Journal of Multidisciplinary Engineering Science and Technology (JMEST)
ISSN: 3159-0040
Vol. 2 Issue 8, August - 2015

A Preliminary Assessment Of Cloud Computing E-learning Solutions In Namibia

Attlee M. Gamundani
Computer Science Department.
Polytechnic of Namibia
transforming into NUST.
Windhoek, Namibia
agamundani@polytechnic.edu.na

Martin Kanyangela
Computer Science Department.
Polytechnic of Namibia
transforming into NUST.
Windhoek, Namibia
mkanyangela@gmail.com

Shadreck Chitauro
Computer Science Department.
Polytechnic of Namibia
transforming into NUST.
Windhoek, Namibia
schitauro@polytechnic.edu.na

***Abstract*— The growth of cloud computing is now visibly active a technological milestone. E-learning on the other hand has become a deliberate platform for learning purposes both in educational institutions and companies in general. Cloud computing has promoted the growth of e-learning platforms with its pay as you go model, which suits all scales of budgets and requirements competitively. Learning has always expanded beyond the walls of the classrooms thus information technology is being used to transform education. E-learning on the cloud provides an environment where students could share resources and actively collaborate. In Namibia, e-learning is still growing and there are challenges being faced in having e-learning implemented overly across the education system. This paper is positioned to assess the current status of cloud computing and e-learning deployment solutions across Namibia. It focuses on the specific benefits and challenges that the targeted research area could enjoy and encounter respectively, if cloud computing is employed. Results from a preliminary survey will give a partial picture as to the way forward and some key pointers that could aid different stakeholders in the educational fraternity on various decision making processes. Such contributions could be extended to other environments with similar experiences if modified to some extent.**

Keywords— cloud computing; e-learning; education; feasibility; Namibia

I. INTRODUCTION

With ongoing new technologies and developments, the internet has been transformed from just a platform for reading and collecting information to an environment that allows users to run their application software, collaborate and interact effortlessly.

The popularity of learning on the internet and construction of a web based learning environment is growing rapidly, the reason being that, it brings students from different geographical areas together and create a notion of a single classroom environment which helps them to share knowledge and exchange strategies. In the near future, cloud computing will play a big role in the education industry. When comparing traditional learning methods to those of modern ways as empowered by cloud computing, there are many and varied. Some of the benefits are leveraging on costs as hardware no longer has to be acquired and it is outsourced to a cloud company to maintain and run it, allowing an organisation to focus fully on its core business.

Namibia is one of the countries that is trying to improve its traditional learning methods and is changing towards a state of the art oriented 21st century educational atmosphere.

E-learning systems need to keep up with the pace of abrupt technological changes such as those witnessed in mobile phones, personal computers, etc. People prefer the flexibility offered through the mobility, where they can take their work anywhere and still have access to the documents they need as well as the ability to interact with other students or teachers globally. This helps as they do not need to have large amounts of physical hard disk space available given the ease of access to their documents via the cloud.

Many developing countries like Namibia are behind when it comes to new technologies especially in regards to cloud computing. The research conducted shows that very few people know what e-learning is and fewer even know what cloud computing is.

According to [1] the cloud computing environment provides a natural platform to support e-Learning systems and enables implementation of data mining techniques. Data mining becomes important when large databases are being used so that meaning can be extracted from data. As espoused by [1] Educational Data Mining (EDM) focuses on exploring data gathered in the educational system and applying the methods to help improve and give a better understanding of content extracted for student's consumption.

In this paper, a look at how incorporating e-learning with cloud computing and the benefits as well as the implications that might come as a result of combining the two will be discussed.

II. RELATED WORK

A. Overview

Cloud computing has become an attractive technology with which most other technologies would like to be affiliated with because of its scalability, cost effectiveness and its flexibility for resource constrained environments. Much focus and research has of late been channeled towards cloud computing applications and its possibilities. E-learning is one of the technologies of interest in cloud computing for various reasons.

According to [2] E-learning is an "Internet-based learning process, using internet technology to design, implement, select, manage, support and extend learning, which will not replace traditional education methods, but will greatly improve the efficiency of education".

Combining E-learning with cloud computing will help meet the educational needs better. E-learning by itself also has quite a lot of advantages such as flexibility, diversity and scalability. Although we have all these advantages of E-learning it still has some few minor setbacks and this is where cloud computing comes in, to solve the few setbacks that are experienced by the E-learning solution.

Cloud computing is thus explained by [2] as a model based on networks especially on internet with a simple task of ensuring that users can use computer resources simply on demand and only pay for the usage thereof. It is more like prepaid water and electricity type of system where you only pay for what you have used. Cloud computing brings about a new type of business model where the services that are provided become computer resources. According to [3] cloud computing is defined as a model for upgrading network services in order to easily connect to the cloud using improved networks to enable interconnection. Cloud computing is a new technology that is trending and is likely to have a significant and positive impact on the teaching and learning environment according to [2].

B. Cloud Computing and E-learning

The cloud environment can either be public or private based on management and administration modalities. Private clouds are basically managed and administered by the organization themselves and provide a sense of security while on the other hand a public cloud is available to the public. The main difference between the two is basically the security risk level and scalability. The fact that it involves service providers that provide the cloud service, the cloud can be seen as a unique access point for all the requests coming from clients worldwide. According to [4] Cloud computing basically comprises of three layers which are:

- Infrastructure as a service (IAAS) – Use an e-learning solution on the providers' infrastructure
- Platform as a service (PaaS) – Use and develop an e-learning solution based on the providers' development interface
- Software as a service (SaaS) – use the e-learning solution given by the provider

Fig 1: Cloud computing [5].

Fig 1 basically explains how cloud computing works. How clients access the cloud and the existence of a scalable data center that has the capability to house large data volumes and high processing demands.

As time moves, the institutions are faced every year with an increased amount of students against static budgets on technological investments, yet they have to secure the necessary software and hardware to accommodate all students. Current e-learning resources are not scalable and do not fully utilize the resources according to [6]. Prompted by the need to improve the existing e-learning infrastructure, cloud computing has been adopted by universities. Cloud computing has necessitated e-learning hosting to increase its efficiency, flexibility and availability. In the cloud based e-learning system the institutions are responsible for the content management, creation and delivery while the service provider of the cloud are responsible for constructing as well as management of the system [6].

Fig 2: Abstract model of cloud computing based e-learning [6].

In Fig 2, the model shows that, the request is sent from a user to the service provider which then connects to the e-learning cloud in order to give a response to a user's request.

There are at least two main players involved in the e-learning system which are students and the teachers or trainers. The students do the online courses, take online exams, send feedback, do homework and complete projects. In this manner they are collaborating with other students as well. On the teacher or trainers side they deal with the content management, test assessment, projects setting as well as engaging with the students on any other matters they may raise. This is easily set up because the architectural design in e-learning is client server architecture. There are many other benefits of e-learning hosted on the cloud platform.

Cloud based e-learning supports creation of a new generation of e-learning systems which are able to run on a number of hardware devices, while storing data inside a cloud. It is imperative to appreciate that e-learning does not replace teachers in fact it only improves the technology. Teachers will still play a role in developing and making use of the e-learning on the cloud. As presented by [2] cloud computing has been introduced to increase the scalability, flexibility, and availability of e-learning systems, hence it offers a complementing facility to the conventional system setups.

Major players in the cloud industry are: Google, Microsoft, Amazon as well as legacy hardware vendors like IBM and Intel. Google owns a massive cloud that connects millions of people. Today the cloud can be accessed by Google Apps intended to be software as a service dedicated to information sharing and security. According to [4] Google Apps covers categories such as; messaging like Gmail and google talk, collaboration such as google docs, video and sites and security such as e-mail security, encryption and archiving.

C. Benefits of E-learning on the Cloud.

Many of educational institutions do not have the necessary resources and infrastructure to run e-learning solutions, thus they stick to the traditional methods of using blackboards. The biggest players in the field of e-learning software have versions of the base applications that are cloud oriented according to [4]. Benefits of e-learning based on the cloud are:

- Virtualization – makes it possible for the rapid replacement of a compromised cloud located server without major costs or damages. It is very easy to create a clone of a virtual machine so the cloud downtime is expected to be reduced substantially;
- Centralized data storage – it makes the management of such resources easy to handle.
- High Availability- through the integration of mass storage and high-performance computing power, this system can provide a higher quality of service. Cloud computing system can automatically detect the node failure and exclude it. The architectural build of cloud computing platforms makes handling of faults modular.
- Easy Monitoring- it becomes an easy task as only one place has to be supervised, not thousand systems belonging to an institution.
- Cost effective - if it is used properly, it is highly cost effective as institutes have to pay only for the server space they use and costs of maintenance and updates.

D. E-learning Challenges

As a way of teaching large classes educational institutions are using e-Learning services which allow learners to complete their studies through distance mode. Although there are several benefits when using e-Learning for delivering classes some institutions experience some challenges when implementing, managing and using the platform. Below are some of the challenges experienced by some institutions in developing countries

As outlined by [12], some of the challenges are:-

- Inadequate ICT and eLearning infrastructure: (computers, internet, network connectivity)

- Financial constraints. More capital is needed when setting up e-learning for the first time. The capital will be used for several activities including staff training so that they can maintain the system in an efficient way and educate the learners.

- Low bandwidth. According to [13] in developing countries there is a challenge on the amount of bandwidth we receive which is low and cannot support more tools to be used to support learning through eLearning platforms. These tools will include but not limited to audio recordings, videos. For the distance learner to listen to audios and videos the person responsible in uploading the content to the system will have to make the recordings short.

- Lack of operational e-learning policies was also mentioned as another factor.

- [12] highlighted that teaching staff lack technical skills since most of them were trained long back when ICT was not there.

- Amount of time required to develop e-Learning content. Developing content to upload on e-learning platform would require more time since the content has to be formatted in a certain way to suit the platform used so that end users will be able to view it correctly without technical errors [14].

[15] listed the following challenges

- English competency. The author highlighted that implementing eLearning in non-English speaking countries will present a challenge since some platforms use English.

- Access to computers. Learners require a computer to use to gain access to the e-Learning

system. Some learners do not have personal computers to use at home to access the platform.

- Resistance to change. In a research done by [16] they indicated that since technology is improving drastically, so are e-learning systems, hence learners are not prepared to upgrade instantly hence they resist change.

The pedagogical, technical and cost implications of e-learning technologies availed by [3], clearly points some key advantages and possible challenges that could be handled by applying a cloud facility.

The challenge of storage facilities had been a hindrance for hosting e-Learning platforms that support multimedia content as pointed by [10], with a cloud facility such challenges could easily be taken care of at minimal cost.

Technology changes regularly and at times institutions are afraid of sourcing e-learning technologies that will be obsolete in a short space of time. To an extent, the cloud platform alleviate the challenge by ensuring up to date technologies are availed through its IAAS wing as there is room for institutions to rent technology that is up to date.

Many of the e-learning challenges literature presents are equally solvable one way or the other to some extent through implementation of cloud based platforms except for connectivity issues which becomes too complicated once the cloud layer is added below the e-learning platform.

E. Cloud computing e-learning solutions applications.

Cloud computing may promote a new era and methods of learning, taking advantage of the fact that it is possible to host e-learning applications on a cloud and following its virtualization features of the hardware which reduces construction and maintenance cost of the learning resource. At the moment e-learning on cloud resources have been narrowly explored. However some relevant efforts of using IAAS cloud technologies in education which focuses on reservation of virtual machines to students for specific amount of time have been widely explored.

According to [1] “Another example of an application that can be referenced from literature is BlueSky, whose architecture has several components aimed at the efficient provision and management of the e-Learning services, being able to pre-schedule resources for the hot contents and applications before they are actually needed, to safeguard the performance in concurrent access, although no details have been found with regard to how this is achieved.”

Another example is the CloudIA framework which is a framework that provides on demand configuration and creating of virtual machines in order for students to have their own java servlet environment for experimentation and testing purposes which contains MySql, Tomcat, PHP and Apache Web server according to [1].

As espoused by [1], new service models are being developed that will enhance the efficiency within a virtual personalized learning environment which will be intended for subscribing learning resources as well as setting up virtual learning environments. This system allows the learning content providers to register their applications in the server and the learners can integrate other internet learning resources to their learning application.

III. METHODOLOGY

A qualitative research method was employed mostly dwelling on case study of institutions of higher learning in Namibia. The descriptive research approach included a survey on a selected sample of population mainly high school and tertiary students as well as the teachers or lecturers. Primary sources as well as secondary methods of data collection were employed.

A survey was conducted to get first-hand information from the individuals themselves such as the students about educational institutions and information on cloud computing and e-learning. Conducting surveys was an important tool for collecting and analyzing data from the selected individuals. A questionnaire survey instrument was used to assess the perception of selected schools, students and teachers regarding the implementation of e-learning on the cloud and how much they actually know about e-learning and cloud computing.

Questionnaires were mailed and some physically handed to the target population. The target population was chosen according to the sampling method chosen which included students, specifically focusing on tertiary students and high school students from grade 11 to 12. The targeted individuals were requested to fill in the questionnaires under anonymity and return or mail them back.

The survey was divided into two sections: Section one: Background of the student being interviewed in terms of knowledge, which addressed the current state of e-learning and cloud computing facilities each student currently has at their institution and the understanding thereof. Also it included how the current set up could be improved and how the students, teachers and institutions actually view the current set up of the e-learning system. Section two: students and their ability to access the necessary hardware and software to be able to use the e-learning and cloud facilities, whether they do have the e-learning facilities at their schools or have any knowledge on it as well as finding if it will improve the learning experience in terms of interaction between teachers and students and the benefits it could provide to the students especially, in light of their individual learning preferences.

A random sampling method was used since it was not going to be very specific to a certain age, gender or course of the selected students. A simple random sample where selections were made by chance as long as the person falls under the category of being a student above grade 10 was used. The focus was mainly on the big universities in Namibia which are the

Polytechnic of Namibia, International University of Management as well as the University of Namibia.

IV. RESULTS ANALYSIS

According to the results obtained the analysis prior to studying and review of all questionnaires, it became visible that quite a significant number of students especially the tertiary level, do know and understand what e-learning is and also do have the e-learning facilities at their institutions as well. Cloud computing was least understood as most students displayed little to no knowledge on cloud computing. A lot of students do acknowledge that distance learning via the web will be beneficial as they will be able to collaborate with one another and their teachers.

About 90% of the students frequently use the internet daily thus cloud based e-learning will be beneficial to them. The availability of a usage pattern of internet is a ripe ground to introduce cloud based e-learning platforms. This will increase acceptance levels, as it will be a matter of adding extra application environments to what they already have been used to, when surfing on the internet.

E-learning is very well understood by most tertiary students thus it signals, it will be a good platform for studying and teaching students on cloud based e-learning.

Those from most secondary schools indicated lack of knowledge, understanding and exposure to e-learning or cloud computing, which safely signal the need for education and orientation of some of the new technologies at such grass root levels, even tracking back to primary school levels.

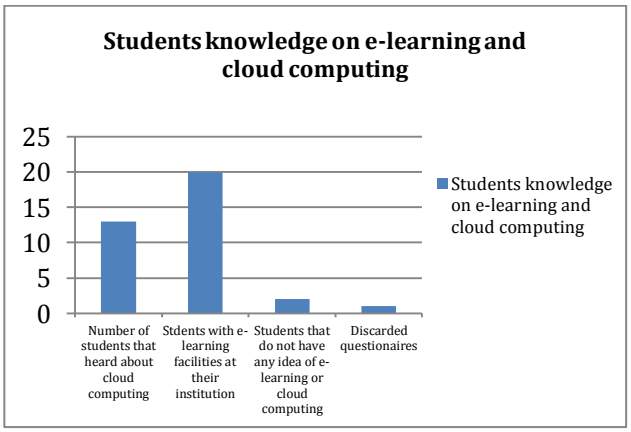

Fig 3: Knowledge on Cloud & E-learning

According to the analysis from the research conducted it shows that cloud computing is still unknown to most and for most that know it, have an e-learning studies in one of their courses as part of the curriculum. This reveals that students only learn about e-learning when they are covering curriculum content for certain institutions and not practically use it for their own learnng. Thus, there is little practical implementation of e-learning in institutions of higher learning in Namibia as mainly one institution has adopted e-learning as depicted by results shown in Fig 4.

The knowledge displayed is mostly from the theory learnt in class and not the hands on experience of practically using e-learning. This signals lack of full implementation of e-learning solutions to a greater extent. Introducing cloud based e-learning solutions will have a threefold task of educating the users on the design, implementation and accessibility thereof.

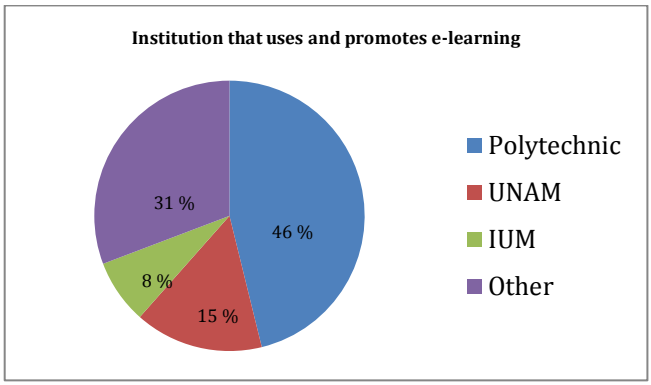

Fig 4: Use and promotion of e-learning

Also from the research conducted it has been observed that Namibia has been able to double its number of internet users, which can be attributed to the general economic growth and falling telecommunication prices[11]. About 100% of the research responses indicate that they have a cellphone and do have access to the internet and frequently uses the internet on a daily basis.

As per this survey, one institution is currently using e-learning for delivery of most of its courses and blending it with traditional learning methods towards a Learner-Centred approach, which is the Polytechnic of Namibia. This clearly communicates the need to explore further the aspects contributing to the low adoption of technologies and forge the way forward based on a detailed informed background.

V. CONCLUSION AND RECOMMENDATIONS

The application and deployment of cloud based solutions in the education sector in Namibia will receive a viable receipient environment, as the economy is fast growing and aligning its developmental projects with those of the international community. Most institutions of higher learning in Namibia have one or more International collaborations to streamline their course content and administrative operations with those of the International institutions. Cloud based e-learning solutions will go a long way in aiding such mandates to be fulfilled and enable students to benefit enormously as international doors for diverse resource sharing will be easy to establish and maintain.

The greatest challenge however will be on the connectivity weakness as the coverage to every corner of the country are not yet 100% smoothened.

Most of the institutions have campuses spread all over the country, to ensure constistency and availability is one haddle to tackle before a practical implementation of cloud solutions. Technical expertise and knowledge is competitively in existence with some companies already in business of selling cloud based solutions for the education sector and offering consltancy services.

For ease deployment, mobile based cloud e-learning facilities are much viable for low connectivity areas as Namibia and many other developing countries face the same odeal. Overally, it could be presented thus, the viability of cloud based solutions such as hosting e-learning packages are possible and could be customised to suit low connectivity areas. The need to educate and inform the users is of paramount importance.

ACKNOWLEDGMENT

For availing a thriving research environment, we extent our gratitude to the Polytechnic of Namibia transforming into Namibia University of Science & Technology. We do respect and thoughtfully appreciate the time the participants who actively contributed to the questionnaires, interviews and surveys conducted for the success of this research. To the security research colloquial, we greatly applause the team spirit you extended to ensure this tangible output. All the reviewers of this work, we appreciate your input for a finer piece.

REFERENCES

[1] A. Fernandez, D. Peralta, F. Herrera, and J.M. Benıtez, “An Overview of E-Learning in Cloud Computing,” Workshop on LTEC 2012, AISC 173, pp. 35–46.

[2] A.Jain and S.Chawla, “E-learning in the cloud,” Vol 2 (1),2013, pp. 478-481.

[3] A.S.Sife, E.T.Lwoga and C.Sanga, “New technologies for teaching and learning: challenges for higher learning institutions in developing countries,” Vol 3 (2), 2007.

[4] D.Madan, A. Pant, S.Kumar and A. Arora, “E-learning based on cloud computing,” Vol 2 (2), 2012.

[5] G.Kaur and S.Chawla, “Cloud E Learning Application: Architecture and Framework,” SSRG International Journal of Computer Science and Engineering (SSRG-IJCSE) , Vol 1(2), 2014.

[6] M. K. Sharma and S.Rana, “G-Cloud,”e-governance, 2011.

[7] M. Al-Zoube, “E-learning on the cloud,” Vol 1 (2), 2009, pp58-64.

[8] P. Pocatilu, F. Alecu and M. Vetrici, “Using cloud computing for E-learning systems,” 2011,pp 54-59.

[9] P.Pocatilu, F. Alecu and M.Vetrici, “Measuring efficiency of cloud computing on e-learning systems,” Vol 1(9), 2010, pp52-51.

[10] A.M.Gamundani, T.Rupere and B.M. Nyambo, "A cloud computing architecture for e-leaming platform, supporting multimedia content." International Journal of Computer Science and Information Security 11, Vol 3, 2013, pp92-99.

[11] C.Stork, E.Calandro, and R. Gamage, “The future of broadband in Africa.” Info, Vol 16(1),2014, pp 76-93.

[12] J.K. Tarus, D.Gichoya, and A. Muumbo, “Challenges of implementing e-learning in Kenya: A case of Kenyan public universities.” The International Review of Research in Open and Distributed Learning, Vol 16(1), 2015.

[13] S. Raturi, “Online tools in elearning in the context of developing Countries: A study at the university of the South Pacific.” In MOOC, Innovation and Technology in Education (MITE), 2014 IEEE International Conference (pp. 112–117).

[14] H.B. Brahim,A.B. Jemaa, M. Jemni, and M. Laabidi, “Towards the Design of Personalised Accessible E-Learning Environments.” IEEE, 2013, pp 419–420.

[15] I.A. Qureshi, K. Ilyas, R. Yasmin, and M. Whitty, “Challenges of implementing e-learning in a Pakistani university.” Knowledge Management & E-Learning: An International Journal (KM&EL), Vol 4(3), 2012, pp310–324.

[16] A.Sife, E. Lwoga, and C. Sanga, “New technologies for teaching and learning: Challenges for higher learning institutions in developing countries.” 2007.