/avil205/cloud-computing-made-easy.pdf>

Mehmet, F. E. & Serhat, B. K. (2011). *Cloud computing for distributed university Campus*. International Conference on the Future of Education, Pixel Publishing International.

Nnadozie, C.E. (2013). *Cloud computing in Nigeria*. Being a dissertation presented to the department of Computer Science in partial fulfillment of the requirements for the award of a Master of Science in Computer Science of the University of Nigeria Nsukka.

NIST, (2016) "Final Version of NIST Cloud Computing Definition Published", Nist.gov, 2016.

[Online]. Available: <http://www.nist.gov/itl/csd/cloud-102511.cfm>. [Accessed: 19- Jun- s2016]. OECD (2010d), PISA 2009 Results: What Makes a School Successful? (Volume IV), OECD, Paris

Okai (2014). Cloud computing adoption model for universities to increase ICT proficiency.

Olabiyisi, S. O., Fagbola T.M & Babatunde, R.S. (2012). An exploratory study of cloud and ubiquitous computing systems. *World Journal of Engineering and Pure and Applied Sciences*, 2(5):148-55.

Omo-Ettu, T. (2011) ATCON wants telecommunications success replicated in power sector. <http://www.dailytrust.com.ng/~trust/index.php/it-world/36531-atcon-wants-telecomsuccess-replicated-in-power-sector>.

Oracle (2011). *Oracle's cloud solutions for higher education and research*, pg 1-18.

Oruame, S. (2008) Corruption is killing ICT in Nigeria. <http://computerworldparaguay.com/articles/2008/11/20/corruption-killing-ict-nigeria>

Opeke, F. (2013) Main One, Phase 3 take broadband awareness to P-harcourt. www.vanguard.com/2013/03/main-one-phase-3-tele-broadband-awareness-to-p-harcourt/.

T-Systems (2011) White paper cloud computing. *Alternative sourcing strategy for business ICT*. http://www.t-systemsus.com/umn/uti/508260_1/blobBinary/White+Paper+Cloud+Computing+%257B%257BPDF%252C+351+KB%257D%257D.pdf.

Cloud Computing: A Tool for Effective Teaching and Learning Process in Unprecedented Conditions

- Sclater, N. (2010). E-learning in the Cloud. *International Journal of Virtual and Personal Learning Environments*, 1(1), 10-19, IGI Global.
- Skiba, D. (2011). Are you computing in the clouds? Understanding cloud computing. *Nursing Education Perspectives*, 32(4): 266-8.
- Sun Microsystem, (2009) Take your business to a higher level. <http://www.slideshare.net/danielfc/cloud-c...>
- Uhunmwuango, S.O. & Aluforo, E. (2011) Challenges and solutions to ethno-religious conflicts in Nigeria: Case Study of the Jos Crises, *Journal of Sustainable Development in Africa*, 13 (5), 109-124.
- Uwaje, C. (2013) Nigeria's ICT industry is still underdeveloped. <http://www.thisdaylive.com/articles/nigeria-s-ict-industry-is-still-underdeveloped/135910>
- Woessmann L., (2008), "Efficiency and Equity of European Education and training Policies". *International Tax Public Finance* Vol. 15, No. 1 pp 199-230 G. Briscoe and P. De Wilde, "Digital Ecosystems: Evolving service-oriented architectures," in Conference on Bio Inspired Models of Network, Information and Computing Systems. IEEE Press, 2006. [Online]. Available: <http://arxiv.org/abs/0712.4102> [49] G. Briscoe, "Digital ecosystems," Ph.D. dissertation, Imper