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INTEGRATION OF CLOUD COMPUTING ON MATHEMATICS TEACHING AND LEARNING IN PUBLIC UNIVERSITIES IN ENUGU STATE

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Abstract
This study investigated the integration of cloud computing in mathematics teaching and learning in public universities in Enugu State. Cloud computing is an Internet-based facility that allows users to access shared computer applications, storage, and resources through a network of remote servers. Service users access the Internet using computers, laptops, or mobile phones. The research design adopted for this study is a descriptive survey research design. This study was carried out in Enugu State. Three research questions and one research hypothesis guided the study. A sample of 50 Mathematics education students and lecturers was used using a simple random sampling technique. Data were collected using a well-structured questionnaire. The reliability was done using Cronbach alpha reliability which was obtained as 0.87. Mean and standard deviation were used to answer the research questions. This study adopted a survey design. The findings reveal that the integration of clouds in mathematics education significantly impacts cost-effectiveness, enhanced availability, increased operability, and so on. The study recommends that computing power provided by the cloud allows students to extend mathematics learning beyond the walls of the classroom, thereby offering the learner's participation and control of the learning process.

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Introduction

Mathematics is crucial for understanding our world. It fortifies science, technology, medicine, economics, and even government. Mathematics is the science of size and numbers, of which arithmetic, algebra, trigonometry, and geometry are branches. The New Encyclopedia Britannica defines mathematics as the science of structure, order, and relationships that has evolved from the elementary practices of counting, measuring, and describing the shapes of objects. Mathematics comprises cognitive process skills, including the ability to use content

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knowledge and conceptual understanding to reason, solve routine problems, develop proofs, and effectively communicate, represent, and model mathematical ideas.

Education in the 21st century is more than mere knowledge transfer. Education has come to be in the lead and plays a major role in future societal development. With the integration of available information and communications technology (cloud computing) components, education has become the fulcrum on which nations' competitiveness in the global community rests (Iji, Abah & Uka, 2013). Cloud computing networks are now making it possible for developing countries to participate in the world economy in ways that were previously not possible in the past (Baez, Kechiche & Boguszewska, 2010). Emerging economies, such as Nigeria, are becoming a destination for new investment opportunities by providing an enabling environment that encourages the development of technological infrastructure. Within the constraints of the education system, the educational process must be amenable. This calls for a fundamental qualitative transformation of education in terms of its content, methods, and, outcomes. Education should seek to inculcate skills that are aimed at accelerating technological change, rapidly accumulating knowledge, increasing global competition, and enhancing workforce capabilities (Partnership for 21st Century Skills, 2002). Schools must equip students who will ultimately spend their adult lives in a multitasking, multifaceted, technology-driven, diverse, and vibrant world. The reality on the ground has made it imperative for the education system to become more strategic, aggressive, and effective in preparing students to succeed and prosper. Although it is clear that technology is not only a solution to present-day education (Lokesh, 2013), using emerging technologies to provide expanded learning opportunities is critical to the success of future generations. The level of penetration of cloud computing among students signals more than a change in pedagogy; it suggests a change in the very meaning and nature of mathematics education itself (Italiano, 2014). Schools all over the world are becoming integral to broadband and technological transformation, harnessing the potential of technology to drive and empower more personalized mathematics learning. One specific way technology is enhancing present-day mathematics teaching and learning is through the use of cloud computing.

The cloud is a set of hardware, networks, storage, services, and interfaces that enable the delivery of computing services (Hurwitz, Bloor, Kaufman & Halper, 2010). Cloud services include software, infrastructure, and storage over the Internet, reducing costs and providing flexibility and mobility (Kovachev, Cao & Klamma, 2011). These services are delivered through the internet from high-specification data centers in locations that are remote from the end user. The educational cloud involves all the learning activities students conduct on mobile phones, smartphones, tablets, palmtops, laptops, and PCs while connected to Wi-Fi. This may include downloading materials for assignments and research, studying online, and other individualized learning conducted through connectivity to the wireless cloud within the campus or elsewhere. The cloud services of public universities provide mathematics education students with access to infrastructure and content, increased openness to new technologies, and general support for teaching and learning. With such readily available, support students' perspectives of mathematics, which have usually been attested to be skeptical, stand to be influenced.

Active utilization of cloud services provided by educational institutions has grown in importance as a result of a new genre of students with learning needs vastly different from those of their predecessors (Thomas, 2011). Present-day students require increased network access to sustain their culture of learning, leisure, and social interaction. The computing power provided by the cloud provides the opportunity to extend students' mathematics learning beyond the walls of the classroom, thereby offering learners greater participation and control of the learning process. The functionality of the cloud is gradually changing the way mathematics education students study and conduct research in schools. Cloud usage must have some measure of impact on students' perceptions

of mathematics education. If this impact exists, it may bridge the gender gap in student attitudes towards mathematics education. The cloud has come to stay in university education in Nigeria as a tool for hooking students to the information grid. Schools across the country are already leveraging the dividends of mobile and wireless technology, considering the ubiquity of smartphones and other computer devices. The level of penetration of cloud services in public universities, particularly in Enugu State, calls for an in-depth assessment of the extent of the impact on learners' disposition towards mathematics education. It is against this backdrop that this study sought to investigate the integration of cloud computing into mathematics teaching and learning in public universities in Enugu State.

Statement of the problem

The state of mathematics in Nigeria, as evidenced by researchers, calls for a regular and effective review of mathematics instruction in schools. The reform movement in mathematics education can be traced to years ago and was a response to the failure of traditional teaching methods, the impact of technology on the curriculum, and the emergence of new approaches to the scientific study of teaching and learning mathematics. There is a need to explore different methods of presenting mathematical concepts to students. It is, however, noted that the use of cloud computing has not been fully applied in Nigeria, particularly in mathematics teaching and learning to determine whether it could reverse the state of mathematics. Therefore, the problem of this study is how to provide evidence on the integration of cloud computing in mathematics teaching and learning in public universities in Enugu State.

Purpose of the Study

The main purpose of this study was to determine the extent of the integration of cloud computing in mathematics teaching and learning in public universities in Enugu State. Specifically, the study determined;

1. to determine the extent of cloud computing integration in mathematics teaching and learning.
2. to identify the challenges faced in integrating cloud computing in mathematics teaching and learning.
3. to determine the extent of cloud computing equipment available in mathematics teaching and learning.

Research Questions

1. To what extent does the integration of cloud computing enable effective mathematics teaching and learning?
2. What challenges do researchers face in integrating cloud computing into mathematics teaching and learning?
3. To what extent is cloud computing equipment available in mathematics teaching and learning?

Research Hypotheses

The following null hypotheses were developed to guide the study. The hypotheses were tested at a significance level of 0.05.

Ho_1: There was no significant interaction between the integration of cloud computing and effective mathematics teaching and learning.

Method

The research design adopted for this study is a descriptive survey research design. The descriptive survey research design is therefore appropriate for use in this study because the sample population is representative of the entire population and was used for the study. This study was carried out in Enugu State. There are six Education zones in Enugu. A sample of 50 mathematics education students and lecturers was used using a simple random sampling technique. The data was collected using a well-structured questionnaire. The validity of an instrument is the degree of accuracy with which the instrument measures what it is intended to measure. The instrument was

presented to three mathematics and computer education experts for validation. Necessary modifications were suggested. The items of the instrument were judged on the extent to which they were intended to be measured. The education experts critically examined the instrument and made useful suggestions that helped improve its quality. The instrument was first trial tested using 20 Godfrey Okoye University students who were not part of the study. The reliability of the instrument was determined using Cronbach's alpha model, with cluster one yielding 0.87, cluster two yielding 0.85, and cluster three yielding 0.90, and a total reliability index of 0.87 was obtained, indicating that the instrument was very highly reliable for the study.

The research questions were answered using the mean and standard deviation. The mean of the 4-point response scale was (4+3+2+1)/4 = 10/4 =2.5. This implies that the cutoff point is 2.5. The research hypotheses were tested at a significance level of 0.05 using the t-test.

Results

The data collected were presented in the table under a suitable heading for each research question and were answered using appropriate statistical methods.

Research question 1. To what extent does the integration of cloud computing enable effective mathematics teaching and learning?

Table 1: Mean responses and standard deviation results on the extent to which the integration of cloud computing can facilitate effective mathematics teaching and learning.

	N	Mean ($\overline{X}$)	Standard Deviation
Lecturers	10	2.67	0.657
Students	40	3.19	0.739
Total	50	2.93	0.698

Table 1 shows that the lecturers and students had a mean score greater than 2.5. This means that we agree with the items of research question 1, which states that the integration of cloud computing causes effective mathematics teaching and learning. The standard deviations of lecturers and students (0.657 and 0.739, respectively) show that the individual responses of the respondents are more clustered around the mean.

Research question 2. What challenges do researchers face in integrating cloud computing into mathematics teaching and learning?

Table 2: Mean responses and standard deviation results for integrating cloud computing into mathematics teaching and learning.

	N	Mean ($\overline{X}$)	Standard Deviation
Lecturers	10	3.25	0.583
Students	40	2.82	0.881
Total	50	3.04	0.732

Table 2 shows that the mean responses of lecturers and students were above 2.5. This means that we agree with the items of research question 2. This indicates that the challenges facing the integration of cloud computing in mathematics teaching and learning are as follows.

Research question 3: To what extent is cloud computing equipment available in mathematics teaching and learning?

Table 3: Mean responses and standard deviation results for the extent to which cloud computing equipment is available in mathematics teaching and learning.

	N	Mean ($\bar{X}$)	Standard Deviation
Lecturers	10	2.02	0.683
Students	40	2.35	0.715
Total	50	2.19	0.699

Table 3 presents the mean response below 2.5. This indicates that cloud computing equipment is not fully available for mathematics teaching and learning.

Ho_1: There was no significant interaction between the integration of cloud computing and effective mathematics teaching and learning.

	N	Mean (X)	Standard Deviation	df	t	Sig of P
Lecturers	10	3.07	0.868			
Students	40	3.35	0.781			
Total	50	3.21	0.825	230	2.53	0.02

Table 4 shows a calculated value of 2.53, which is significant at 0.02 which is less than the 0.05 level of significance set for the study. Therefore, the null hypothesis is rejected, indicating a significant interaction between the integration of cloud computing and effective mathematics teaching and learning.

Conclusions

The findings presented in Table 1 reveal that the integration of cloud computing facilitates effective mathematics teaching and learning. Therefore, there is a need to integrate cloud computing into mathematics education. The results of the findings presented in Table 2 indicate that there are challenges to integrating cloud computing in mathematics teaching and learning. These challenges should be considered to ensure the integration of the cloud in mathematics education. The results presented in Table 3 reveal that some cloud computing equipment is not fully available for mathematics teaching and learning. This creates a problem with its integration into mathematics education. The findings in Table 4 show that there is a significant interaction between the integration of cloud computing and effective mathematics teaching and learning. This shows that the cloud should be enhanced in mathematics education. The results of this study reveal that the integration of cloud computing in mathematics teaching and learning has a significant impact on cost-effectiveness, enhanced availability, low environmental impact, reduced IT complexities, mobility, scalability, increased operability, and reduced investment in physical assets. However, the major challenges confronting the integration of cloud computing in mathematics teaching and learning are the high cost of hardware and software, poor communication and ICT infrastructure, high cost of training, lack of funds for ICT and training, little priority given to e-learning by management, lack of interest by potential users, lack of clear e-learning policies and plans, data insecurity, internet connection, reliability, electricity, regulatory compliance concerns, lock-in privacy concerns, among others.

Conclusions

Cloud computing is a technology that has come to stay with education. Its benefits and practical uses in the educational sector cannot always be over-emphasized. Although it has its shortcomings, such as security issues, data theft, and poor internet connection, especially in rural areas, cloud computing's benefits outweigh its limitations. With cloud computing playing an obvious role in education research in general and mathematics education research in particular, it is expected that its use will continue and be encouraged. This will ensure that

quality and relevant education that portrays present-day world realities is offered at all times and the possible minimum cost. The study found that cloud computing was not adequately integrated into mathematics teaching and learning. It also concluded that the government should provide schools with cloud computing infrastructure to enable lecturers to integrate cloud computing into mathematics teaching and learning.

Recommendations

This study recommends that cloud computing be incorporated into mathematics education research. This will inevitably, in no small way, provide everybody in the field with every opportunity to realize their various academic goals. Equally, it will ensure quality research that will reposition mathematics education within the field of education and beyond, making it more relevant to the needs of society. With the implication of cloud computing in mathematics education curricula, it is expected that curricula will be adjusted and adapted to maximize the benefits of cloud computing and, in the long run, serve the community it was meant for.

References

Al-Asmari, R. K., (2014).” E-learning in Saudi Arabia: Past, present and future,” Near and Middle Eastern *Journal of Research in Education,* vol. 2, no. 1, pp. 1-11.

Averitt, S., Bugaev, M., Peeler, A., Shaffer, H., Sills, E., Stein, S., (2007). *Virtual computing laboratory (VCL).* Proceedings of the International Conference on Virtual Computing Initiative (ss. 116). NC: IBM Corp., Research Triangle Park.

Baez, G., Kechiche, B.B., & Boguszewska, S., (2010). *Impact of mobile services in Nigeria: How Mobile technologies are transforming economic and social activities.* Pyramid Research Cambridge, MA: Pyramid Research. 3145.

Dong, B.,Zheng, Q., Quiao, M., Shu, J. & Yang, J. (2009). Blue Sky Cloud Framework: an e-learning Framework for cloud computing. *Lecture Notes in Computer Science*, 5931, 577-582.

Hurwitz, J., Bloor, R., Kaufman, M. Halper, F. (2010). *Cloud computing for dummies.* Hoboken, NJ: Wiley Publications, Inc.

Iji, C. O., & Abah, J. A. & Uka, N. K. (2013). *Attaining the Millennium Development Goals (MDGs) Through Effective Mathematics Education*. Proceedings of the 54th Annual Conference of Science Teachers Association of Nigeria, 99-107.

Italiano, E., (2014). *Community, contemplation, and computers*: The role of technology in education. From http://www.thepublicdiscourse 02/11789.

Kovachev, D., Cao Y., & Klamma, R., (2011). *Mobile cloud computing:* A comparison of application models. Aachen: RWTH Aachen University, 1-8.

Li, G., & Chen, G. (2011). *A novel enhanced education application of Cloud computing*. Cloud Computing and Intelligence Systems (CCIS), 2011 IEEE International Conference on, 526- 529.

Lokesh, U. (2013). *Technology and its role in 21st-century education*. Retrieved from http://www.edtechreview.in/trends-insights/insights/277-role-of-technology-in-21st- century.

Microsoft. (2011). *Cloud computing in education:* http://www.microsoft.com/education enus/solutions Pages /cloud_computing.aspx

Morley, D., & Parker, C. S., (2011). *Understanding computers:* today and tomorrow (13th ed.). Cengage Learning.

Nasir, U., & Niazi, M., (2011). *Cloud computing adoption assessment model* (CAAM) (pp.34-37).

Proceedings of the 12th International Conference on Product-Focused Software Development and Process Improvement. New York, NY: ACM

Nidal, H.H., & Ahmed, K., (2016) "A survey of Cloud Computing Security challenges and solutions", *International Journal of Computer Science and Information Security (IJCSIS), Vol. 14, No. 1, pp. 52-56.*

Partnership for 21st-Century Skills (2002). *Learning for the 21st century*: A report and mile guide for 21st-century skills. Washington: Partnership for 21st Century Skills, 1-5.

Sahu, R. (2016). Cloud computing: *An innovative tool for library services.* National Conference on Library Information Science and Information Technology for Education. 213-217.

Sandhu, R., & Sood, S. K. (2015). *A commercial, benefit-driven, and secure framework for e-learning in cloud computing*. Computer Applications in Engineering Education, n/a–n/a. doi:10.1002/cae.21621.

Thomas, P. Y. (2011). *Cloud computing:* A potential paradigm for practicing the scholarship of teaching and learning. Electronic Library, 29(2), 214-224.