

## USABILITY OF CLOUD COMPUTING SOFTWARE AS A SERVICE FOR EFFICIENT SERVICE DELIVERY IN PRIVATE UNIVERSITIES IN RWANDA

**\*Ntirenganya Lenatha, Dr. Yonah Etene and Dr. Anselemo Ikoha Peters**

Kibabii University, Kenya.

Article Received on 22/06/2021

Article Revised on 12/07/2021

Article Accepted on 01/08/2021

**\*Corresponding Author**

**Ntirenganya Lenatha**

Kibabii University, Kenya.

### ABSTRACT

Currently the growth of Information Technology (IT) in public and private sector speed up service delivery. Particular, hardware and software technologies have developed dramatically. One of the computing technologies, which is very common nowadays, is cloud computing technology. Research reveals that this is an essential technology in many sectors especially in education sector. Cloud computing enhances educational users' flexibility and access to a variety of educational resources. Students and staff can use numerous application platforms and resources on-demand rapidly and affordably on web pages. Usability of cloud computing in education sector is wide- ranging to many services, as recognized to many educational institutions across the world. Cloud computing provides services to university users such as software as a service, platform as a service and Infrastructure as a service. These services are under utilized by university staff and students. However, usability of cloud computing is still an issue in many private universities in Rwanda. The cloud users have challenges in terms of usability of software as a service. The study sought to investigate usability of cloud computing services based on software as a service. The objective of this study was to analyze the effect of cloud computing software usability on the efficient service delivery in private universities in Rwanda. This study adopted a case study research design. The target population of the study was three hundred (300) computing students and lecturers who offer computing courses. Sampling techniques such as simple random sampling, purposive sampling were used and stratified sampling which were used to group respondents into heterogeneous strata, the sample size was 103 respondents. This study employed both questionnaire and interview

guide as the research tools in order to collect primary data. Research tools were tested for validity using content validity and face validity while reliability was performed by computing Cronbach's alpha to measure internal consistency, with alpha coefficient higher than zero point seven (0.7). Data was analyzed using descriptive and inferential statistics. Findings, showed significant effect of usability of cloud computing software as a service on efficient service delivery. The study revealed that most respondents still face challenges of lack of enough technical skills, lack awareness and security of data/information. The result of this study will be of great advantage to the Students and Academic staff in Universities in Rwanda as whole. The study will also help universities to reduce the cost of hardware by using cloud computing services to enhance service delivery in learning, teaching and operations in universities in Rwanda.

**KEYWORDS:** Cloud computing, Software as a Service, Efficient service Delivery, Usability.

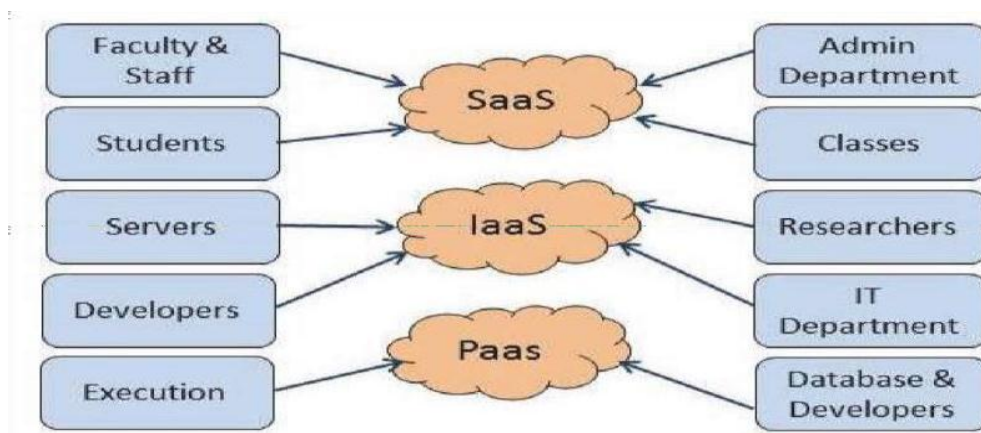
## INTRODUCTION

Cloud computing is one of the universal developments for ICT, which can contribute to the resolution of existing challenges and to the fulfillment of education targets at a reasonable price.<sup>[4]</sup> Using cloud computing at universities provides various benefits for academic staff, administrators, students and other university employees. It provides access to file storage, e-mail, databases, educational resources and tools wherever they are.<sup>[3]</sup> IT services for the universities provisioned in cloud computing environment are: E-learning, Email service, servers, virtual desktop, storage of data/information, resource sharing. Cloud services are being utilized and taken on board, although the rates and scale differ according to the fields and the financial situation of the institution.<sup>[9]</sup> Big businesses, such as Microsoft, had already begun operations to provide universities with free cloud services. The provided services include document storage, email, report building and exchange and site building capacity.<sup>[9]</sup> In a generally higher education institute,<sup>[12]</sup> the key customers of the information technology assets are respected lecturers, students, developers, administrative employees, researchers and analysts. The cloud services were taken up in different forms in higher education institutions and are used in these institutions for different tasks. Some are specifically used to deliver knowledge, while others are used for various exercises that assist the teaching process. Many universities are already reaping several benefits, including cost reduction, flexibility, quickness and modernization, offered by the Cloud. Most of them have accepted a

collaboration system based on the cloud in order to increase information sharing on the university grounds.<sup>[5]</sup>

### I. Cloud Service Models for Education

Various service model architectures can be adopted to deliver Cloud computing. These are: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS are implemented via the web and accessed through the browser or interface of the programme. Because software is on-demand, applications can be implemented fast, easily, and economically. For example, Google applications, E-mail, documents and calendar. PaaS offers a flexible environment that permits clients to quickly build and adopt applications immediately. Consumers may use the platform for creating applications through provider-supported languages, libraries, services and tools. IaaS provides various support services such as database, storage space, and networking services, as well as other computer resources while the OS and applications are managed by the user.<sup>[7]</sup> The Figure 1 illustrates services that involved to educational cloud.



**Figure 1: Users of an education cloud services, (Adopted) from.**

**Source:**<sup>[1]</sup>

### Benefits and drawbacks of cloud computing in education

Cloud technology has numerous advantages in education as defined in many research studies. Cloud computing reduces expenditure in hardware and software infrastructure in universities. Cloud services also minimize their carbon footprint and have lower environmental impacts. Universities can save huge quantities of data inexpensively and obtain resources on request. With the cloud technology, it is easier to manage resources and available storage. Learners can also use a broad range of learning styles and interests suited resources and software tools.

Cloud computing also increases cooperation by enabling virtual meeting and sharing of data.<sup>[11]</sup> However, Cloud computing have some drawbacks in the academic system such as cybercriminal attack, platform attack, network threat, data inaccuracy, absence of confidentiality and compliance with standards.<sup>[10]</sup>

### **Problem of statement**

Cloud computing provides services to users such as software as a service, platform as a service and Infrastructure as a service. These services are under utilized by university staff and students. The cloud users still face challenges in terms of usability cloud software as a service. The purpose of this study was to investigate the usability of cloud computing Software as a service for efficient delivery in Private Universities in Rwanda.

### **METHODOLOGY**

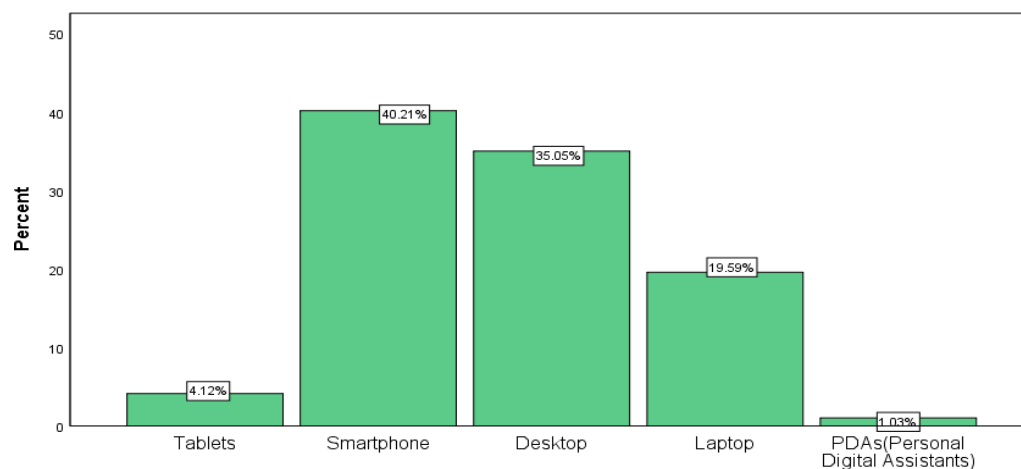
This study adopted a case study research design. Case study is a detailed study that investigates into the real world of an individual, group, institution or phenomenon particularly when phenomena and contexts make a minor difference.<sup>[8,11]</sup> This study adopted to use case study because it helped in-depth understanding of the research problem. Furthermore, it enhanced existing knowledge and also removed the possibility of possible biases by offering the topic under study chances to develop a greater understanding. There exist Twenty-nine (29) private higher institutions operating in Rwanda.<sup>[6]</sup> Therefore, the target population of this study was 29 private Universities in Rwanda. Although there are 29 Private Universities in Rwanda, only eight Private Universities offer computing courses and other courses and hence formed the study population. The 30% of population is considered representative enough for the study.<sup>[2]</sup> 30% of the eight private universities offering computing courses and other courses were used in this study. The researcher randomly selected two Private Universities out of eight which offer computing courses and other courses because they were representative enough and gave enough information of the whole population of the study. The sample size of this study was 103. The study also targeted Lecturers who offer computing courses and students who study computing courses in the selected Private Universities in Rwanda. Questionnaire and interview guide were used to collect data for this study. Quality control of the tools of the study was done to establish both validity and reliability. Content and face validity was done by a team of experts and average value of judgement calculated which was 0.766. Reliability of the tools was established through pretesting and piloting where the Cronbach's alpha of .756 value calculated for 14 items.

## Findings

The study collected and analyzed data about the usability of cloud computing software as a service in private universities in Rwanda. The study targeted only private universities which adopted cloud computing services in their educational services and had the computing courses and other courses at the time of study.

## Computing devices

The study sought to investigate computing devices that are used by computing students in accessing learning materials in private universities in Rwanda.

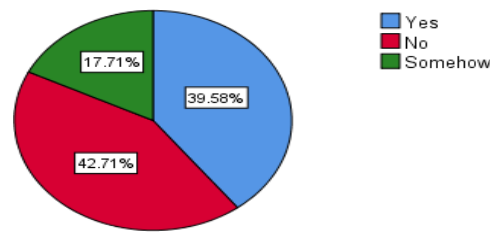


**Figure 1: Computing devices.**

A descriptive analysis of computing devices shows that 40.21% use Smartphones, 35.05% use desktops, 19.59% laptops, 4.12% tablets while 1.03% use PDA. This indicates that large number of students used Smart phones, Desktops and Laptops respectively. In addition, Lecturers who were interviewed said that the most computing devices they normally use are Laptops, smartphones, desktops and tablets.

## Knowledge of cloud computing

The study further sought to investigate whether computing students had knowledge on cloud computing. Figure 2 summarizes the percentage of respondents who had knowledge of cloud computing in their universities.



**Figure 2: Knowledge of cloud computing.**

Figure 2 reveals that 57.29% of respondents agreed to have some knowledge of cloud computing while 42.71% agreed that they don't have knowledge of cloud computing. This implies that most students had knowledge of cloud computing. Furthermore, Lecturers who were interviewed agreed that they have knowledge of cloud computing.

### Usability of Software Application

The study sought to investigate the usability of software Application for Software as a Service of cloud computing. Table 1 summarizes the usability of software application used in accessing information and learning materials.

**Table 1: Software Application.**

Software Application	Frequency	Percent (%)
Gmail	32	33.0
Yahoo	6	6.2
Youtube	14	14.4
Google app	7	7.2
Twiter	3	3.1
Facebook	10	10.3
Skype	6	6.2
WhatsApp	14	14.4
Instagram	5	5.2
Total	97	100.0

Table 1 reveals that computing students in private universities in Rwanda used the software application for accessing their learning materials as well as communication. 33% use Gmail, 14.4% WhatsApp and Youtube, 10.3% Facebook, 7.2% use Google App, 6.2% use Dropbox, 5.2% Instagram, and Skype while 3.1% used Twitter. This implies that most students used Gmail and Whatsapp to access their learning materials and communication. In addition, most Lecturers who were interviewed agreed that they use Gmail, Whatsapp, Google App and Dropbox.

### Significance of cloud computing services

The study sought to determine the significance/ importance of cloud computing in private universities in Rwanda. Table 2 presents the importance of cloud computing services in private universities in Rwanda.

**Table 2: Significance of cloud computing services.**

Significance of cloud computing	Frequency	Percent (%)
Access of application anywhere	29	29.9
Pay per use	6	6.2
User friendly (Ease to operate and understand)	20	20.6
Green IT	5	5.2
Reduce Hardware cost	4	4.1
Enable students to communicate with colleagues	7	7.2
Supports in Learning and teaching	9	9.3
Increased openness of Learner to new technology	6	6.2
Enhanced staff skills and increased knowledge of student access technologies	11	11.3
Total	97	100.0

The analysis of responses found out that 29.9% of respondents agreed that it helps them in accessing software application anywhere, 20.6 % of respondents agreed that it is ease to operate and understand, 11.3 % said that there is enhanced staff skills and increased knowledge of student access technologies, 9.3% agreed that it supports in Learning and teaching, 7.2% agreed that it enables them to communicate with colleagues, 6.2% Pay per use, 5.2% green ICT while 4.1% agreed that it reduces hardware cost. The higher percentages were for accessing application anywhere, user supports in Learning and teaching, friendly and enhanced staff skills and increased knowledge of student access technologies. In addition, most lecturers said that cloud computing services help them to improve their skills, support in teaching and they can also access software application anywhere at any time. This implies that the cloud computing services are very important in daily activities for both learners and educators.

### Challenges in usability of cloud computing services

The study also sought to find out the challenges faced by students in usability of cloud computing services in private universities in Rwanda. Table 3 summarizes the challenges faced by students in usability and accessibility of cloud computing services.

**Table 3: Challenges of Usability of cloud computing services.**

Challenges	Frequency	Percent (%)
Lack of awareness	31	32.0
Lack of enough skills	23	23.7
Lack of trust of cloud service provider	4	4.1
More cost of cloud computing	1	1.0
Security of data / information	20	20.6
Unreliable internet	17	17.5
I don't know	1	1.0
Total	97	100.0

Table 3 reveals that the 32% of respondents face challenges of lack of awareness, 23.7% lack of skills, 20.6% more cost of cloud computing, 17.5% unreliable internet, 4.1% lack of trust of cloudservice provider while 1.0% they don't know. This implies that most students face the challenge of poor awareness, lack of skills, more cost of cloud computing and unreliable internet. However, the most lecturers who were interviewed also said that there is a challenge of lack awareness, lack of enough skills and security of data/information.

#### **The effect of the usability of cloud computing software on the efficient service delivery in private universities in Rwanda**

The study also sought to investigate the effect of usability of Software as a Service of cloud computing (focused on software application) on efficient service delivery in private universities in Rwanda. Table 4 displays the findings of the effect of usability of cloud computing software as a service (Software application) on the efficient service delivery.

**Table 4: Effect of cloud computing software (Software application) on the efficient service delivery.**

Statement		SD	D	N	A	SA
Using application of software as a service for cloud computing improve performance of academic learning	Count	2	23	1	39	29
	Row N %	2.1%	24.5%	1.1%	41.5%	30.9%
The usability for the application of software as a service of cloud computing is satisfied and it saves time.	Count	3	63	12	12	2
	Row N %	3.3%	68.5%	13.0%	13.0%	2.2%
Using application of software as a service of cloud computing enhance effectiveness in my study/job	Count	3	7	35	44	3
	Row N %	3.3%	7.6%	38.0%	47.8%	3.3%
Email is the most Software application I use to Access learning materials and personal communication.	Count	1	9	17	63	2
	Row N %	1.1%	9.8%	18.5%	68.5%	2.2%
It is easy to find all the information I need to work through the software applications	Count	6	46	7	32	2
	Row N %	6.5%	49.5%	7.5%	34.4%	2.2%



Students and university staff can easily access the services through software application	Count	7	53	9	22	3
	Row N %	7.4%	56.4%	9.6%	23.4%	3.2%
The software application allows for quick modification of existing products and services	Count	6	45	16	20	6
	Row N %	6.5%	48.4%	17.2%	21.5%	6.5%
The software application responds quickly to requests	Count	7	8	24	49	4
	Row N %	7.6%	8.7%	26.1%	53.3%	4.3%

Table 4 reveals that, 72.4% of respondents agreed that they are using software application to improve performance of their academic learning. 71.8% of respondents were not satisfied on the usability of software application, 51.1% of respondents agreed that using cloud computing software enhance effectiveness in study/job, 70.7 % agreed that they used emails in accessing learning material and their personal communication, 56 % agreed that it is not easy to find all information they need through software application, 63.8% of respondents agreed that there were difficult in accessing services through software application while 57.6% of respondents agreed that the software application respond quickly to their requests. Furthermore, most of the lecturers who were interviewed strongly agreed that using software application improve performance of academic learning and teaching and they found all information they need through application of SaaS for cloud computing and they can access services. This implies that the usability of software application of cloud computing has the effect on efficient service delivery because it improves performance in academic learning and teaching, enables the communication with peers and accessing of services.

## DISCUSSION

The analysis in Figure 1 revealed that most computing devices used in universities are smart phones (40.2%), laptops (35.1%), desktops (19.6%). Using those computing devices enhance the usability of cloud computing software as a service, help universities to achieve efficiency in service delivery and computing devices are useful in academic learning, teaching and accessing learning materials. The analysis in the Figure 2 reveals that the most 57.29% respondents do have knowledge on cloud computing, agree that they have knowledge on cloud computing but few do not have knowledge on cloud computing. Knowledge on the usability of cloud computing is very key in order to achieve efficiency in service delivery. The analysis of Table 1 reveals that the most software application of cloud computing used by the universities are Gmail (33%), WhatsApp and Youtube (14.4%), and Facebook (10.3%) and Google app (7.2%). The usability of software applications of cloud computing help universities in learning, teaching, resource sharing and communication. Investigations on the extent significant of cloud computing in the universities revealed that 29.9% of the

respondents agree they access application anywhere, 20.6% User friendly (Ease to operate and understand), 11.3% enhanced staff skills and increased knowledge of student access technologies, 9.3% supports learning and teaching and 7.2% enables students and university staff to communicate with colleagues. This implies that the cloud computing services are very important in daily activities for both learners and educators. The investigation on the extent of the challenges in usability of cloud computing in the universities revealed that 32.0% of respondents agree they face challenge of lack of awareness, 23.7% of respondent agree that they face challenge of lack of enough skills, 20.6% of respondents agree that they face challenge of security of data/information and 17.5% of respondents agree that they face challenge of unreliable internet. This implies that the majority of respondents use cloud computing but still face challenges of lack of awareness, lack of enough skills, security of data/information and unreliable internet. so there is need to provide training to bring awareness and technical skills on the usability of cloud computing.

Data was also collected and analyzed to find out the effect of cloud computing software as a service on efficient service delivery. The results in Table 4 revealed that the majority of respondents 72.4% agreed that using application of software as a service improve performance of academic learning. 51.1% use application of software as a service of cloud computing to enhance effectiveness in study/job, 70.7% of respondents agreed that email is the most Software application they use to access learning materials and personal communication. This implies that usability of cloud computing software as a service has effect on efficient service delivery, by improving the performance of academic learning, enhancing effectiveness in study/job and use email to access learning material, resource sharing and communication. However, 54.9% of respondents do not agree that the software application allows for quick modification of existing products and services. 56% of respondents agreed that it is not easy to find all the information they need to work through the software applications. This implies that there still need to increase technical knowledge and awareness on the usability of cloud computing software as a service in order to achieve highly efficient service delivery in the universities. Based on findings, the elements of usability of cloud computing software as a service are computing devices, software application of cloud computing, performance, application support, communication, satisfaction, ease to find information, user- friendliness and efficiency.

## CONCLUSION

The study concluded that the usability of cloud computing software depends on the computing devices used in universities. The computing devices identified were mainly Smartphones, Desktops, and Laptops. These devices enhance the usability of the cloud computing in universities. The software application that are mostly used in the universities were Gmail, Whatsapp, Facebook, Google App and Dropbox. The study concluded that usability of Software application of cloud computing help tackles the issues linked with the learning process. The study also concluded that usability of cloud computing software has major effect on efficient service delivery since they used the software application of cloud computing to access their learning materials, improve academic performance, supports in learning and teaching and it also enables them to communication with peers. The study also concluded that cloud users in the universities still face challenges in usability of cloud computing software as a service such as lack of awareness, lack of enough skills, security of data/information and unreliable internet, so there is need to increase technical skill and awareness on the usability of cloud computing services through the training. The study also concluded that in order to achieve highly efficient service delivery, major infrastructure development such as high-speed Internet connection is needed to facilitate the use of on-demand web cloud services, reducing the costs of investing in powerful hardware, such as stand-alone servers and software for each unit, some of which are extremely costly to purchase and maintain. The study concluded that the elements of usability of cloud computing software as a service are computing devices, software application of cloud computing, performance, application support, communication, satisfaction, ease to find information, user-friendliness and efficiency.

## REFERENCES

1. Attaran, M., Attaran, S., & Celik, B. G. Promises and Challenges of Cloud Computing in Higher Education: A Practical Guide for Implementation. *Journal of Higher Education Theory and Practice*, 2017; 17(6): 20–38.
2. Borg, W .R. & Gall, M. D. *Educational research: An Introduction*(Fifth Ed.). New York: Longman, 2003.
3. Erkoc, M. F., & Kert, S. B. Cloud Computing For Distributed University Campus: A Prototype Suggestion. *International Conference on Future of Education*, 2011; 10–17.
4. Etene, Y., Ikoha, A. P., & Wabwoba, F. Integrated Cloud Computing Environment Model (ICCEM) Towards Affordable ICT Integration in Education, 2019; 21(2): 23–33.

Available:<https://doi.org/10.9790/0661-2102032333>.

5. Green, K. The Campus Computing Survey. The Campus Computing Project. Available: <http://www.campuscomputing.net/item/campus-computing>, 2014.
6. HEC, R. List of academic programs offered by private higher learning institutions in Rwanda no institution academic programs. Rwanda News, 2019.
7. Matsumoto, R. SaaS Does Not Necessarily Equal Cloud. Available:<http://www.rickmatsumoto.com/saas-does-not-necessarily-equal-cloud>, 2012.
8. Mugenda, O. M. & Mugenda, A. G. Research methods: Quantitative & Qualitative approaches. Nairobi: African Centre for Technology Studies press, 2003.
9. Muriithi G, K. E. Cloud computing in higher education: implications for South African public universities and FET colleges. Proceedings of the 14th Annual Conference on World Wide Web Applications Durban. PMCid: PMC3288012, 2014.
10. Nielsen, T. and Donovan, P. Addressing Cyber Security Concern of Data Center Remote Monitoring Platform. Schneider Electric. Retrieved from: <http://www.forbes.com/sites/stevemorgan/2016/01/17/cyber-crime-costs-projected-to-reach-2-trillion-by-2019/#45018db93bb0>, 2016.
11. Sjøberg, D. I. K., Dybå, T. & Jørgensen, M. The future of Empirical Methods in Software Engineering Research. Future of Software Engineering, IEEE-CS Press, 2007.
12. Sultan, N. Cloud computing for education: A new dawn? International Journal of Information Management, 2010; 30(2): 109–116. <https://doi.org/10.1016/j.ijinfomgt.2009.09.004>.