Assessment of Cloud Computing Adoption for E-Learning by Institutions of Higher Learning in Nairobi County, Kenya

1. **Jackson Kipchirchir Machii; BSC (Computer Science), MBA (MIS)**

E-mail: machiijack@gmail.com

P.O Box, 2966-30100, Eldoret, Kenya

2. **Josphat K. Kyalo; BSC, MSC [IS], PhD - MIS (Candidate)**

E-Mail: joskyalo@gmail.com; kyalo.kjosphat@ku.ac.ke

P.O. Box: 222 – 00519; Mlolongo, Kenya

Abstract

The Cloud computing is a platform that facilitate a great advantage of flexibility and availability of cloud services and resources at cost-effective, high scalability and low energy usage through provision of applications as a service via the internet. This approach has uplifted the E-learning as a learning methodology involving digital with traditional learning support and delivery. Today, E-learning platform has been adopted by Kenyan private and public universities and institution with cloud computing as a new technique for managing content, teaching and learning aspect. This paper majorly assesses the   cloud computing adoption, benefits and issues and integration concepts in an e-learning system in higher education.

Keywords: E-Learning Adoption; Cloud Computing, Higher Education; E-Learning Platform; Information Technology Infrastructure; Learning Technologies

1. Introduction and Background of the Study

Today global network has boosted the e-learning among many institutions with the integration of learning technologies with enormous IT infrastructure. The E-learning is a learning approach based on internet technology to initiate, implement, control and support learning which has enhanced flexibility and efficiency to traditional method of education (Viswanath, Kusuma, & Gupta, 2012).According to Ouahabi, Eddaoui, Labriji, Benlahmar, & Guemmat (2015) E-learning currently has overwhelmingly been adopted and is becoming a likely alternative to the traditional method of attending and learning in classroom. It integrate learning tools, materials and training content and services to enable efficient and economical delivery of educational content in a configurable infrastructure.

Cloud computing is not an exception; it has become a suitable platform architecture for E-learning system and education services (Sharma, 2014). The adoption of cloud computing for E-learning will pose numerous benefits which counter some constraints of e-learning systems in higher institutions. Joseph, Kathrine, & Vijayan, (2014) stated that cloud computing is a pattern of facilitating on demand network for access of the shared pool of resources virtually. However, virtualization technology has transforms cloud computing in a way to look like a physical resource to enable flexibility, availability and efficiently use of this logical resources such as storage, application and services. The cloud computing basically enable the access of the shared common resources, services and infrastructure available on demand to perform varied operations and task within the network that cope with the dynamics of business needs and environment (Kulkarni, Gambhir, & Palwe, 2012).Hence the place or location where the accessed resources are not aware by the users and not worried of management or maintenance of the virtual resources hence allow users to create, disseminate and control applications in the cloud.

The cloud computing service and application providers are giving higher education chance to alternate the presence method and enable institutions current data center, applications and replacing traditional and physical being in campus (Ouahabi, Eddaoui, Labriji, Benlahmar, & Guemmat, 2015). However, Maskare& Sulke, (2014) argued that traditional education is not able to cope with social aspects and changes within the society and the high demand of education and thereby a paradigm shift in the use of computer network and other technologies has bring an opportunity to catch up in educational development by used of this learning modes as virtual learning, virtual learning, web-based learning, network and distributed learning.

The competitive advantages aspect has compelled the higher institution to adopt and the implement the e-learning as an acceptable and formal mode of education delivery system. This decision has enabled the institution to benefits much. The pursuit for effectiveness, flexibility and low cost deployment of ICT infrastructure and strategies as prompted the institution to engage on a new paradigm of services and resources deployment and thus cloud computing is the way(Odunaike, Olugbara, & Ojo, 2012).

This study embarked on the aspects as benefits of cloud computing adoption on E-learning environments; and the issues of cloud computing adoption on E-learning environments. Generally the study carried out an assessment of cloud computing adoption for E-Learning environments in institutions of higher learning in Nairobi County, Kenya; especially in view to:-

i. Establish the extent of cloud computing adoption for E-Learning environments in institutions of higher learning in Nairobi County, Kenya.

ii. Assess the benefit of cloud computing adoption for E-learning environments in institutions of higher learning in Nairobi County, Kenya.

iii. Examine the issues of cloud computing adoption for E-learning environments in institutions of higher learning in Nairobi County, Kenya.
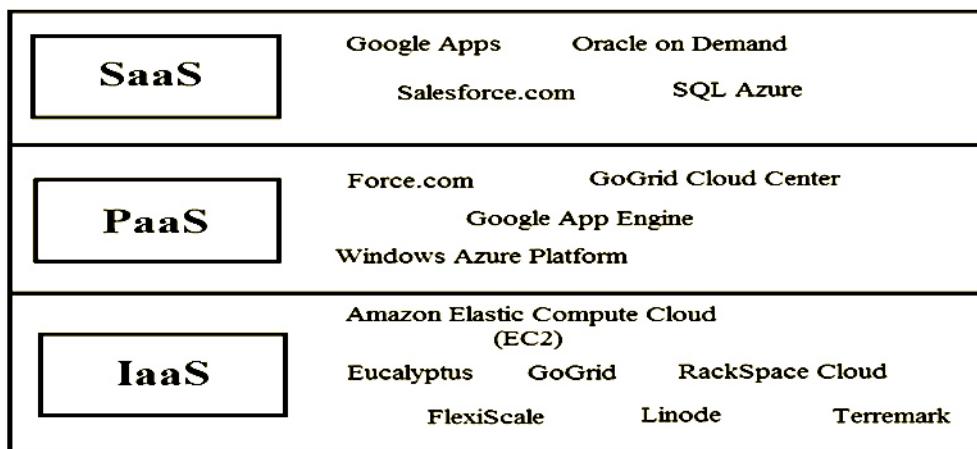
2.   Cloud computing

NIST (2011) define the cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". Consequently, Bhure & Bansod (2014) terms it as both applications and services residing within a network that is distributed and resources accessed virtually through internet protocols as well as appropriate networking standards which reveals the physical systems as an abstract to the user through abstraction and virtualization technology concepts.

According to Mokhtar, Ali, Al-Sharafi, & Aborujilah (2013) argued that despite increased adoption of cloud computing especially in the industry and service sectors which involved 96% while only 4 % within the education sector. Also, the swelling use of cloud computing as resulted in tremendous growth of $40 billion in 2011 to approximately $240 billion by 2020 in the market. According to Odunaike, Olugbara, & Ojo (2012) argued that the market share and growth has overwhelmingly increased   due to cloud computing Moreover, from his studies the cloud computing global market growth shifted from $40.7 billion in 2011 to almost $241 billion in 2020. The public cloud total size is predicted to shoot from $25.5 billion in 2011 to $159.3 billion in 2020. Added that Forbes indicated $12.1 billion cloud computing growth of service in 2011 which is approximated growth value of $35.6 billion by 2015.Additionally, Saraswathi & Bhuvaneswari (2013) stated that cloud computing enables availability of services 24/7 anytime-anywhere to the user without accountability of maintenance of applications or rather the location of such services since they are in charge service providers (i.e. Amazon EC2, Google). Gokuldev & Leelavathi (2013) pointed out that Cloud computing "are a new computing paradigm that is built on virtualization, parallel and distributed computing, service-oriented architecture, and utility computing". Consequently most of the cloud computing concepts and cloud services commonly users do interact on daily basis include but not limited to Gmail Docs, drives and Google Calendars, Apple's iCloud, Microsoft's SkyDrive, Dropbox and Samsung's SCloud (Jeong, Kim, & Yoo,2013).

The higher education in the entire globe has embraced cloud computing for instance UK institutions (e.g. Leeds Metropolitan University, the University of Glamorgan, University of Aberdeen and etc.), US (University of California, Harvard University etc.) as well as Africa (Sultan, 2010). According to Drissi, Ouman, & Medromi (2013) there are a number of classification models of cloud based on their uses, such as cloud Platform as a Service (PaaS) that offers environment implementation virtually of services for instance Google App engine etc., Moreover it facilitate users to deploy and perform specific task on application software's in the cloud with the tools, languages, functions, libraries and services enable by the service provider (Odunaike, Olugbara, & Ojo, 2012). cloud Software as a Service (SaaS) that offers software applications through the internet as a service like Google Docs, Salesforce.com CRM, Zoho Office etc. and cloud Infrastructure as a Service (IaaS) that facilitate computing of resources virtually i.e. Amazon EC2. Bhure & Bansod (2014) too acknowledge that IaaS offers virtual machines, infrastructure and storage which availed resources to the clients and interactivity with the system applications.
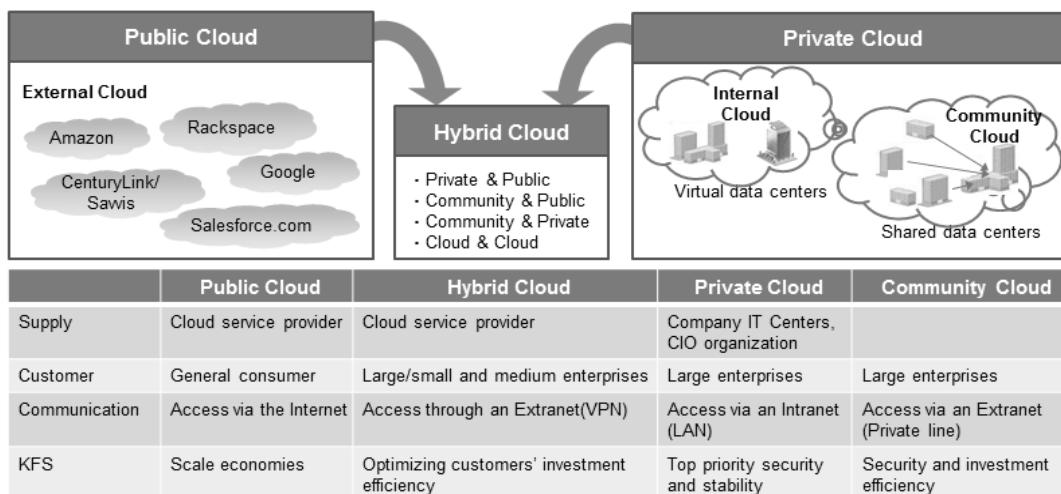
Fig 2.1 Cloud Model

Source adapted from Jain & Chawla, (2013)

However Drissi *et al.*,(2013) pointed out the deployment models associated to cloud architecture; First, is Private cloud where the platform is only associated to a specific organization, Second, Community cloud where a number of organizations share the infrastructure and also a specific community which has communal concerns is supported, Third, Public cloud that is available to the registered public users privilege to make use of the and Lastly, the Hybrid cloud that can consist of combination of two or more models.

Fig 2.2 Deployment Model

	Public Cloud	Hybrid Cloud	Private Cloud	Community Cloud
Supply	Cloud service provider	Cloud service provider	Company IT Centers, CIO organization	
Customer	General consumer	Large/small and medium enterprises	Large enterprises	Large enterprises
Communication	Access via the Internet	Access through an Extranet(VPN)	Access via an Intranet (LAN)	Access via an Extranet (Private line)
KFS	Scale economies	Optimizing customers' investment efficiency	Top priority security and stability	Security and investment efficiency

* KFS(Key Factor for Success), VPN(Virtual Private Network), CIO(Chief Information Officer), LAN(Local Area Network)

Source: Wikipedia (2015)

Jeong, Kim, & Yoo (2013) identified some of the cloud computing benefits for e-learning in the higher education such as minimal cost, high performance, improved compatibility and format of documents, resource availability to both learners and trainers (as online assignment, examination, projects, courses and learning materials)
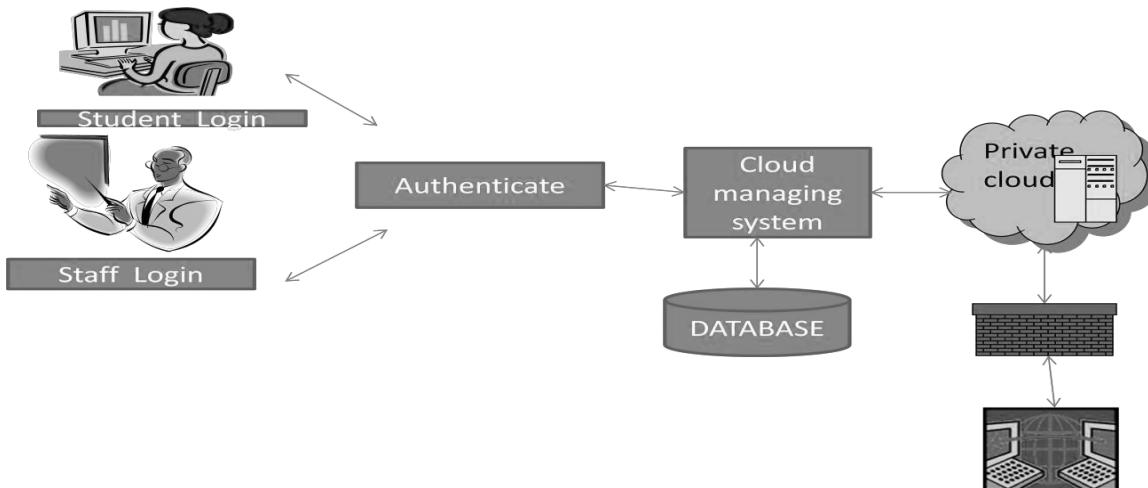
2.2 E-Learning

Sangra, Vlachopoulos, & Cabrera (2012) define the E-Learning as the use of the electronic media for a multiplicity of learning reasons that vary from add-on functionalities in a typical classrooms to full replacement of the face-to face encounters through online sessions or a distance education system by use of remote resources. According to Kakoty, Lal, & Sarma,(2011) the E-learning revolution as enable new education dimensions which has turn the world as a global village and get rid of barriers of time, place, time, age, social and economic aspect. The E-learning provides a platform incorporating ICT resources enabling students and teachers interactivity with online environment. The E-learning have revolutionized the distance learning by utilizing a combination of mass- latest technologies in structuring practices involving teaching, learning and education (Sangra, Vlachopoulos, & Cabrera, 2012).

Jeong, Kim, & Yoo (2013) affrimed that a number of institutions have now embraced the E-Learning by incorporating the cloud computing technologies within the academia therefore offering a more flexible, scalable, efficient and reliable learning content. Additionally, they stated that universities nowadays are now utilizing opportunities of cloud computing for distance learning as well as economic benefits and privileges. The various institutions utilized E-learning to spearheads learning solutions through a number of educational levels ranging from academics training, company trainings and so on involving entities as the students [online course , exams , homework, projects] and the trainers[notes , Cats, assignment dissemination] (Bhure & Bansod ,2014).

Adhyapak (2015) stated that the demand for education development within the society is growing all the time and therefore quality, improved and advanced e-learning solutions is obligatory which is demanded and must go in hand with technology dynamics and consequently, the adoption and use of cloud computing is essential. Also the institutions around the world are increasing burden to devote and use the ICT to manage and served all the wellbeing of the students, staff and management fraternity which are overwhelmingly doubling every intake.

Fig 2.3   Private cloud Architecture in E-Learning

Source: Adapted from Adhyapak (2015)

The implementation of E-learning within the higher institutions is faced by various challenges and the universities that want to adopt and implement the idea must be ready to tackle the challenges that can be encountered in the process such as infrastructural challenge, legal issues, security issues, social and cultural challenges, leadership challenges among others. Most universities in Kenyan is forced to align with the vision 2030 hence needs to blend the education system with the e learning as alternates for traditional system delivery of knowledge (Tarus, Gichoya, & Muumbo, 2015). They also indicated that according to the survey on Kenyan universities a number of them have adopted the e learning where at some point they combined with the face to face learning such as seminars, Cats and Exams administering. Among this Wedusoft platform was the e learning initially first launched by University of Nairobi in the way back 2004, Kenyatta University started theirs in 2005 where they used Moodle while Moi University launch MUSOMI as e–learning platform in 2007.Consequently, today the Kenyan universities both public and private have taken a step in inclusive of collaboration technologies and other e learning paradigm as cloud computing to improve quality and efficiency of education sector.

2.3 Benefits of Cloud Computing

According to Patil & Babu (2013) among the benefit of cloud services is that they require no capital investment for the users to access with neither geographical nor time limitation, efficiency, flexibility, cost reduction, scalability and pay per use criteria.
Sultan (2010) indicated that the used of pay–as you-go model has enable the users to enjoy simplicity, accessibility and economics where no cost incurred in terms of architecture, application installation and labour. This is because installation and maintenance are not locally run on the IT infrastructure but is cloud – based and thus the company, organization or institution is free from cloud architecture-related expenses shifted to external providers.

El-Ala, Awad, & El-Bakry (2012) affirmed that cloud computing is able to saves cost required for advancement of various labs' software's and hardware licenses or purchase and can also lessens the user of regular maintenance as well as enabling a high degree of privacy and security. However, most of the Universities are acknowledging the capacity of cloud computing in the improvement effectiveness, efficiency, reduction in cost and convenience in the educational sector (Sultan, 2010).

According to Bhopale (2012)summarizes benefits of cloud computing as unlimited scalability, reduced cost, increased storage, automation, flexibility and better mobility; moreover, Sharma (2014) pointed out reduction in cost, infrastructure flexibility, virtualization, ease monitoring and access of data, unrequired data backup and the availability increased. Therefore the adoption and implementation within the Kenyan higher institution would greatly boost and improved education quality.

The adoption of cloud on e-learning has much improved performance as a result of running the processes and applications within the cloud and thus client machine cannot create problems based on performance problems (Viswanath, Kusuma, & Gupta, 2012).Jain & Chawla (2013) argued that cloud computing is cost effective since the university is liable to server space, updates and maintenance cost. In addition the data access control

and monitoring is simpler since a single place require supervision .The aspect of virtualization too help in minimizing cloud downtime.

2.4   Issues of Cloud Computing

Cloud computing as a new technology paradigm is fastened with uncertainties and fears on concerns relating to control, performance, vendor lock, security, privacy, latency and reliability (Sultan, 2010).

Security - The confidentiality and privacy of data within the cloud entrusted to the service providers is questionable and thereby many academic institutions are reluctant to embrace the idea of cloud computing. Thereby there concern of cloud computing to effectively handle regulations on privacy (Maskare & Sulke, 2014; Mokhtar *et al*, 2013).

Lack of control - The users lack the freedom to physically own and control their data stored in cloud since they are left in the hand of the third party or the cloud service providers (Viswanath, Kusuma, & Gupta, 2012).

Bandwidth - Since the cloud computing is an internet based service; it is quite challenging to offer education services effectively in such a case the bandwidth is limited especially the deployment model as public cloud (Mokhtar *et al*, 2013).

Educational management rules - The control, monitoring and management are quite difficult with cloud computing in relation to the traditional education that decision makers and management board are used to in control of teaching, content and examination within the institution, hence reluctant in implementation (Mokhtar*et al*,2013; Avram, 2014)

3.   Discussion and Conclusion

The various services offered through web services(such as Google Maps) , utility computing including infrastructure as a service(IaaS), software as a service(SaaS), and platform as a service (PaaS)where the end users exploit these services using browsers via internet. The SaaS application involved sales force applications, CRM applications, ERP applications, meeting applications, Google Apps i.e. Google Talk, Gmail, Google Calendar, Google Docs (e.g. spreadsheets, collaboration), etc., and Microsoft Windows Live such as Messenger ,Hotmail, Photo Gallery (Kim, 2009)

Jeong, Kim, & Yoo (2013) argued that a number of institutions are embraced the E-Learning by incorporating the cloud computing technologies within the academia therefore offering a more flexible, scalable, efficient and reliable learning content. Consequently, Mircea & Andreescu, (2011) expounded various instances of utilization of cloud computing services in universities in the whole world and regionally, this include Virginia virtual computing lab as a composition of Commonwealth colleges and universities. Moreover, North Carolina State University have facilitated the cloud services through software licensing cutting cost and time saving among IT campus staff. Kuali Ready is also a chartered community-source project facilitating cloud computing services as higher education institutions.

According to Sultan, (2010) the benefits and opportunities of utilizing cloud computing among higher education institution as Washington State University's School of Electrical Engineering and Computer Science, University of California, institutions from UK, U.S, Africa and so on .The Cloud computing infrastructure and technologies have allowed most of the institutions to enjoy the services even without technical expertise host own platform. It has given the freedom for everyone to deploy their tools to enjoy on demand services and application as, Google Docs, YouTube, Spread sheets, etc. The institution globally have benefited from the service to enabling them to cut cost of implementation, maintenance, data storage, security ,computing power that allow both trainers and students enjoy proprietary tools and applications as virtual office, databases, spreadsheets, and social software (Al-Zoube, 2009). Bhopale (2012) stated key privileges of cloud computing among them are unlimited scalability, reduced cost, increased storage, automation, flexibility and better mobility; Additionally, Sharma (2014) outlined the reduction in cost, infrastructure flexibility, virtualization, ease monitoring and access of data, unrequired data backup and the availability increased. Therefore the adoption and implementation within the Kenyan higher institution would greatly boost and improved education quality.

The Cloud computing has enables the institutions to meet customer satisfaction and deliver quality service in low cost with efficiency and effectiveness. The journal articulated the cloud services, deployment model, adoption, benefits, issues of cloud computing and incorporation of e learning among the higher education institutions. The pressure of large intake of students, education content growth and dynamic change of IT has necessitate most universities to seek alternatives solution in their e-learning which has promote high spending ,lack of efficient resource utilization and scalability on the current systems of learning. Therefore, not only international institutions in UK and US but also in Africa especially Kenya such as University of Nairobi, Kenyatta University, Jomo Kenyatta University of Science and Technology, Strathmore etc. are now reaping benefits of cloud computing adoption and incorporation in their e-learning within higher education (Jain & Chawla, 2013).

References

Adhyapak, S. (2015). Cloud Computing and Benefits of Private Cloud In E-Learning Solutions. International Journal of Computer Application, 5(3), 77-82.

Al-Zoube, M. (2009). E-Learning on the Cloud. International Arab Journal of e-Technology, 1(2), 58-64.

Avram, M.-G. (2014). Advantages and challenges of adopting cloud computing from an enterprise perspective. The 7th International Conference Interdisciplinarity in Engineering (INTER-ENG 2013) (pp. 529-534). Elsevier Ltd .

Bhopale, S. D. (2012). Cloud Migration Benefits and Its Challenges Issue. IOSR Journal of Computer Engineering (IOSR-JCE), 40-45.

Bhure, G. C., & Bansod, S. M. (2014). E-learning Using Cloud Computing. International Journal of Information and Computation Technology, 4(1), 41-46 .

Drissi, S., Ouman, H., & Medromi, H. (2013). Survey: Risk Assessment for Cloud Computing. International Journal of Advanced Computer Science and Applications, 4(12), 143-148.

El-Ala, N. S., Awad, W. A., & El-Bakry, H. M. (2012). Cloud Computing for Solving E-Learning Problems. International Journal of Advanced Computer Science and Applications, 3(12), 135-137.

Gokuldev, S., & Leelavathi, S. (2013). HASBE: A Hierarchical Attribute-Based Solution for Flexible and Scalable Access Control by Separate Encryption/Decryption in Cloud Computing. International Journal of Engineering Science and Innovative Technology, 2(3), 294-301.

Jain, A., & Chawla, S. (2013). E-Learning in the Cloud. International Journal of Latest Research in Science and Technology, 2(1), 478-481.

Jeong, J.-S., Kim, M., & Yoo, K.-H. (2013). A Content Oriented Smart Education System based on Cloud Computing. International Journal of Multimedia and Ubiquitous Engineering, 8(6), 313-328.

Joseph, A. O., Kathrine, J. W., & Vijayan, R. (2014). Cloud Security Mechanisms for Data Protection. International Journal of Multimedia and Ubiquitous Engineering, 9(9), 81-90.

Kakoty, S., Lal, M., & Sarma, S. K. (2011). E-learning as a Research Area: An Analytica lApproach. International Journal of Advanced Computer Science and Applications, 2(9), 144-148.

Kim, W. (2009). Cloud Computing: Today and Tomorrow. JOURNAL OF OBJECT TECHNOLOGY, 8(1), 65-72.

Kulkarni, G., Gambhir, J., & Palwe, R. (2012). Cloud Computing-Software as Service. International Journal of Computer Trends and Technology, 2(2), 178-182.

Maskare, P. R., & Sulke, S. R. (2014). Review Paper on E-learning Using Cloud Computing . International Journal of Computer Science and Mobile Computing, 3(5), 1281-1287.

Mircea, M., & Andreescu, A. I. (2011). Using Cloud Computing in Higher Education: A Strategy to Improve Agility in the Current Financial Crisis. Communications of the IBIMA, 1-15.

Mokhtar, S. A., Ali, S. H., Al-Sharafi, A., & Aborujilah, A. (2013). Cloud Computing in Academic Institutions. ICUIMC(IMCOM), 17-19.

NIST, N. I. (2011). The NIST Definition of Cloud Computing. Information Technology Laboratory.

Odunaike, S. A., Olugbara, O. O., & Ojo, S. O. (2012). Using Cloud Computing to Mitigate Rural E-Learning Sustainability and Challenges. Proceedings of the World Congress on Engineering and Computer Science 2012, 1. San Francisco, USA.

Odunaike, S. A., Olugbara, O. O., & Ojo, S. O. (2012). Using Cloud Computing to Mitigate Rural E-Learning Sustainability and Challenges. Proceedings of the World Congress on Engineering and Computer Science 2012 , 1. San Francisco, USA.

Ouahabi, S., Eddaoui, A., Labriji, H., Benlahmar, E., & Guemmat, K. E. (2015). Using IMS LD Specification for e-Learning in the Cloud Computing. International Journal of Information and Education Technology, 5(11), 860-864.

Patil, M., & Babu, A. S. (2013). HASBE: A Hierarchical Attribute-Based Solution for Flexible and Scalable Access Control In Cloud Computing. International Journal of Electrical, Electronics and Computer Systems (IJEECS), 1(3), 44-47.

Sangra, A., Vlachopoulos, D., & Cabrera, N. (2012). Building an Inclusive Definition of E-Learning:An Approach to the Conceptual Framework. The international Review of Research In Open and Distance Learning, 13(2), 145-159.

Saraswathi, M., & Bhuvaneswari, T. (2013). Multitenancy in Cloud Software as a Service Application. International Journal of Advanced Research in Computer Science and Software Engineering, 3(11), 159-162.

Sharma, P. (2014). E-Learning Using Cloud Computing and IT. Advances in Computer Science and Information Technology (ACSIT), 1(1), 6-10.

Sultan, N. (2010). Cloud computing for education: A new dawn? International Journal of Information Management, 109-116.

Tarus, J. K., Gichoya, D., & Muumbo, A. (2015). Challenges of Implementing E-Learning in Kenya:A Case of Kenyan Public Universities. The International Review of Research in Open and Distributed Learning(IRRODL), 16(1).

Viswanath, D. K., Kusuma, S., & Gupta, S. K. (2012). Cloud Computing Issues and Benefits Modern Education. Global Journal of Computer Science and Technology Cloud & Distributed, 12(10).