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Influence of Availability of Information Communication Technologies Infrastructure on Quality of Distance Teaching and Learning in Kenyan Universities

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Abstract: ***Information Communication Technologies are many and varied and they include different types of network infrastructure and internet connectivity. Information communication technologies play a key role in distance teaching and learning. The study investigated the influence of availability ofICTs infrastructure on quality of distance teaching and learning in Kenyan universities.The study was guided by mixed methods research approaches. Quantitative and qualitative data was collected.The target population wasODeL directors, lecturers who taughtODeL students, ICT technical staff and ODeL students from the selected universities that offer programmesthrough ODeL. Sampling wasdone by use of stratified, systematic and purposive sampling. Among all the universities that offer ODeLprogrammes, four universities were purposively sampled for the study. The sample size included 4 ODeL directors, 78 lecturers, 4 ICT technical staff and 156ODeL students. Data was collected by use of questionnaires, interview guide and documents analysis guide. Descriptive and inferential statisticswere used to analyze the data. Analysis of quantitative data was done by the help of Predictive Analytical System (Version 20.0).Qualitative data was coded and analyzed in themes emerging from the narratives. The findings revealed that computers were the most available ICT infrastructure used in distance teaching and learning in the sampled universities while the audio and videoconferencing were not available for distance teaching and learning.Based on students' opinion,availability of ICT infrastructure was significant in enhancing quality of distance teaching and learningcontrary to lecturers' opinion.The study recommended that distance teaching universities should embrace video and audio conferencing as they offer two way interactive communications between the learner and the tutor thus improving quality of instructional delivery for distance learners.***

Keywords: Information Communication Technologies; Open, Distance and e- Learning; Quality

1. Introduction

Information Communication Technologies (ICTs) are many and varied and they include different types of network infrastructure and internet connectivity for instance wireless network technologies, video conferencing technologies, satellite broadcasting, and internet enabled computers, various software applications and data storage infrastructure.Information Communication technologies play a key role in distance teaching and learning (Mbuthia & Seviila, 2011).

Yusuf, (2006) argues that thriving distance education can only be guaranteed bymaking use of useful communication and technological tools. However, Gakuu (2006) points out that in many developing countries, teledensities are exceedingly and comparatively low. Miniwatts Marketing Group (2006) cited byMbuthia and Seviila (2011) also reported that byJune 2010, Africa had the lowest internet connectivity as compared to other regions of the globe, such as North America and Europe. For example, in a ten African countries survey on ICT access and usage, Gillwald and Esselaar (2005) affirm that Botswana had the highest fixed line penetration as per household at 22.4% while South Africa had 22.1%. At Zambia, internet penetration was 18.6%,Namibia had 14%, Tanzania 6.1%, Ethiopia 5% and Rwanda 4.4%. Uganda had the lowest internet penetration of below 1%.

To encourage the use of ICT in education institutions of higher learning in Kenya, Kenya Education Network (KENET) was formed. According to Situma (2015) KENET aimed at interconnecting all universities, tertiary and research institutions in Kenya by setting up cost-effective and sustainable private networks with high-speed access to the global internet. According to Situma, digital villages were rolled out by the Government of Kenya in the year 2010 with the purpose of providing a suite of services to the public via computers linked to the internet and other communication infrastructure.

Kenyan universities have actively embraced ICT use in ODeL as it is a core method of instructional delivery rather than supplementary as in the case of traditional face to face education system.The study sought to investigate the influence of availability ofICT infrastructureon quality of distance teaching and learning in Kenyan universities.

2. Literature Review

For efficient delivery of ODeLprogrammes, ICT infrastructure is vital. However, there are many challenges facing integration of ICT in education especially in developing countries.For instance, Jamtsho and Bullen (2007) point out that several cities and rural areas in Zimbabwe experience fluctuation in electricity on a regular basis. In rural areas of Zimbabwe, most people do not have access to telephones and communication devices due to their

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prohibitive costs. Within urban areas, telephone lines are not enough to serve the high population of residents. They further point out that internet connectivity is factor that affects how student access the World Wide Web based on the availability and connection speed which are generally slow. Jamtsho and Bullen (2007) further reported that where Zimbabwe Open University (ZOU) had regional centers connected to the internet, students still found access to internet to be limited. For instance at Bulawayo region, out of 900 students registered, only 10 computers are connected to the internet. This made the incorporation of ICTs to deliver distance education difficult. However, in the recent past, Zimbabwe has experienced exponential growth in the use of internet and in mobile cellular sector. According to Zimbabwe National ICT policy (2016), ICT sector has been liberalized with introduction and growth of internet users in the country and as at December 2015, mobile cellular subscription was 95%. The policy envisaged that a vibrant ICT sector would provide adequate and efficient telecommunication and internet services all over the country. In Ghana, ICT policy in Education was launched because it was believed that it would have an impacton learners, teachers, managers and the administrators. However, it is argued that for ICT to have the impact, it will depend onon affordability and continuous access to hardware, software and internet connectivity (Republic of Ghana, 2008).

In their study of secondary schools in Kenya, Wims and Lawler (2007) found that educational hardware and software, and access to the internet was lacking in many schools. In addition, only 35-40% teachers in secondary schools had made use of a computer. They recommend the training of staff, incorporation of ICT across the curriculum and provision of appropriate ICT equipment as ways of enhancing integration of ICT in curriculum delivery.

In a baseline survey report commissioned by the Commonwealth of Learning on open and distance learning in Kenya, Nyerere (2016) reported that about 66.7% of the participants indicated that they had adequate computers for delivery of ODeLprogrammes and their accessibility was sufficient, while 24% indicated that there were inadequate computers for instructional delivery of ODeLprogrammes. In addition, the study reported that some universities such as Kenyatta University had invested in providing tablets to all students enrolled in Digital School. Kenyatta University offered the tablets to students during registration and the costs were included in the tuition fees. About 67% of the participants, however, indicated that tablets were not available to students in other universities. According to the reviewed literature, it was evident that ICT infrastructure for distance teaching and learning was found to be limited in most areas in developing countries.

3. Statement of the Problem

Due to expansion of avenues of educational provision through a conventional system of education which leads to high teacher-student ratio and limited facilities, distance education is seen as an alternative to offer access to education which is in great demand because of its flexibility (Ngeera, 2010). Despite the growing demand for distance education, Braimoh (2002) argued that it is commonly and regularly considered as an inferior type of education acquisition. Programmes offered through distance learning have been criticized on basis of poor quality and not being at par with the traditional face to face programmes. Enhancing the quality of distance education is a critical issue, particularly at this time of educational expansion and with the advent of ICTs. This study, therefore, was important in investigating the influence of availability of ICTs Infrastructure in enhancing quality of distance teaching and learning.

4. Methodology

This study used the mixed method approach for concurrent triangulation specifically, convergent parallel research design. According to Creswel(2015), mixed method approach involves mixing of both qualitative and quantitative approaches.The study used convergent parallel design.

The study was carried out in four universities which were purposively sampled on the basis of offering ODeL programmes. The universities included two public universities, College of Education and External Studies of University of Nairobi, and Kenyatta University, Digital school. The other universities that were included in the study were two private universities, Kenya Methodist University; Digital Campus and Africa Nazarene University; Institute of Open Distance Learning. The target population was 4 ODeL directors from the four universities. The study also targeted 78lecturers who taught ODeL students in the Bachelor of Education programme (Arts). Four (4) ICT technical support staffwas targeted. The study also targeted 3,101ODeL Bachelor of Education students (Arts).

The sample size for lecturers comprised of twenty five (25) lecturers from University of Nairobi; School of Continuing and Distance Education, twenty (20) lecturers from Kenyatta University; Digital School, eighteen (18) lecturers from Kenya Methodist University; Digital Campus and fifteen (15) lecturers from Africa Nazarene University; Institute of Open and Distance learning. In total, seventy eight (78) lecturers were purposively sampled from the selected universities. The researcher sampled four (4) ICT technical support staff from the four universities. In this case, one (1) ICT technical support staff from each university was sampled to participate in the study. The researcher used purposive sampling to select fourth year ODeL students taking Bachelor of Education (Arts) to take part in the study. The samplesize for the students comprised of; 156ODelstudents. Fifty six were from University of Nairobi, 40 students from Kenyatta University, 30 students from Kenya Methodist University and 30 from Africa Nazarene University.

Data was collected using open and closed ended questionnaires for lecturers and ODeL students, interview guides for ODeL directors and ICT technical staff and documents analysis guide.Data was analyzed using descriptive statistics such as the mean, mode and percentages. Statistical Package for Social Sciences (S.P.S.S) version 20.0 was used toanalyze the data.

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Data collected through in depth interviews was transcribed from audio tapes to words. Data was organized using research questions and then coding was done. The findings were then analyzed in the thematic forms. Narrative discussions were used to present the results. Documents were analyzed using content analysis. Results from the interviews and document analysis were used to validate resultsfrom the questionnaires in order to draw study conclusions and recommendations.

5. Response Rate

A total of one hundred and fifty six (156) questionnaires were distributed to the female and male students who are currently pursuing their studies through open and distance learning mode in the four universities. Also a total of seventy eight (78) questionnaires were administered to ODel lectures from the same universities. This represented 75% and 76 % respectively. Out of four ODeL directors sampled for In-depth interviews, one (1) declined to be interviewed translating to 75% response rate. Out of four ICT technical staff sampled for in-depth interviews, one (1) also declined translating to 75% response rate. According to Mugenda and Mugenda (2003), above 70% response rate is acceptable. Table 1 shows the response rate.

Table 1: Response Rate

Respondents	Sample size	Return rate	Response rate (%)
ODeL Students	156	117	75
ODeL Lecturers	78	60	76
ICT technical staff	4	3	75
ODeL Directors	4	3	75
TOTAL	**242**	**183**	**75.5**

6. Findings and Discussions

The researcher sought to establish the Influence ofavailability of ICT infrastructure on quality of distance teaching and learning in the sampled universities. Students' and lecturers were asked to indicate the ICT infrastructure that was available in their university to influence quality of distance teaching and learning in sampled universities. The ICT infrastructure included both software and hardware. The responses were; available, not sure and not available. The results are presented in Table 2.

Table 2: Availability of ICT Infrastructure

ICT Infrastructure	N	Available		Not sure		Not Available	
		F	%	F	%	F	%
Computer	177	166	93.8	5	2.8	6	3.4
Digital libraries	177	137	77.4	27	15.3	13	7.3
Internet	177	166	93.8	6	3.4	5	2.8
Fast Internet	177	129	72.9	29	16.4	19	10.7
Band Width	177	66	37.3	100	56.5	11	6.2
Photocopy Machines	177	146	82.5	17	9.6	14	7.9
Video Conferencing	177	8	4.5	74	41.8	95	53.7
Audio conferencing	177	19	10.7	89	50.3	69	39.0
Scanners	177	106	59.9	48	27.1	23	13.0
Print Materials	177	152	85.9	17	9.6	8	4.5
Mobile Devices	177	158	89.3	9	5.1	10	5.6

From the findings, it was established that computers at 166 (93.85%), were the most available ICT infrastructure used in distance teaching and learning in the sampled universities. Internet and fast internet was also available as evidenced by 166(93.8%) and 129 (72.9%) respectively. Mobile devices at 158(89.3%), print materials at 152(85.9%) photocopy machines at 146 (82.5%) and digital libraries at 137 (77.4%) were also available. Availability of computers and mobile devices in the sampled universities is an indication that the universities have realized that to ensure quality in ODeL, effective communication and telecommunication tools which are internet enabled need to be available. This concurs with Yusuf (2006) that successful distance learning can only be assured with the use of effective communication tools. However, the results defers with Jamtsho and Bullen (2007) that in Zimbabwe there is low access to telephone and other telecommunication facilities and poor internet connectivity. Since then, there is a paradigm shift in electronic communication especially in Kenya. Situma (2015) points out that with establishment of KENET, universities, tertiary and research institutions in Kenya have been interconnected with cost effective and sustainable private networks with high speed access to global internet.

Availability of print materials and photocopy machines indicates that the sampled universities use both electronic and print technologies. This influences quality of distance teaching and learning as print materials are able to supplement e-learning materials and alleviate the challenges of electronic learning such as fluctuation in the supply of electricity as noted by Jamtsho and Bullen (2007).

For a distance learner who is separated from the institution, digital libraries are very vital. Digital libraries enable learners to access the library materials anywhere and anytime. There is a close connection between digital libraries and internet connectivity. Where there is low internet connectivity, students cannot access digital learning materials. Mungai (2015) argues that distance learning in Kenyan universities is faced with challenges such as slow Internet connectivity and low bandwidth. Other challenges include lack of access to advanced information technology connections as well as digital libraries which are important for distance learning students.

Despite availability of computer, fast internet and mobile devices, it was established that video conferencing and audio conferencing were either not available or the respondents were not sure. This is indicated by 95.5% and 89.3% respectively. Video and audio conferencing offer two way interactive communications between the learner and the tutor thus improving instructional delivery for distance learners.

During the in- depth interview with the ODeL directors and ICT technical staff, they were asked the ICT infrastructure that was available to influence quality of distance teaching and learning in sampled universities. The ICT technical staff and ODeL directors who were interviewed indicated that the computers were major ICT infrastructure that was available in the sampled universities. They pointed out that internet enabled computers which are found in the computer laboratories to access e-learning platforms were available in the universities. In addition, WI –FI hotspots were made available to provide internet connectivity to all the students and lecturers in the universities. They however pointed out

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that video conferencing and audio conferencing facilities were not available for distance teaching and learning. Even in the university where such facilities were available, they were used for meetings. One of ODeL director (name withheld) had the following to say;

> *'We have very expensive video conferencing facilities which connect all our campuses but they are not available for distance teaching and learning. They are used for meetings to cut down on the cost of travel. He added that 'the audio conferencing facilities which we have are the IP phones which we also use to conduct departmental meetings'.*

The ICT technical staff and ODeL directors pointed out that apart from computers other ICT infrastructure that are available in the sampled universities are; mobile devices, photocopiers, fast internet and digital libraries. The results of the in-depth interviews compared the findings from the quantitative items from the questionnaires from both the students and the lecturers.

7. Hypothesis test on influence of availability ICT infrastructure on Quality of Distance Teaching and Learning

Logistics Regression Analysis was used to establish the relationship between availability of ICT infrastructureand quality of distance teaching and learning. Wald test statistic was used to test the hypotheses at a significant level of (5%). The decision rule was that if p-value was less than or equal to 0.05 ($p = \leq 0.05$) the null hypothesis was rejected, meaning that there was a significant influence between variables under study. However, if the p-value was greater than 0.05 ($p = \geq 0.05$), then there was enough evidence not to reject the null hypothesis. Omnibus Test and Hosmer and Lemeshow were also computed to test the fitness of the models.

7.1.1 Students opinions

The study sought opinions from students to determine the influence of availability of ICT infrastructure on quality of distance teaching and learning based on students opinion. Table 3 shows the results of the fitness of the model.

Table 3: Model Fitness Tests for ICT Infrastructure

Test	Type of Statistic	Value of Statistic	P-Value
Omnibus	Chi-Square	13.001	0.000
Hosmer and Lemeshow	Chi-Square	11.853	0.106
Model Summary: Nagelkerke R Square = 0.14			

Omnibus test of model coefficient (ICT infrastructure) shows the significance of the predictive capacity of the model. It can be observed that the p – value was p=0.000 which is less than 0.05. This shows that the model has significant predictive capacity. This shows that the ICT infrastructure significantly explains the variations in the quality of distance teaching and learning. Hosmer and Lemeshow Test measures whether the model which consists of only ICT infrastructure is fit for prediction with the null hypothesis that the model is fit against the alternate that the model is not fit. The results show that χ^2 (7) = 11.853, p=0.106. Therefore, the null hypothesis is not rejected implying that the model is fit and that it has significant predictive capacity.

Model summary shows that ICT infrastructure predicts 14% of the variations in quality of distance teaching and learningbased on the Nagelkerke R Squared which is a pseudo Pearson's R square, while Table 4 shows the results of hypothesis test on influence of availability of ICT infrastructure on quality of distance teaching and learning.

Table 4: Influence of availability of ICT Infrastructure Hypothesis Test (students)

Variables	B	S.E.	Wald test	P-value	Odds Ratio
ICT Infrastructure:					
No ICT Infrastructure (reference)	-	-		-	1.000
Present ICT Infrastructure	0.249	0.075	11.089	0.001	1.283
Constant	2.925	0.885	10.921	0.001	0.054

The Logistic Function 1

$\text{Ln}(P/(1-P)) = -2.925 + 0.249X_1$
Where;
P: Probability of Quality of Distance Teaching and Learning
Ln (P/1-P): Logit of Quality of Distance Teaching and Learning
X_1: ICT Infrastructure

From Table 4and the Logistic Regression Function 1, it can be concluded that a marginal increase in ICT Infrastructure increases the logit of the quality of distance teaching and learning by 0.249 while holding all other factors constant. Also, looking at the odds ratio, it can be construed that unit increase in ICT infrastructure increases the odds (likelihood) of quality of distance teaching and learning by 1.283 while controlling other factors.

From Table 4it can be observed that the relationship between availability of ICT Infrastructure and quality of distance teaching and learning as described in equation (1) is significant given that the p-value was 0.001 which was less than 0.05. Based on the opinions of the students', the null hypothesis on availability of ICT infrastructure was rejected implying that availability of ICT infrastructure is crucial for the success of distance teaching and learning. This agrees with Yusuf (2006) that distance teaching and learning can be assured with the use of effective communication tools.

According to interviews conducted, the ICT technical staff affirmed that ICT infrastructure was necessary for the success of any distance education programmes. One of them added that ICT infrastructure is a shared resource which are used by all the students, especially in a blended learning and not only distance learners. It is, therefore, necessary for universities to invest in ICT infrastructure both hardware and software. The document analysis and specifically the strategic plans indicated that one of the universities responsibilities was to provide ICT infrastructure for the provision of quality distance teaching and learning.

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7.1.2 Lecturers' opinions

The study sought opinions from lecturers to determine the influence of availability of ICT infrastructure on quality of distance teaching and learning. Table 5shows the results of the fitness of the model.

Table 5: Model Fitness Tests for ICT Infrastructure (Lecturers)

Test	Type of Statistic	Value of Statistic	P-Value
Omnibus	Chi-Square	1.009	0.315
Hosmer and Lemeshow	Chi-Square	3.977	0.409
Model Summary: Nagelkerke R Square = 0.022			

Omnibus test of model coefficient (ICT infrastructure) shows the significance of the predictive capacity of the model. It can be observed that the p – value was p=0.315 which is more than 0.05. This shows that the model has significant predictive capacity. Therefore, ICT infrastructure significantly explains the variations in the quality of distance teaching and learning.

Hosmer and Lemeshow Test measures whether the model (which consists of only ICT infrastructure) is fit for prediction with the null hypothesis that the model is fit against the alternate that the model is not fit. The results show that χ^2 (4) = 3.977, p=0.409 > 0.05. Therefore, the null hypothesis is not rejected implying that the model is fit and that it has significant predictive capacity.

Model summary shows that ICT infrastructure predicts 2.2% of the variations in quality of distance teaching and learningbased on the Nagelkerke R Squared which is a pseudo Pearson's R square.

Table 6: Influence of Availability of ICT Infrastructure Hypothesis Test (Lecturers)

Variables	B	S.E.	Wald test	P-value	Odds Ratio
ICT Infrastructure:					
No ICT Infrastructure (reference)	-	-		-	1.000
Present ICT Infrastructure	0.128	0.130	0.968	0.325	1.136
Constant	-1.197	1.512	0.627	0.429	0.302

The Logistic Function 2

$\text{Ln}(P/(1-P)) = -1.197 + 0.128X_1$

Where;

P: Probability of Quality of Distance Teaching and Learning

Ln (P/1-P): Logit of Quality of Distance Teaching and Learning

X_1: ICT Infrastructure

From the Table 6and Logistic Regression Function (2) observations can be made that a marginal increase in ICT Infrastructure increases the logit of the quality of distance teaching and learning by 0.128 while holding all other factors constant. Also, looking at the odds ratio, it can be construed that unit increase in ICT Infrastructure increases the odds (likelihood) of quality of distance teaching and learning by 1.136 while controlling other factors. The availability of ICT infrastructure had a p- value of 0.325 which is more than 0.05. There is enough evidence not to reject the null hypothesis which states that there is no significant relationship between availability of ICT infrastructure and quality of distance teaching and learning in Kenyan universities.

The findings imply that according to the lectures, availability of ICT infrastructure is not significant in influencing quality of distance teaching and learning. Lecturers may not be constrained by finances contrary to distance learners and hence can afford to purchase ICT infrastructure such as laptops, iPads, smart phones and high powered modems for provision of internet without depending on the institution. The results disagree with Olusola and Alaba (2011) that instructional delivery using ICTs in Nigerian universities is a challenge to both academic staff and university management due to high cost of purchasing ICT equipment and the fact that many of them are not computer literate.

8. Conclusion

Findings indicated that the computers were the most ICT infrastructure available for distance teaching and learning. Despite availability of computers, fast internet and mobile devices, video conferencing and audio conferencing infrastructures were not available for distance teaching and learning. Video and audio conferencing offer two way interactive communications between the learner and the tutor thus improving instructional delivery for distance learners. Availability of ICT infrastructure was found to be significant factor in enhancing quality of distance teaching and learning. Information Communication technologies were more preferred to print in ODeL instruction. Distance teaching universities are now using interactive Learning Management System (LMS) such as Canvas, mElimu, Claroline and Moodle. However, with availability of print materials, scanners and photocopy machines, it can be concluded that both print and electronic technologies are available for distance teaching and learning. It was concluded that with the advent of ICTs, providers of ODeLprogrammes have explored use of modern technological devices and they have offered varied multimedia for instruction.

9. Recommendations

The study recommends that Distance Education providers should leverage on emerging technologies to provide more opportunities for university education. Mobile learning as indicated by availability of mobile devices is the most recent development in distance learning. Availability of print materials and photocopy machines is an indication that the universities use both print and electronic materials. The Distance Education Providers should gradually transit from print media to e-Learning as this has been found to enhance quality.

Providers of distance learning should make it a requirement for all students enrolling for ODeL to have laptops or 'tablets' with the same specifications and for learning purposes. The ODeL directors should explore collaborations with the private sector to purchase these items at subsidized prices or advance soft loans for the students who may not afford the devices. The devices will be used to host the

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recommended reading materials and make it easier to communicate with their instructors. This would attract many students and have more enrolled in the programmes.

University managers should ensure that they have adequate facilities required for ODeL. In order to improve quality in ODeL, the university managers should invest in the necessary ICT infrastructure such as video and audio conferencing facilities and Internet connectivity for distance teaching and learning. Video and audio conferencing facilities offer two way interactive communications between the learner and the tutor thus improving instructional delivery for distance learners.

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