Cloud Computing Technology: An Effective Tool for Curriculum Delivery in Nigeria Educational Process

Abstract

The paper examined Cloud Computing Technology: An Effective Tool for Curriculum Delivery in Nigeria Educational Process. This is because the current technology is a paradigm shift towards making the whole process of teaching and learning students' centre thereby ensuring the development of the needed skills in this 21st Century that include, critical thinking, collaborations and problem solving. Notable to all, majority of students and teachers have one form of technology or the other, such as cell phones, mobile phones and mini-computers which makes it easy to access the internet at their fingertips. With this development, Teaching-Learning and Research in Education will undergone a phenomenal change which would makes the whole process changing so significantly. Hence, the use of these tools in the education sector will strengthen further and reform the system. Because it would enables learning everywhere and all the time. Based on the above, the paper explored the definitions and meaning of cloud computing; Implementation & Use of the tools for Teaching and Learning, were discussed. Similarly, the components structure and its types was identified and explained such as: Public Cloud, Private Clouds and Hybrid Clouds The paper equally, identified Advantages as well as dis-advantages of the use of cloud computing in education. Such advantages include Accessible educational tools; Improved collaboration & Better learning facilities. Lastly, conclusion and recommendations for the improved use of cloud computing in education were highlighted and this include, Educators considering implementing of the cloud into their context for teaching and learning should ensure that the tools can be effectively handle both by the students and teachers in order to achieve the curriculum objectives

Keywords: Cloud computing, Technological Tools, Curriculum delivery, & Educational process

Introduction

In this 21st Century, educationist around the globe have agreed and show case through research evidently available that, teaching and learning process have undergone a phenomenon changes due to the use of technologies in educational process and this is so because, students and teachers have one form of technology or the other with them, such as cell phones, mobile phones and mini-computers which they used to access the internet at their fingertips. (Peter, 2019). Hence,it was envisaging that, the use of Cloud Technologies in the education sector will further strengthen and reform the system, thereby making the entire teaching and learning more productive and result oriented. This will therefore, allow educational sector such as universities to reduce huge costs around purchasing expensive hardware devices and gadgets with large amounts of moony. Therefore, the transfer of educational provision and engagement to the cloud services will facilitate switching to a format of learning everywhere and anytime since the avenue is all time available (Peter, 2019: Al-Zoube, et al; 2010; Beaumont, 2018; Changchit, 2015;.& Davis, 2017)

Cloud computing is an innovative technology that organizations should use to give themselves a technological foundation to deliver their programs effectively (Krelja et al., 2018). Cloud computing can offer better scalability as well as portability when applied to learning programs by making a wide range of cloud based apps available to prospective clients, like teachers and students, who can help them with their academic objectives (Alharthi et al., 2015; Stergiou et al., 2018). Moreso, Cloud technological tools in education is indeed changing the way in which teaching and learning is being conducted due to its open source availability. It is now seen as the leading technology in data processing and that was why different types of organization not only education they were leveraging on its usage for effective job satisfaction and objectives realization. But, for education it provides a good opportunity for administrators, educators, and students with technology-based devices, needs, and desires is being prioritized. Cloud computing tools help to transforms how educational institutions conducts their activities, thereby adding value to computing services and operations management in order to providing cheaper and a more flexible way. Following, this background, therefore, the National Institute of Standards and

Technology do define cloud computing platform as a convenient and on-demand network access to a shared pool of configurable computing resources which include networks, servers, storage, applications and services among others, that are rapidly provisioned and deployed. Similarly, the concept can be defined as a model that enables and published with minimal administration or interaction with a service provider. (Hajara 2022),

In this perspective, implementation of cloud computing technologies in an educational institutions will undeniably be helpful especially in university system to enable them work toward their strategic vision and mission and as well it would go a long way to ensure student are successful in their educational pursuits and this is because, **by** hosting educational resources on a cloud platform it eliminates the use of physical textbooks of any kind and in any subject areas which the use of cloud tools makes them easily accessible to students and the teachers. Teachers can upload a more relevant course material either remotely or otherwise and students can acquire them when they need it or when they are very necessary for use in respect to such books and modules, hence, the cloud tools with a strong internet connection will do that. The belief is that, Cloud tools technologies is an integral aspect of any given hardware devices such as computer services providers which is use for the delivery of storage, database, software, analytics and networking, process over the internet and or the cloud for backup storage which is in line with economies of scale. (Aigul, et al: 2017). Therefore, in a nut-shell, Cloud computing could be thought of as a large collection of resources that have been virtualized and managed to grow dynamically by a demand-utilized pay-per-resources pricing model and the computing resources can be accessed using cloud technology that institutions are gradually adopting along with services based on those that may be accessed via the internet, the resources also comprise software and hardware from distant data centers (Aigul, et al: 2017

Higher education institutions are moving forward with Internet usage by embracing cloud computing. This is due to its ability to share IT-related services in the cloud and provide students and faculty personnel with crucial tools (M. A. Islam, et al 2019). Many institutions are trying their best to keep up with the rapid growth of technological advancements, which is seen in all areas of human activity, the use of emerging innovations is now seen as a need in the Information and Communication Technology (ICT) era, as they may quickly enhance the majority of organizational activities (Alhelou et al., 2021). As a result of intense competition and shifting corporate environments, organizations continuously strive to upgrade their advertising

content by implementing new technology, and cloud computing is no different. It is an easy technique of computing services provided over the internet.

In the view of Udenor *et al.,* (2018) claim that ICT improvements have consistently had a major impact on educational systems resources are spread among educational institutions, they can focus more on fundamental academic tasks like research. Universities in particular have viewed cloud computing as a revolutionary technical advancement in higher education institutions as well as an innovation in which internet technologies provide IT-driven skills that are flexible and accessible (Sultan, 2010). Since cloud computing allows for the rapid adoption of IT resources, particularly for research, which surpasses conventional software platforms. Additionally, socially progressive learning theories and collaborative learning can be implemented and utilize cloud computing systems. Using centralized data storage, and virtualization, including all capabilities, the resources of the cloud can be used to create e-learning environments, technology, as well as educational facilities. In light of all these reasons, cloud computing is crucial for several higher education institutions. Several organizations depend on technology to cut costs, maintain competitiveness, to attend to students' andteachers' needs (Garcia-Penalvo *et al.,* 2014). Higher education institutions can take advantage ofexisting knowledge to their mutual advantage due to the availability and openness of cloud computing services. Forthe client, using applications through cloud computing is more affordable and flexible.

Definitions and Meaning of Cloud Computing Technology

Cloud computing can be seen as a term use for delivering the hosted services which is in the internet. Therefore, it implies the Cloud based educational services are Infrastructure which include such service as (Iaas),Platform, secondly, as a service (Paas) and as well, Software as a service (Saas), Anything/ Everything as a service(Xaas) and lastly, Function as a Service(FaaS) (Pandey,2023). Is first usage was in 1996 which describe a computing model where all desktop applications were kept in the cloud. Unfortunately, during this period mentioned, the technology to share and deploy cloud computing were not readily available. The cloud computing model was later been reintroduced in 2006. And it was fairly accepted then. However, Cloud computing became recognized and being accepted when the Internet giants such as amazon.com, google.com, microsoft.com, and IBM started using it and offer this facility to other web users. From that period, various services, software and storage has been implemented based on cloud computing (Van Ommeren et al., 2009).

In its simple connotation, the phrase Cloud, means a formed image, a very soft thing which is not a solid substance. Therefore, it is important to reiterate that, the digital version of clouds is usually rooted in physical and virtual infrastructure. This implies cloud is indeed a very real and it consist of a reliable network of infrastructure which hosted all data and services providers for computing purposes. Ideally, customers use internet in order to access all the server-based cloud networks and their resources which can include data storage, online streaming content among others. Examples of these are: YouTube, Netflix and infrastructure platforms like Google Cloud. Within a decade now, technology and importance of cloud computing have caused significant shifts in education and how teachers' engaged and the students learn. It has been established that by incorporating the needed type or the right form of technology into classroom teaching both the teachers' and students will experience improved outcomes in term of performance and increased engagement. It would be a great idea nowadays to see students leaving the classroom setting with mastery of needed skills and competency such as the ability to create, collaborate, think critically, and communicate effectively. Essentially, with the afore-mentioned it would foster an environment of innovation in schools system as a result of cloud computing implementations which characteristically, it is safe and cost-effective. (Peter, 2019: Al-Zoube, et al; 2010; Beaumont, 2018; Changchit, 2015; & Davis, 2017). In recent time, Cloud Computing technologies is indeed being used by educationist and other organizations because, it involves different forms of independent technologies which include hardware virtualization, distributed processing, utility computing, network system, web services, platform as a service, and software as a service. The computing model it's basically on a service-oriented architecture (SOA) model which offers high flexibility and reduce cost of ownership, scalability and services on request (Baun e t al., 2011).

"Following this development, it is important to note that, the concept of cloud computing has indeed change the traditional ways of delivery, management and integration of applications. So therefore, making comparison with the traditional perspective, it becomes so glaring that, cloud computing enables running a more bigger infrastructures, which is serving various groups of users within a single cloud entity and implies dependence on a cloud services provider. Cloud computing is informatics in nature and a model of providing the overall convenient network access on demand for common computing resources which include data-transmission networks, servers, data storage units, application programmes and other services with minimum operating cost and/or addresses to the provider" (Sklejter, 2010: & Sarrab et al., 2015)

Components and Structural Pattern of Cloud Computing Technologies:

Cloud Computing is one form of the current Emerging Technologies that can be used for effective curriculum delivery as a result of this it has some fundamental layers which makes it user friendly, and based on this fact, Akshay, (2023) identified the following:

Virtualization Process

This is a process through which the virtual versions of computing resources, such as servers, storage, and networking are being created. It enables multiple virtual machines (VMs) or containers to run on a single physical server, maximizing the hardware utilization and providing isolation between different workloads.

Infrastructure as a Service (IaaS) Process

It is a cloud computing service which provides virtualized computing resources over the internet. The users can rent virtual machines, storage, and networking infrastructure though, he has to pay for what they use. The process offers flexibility and scalability and it allows users provision and manage resources as needed.

Platform as a Service (PaaS) Process

This is another cloud service which the users get a complete platform and environment to develop, test, and deploy applications of ones need, these includes all the necessary tools, development frameworks, databases, and middleware, abstracting the infrastructure from developers and allowing them to focus on mainly building applications.

Software as a Service (SaaS) Process

Software as a Service (SaaS) is a cloud service model which help to delivers software applications over the internet but strictly on subscription basis. The intended users can access and use these applications through a web browser, eliminating the need for local installation and maintenance. An examples include Google Workspace, Microsoft 365, and Salesforce among others

Cloud Storage Process

It is a Cloud storage services which offer scalable and distributed storage resources over an internet. Users have the advantage of storing and retrieve data from these services, and they usually comes along with such features like data replication, backup, and access controls to ensure data durability and security process

Cloud Networking Process

This simply refers to the infrastructure and services that provide connectivity between the various cloud components and it includes virtual private networks (VPNs), content delivery networks (CDNs), load balancers, and other related networking components which stand to ensuring efficient and secure data transfer.

Cloud Security System

The Cloud security have to do with a set of practices and technologies which was designed to protect cloud-based systems, data, and applications from unauthorized access, data breaches, and other cybersecurity threats that might possibly wanted to have effect and it includes authentication mechanisms, encryption, access controls, and monitoring tools as well

Application Programming Interfaces

The APIs interfaces allows different applications and services to communicate and interact with each other. Cloud providers expose APIs that enable developers to integrate their applications with cloud services and access various functionalities programmatically without any hitches

Service Level Agreement (SLA)

“It simply refers to a contract reached and agreed between the cloud provider and the user which defines on an agreed-upon level of service, including performance metrics, uptime guarantees, support response times, and other service-related terms”. (Akshay, 2023)

Types of Cloud Computing Services and Their Application

Three main types of cloud computing services have been identified which are being hosted by the third-party providers and in-turn they were offered to customers through the internet services. Each service user data flow from front-end clients through the Internet provision and to the cloud provider's systems and then then back again. However, each cloud service performs these functions differently and base on users and the current functions. These are thus, explained below:

- **Public Clouds Type**

Foremostly, the Public Cloud can be described as a virtual environment with different sections being redistributed to many customers and it's referred to as tenants. They are usually created from Information Technology infrastructures that the customers don't own. For instance, the Amazon Web Services (AWS), Google Cloud, Microsoft Azure, Alibaba, and IBM are the well known examples of public cloud computing services. The public clouds are typically run off-site, some cloud providers have begun offering customers cloud services that are in the clients' on-site datacenters and this practice has blurred the lines of ownership distinctions and locations.

- **Private Clouds Type**

On the other hand, the, private clouds are cloud environments which solenly being dedicated to a single group, entity, or user as the case may be which set behind the customer's firewall. Any cloud located in an IT infrastructure isolated from the public and dedicated to one client or one person or a group is automatically considered a private cloud. Therefore, the Private cloud offerings include the following as HPE, VMWare, IBM/Red Hat, and OVHcloud among otners. It is important to note that, Private clouds they are not limited to on-site of IT infrastructures nowadays. Users can build private clouds on off-site, rented, vendor-owned data centers. As a result of this it makes private clouds to have two sub-categories which are Dedicated Clouds: meaning a cloud within another cloud, located either in a public or private cloud. While, the second categories is called Managed Private Clouds and they are configured, deployed, and managed by a third-party vendor but created and used by customers..

- **Hybrid Clouds Type**

The Hybrid clouds are a single IT environment consisting of multiple settings linked through application programming interfaces of the APIs, virtual private networks (VPNs), local area networks (LANs), and wide area networks (WANs). However, there isn't a single accepted hybrid by definition but the requirements and characteristics varied as the number of people

Multi-Clouds Type

"Multiple cloud consists of more than one cloud service taken from more than one cloud vendor which include the AWS, Azure, among others. Which could be public or private. All hybrid clouds are multi-clouds, but the reverse isn't true. But multi-clouds become hybrid clouds if multiple clouds connect through a form of orchestration or integration through third-party tools.. It involves patching together various SaaS, Iaas, PaaS, and other services from multiple providers (or internal IT) to fit current educational uses or business objectives". (Peter, 2019: Al-Zoube, et al; 2010; Beaumont, 2018; Changchit, 2015;. & Davis, 2017)

Implementation Process Around the Uses of Cloud Computing Services

Cloud computing can be used for teaching and learning processes it depends on the current users application for instance, lecturer who intend to share a journal paper with fifty of his graduate students by the use of this method, can e-mail this paper to his students and out rightly they will all received it. While, another method could be by using a client-server based Learning Management System such as SPIN. Through this means the lecturer can upload the paper to the SPIN website and the students will download the paper from SPIN. Though, the process is seen as being inefficient because all users need to access the SPIN website to upload and to download the said document. But on the alternatively, a client-server based model for sharing reference materials over the Internet using LCMS (Learning Content Management System such as SPIN). Can be applicable. This is because SPIN uses the concept of one-way partnership where a lecturer can share materials with his students and vice-versa. (Mohd, 2011; Baun, et al; 2011; and Stanoesyska-Slabeya, et al; 2010)

Similarly, another examples of implementation of clouds for teaching-learning can involves the development of a web-based application. For instance, a web-based which application

development requires adequate computing infrastructure such as storage, networking, software, database, operating system, and an application framework. Though, infrastructure involves monetary investment and technical knowledge from the users. If the web-based application requires extra resources such as a more storage or more computing power, the infrastructure needs to be upgraded to ensure its effectiveness. Therefore, the developers only need to develop the applications and then hosted the applications on the cloud and cloud computing services ***such as computer processing, storage, networking and application developments.*** Cloud computing alleviates the need for the developers to upgrade or to maintain their own computing infrastructure. (Mohd, 2011; Baun, et al; 2011; and Stanoesyska-Slabeya, et al; 2010)

In a similar way students have an opportunity to interact both with teaching staff and their group mates. The own Cloud users can grant access to a file to a predetermined group of people. The given concept might facilitate students' work over a common academic project or any other activities carried out in groups. The concepts also include an opportunity of file distribution among people not registered in own Cloud system - exchange is performed via public links. The change of record is one of the functions ensuring data integrity. A version of a control subsystem enables users to receive access to old file versions with an opportunity to trace down records of their changes. Students and instructors are able to cancel file updating at any moment and return to the earlier version. Also, when assessing students, a lecturer as an administrator can see which contribution was made by each student during their work on the project, hence they can assess separate student's activities in an unbiased manner.

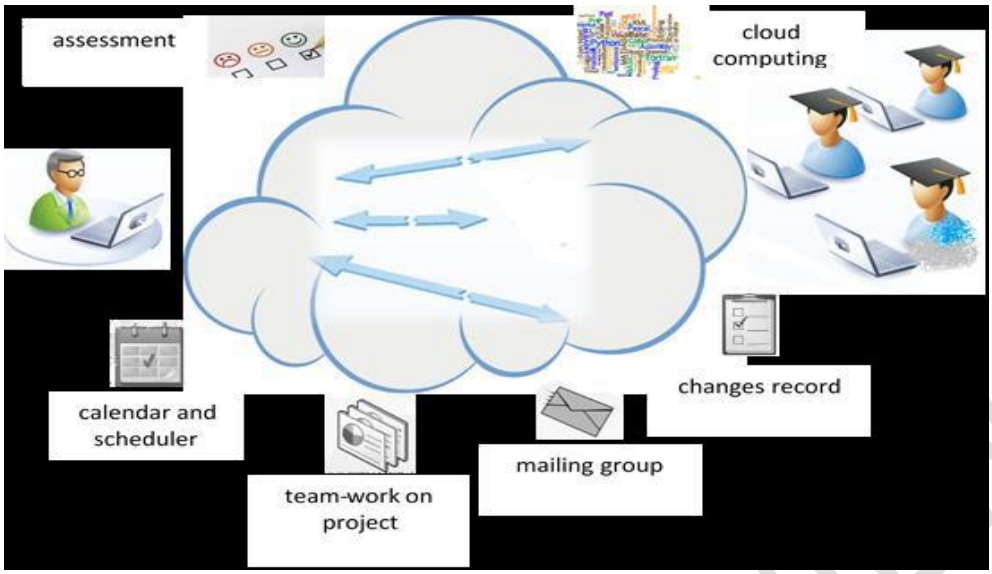

Figure 1: Model of data exchange within personal cloud storage between a student and an instructor. **Source:**(Kopyltsov et al., 2010; and Schmidt, 2016).

At the given moment, we have been considering a possibility for students to carry out cloud computing using the resources of a remote server, so that they could compile a program and receive results not without installing software on their own computers.

Advantages of the Uses of Cloud Computing for Educational Process

Cloud computing has attracted numerous organizations to take advantage of this technology to support teaching, learning, and research. It is seen as being able to support institutions in managing and storing information in a more flexible, cost-effective, and scalable manner. Therefore, in this era of technological advancement, education sector cannot be left behind and it is in light with this development, cloud computing used in education has the potential to significantly enrich the learning process and place education within the reach of many students within and outside the school system. Therefore, the identified below are some of the advantages of use of cloud computing in education as postulated by Rabiu and Abubakar (2023).

i. It access educational tools and services
ii. It Improve collaboration among students
iii. It provides better learning facilities
iv. It's Flexible and very efficient processes
v. It is cost efficiency

vi. Ensure data security

Access educational Tools and Services

One of the significant advantage of Cloud Computing is that it enable users to have access to various forms of the hosted educational resources which is situated on a cloud platform and it goes along way to eliminate users handling physical textbooks. This accessibility advantage is opened to teachers-students usage thereby they can easily acquire all the necessary books and modules with their various devices on the internet connection.

Improved collaborations among Student

Cloud Computing services has advantage of bringing about students collaborations and peering on a real-time basis from anywhere and locations around the world, It's use in education enables students to work together on teachers assignments and other related class work without necessary physically present in the same classroom. This open up an avenue for students who might have not being privilege to attend classes and thereby afford them opportunity to keep up with their peers, even from home. Similarly, it opens up advantage to teachers to collaborate online and to efficiently share lesson plans or feedback with faculty members across departments and within the entire schools system.

Provides better learning facilities

The Cloud tools in education equally enhances access to education of the vonulrables and the marginalized students without any access to non-conventional educational facilities were they are located and this could be possible through her affordable services providers with high level of connectivity process. Moreso, Students from rural villages can also rely heavily on a cloud-based learning system to access and acquired education freely. Lastly, the existing modernization trends in the world can provides the education system with the benefit of working professionals whom possibly lack adequate time to attend regular classes and this avenue would offer them participation in online classes at their convenient times.

Flexible and efficient via Usage

The use of Cloud computing in the education system have afforded opportunity to save time and effort for both the faculty management and the students alike and this is largely based on its greater functionality flexibility. This implies, a given scenario which might have requested possibly the physical presence and attendance of both parties, either at the school, college, or university can now easily taken care of through remotely engagement within shortest possible time frame. Additional students can also leverage on the cloud-based applications and platforms to learn at home and at their own pace, and several students spread across various locations can learn from a single teacher at a time.

Cost efficiency

The Cloud computing being implemented for the purpose of educational systems would automatically, cost less when compared with that traditional system of education because it would go a long way in making engagements of Faculty and its institutions very easy. Similarly, would give students advantage of not investing on the latest hardware because the cloud-based has taken care of that. It would equally, ensure cloud-native applications use the cloud for processing power be easily run on even the most basic devices.

Disadvantages of Its' Uses for Educational Process are:

Despite the numerous advantages of the uses of cloud computing tools in educational system in this modern era of technology advancement, there are nevertheless some key dis-advantages which needs to be taken care of in order to improve on its utilization for educational purposes and these can include the following:

- Issue of data loss or theft in the process of usage
- Issue around data leakages by the users or client
- Possibility of an account or service hijacking by hacker
- Problem of the insecure interfaces and as well APIs.
- Possibility of denial of service attacks during usage

- Possibility of technology vulnerabilities during shared environments.

Challenges & Possible Risks During Its Use for Learning Process

It has been observed that Clouds Computing have started gaining momentum as regards its usage for teaching and learning processes and this is for the fact that, its applications does not need huge infrastructure and high monetary cost for its effective functions. However, despite these advantages there are some specific challenges or risk that need to be aware of and take measures towards curtailing it for maximum utilizations and these includes:

- Issue Around Security and Privacy.
- Issue Around Data Loss and Recovery
- Users' compliance and Legal Issues
- Issue Around Vendor Lock-in.
- Performance and Latency Problem and
- Cost Management for users. Among others

The identified above can be seen as some of the challenges and possible risk around the uses of cloud computing tools in educational system. The listed are not exhaustible but rather been enumerated for the purpose of creating awareness for Cloud computing client to be conversant with them and sort for mitigating or remedies with the view of achieving maximum advantages of its used in educational system

Conclusion

At this juncture it is important to reiterates that, the used of cloud computing tools for educational process is a welcome development in educational provisions given the fact that, the needed skills and competency for teachers and students growth in this 21st Century such as collaborations, critical thinking, problem solving and effective communication process with technological tools such as the cloud computing were easily achieved and this makes the whole of learning process to challenge the former traditional perspective which students' learning demands his presence in the classroom while the current shift breaks these barrier by making learning to happens anywhere, anytime and in any location with the cloud services

Recommendations

The following recommendations were made with the view of improving on its uses for educational system. This is because researches has revealed that, if university educational system

would embrace this novel idea for teaching-learning process it would reduce the institutional cost for hardware procurement and as well improved on students learning. Therefore, the following recommendations made include:

- Cloud computing is still a new paradigm shift hence, there is the need for more research out to show-case why its adoption and used is justifiable in our educational system
- Educators considering implementing of the cloud computing tools into their teaching and learning should think and consider how to mitigates existing challenges for a more improve uses by the students.
- Educators willing to implements clouds computing for learning may also consider how relevant or meaningful the tools for easy use by the teachers and students.
- Teachers' and students willing to employ Clouds computing tools should endeavor to be acquainted with the various form available in order to consider the appropriate one in a given learning environment

References

1. Alharthi, A., F. Yahya F, RJ. Walters, and GB. Wills. (2012). An Overview of Cloud Services Adoption Challenges", in Higher Education Institutions
2. Aigul, S. Meryert, S; & Jaroslav, K., (2017), Using Cloud Technologies As A Tool In Organizing The Education Process
3. Alhelou, E.M., Rashwan, A.R., and Abu-Naser, S. (2021). The Role of Cloud Computing in Improving the Quality of Accounting Education in Palestinian Universities in Light of the COVID-19 Pandemic. *The Journal of Economics, Finance, and Accounting Studies (JEFAS)*.
4. Akshay, B., (2023) How Cloud Computing Works? A Comprehensive Overview Last updated on Aug 10, 2023
5. Al-Zoube, M., El-Seoud, S. A., & Wyne, M. F. (2010). Cloud computing based e-learning system. International Journal of Distance Education Technologies, 8(2), 58.
6. Baun, C., Kunze, M., Nimis, J. & Tai, S. (2011). *Cloud Computing – Web-Based dynamic IT services*. (2nd ed.). doi: 10.1007/978-3-642-20917-8
7. Beaumont, K., (2018). Google Classroom: An online learning environment to support blended learning. Compass: Journal of Learning and Teaching, 11(2). https://dx.doi.org/10.21100/compass.v11i2.837
8. Changchit, C., (2015). Cloud Computing: Should it be Integrated into the Curriculum? International Journal of Information and Communication Technology Education, 11(2). Retrievedfromhttp://link.galegroup.com/apps/doc/A416501416/AONE?u=ko_acd_uoo&sid=AONE&xid=504430e2
9. Davis, M. R. (2017). Google Docs Fuels Shift to Collaborative Classroom Writing. Education Week. Retrieved from

https://www.edweek.org/ew/articles/2017/06/14/google-docs-fuels-shift-to-collaborative-classroom.html
10. Ede, G.O., Udoetta, V. & Opupus, L.A. (2023). E-Learning Infrastructure and the Task of Onboarding the Nigeria Teacher on Computer and Cloud-Based Learning. International Journal of Research in Education and Sustainable Development, 3(7), 72-83
11. Islam, M.; Reza, S. (2019). The Rise of Big Data and Cloud Computing. Internet Things Cloud Comput., 7, 45.
12. García-Peñalvo, F.J.; Johnson, M.; Alves, G.R. and Conde-González, M.Á. Informal learning recognition through a cloud ecosystem. Future Gener. Comput. Syst., 32: 282–294
13. Hajara U. I., (2022), Cloud Computing Adoption In Nigerian University: Conceptualized Model Based on Stakeholder Perception;: *A Thesis Presented to the Department of Computer Science African University of Science and Technology* In Partial Fulfilment of the Requirements for the Degree of Master of Science Abuja, Nigeria December, 2022
14. Kopyltsov, A. V., Serik, M., & Bakiyev, M. N. (2014). Modelirovaniye i realizatsiya algoritma otsenivaniya kachestva obucheniya studentov na klastere vysokoproizvoditelnyh parallelnyh vychisleniy. Vestnik ENU, 3 (100)., 147-152.
15. Krelja, K., Tomljanović, J., and Bronić, K. (2018). Usage of cloud applications by students. Zbornik Veleučilištau Rijeci, 2(1): 13–26.
16. Mohd Z. M., (2011), Teaching and learning cloud computing; *UKM Teaching and Learning Congress 2011Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia*
17. Pang, L. (2009). Applying Cloud Computing in the Classroom . Retrieved March 28, 2017, from http://deoracle.org/online-pedagogy/teaching-strategies/applying-cloud-computing.html
18. Pandey, H. (2023). Cloud based services. https://www.geeksforgeeks.org. Accessed30/06/2023
19. Rabiu, I., and Abubakar (2023). Determinants of Cloud Computing Adoption and Usage in Nigerian Universities.Nigeria Journal of Engineering Science Research (NIJESR). 6(2), pp. 12-23
20. Sultan, N. (2010). Cloud computing for education: A new dawn? International Journal of Information Management,30(2): 109–116.
21. Sarrab, M., Alalwan, N., Alfarraj, O., & Alzahrani, A. (2015). An empirical study on cloud computing requirements for better mobile learning services. International Journal of Mobile Learning and Organisation, 9(1), 1-20.
22. Schmidt P. (2016). Bezpečnosť a ochrana údajov z pohľadu cloud computing. In Ekonomika a informatika, 14 (2), 153-165.
23. Voevodin, V. V., & Zhumatij, S. A. (2007). Vychislitel'noe delo i klasternye sistemy. M.: Izd-vo MGU, 15