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Full Length Research Paper

Dynamics of Cloud Computing in Nigeria: Strategic Options for Sustainable Higher Educational Institution

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The cloud computing model enables dynamics on-demand computing and promotes sustainable development for Higher Institutions in Nigeria. However, it requires careful and full understanding of the technology, opportunities and challenges that may be encountered. It reviews literature, discusses and explores different aspects of cloud computing as part of a continuous research in the area of dynamic and interactive higher institutions. The study used both primary and secondary sources of data. One hundred and twenty questionnaires were distributed to a state in each of the six geo-political zones and FCT Abuja, thus, making a total of 840 questionnaires distributed. The study used simple percentage, pie chart, chart, tables and chi-square to analyze data collected. The chi-square result shows that X^2 obs. 342.1 is greater than the value of X^2 Crit. 26.296 at 0.05 significant levels. Therefore, the null hypothesis was rejected. The study concludes that cloud computing model dynamics have significant impact on higher institutions for sustainable development in Nigeria. The study recommended cloud service providers should be available in Higher Institutions to encourage adoption of cloud computing for sustainable development in Nigeria.

Keywords: Dynamics, education, cloud computing, services, sustainable

INTRODUCTION

In recent years, cloud computing has become highly popular among educational institutions and learners. Beyond saving time and money for learners, it can be used to upgrade labs with hardware or software licenses while ensuring that periodic maintenance operational expenses are aligned with real-time usage and revenue (Karim and Goodwin, 2013). Most online educational systems prefer to adopt cloud computing for their e-learning systems because it supports their aim to motivate learners to use their services. This preference results partly because educational cloud computing services are more efficient and reliable than traditional e-learning platforms, and they provide the most unified users' experience. These benefits can even be reaped by traditional educational institutions due to the development of innovative solutions that enable educational institutions to transform some of their systems to e-learning (Pund et al., 2012).

To make the transition educational institutions decide whether to build their own cloud computing platforms or to use services from specific service providers in a public cloud. It is optimal to make this choice after they have identified their own parameters. Therefore, it is highly recommended that educational institutions identify which services they prefer before committing to transforming e-learning systems to cloud computing. They should create a service catalog by identifying and determining what parameters they will need to access in order to share this information with their service providers; doing so will also help them whenever they need to update the system. Consequently, despite the fact that e-learning is still in its infancy in many developing countries, most universities in

Nigeria shows a great enthusiasm in the adoption of teaching/learning tools and technologies. Thus, identifying the significance factors affecting the usage of such a tool and technology is vital before its adoption. Unfortunately, based on our review of existing scientific literature on cloud computing, limited studies have been led to scientifically explore the ways in which individuals adopt and the factors that influence individual adoption of innovation. No studies to date have explored usage and acceptance of cloud computing in higher institutions setting in Nigeria. Since Higher institution benefit significantly from the available cloud-based applications offered by service providers and as a result of supporting their students to perform academic tasks, the purpose of the current research is to examine the factors influencing students at the Higher institution in country to use cloud computing and benefit from services such as Google Docs and Google Drive. Despite the significant of cloud computing, so many people including academics especially in developing countries are still unfamiliar with its features, although they unintentionally adopt cloud computing in various ways. The main objective of this study is to investigate the impact of cloud computing model dynamics in teaching and learning on sustainable development in Higher Institutions (His) in Nigeria. Other specific objectives include identifying:

(i) The extent of cloud computing adoption in higher education in Nigeria.
(ii) Motivating factors for cloud computing adoption in Nigerian Higher Institutions.
(iii) Current issues affecting the adoption of cloud computing in higher education in Nigeria.

The paper is organized as follows. Following the introductory section which includes the research motivation and objectives, comes the literature review which covers relevant research dealing with cloud computing. This is followed by the methodology, the results, and the discussions of the issues raised in the paper and policy recommendations. The National Institute of Standards and Technology defines cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (example networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Similarly, Priya, (2011) also defined Cloud computing as a technology which provide you a service through which you can use all the computer hardware and software sitting on your desktop, or somewhere inside your network but they are not actually installed on your computer, it is provided for you as a service by another company and accessed over the Internet. Dave, (2012) in his definition defined Cloud computing as a technology that uses the Internet alongside the central remote servers to maintain data and application. Hence, cloud computing is a fast-emerging technology that permits users to store files, share files and applications on the Internet. According to Youseff et al. (2008) Cloud Computing can be considered as new computing paradigm that allows users to temporary utilize computing infrastructure over the network, supplied as a service by the cloud-provider at possibly one or more levels of abstraction. Armburust et al. (2009, also states that Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The data center hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. This study adopts Davis's theoretical Framework, Davis, (1989) presents the idea of the acceptance model from the computer system perspective. When a new technology is introduced, the psychological theory is addressed, thus revealing the perceptions or behavior as a reaction towards technology use. Davis, (1989) defines perceived usefulness (PU) as the degree to which a person believes a system can enhance his job performance. Perceived ease of use (PEU) is referred to as the least amount of effort needed to use a system. The basic theory of the TAM has been further evaluated and extended. The rapid advances in technology in the last few decades have had a significant impact on work, leisure, culture and social interaction. The kind of skills students need to develop to be prepared for the jobs of the 21st century is different from what they needed 20 years ago. Therefore, it is not an option but is a necessity, the move beyond our comfort zones towards adopting constructivist approaches that can better equip our students for the needs of the 21st century. It is hoped that this move can be effectively facilitated by adopting the ideals of the Scholarship of Teaching and Learning (SoTL) through innovative research approaches that befit the digital age in ways it is conducted, conveyed, and shared among colleagues and the public, and how it is integrated into one's own teaching to achieve a new level of efficiency and effectiveness for sustainable national development. Scholarship of Teaching and Learning (SoTL) is becoming increasing evident that teaching should no more be a private affair (as it used to be traditionally) but a peer-reviewed transparent process that makes it known what makes learning possible and how student learning can be improved generally. Mell (2009), constructivism and SoTL must then be incorporated into the teaching practice. By constructivist belief, the emphasis is on learner-centred teaching and learning environments that is nurtured/ supported by the affordances of emerging communication technologies for development of higher institution for national development. Many research works exist in literature that

deal with the impact of cloud computing on the development of Higher Education and the delivery of its various services. The IBM/Google Academic Cloud Computing Initiative (ACCI) is joint university initiatives to assist computer science students acquire the required skill in developing cloud infrastructures and applications. The UK Government's CIO office announced the establishment of a Pivate Government Cloud Computing (PGCC). On the use of the cloud for education related activities (Ofulue, 2010), introduced Cloud Computing (CC) to increase the scalability, flexibility and availability of e-learning systems. Having considered the issues and advances of traditional e-learning models, the authors explored the migration of e-learning systems out of the schools to a CC infrastructure. In their proposal, schools will focus on the education process, content management and delivery while the cloud provider takes care of system construction, maintenance, development and management. Kshetri, (2010) demonstrated the use of a CC infrastructure to effectively improve the teaching and learning process. The proposed model is a private cloud, implemented as part of the institution's existing infrastructure, which provides users (students and faculty) access to virtualized infrastructure, environment and services. The approach presented in this paper extends these models, by proposing a national cloud infrastructure that offers lower cost for e-education and reduces the operation complexities.

Kshetri, (2010) classified CC technologies used in educational institutions into e-learning, communications and administration used by faculties, students and administrators. In this paper, we defined users of an education cloud to include faculty (lecturers), researchers, students and administrative staffs. In most of the study reviewed, known was able provide evidence-based research to the relationship between cloud computing and higher institutions in Nigeria. This study will provide evidence based on the relationship between cloud computing and higher institutions for sustainable development in Nigeria.

METHODOLOGY

The study used both primary and secondary sources of data. The primary source data were collected using questionnaires and interviews, while the secondary source data were gathered from academic Journals, publications, the Internet and literature based on cloud computing. The information gathered from secondary data was the building blocks with which the researcher was able to develop the paper topic and also determine the information necessary in obtaining the primary data for analysis. The study employed multistage sampling techniques to select one state in each of the six geo-political zone and Federal Capital Territory Abuja. In each of the state, two university (state/private and federal), two college of education (state and federal/ Private) and two polytechnics (state/private and federal) were selected and each category of institutions were attached with twenty questionnaires. Simple random technique was used to select 120 respondents in each of the state include FCT Abuja. Thus, making a total of 840 questionnaires distributed. In each of the institutions, questionnaires were administered to employees in IT and Telecommunication companies and user of the device that support cloud computing.

RESULTS

Research objective 1

To investigate the perception of employees in IT & Telecommunication companies and users of devices that support cloud computing in Higher Institutions (HIs), regarding cloud computing being the next generation of computing technology. In order to achieve this goal, a number of questions were asked and the survey revealed that only 15% of respondents were very aware about cloud computing and believe it will be the next generation of computing technology while 65% were aware and also believe it will be the next generation of computing technology and 20% were not very aware as shown in (Figure 1).

Research objective 2

To know the extent of cloud computing adoption in higher education in Nigeria. Figure 2 shows that the level of cloud adoption in higher education in Nigeria is perceived to be low with 64% of the population, 30% believing that adoption is still on average and just 6% says the level of adoption is high. Figure 3 revealed that web-based email is the highest cloud service used, which is represented by 100%, in the figure below, followed by cloud based collaborative tools represented by 50%, server represented for 40% while 30% each for CRM/ EPR software and Human resource application, however no respondent opted for development software, project management applications and server.

Research objective 3

To identify motivating factors for cloud computing adoption in Nigerian Higher Institutions. In order to achieve this, the benefits of cloud computing were used as the determining factors. The result identified reasons for adopting the cloud computing which are represented in Table 1. The majority representing 80% of the sampled population strongly agreed that increased focus on core research is a major factor for adopting the cloud while

Table 1. Factors Motivating and mitigating adoption of cloud computing.

To identify motivating factors for cloud computing adoption in Nigerian Higher Education.			
Response	**Strongly agreed (%)**	**Neutral (%)**	**Strongly disagreed (%)**
Increase focus on research	80	15	5
Easy accessibility	85.5	10	5.5
Collaboration	78	22	0
Reduction in IT	30	45	25
Device Independent	81	11	8
To identify current issues affecting the adoption of cloud computing in Nigeria			
Poor awareness	83	10	7
Unstable power supply	95	5	0
Inconsistency & high cost of internet services	90	6	4
Lack of trust in cloud service provider	56	43	1
Future increase in cost of cloud computing	40	50	10

Source: field survey, 2017.

Table 2. Impact of cloud computing.

Cloud Computing Model Dynamics in Teaching and Learning has impact on Sustainable Higher Educational Development in Nigeria	**No of Respondents**	**Percentage (%)**
Strongly agreed	581	83
Disagreed	19	3
Neutral	100	14
Total	700	100

Source: Author's computation. (X^2 Obs.342.1; X^2 Crit.26.296; DF -16; P.05).

15% of respondents were neutral, but 5% respondent strongly disagreed. On easy accessibility 85.5% of sampled population strongly agreed that easy accessibility of data with any device and at any time was a motivating factor for adopting cloud computing, while 10% of respondents were neutral and 5.5% strongly disagreed as shown in (Table 1). While on collaboration: 78% of respondents strongly agreed that collaboration was a motivating factor for cloud adoption while 22% of the sampled population were neutral and no respondent strongly disagreed. With respect to reduction in IT staffs, 30% of respondents strongly disagreed that the reduction in IT staff will motivate the adoption of the cloud computing while 45% of the sampled population were neutral and 25% of the respondent strongly disagreed. While on device Independent, 81% of the respondents strongly agreed that collaboration was a motivating factor for cloud adoption while 11% were neutral and 8% respondents strongly disagreed as indicated in (Table 1).

Research objective 4

To identify current issues affecting the adoption of cloud computing in higher education in Nigeria. The result identified five major factors affecting adoption rate in HIs in the country.

Lack of awareness of cloud computing accounted for 83% of respondents who strongly agreed that the issue is affecting the adoption of cloud computing in Higher Institutions, 10% of the respondents were neutral while 7% strongly disagreed that the issue is affecting the adoption of cloud computing in HIs in Nigeria. While unstable power supply, 95% respondents strongly agreed that the issue is affecting the adoption of cloud computing in HIs in Nigeria, 5% respondents were neutral about it but no respondent disagreed as shown in Table 1. Inconsistency as well as high cost of internet services, was also a huge factor in which 90% of respondents strongly agreed that the issue is affecting the adoption of cloud computing in HE in Nigeria. Lack of trust in cloud provider was also highlighted and the percentage of respondents that strongly agreed were 56% and 43% of respondents were neutral while 1% of respondents strongly disagreed that the issue is affecting the adoption of cloud computing in HIs in Nigeria. Finally, the future increase in cost of cloud computing show that 50% of respondents were neutral about the cost of cloud computing being high in the future, 40% strongly agreed while 10% strongly disagreed as shown in (Table 2).

Table 2 shows that 83% of the respondents strongly agreed that cloud computing model dynamics in teaching

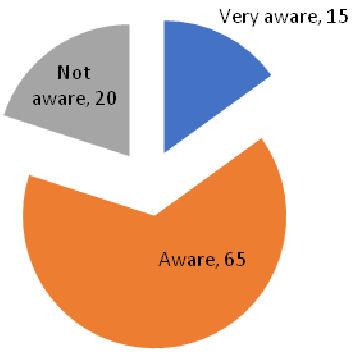

Figure 1. Level of awareness of cloud computing in higher education
Field survey, 2017.

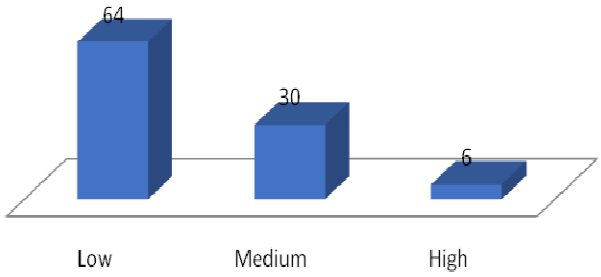

Figure 2. Extent of cloud computing adoption in education. Field survey, 2017

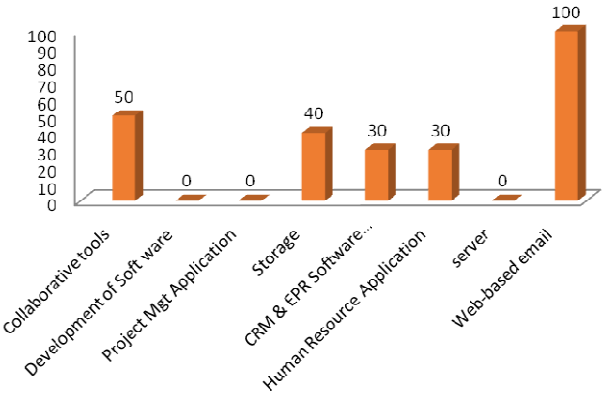

Figure 3. Cloud services adoption in Nigeria
Field survey, 2017

and learning has impact on sustainable development in HIs in Nigeria, while 14% were neutral and 3% of the respondents strongly disagreed that cloud computing model dynamics in teaching and learning has impact on sustainable development in HIs in Nigeria. This result was subjected to chi square test, to determine whether relationship exist between cloud computing model dynamics and sustainable development in HIs in Nigeria. The null Hypothesis (H_0): cloud computing model dynamics in teaching and learning has no impact on sustainable development in HIs in Nigeria. The overall result of the chi-square in (Table 2) shows that X^2 obs. 342.1 is greater than the value of X^2 Crit. 26.296 at 0.05 significant levels and at 16 degree of freedom. Therefore, the null hypothesis was rejected. This evidence shows that cloud computing model dynamics in Teaching and Learning has significant impact on sustainable development in HIs in Nigeria.

DISCUSSION

Majority of the respondents believed that the adoption of cloud computing in the country is still very low. Though the survey and interview revealed that a large percentage of companies use mostly Software as a service (SaaS) and very few companies use Infrastructure as a service (IaaS). This validates findings from Colt a leading provider of integrated managed IT and networking solution, (Kshetri, 2010) and KPMG (2010) that Software as a service (SaaS) has a higher rate of adoption than Platform as a service (PaaS) and Infrastructure as a service (IaaS). Findings from both survey and interview differed on this point. The difference in the findings could be as a result of the closed ended questions, which did not provide the participants view to be disclosed. From the survey, most respondents regarded an increased focus on primary services; collaboration and easy access of data were the main causes of adoption. On the other hand, findings from the interviews showed that the major motivating factor for cloud adoption requires the provision of a basic infrastructure. Furthermore, a lack of basic infrastructure will have impact on cloud providers due to relatively few clients. However, providers will have to find alternative ways to encourage growth of cloud usage before infrastructure are provided. Also, findings from the survey showed that a reduction of IT expertise was less of a motivating factor for adopting cloud computing. This is because cloud adoption is seen as a disadvantage rather than an advantage for most IT personnel. Greengard, (2010) highlighted that cloud computing would lead to the downsizing of staff in IT departments if they are major into providing hardware and software support.

The study revealed that three major factors which have greatly affects the adoption of cloud computing. 83% of respondents indicated that poor awareness of cloud computing had been a setback for using cloud computing. Findings from the interview also supported this fact that people are not aware of the benefits of cloud computing. The major issue of adoption is awareness. Just a few businesses have identified with cloud computing because the awareness level is still low.

Unstable power supply was another major factor which can lead to loss of data and inaccessibility of cloud service (Greengard, 2010). Also, the high cost of bandwidth when transferring data-intensive application through the internet, unreliability of internet service due to distance barrier and low bandwidth capacity.

In addition, he issues of security and privacy was supported by some respondents. This finding was also supported with the result gathered from the survey conducted by Chief Information Office (CIO) stating cloud adoption considered as a risk due to insecurity and loss of privacy. This shows that security will continually be a concern as regards adoption. However, it was interesting to find out that security was not a major concern for cloud adoption as compared to survey findings of developed country. However, the study showed that more respondents were neutral as regards cost of cloud computing. This is in line with the findings of Durkee, (2010) that increased cost of computing with cloud service providers will remain cost effective due to elasticity and transference of risk during under provisioning and over provisioning of IT resources. Finally, the result of the chi-square in table 2 shows that X^2 obs. 342.1 is greater than the value of X^2 Crit. 26.296 at 0.05 significant levels and at 16 degree of freedom. Therefore the null hypothesis was rejected. This evidence shows that cloud computing model dynamics in Teaching and Learning has significant impact on sustainable development in HIs in Nigeria.

Conclusion

The study concluded that cloud computing is no longer a hype but a technology that is set to change teaching and learning in HIs in Nigeria. It allows computing resources readily available on demand, flexible and scalable. This study reveals that the perception of cloud computing being the next computing tool is similar with findings of previous surveys. Cloud computing is the next computing technology but the extent of adoption in Nigeria is low compared to some countries. This can be as a result of lack of adequate infrastructure as in the case of Nigeria. This study also reveals there is need for continuous improvement on basic infrastructure. The availability of basic infrastructure and awareness of cloud computing are necessities for teaching and learning in HIs in Nigeria. Based on the outcome of the research, the following recommendations are put forth to boost the growth of cloud computing in Nigeria. Proper awareness by the cloud service providers on the risk and benefits of cloud, for instance, what it takes to migrate to cloud and how to migrate to cloud should also be given consideration by cloud service providers. Availability of more cloud service providers should encourage adoption of cloud computing for sustainable HIs for national development. This shall increase the awareness of cloud computing and reduce issues of inaccessibility due to wide geographical distance between computing resources and consumers. Cloud providers should provide free trial of cloud services to clients for a stipulated period to encourage adoption of cloud computing for enhancing sustainable development for HIs in Nigeria.

Author's Declaration

I declared that this study is an original research that was carried out by me by and I agree to publish it in the journal.

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