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FACTORS CHALLENGING THE ADOPTION OF CLOUD COMPUTING APPLICATION IN E-LEARNING AMONG POLYTECHNICS IN NORTHEASTERN NIGERIA

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ABSTRACT: *The trend of teaching and learning actives is moving fast towards cloud computing application as the universe becoming global village. The aim of this research is to determine factors that are responsible for the challenges of adopting cloud computing application in e-learning system among Polytechnics in the North East, Nigeria. Sampling techniques was used in to gathering data and average coded total was used in data analysis. The findings of the research revealed that cloud computing application is associated with following challenges: delay/denial of service, compatibility issue, ICT infrastructure, lack of trained personnel; breach of trust, poor policy, managerial issue, confidentiality, integrity, inadequate user access and technological bottlenecks. Also, the research shown that academic and IT staff are familiar with cloud computing application. The study recommended among other things using compile application (user will not have access to the address link) for effective security.*

KEYWORDS*:* challenging, adoption, cloud computing, application, e-learning, polytechnics northeastern, Nigeria

INTRODUCTION

This research is a continuation of the earlier published paper title "*Investigation of Trends, Benefits and Challenges in the Adoption of Cloud Computing Application in E-learning Among Polytechnics in North-East"*. This aspect discuses factors that are responsible for challenges of adopting cloud computing application in e-learning system. Recent studies revealed that cloud computing application in education is associated with various challenges (Saidu and Kwadan (2020), khan *et al.*, 2016, Sultan, 2010, Mathew, 2015, Alam, 2013, Tsegay, *et al.*, 2014, and Oyerele*et al.*, 2016). Cloud computing is a large-scale distributed computing paradigm driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to customers over the Internet (Tsegay, *et al.*, 2014). Cloud computing have emerged as powerful platforms for teaching and learning activities in developed and developing countries. Knowledge is the backbone for economic development for sustaining self-reliance and stability for any society. For this reason, knowledge need to be improved at any point in time, adopting cloud computing in e-learning environment will facilitate impacting knowledge to younger generation. This research has been divided into five segments. The first segment deal with litterateur review, second

segment deals material and methods, third segment deals with result and discussion, fourth segment deals with conclusion and the fifth part deals with recommendation.

According to study conducted by Mathew (2015), examined the trends, benefits and challenges being encountered for adopting cloud computing in Nigerian Universities. An empirical research via questionnaire was used to generate data for the study. A total of 10, 800 questionnaires were administered to 54 public universities across the 6 geo-political zones in Nigeria while 8756 copies were returned which represents a respondent rate of 81.1%. The analyzed data revealed that 92% of the total respondents are aware of cloud computing in education, 45 universities adopted the use of cloud. The study found that there is cost benefits, but the key constrain are data insecurity, regulatory compliance anxiety, lock-in and privacy worry. This result has been supported by Sultan, (2010) who reported that cloud computing has potential cost flexibility, but security, reliability and portability are the major concern of cloud adoption for education. Similarly, Alam, (2013) found that cloud computing offer flexibility cost benefits in education which agreed with (Mathew, 2015 and Sultan, 2010). Tsegay, *et al.* (2014) supported Alarm by revealing cloud benefits in education such as flexibility, opportunity, innovation, savings, accessibility and efficiency. Mathew, concluded by proposing a cloud archetype that could mitigate the challenges identified and offered improved agility, low cost adoption, access and use of sophisticated educational ICT infrastructures for Nigerian universities.

In a study conducted by Dahiru, *et al.* (2014) which explored the emergence and adoption of cloud computing by Small and Medium Sized Enterprises (SMEs). The Grounded Theory (GT) methodology was surveyed in conducting the study. SMEs in Nigeria was chosen as research sites. Data were collected through selection/sampling with use of open-ended and face-to-face semi-structured of the research sites; pieces of information gathered from initial research sites are used. The study found that there are some issues and challenges impede successful adoption of cloud computing in respect of SMEs such as security, privacy, trust issues, data loss concerns, awareness, top management support issues, availability of good internet connection and cost issues. These results are consistent with recent findings (khan *et al.,* 2016, Sultan, 2010 and Mathew, 2015). Khan revealed that lack of competency to manage the risk; compliance and security related to cloud issues are major hindrance of cloud adoption in many organizations.
Dahiru, *et al.* (2014) reported that there is limited number of reputable resources to consult issues concerning adoption of cloud computing by SMEs especially in sub-Saharan Africa. This means that the finding of this study is not dependable. According to the research, there is no direct impact of cloud computing to development, therefore, a generalized conclusion will not be accepted at this stage. However, the study acknowledged that cloud computing may offers potential opportunities to SMEs which are seemingly real.

Oyerele *et al.* (2016) investigated M-Learning adoption as new paradigm of learning ICT in Nigeria. Questionnaire were administered to find out primary and secondary school students' readiness in Nigeria to adopt m-learning, with prediction to use specific m-learning devices and solutions in learning situations, as well as to obtain opinions regarding the suitability of m-

learning for learning ICT-related subjects. This result confirmed that students have experience with the use of mobile devices. This experience can be utilized in adopting m-learning. It also showed that less than 13% of students who participated in the survey are yet to own a mobile device which could be attributed to lack of money and parental dissatisfaction. The study indicated that less than one fifth of the respondents are not specific whether to commence m-learning, while only 6 % of the respondents are completely unprepared for m-learning. The research concludes that possession of mobile phones by students and familiarity with it features such as social media forums, chatting, browsing the internet, e-book reading revealed by students in primary and secondary schools in Nigeria are good indicators to students' willingness for accepting the new learning paradigm.

Alabbadi (2011) discussed the use of cloud computing in the educational and learning platform, known as "Education and Learning as a Service" (ELaaS), with emphasis on likely benefits and contributions. The study proposes a Complete Cloud Computing Formation Model (C3F), based on the Cloud Cube Model (CCM) developed by the Jericho Forum. The IT activities in the educational and learning organizations will be classified with respect to the two measures: mission criticality and sensitivity. Both measures are categorized as Low and High. Each category of the IT activities will then be mapped into the appropriate position of in the C3F. The mapping will create "Education and Learning as a Service" (ELaaS). ELaaS is a hybrid approach, including cloud and non-cloud based solutions. This proposal was adopted by (Tsegay, *et al.,* 2014).

The study of Dahiru *et al.* (2014) revealed some issues and challenges militating against adoption of cloud in SMES. Nevertheless, the methodology adopted did not specify the actual size of the population and region covered during data collection. Accordingly, findings did not give through picture of cloud computing adoption on SMEs in Nigeria as Sub-Sahara region of Africa. The study also showed that there is no direct impact of cloud computing adoption in SMEs. This indicated the need to conduct another research to substantiate the adoption of cloud computing in SMEs and other areas such as e-learning in Africa Sub-Sahara, particularly Nigeria. The study proposed further work to develop a model on analytical framework of cloud computing adoption through ICT4D on issues like legal and regulatory issues, ICT policy issues and institution to determine how technology will impact on development in Sub-Saharan Africa.

The investigation carried out by Oyerele *et al.* (2016) revealed the readiness of primary and secondary students for adopting m-learning as a new paradigm for ICT learning but the major limitation of the study is that, it did not cover tertiary institution. Khan *et al.* (2016) determined major impediments of cloud adoption in organization using case study methodology. The findings of this methodology cannot be generalized, hence a different methodology such as survey or otherwise may be applied to validate the argument. Also, a similar research on academic institution should be conducted for comparison with that of organization.

From the reviewed carried out, Alabbadi (2011), proposed Complete Cloud Computing Formation Model (C3F) for implementing cloud computing in education but the major drawback of the study is that it did not address the methodology adopted. In a study conducted by Tsegay, *et al.* (2014) who reveals potential of cloud computing in education with a proposed model of implementing lacks introduction, abstract and adopted methodology. A recent study conducted by Mathew (2015) revealed that financial benefit and some key challenges of adopting cloud computing in Nigerian universities. However, major predicament of Mathew, only 54 public out of more than 150 public and private universities were considered for the research. This finding cannot be generalized across the Nigerians universities and consequently, more research needs to be conducted for trustworthiness. Moreover, the study recommended that future research work may investigate how the constraining factors to successful adoption of cloud computing in Nigeria universities can be managed easily without incurring additional overheads. Similarly, Sultan (2010) disclosed that cloud computing application in education has flexibility of cost and some major challenges. The main limitation of Sultan is that the methodology adopted for the study was not clearly stated and more importantly, the research was conducted in UK, University of Westminster as a case study which may have different situation in Nigeria. Equally, this result cannot be generalized with developing countries. These limitations create gap for similar research to be carried out in developing countries to substantiate some of these claims. Therefore, this research focuses on the factors that are responsible for challenges of adopting Cloud Computing in E-learning Environment among Polytechnics in North-East.

MATERIALS AND METHOD

Qualitative approach has been employed since it underlines numerical analysis of data collected through polls, questionnaires, and surveys or objective measurements and statistical, mathematical, or by manipulating pre-existing statistical data using computational techniques. Collected data through quantitative research focuses on arithmetical data have been generalized across groups of people to explain a given phenomenon, which are categorized into descriptive, correlation, quasi-experimental and experimental quantitative research (Creswell, 2009). In quantitative research design is regularly used to recognize the associations between variables, test conceptual models, determine the opinion/view of a given group of samples. This indicates that a researcher may establish a measures of evaluations by means of quantitative research design (Christenson & Gutierrez, 2016). An extensive literature were reviewed through journals, textbooks and internet which assisted the conduct of the study in proffering appropriate solution to the identified challenges of cloud computing application in e-learning.

The study has considered fifty (50) staff from each Polytechnic in the North-Easth, simple random sampling techniques have been conducted within the selected Polytechnics. About two hundred and fifty (250) prepared questionnaires were distributed to the targeted audiences within ICT staff managers and lecturers from representative sample of Polytechnics in the North-East. Simple random sampling offers an effective way of minimizing sampling error, and in quantitative research, it focuses sample from the larger population.

The study considered five (5) Polytechnics in the North-East, at least one from each state. In Taraba state, Federal Polytechnic Bali; in Adamawa state, Federal Polytechnic Mubi; in Borno state, Ramat State Polytechnic Maiduguri; in Yobe State, Federal Polytechnic Damaturu and in Buachi state, Federal Polytechnic Bauchi.

Data were gathered using questionnaires encountered in the selected Polytechnics within five (5) in the North-East.

RESULT AND DISCUSSION

The scales used to carry out the research were represented as follows: Y (Yes), N (No), SA (Strongly Agree), A (Agree), D (Disagree) and SD (Strongly Disagree). About two hundred and fifty (250) questionnaires were distributed among five Polytechnics in the North-East and average of two hundred and twenty (220) was responded. The scales used in obtaining responses were coded as follows: Y and SA = 4, N and A = 3, D = 2 and SD = 1. The figures below indicate average coded from responses obtained.

Basic Knowledge of Cloud Computing Application in E-learning

Figure 1, indicated that the respondents are familiar with the application of cloud computing in e-learning which facilitate teaching and learning activities by sharing information over the internet. These findings was supported by Cutkosky *et al.* (1996) in their study that e-learning collaboration tools enabled sharing information, both asynchronously via email and real-time. Also, the result of the study is in accordance with Geissbuhler & Ly (2007), who emphasized that knowledge sharing get across professionals in different countries through internet connection. Furthermore, a study conducted by matthew (2015) revealed that students, IT staff and lecturers are aware of cloud computing and its relevance in Nigerian University as a result of their direct access with mobile devices through internet. This result agreed with this research.

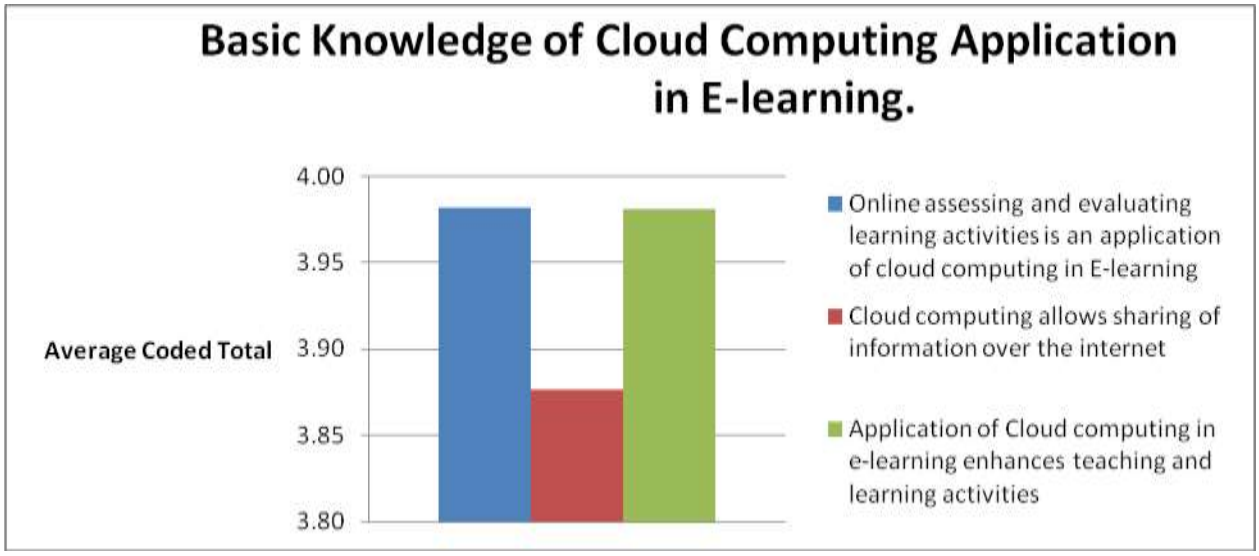

Figure 1: Average of coded total showing basic knowledge of cloud computing application in e-learning.

Factors that are Responsible for the Challenges of Adopting Cloud Computing in E-learning System

The analysis of the result obtained in figure 2 shown that, the average coded total of the respondents was significant and this indicates that cloud computing adoption has a lot of challenges in e-learning system that needs to be addressed for proper acceptability. These challenges include delay/denial of service, compatibility issue, ICT infrastructure, lack of train personnel; breach of trust, poor policy, managerial issue, confidentiality, integrity, and user access. A similar study conducted by Matthew (2015), for determining cloud computing in education for effective adoption in Nigerian Universities reported that the challenges of adopting cloud computing in e-learning include: data insecurity, privacy concerns, reliability challenge, regulatory compliance concerns / user control, institutional culture / resistance to change in technology. Despite the fact that the two researches were carried out in different educational system but their result agreed. Likewise, a review carried out by Saidu (2019), Wycliff & Saidu (2018) and Saidu *et al.*, (2016) uphold the above findings. Also, the findings of Sultan (2010) corroborate with the above assertions that there are inadequate IT resources to carryout test before moving new application into production. Likewise the findings of Alabbadi (2011), revealed that cloud computing has five main challenges: security, interoperability, availability, performance, and data migration which is in accordance with above results. Masud (2012,) also reported that latency and networked congestion affect e-learning system which is in line with the above results. This study realized that challenges of Cloud computing cannot be avoided completely but can be managed effectively.

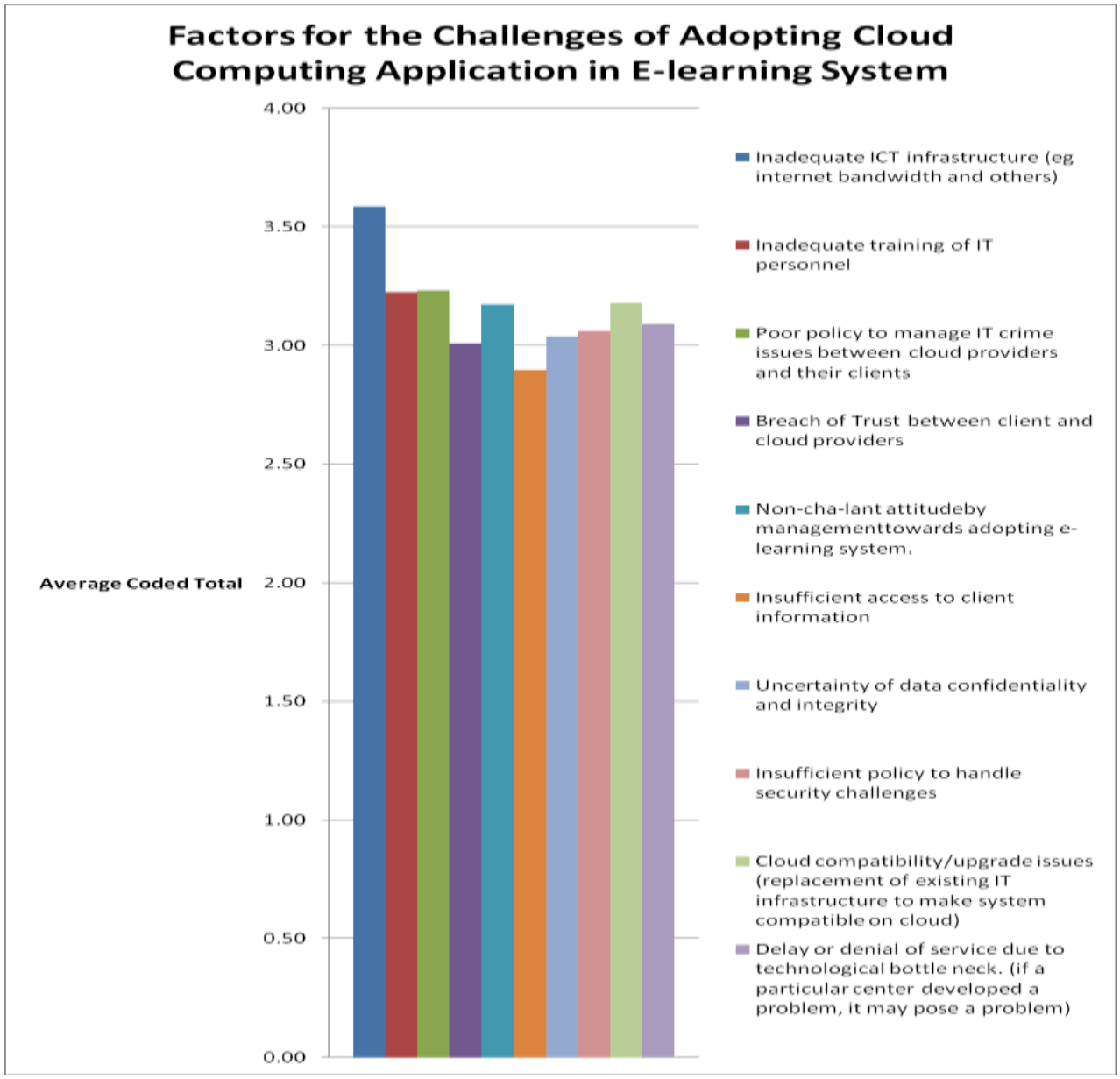

Figure 2: Average coded total showing factors that are responsible for the challenges of adopting cloud computing application in e-learning system

CONCLUSION

This research is aimed to determine the factors that are responsible for the adoption of cloud computing in e-learning environment among Polytechnics in the North-East. It was revealed that respondents are aware of cloud computing application in e-learning. Furthermore, the study shown that the constraints factors for successful implementation of cloud computing application

in e-learning are significant. These constraints include: delay/denial of service, compatibility issue, ICT infrastructure, lack of train personnel; breach of trust, poor policy, managerial issue, confidentiality, integrity, and user access. Due to challenges associated with cloud computing application, the study recommended using compile application (user will not have access to the address link). Also, provision of adequate IT infrastructure; well training IT personnel, sufficient policy to manage IT challenges and mutual understanding between cloud providers and client should be provided accordingly. Further research should be carried out in other zone of the country to fetch out more challenges and dependable solution.

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Appendix

Questionnaire for Investigation of Trends, Benefits and Challenges in the Adoption of Cloud Computing Application in E-learning Among Polytechnics in North-East

Section A: General Information

This section requires you to provide your information:

Please fill the blank space and tick the appropriate box using (√)

1. Name of the Polytechnic……

Cadre

Lecturer ☐

Technologist ☐

Instructor ☐

Technician ☐

IT Professional ☐

Others ☐

Section B: Basic Knowledge

Please tick (√) appropriate in the space provided using the following scales:

Yes (Y), No (N)

S/N	**Basic Knowledge of Cloud Computing**	Y	N
1	Online assessing and evaluating learning activities is an application of cloud computing in E-learning	156	3
2	Cloud computing allows sharing of information over the internet	135	19
3	Application of Cloud computing in e-learning enhances teaching and learning activities	150	3

Section C: Benefits of Cloud Computing Application in E-learning

Please tick (√) appropriate in the space provided using the following scales:
Strongly Agree (SA), Agree (A), Disagree (D) Strongly Disagree (SD)

S/N	**Benefits of Cloud Computing Application in E-learning System**	SA	A	D	SD
1	Cloud computing is cost effective	80	105	26	8
2	Cloud computing has high computing capability (effective and efficient)	84	127	15	5
3	It posses global scale (deliver the right amount of IT resources)	80	117	28	4
4	Cloud computing improve learning productivity	79	115	13	8
5	It support good performance (it reduces network latency for applications)	78	105	32	
6	It support security tolerance (some cloud providers offer good level of data protection)	73	132	26	4
7	It enhanceslearning collaboration	75	111	18	11
8	1. Cloud computing support data portability (users can access their data from anywhere, if there is internet connectivity)	112	85	21	3
9	Cloud computing sustain unlimited storage of data	97	107	23	11
10	It promote global sharing of knowledge	75	88	11	8
11	It provides effective monitoring and controlling of learning activities	66	112	33	5

Section D: Challenges in the Adoption of Cloud Computing Application in E-learning system.

Please tick (√) appropriate in the space provided using the following scales:
Strongly Agree (SA), Agree (A), Disagree (D) Strongly Disagree (SD)

S/N	**Challenges of Cloud Computing Application in E-learning System**	SA	A	D	SD
1	Inadequate ICT infrastructure (eg internet bandwidth and others)	101	53	7	
2	Inadequate training of IT personnel	62	75	24	1
3	Poor policy to manage IT crime issues between cloud providers and their clients	54	54	22	1
4	Breach of Trust between client and cloud providers	39	76	30	4
5	Non-cha-lant attitudeby managementtowards adopting e-learning system.	51	75	25	
6	Insufficient access to client information	33	86	38	6
7	Uncertainty of data confidentiality and integrity	45	81	29	5
8	Insufficient policy to handle security challenges	51	64	32	5
9	Cloud compatibility/upgrade issues (replacement of existing IT infrastructure to make system compatible on cloud)	56	89	24	1
10	Delay or denial of service due to technological bottle neck. (if a particular center developed a problem, it may pose a problem)	51	70	35	1

Section E: Trends towards Adopting of Cloud Computing Application in E-learning system.
Please tick (√) appropriate in the space provided using the following scales:
Strongly Agree (SA), Agree (A), Disagree (D) Strongly Disagree (SD)

S/N	**Trends towards Adopting of Cloud Computing**	SA	A	D	SD
1	Learning activities is moving towards cloud computing	86	66	11	
2	Educators and learners accept cloud computing	37	85	28	1
3	Educators and learners have key interest in cloud computing	32	94	21	1

Section F: Your opinionand suggestion.
Please feel free and provide your opinion orsuggestion that is not captured in this instrument in respect of *trends, benefits and challenges of cloud computing application in e-learning system.*
……
……
……
Thanks for using your immense time and accept our highest esteem.

Assessment Obtained for Basic Knowledge of Cloud Computing

S/N	**Basic Knowledge of Cloud Computing**	**Y**	**N**
1	Online assessing and evaluating learning activities is an application of cloud computing in E-learning	156	3
2	Cloud computing allows sharing of information over the internet	135	19
3	Application of Cloud computing in e-learning enhances teaching and learning activities	150	3

Assessment for Challenges of Cloud Computing Application in E-learning System

S/N	**Challenges of Cloud Computing Application in E-learning System**	**SA**	**A**	**D**	**SD**
1	Inadequate ICT infrastructure (eg internet bandwidth and others)	101	53	7	
2	Inadequate training of IT personnel	62	75	24	1
3	Poor policy to manage IT crime issues between cloud providers and their clients	54	54	22	1
4	Breach of Trust between client and cloud providers	39	76	30	4
5	Non-cha-lant attitude by management towards adopting e-learning system.	51	75	25	
6	Insufficient access to client information	33	86	38	6
7	Uncertainty of data confidentiality and integrity	45	81	29	5
8	Insufficient policy to handle security challenges	51	64	32	5
9	Cloud compatibility/upgrade issues (replacement of existing IT infrastructure to make system compatible on cloud)	56	89	24	1
10	Delay or denial of service due to technological bottle neck. (if a particular center developed a problem, it may pose a problem)	51	70	35	1