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Availability of ICT Infrastructure and use of Student Management Information System in Teacher Education Programme by Distance Learning in selected Universities in Kenya

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ABSTRACT

Student management information system (SMIS) is used in educational institutions to provide easy access to students' bio data which leads to increased efficiency, effectiveness and quality. About 80 per cent of Universities in Kenya that provide teacher education programme by distance learning. The objective of the study was to establish the extent to which availability of ICT infrastructure influences the use of SMIS in teacher education programme by distance learning in selected universities in Kenya. The study was based on Adaptive Structuration Theory, and cross-sectional survey design was used to guide the processes. A mixed approach was used for data collection involving structured questionnaires, key informant interviews and focus group discussions and data was collected from a random sample of 445 participants drawn from a target population of 9,936. Quantitative data was analyzed by descriptive and inferential. Statistical techniques were used to test the relationships between independent and dependent variables. The overall Chi-square test results revealed that there was a significant relationship between availability of ICT infrastructure and use of Student Management Information systems (Chi-Square value = 62.609; P-value=0.000<0.05) leading to rejection of the null hypothesis that here is no significant relationship between availability of ICT Infrastructure and use of Student Management Information System and acceptance of the alternative hypothesis. It was therefore concluded that availability of ICT infrastructure has an influence on the use of student management information system in teacher education programmes by distance learning. The finding will be useful to development planners and education policy makers by providing empirical knowledge for interventions that promote ICT infrastructure in universities. The study recommended that all universities in Kenya should adopt SMIS to support their administrative and academic functions and that the government should fast track rural electrification and laying of high speed internet cables to support the use of SMIS.

KEYWORDS:

Teacher education, availability of ICT infrastructure, SMIS, distance learning, internet, network, rural electrification.

1. Introduction

Student management information system (SMIS) refers to a collection of interrelated and interacting components that gather, store, analyze, and report data and information that can be utilized to enhance the process of decision making. Wider availability of ICT infrastructure in teacher education enables the sharing of information by all users. Availability of ICT infrastructure makes it feasible to use applications like word processors, electronic databases, e-mail, and student management information systems, which also results in more effective and efficient communication (Ndede-Amadi, 2013). According to a study by Ocholla (2015), 90 per cent of Kenyan universities have websites with fully functional SMIS. The study showed that students enrolled in teacher education programme by distance learning would find it easier to access and use SMIS if ICT infrastructure were available in remote areas. He also added that systems such as SMIS are built to manage students' academic and personal records, are available for decision-making and for enhancing the effectiveness of educational programs. Because it enables simple information and communication flow to systems used by higher education institutions, the availability of SMIS promotes correctness, timeliness, and effectiveness in teacher education programme by distance learning (Ocholla, 2015).

A study by Makokha and Mutisya (2016) also indicates that 90 per cent of universities in Kenya have websites with fully functional SMIS, and if ICT infrastructure is available in the remote areas teacher education programme by distance learning, students would find it easier to access and use SMIS and avoid flocking in system administrators offices to check for missing marks before, during, and after residential sessions in April, August and December. Recording data electronically, storing it centrally, and sharing it with colleagues is vital in reducing workloads through available ICT structures (Unwin, 2005). There are various types of information systems available for decision making on improvement of efficiency in teacher educational programmes, such as student management information system that are developed to handle students' academic and personal records (Kibuku, Ochieng, & Wausi, 2020).

Learners in teacher education programme by distance learning are forced to move to distant towns where ICT infrastructure is available so as to have access to the facilities. They face several challenges due to the distance from the institutional facilities, learning centres and cyber cafes where they can get access (Omwenga, Waema, & Wagacha, 2004). The learners find it easy to pick up any available electronic device and learn how to use it to easily communicate, but this is hampered by inadequate electronic devices. For example, students of teacher education programme by distance learning who are in remote areas where electricity is not available lack network and in some instances the learners are computer illiterate and cannot use internet (Kessy, Kaemba, & Gachoka, 2006; Matovu, 2009).

Availability of ICT infrastructure enables the use of SMIS, especially in the teacher education programme by distance learning. The impact of technological infrastructure in the use of ICT in teaching and learning is acknowledged across the globe (Pelgrum & Law, 2003). The British Educational Communications Technology Agency (BECTA) was established in Britain to superintend technology procurement. The ratio of students to computers in some countries, such as Australia and the United States of America, is five students to one computer (Ando, 2012). This is not the case in universities in Kenya where nearly 80 per cent of students have enrolled in teacher education programme by distance learning. These students come from rural and remote areas in Kenya where many of them lack access to roads, electricity, and internet.

In Chile, the Enlaces educational program is designed to create a structural change in Chilean education in order to prepare the youth, along with their parents and guardians, to play a part in the

emergent society of knowledge, and to create networks of communication that help incorporate them in the world (Pelgrum & Law, 2003). This program provides three computers and one printer to schools with fewer than 100 students, six computers and two printers to schools with between 100 and 300 students and nine computers and two printers to schools with more than 300 students. As part of collaboration with the Japanese government, 1,000 public secondary schools received hardware, software, and instruction in basic computer literacy. Connectivity and equipment access are examples of ICT infrastructure (Omito, 2016).

In Kenya, only a few areas have ICT infrastructure, resulting in a relatively low level of basic computer literacy. The majority of Kenya's secondary schools lack ICT infrastructure and 90 per cent of its rural schools lack computers and so teachers and students must travel long distances in order to access ICT infrastructure. Thus, using SMIS in teacher education programme by distance learning program is nearly impossible. Only particular towns have ICT infrastructure thereby making basic computer literacy quite expensive. Most secondary schools in the remote parts of Kenya do not have ICT infrastructure. Consequently, teachers and students go very long distances in search of ICT infrastructure. This makes the use of SMIS in teacher education programme by distance learning almost impossible.

According to Pelgrum & Law (2003), equipping universities and keeping them up to date with ICT equipment is very expensive due to hardware and software purchases, as well as the recurrent costs associated with maintenance and support. A general observation is that, despite huge investments, ICT is hardly integrated in daily classroom practices, even in countries that were forerunners. ICT infrastructure may have been emphasized too strongly in educational policy making in the past, causing attention to be diverted away from the pedagogical mission of institutions. Pelgrum and Law (2003) also argued that ICT is not a goal in itself, but rather a potential tool that may help institutions to improve their performance.

There are initiatives to deploy mobile internet centers in the rural areas to make them accessible. These centers, sometimes based in institutions, are vital tools to provide to learners (including teachers) of ICT outside of formal institution settings (Pelgrum & Law, 2003). In Kenya universities are not able to invest in ICT infrastructure because some parts of Kenya do not have electricity and internet network infrastructure. Thus, for a student to access or get hold of a computer, it takes them quite some time because the workload that they have as students and teachers is also heavy.

In Kenya, higher learning institutions offering teacher education programme by distance learning do not have computer laboratories in the remote areas where users can access SMIS to check their timetables, register, or even communicate with their various institutions, thereby making these institutions not comparable with their counterparts in other parts of the world. The implementation of ICT technologies in African countries is not an easy endeavor. There are challenges that face these countries such as unreliable power supply uncompleted networks for data and telecommunications, coupled with the high cost of energy and telecommunications. The Economic Community of West African States (ECOWAS) notes that its countries face the serious challenge of affordable and accessible telecommunication backbone and stable electricity (Edoho, 2013).

Kruss, Adeoti and Nabudere (2012) noted that differences in the status of infrastructure in universities, donor interventions and the level of economic development have led to different levels of ICT adoption. Eighty per cent (80%) of underlying infrastructure in African universities is not suitable for the intensive applications that require broad bandwidth. Bates (2008), in his study on transforming distance education through new technologies, emphasized that availability of ICT infrastructure,

consciousness of the existing technical options, as well as their maintenance is an important consideration for teacher education programme by distance learning users especially when making choices about how best to use ICT for development. As the technology infrastructure options continually change, flexible approaches to modeling costs and assessing the cost-effectiveness of various options are likely to be a constant requirement for users (Bates, 2008).

Selwyn (2014) contends that any modern institution of higher learning is critically dependent on the smooth operation of the new innovations of student management information system. This is the trend that most universities now use. Information communication and technology on the other hand has spread vastly and has become faster and cheaper and is supported in its entirety. However, it should be noted that if ICT facilities are put in place, they can result in more efficient communication and reduction in fraud in exams (Unwin & Unwin, 2017). They further stated that ICT application depends on the availability and existence of ICT infrastructure, students' skills and knowledge at all levels. Teacher education programme by distance learning students in universities in Kenya, are expected to use ICT not only to create value to the educational institutions but to solve analytical problems and make valuable decisions that would lead and help educational institutions in innovative ways. This would also equip them with technical abilities for planning and organizing educational institutions (Onguko, Abdalla & Webber, 2008).

This study is based on the theoretical dimensions of Adaptive Structuration Theory (AST) of DeSanctis and Poole (1994) and Anthony Giddens (1984). According to Giddens (1984), users, particularly students, adapt to the use of student management information system to meet their specific work needs, or they resist and do not use them at all. Giddens also observed significant shifts in system usage patterns and their consequences for decision making and other outcomes. He further stated that the setup of the student management information system cuts across all such systems. It is, therefore, not clear whether the low uptake of SMIS by the teacher education programme by distance learning users is because of lack of ICT infrastructure.

In this study, availability of ICT infrastructure was envisaged to influence the use of SMIS in the teacher education programme through its indicators consisting of internet connectivity, teleconferencing, audio conferencing, radio broadcasting, television lessons, power connectivity, ICT equipment, computers and printers. The study focused on teacher education programme by distance learning in selected universities in Kenya.

2. Methodology

Positivism and constructivism are the two main philosophical movements that shape social science research (Mutch, 2013). As cited in Zhao (2016), the positivist philosophy was more prevalent in this study, which primarily utilized both quantitative and qualitative methods of analysis. Thematic analysis from the constructivist paradigm was used to assess information obtained by interview guide, focus group discussions and personal observation. These two paradigms therefore allowed data collection and analysis to be done qualitatively and quantitatively to answer the research questions on the use of SMIS in teacher education programme by distance learning. This paradigm choice was based on the fact that the empirical approach in positivism allowed the study to establish the influence of availability of ICT Infrastructure on use of SMIS in teacher education programme by distance learning. It enabled hypotheses to be formulated and tested and for the findings to be generalized for the entire study population. The qualitative approach, on the other hand, allowed thematic analysis of descriptive information obtained mainly from the interview guide and parts of the questionnaire.

This study employed a cross-sectional survey research design to gather data from a sample of respondents in selected universities in Kenya that use student management information system in teacher education programme by distance learning. The design allowed the researcher to establish whether there was a significant influence of the independent variable on the dependent variable. This approach has been employed in numerous studies such as by Omito (2016) and Omallah, Maina and Wamalwa (2016).

The target population comprised a total of 9,936 lecturers, system administrators, second and third year students drawn from three (3) purposively selected universities in Kenya that were certified by the Commission for University Education (CUE, 2018). They comprised the University of Nairobi which had a population of 4,697, Maseno University with a population of 3,399 and Mount Kenya University with a population of 1,840. According to the Commission for University Education, there was a total of 46 public and private chartered universities in Kenya by 2018 (CUE, 2018). Out of these, only three (3) universities qualified for this study. The sample size of this study was 445 respondents drawn from the target population of 9,936 respondents and was divided into various strata.

In order to obtain representative samples from the respondents for this study, purposive and random sampling techniques were used. Purposive sampling was used to select second and third year students from the three universities because they were at an active stage of their studies where they were neither too new to the university systems and operations, nor were they predisposed to taking matters for granted. Once this category of students was selected, random sampling was applied to draw 147 from the University of Nairobi, 139 from Maseno University and 132 from Mt. Kenya University. Random sampling was also used to select lecturers of the teacher education programme by distance learning such that 10 were drawn from the University of Nairobi, 7 from Maseno University and 4 from Mt. Kenya University. In the same way, purposive sampling was used to select 2 SMIS administrators from each of the three Universities.

Primary data was collected by use of structured questionnaires made of closed ended questions, focus group discussion and key informant interviews. Secondary data was obtained from books, theses, journals, and reports pertinent to student management information systems and teacher education programme by distance learning.

3. Analysis of Findings

A total of 442 questionnaires out of 446 were completed and returned, resulting in a response rate of 99 per cent which was deemed adequate. The objective of this study was to establish the extent to which availability of ICT infrastructure influences the use of SMIS in teacher education programme by distance learning in selected universities in Kenya. In this regard, the respondents were asked whether they owned a computer and the responses are shown in Table 1 where 280 (63.3%) students did not own any computers. This implied that the teacher education programme by distance learning students relied entirely on other ICT devices like smart phones, iPad, tablets, or media to be able to obtain the institutional information. Only 156 (35.3%) respondents said they own a computer. This clearly demonstrated that a percentage of the students were disadvantaged and this had a negative impact on the use of SMIS. Specifically, students from the rural areas may be demotivated from participating in teacher education programmes by distance learning for this reason.

Table 1: Possession of computers (n=442)

Possession of computers	Frequency (f)	Percent (%)
Yes	156	35.3
No	280	63.3
Total	436	98.6
Missing System	6	1.4
Total	**442**	**100.0**

According to Noor-Ul-Amin (2013), ICTs have the potential to innovate, accelerate, enrich, and deepen skills, motivate and engage students, help relate school experience to work practices, create economic viability for tomorrow's teachers, strengthen teaching, and assist schools in changing their methods of delivery. To facilitate learning, various forms of ICT, including smart phones, were used. This goes a long way toward compensating for limited internet capability in some remote areas of Kenya, while also allowing students to continue with their higher education without disrupting their work or family life.

The respondents were further asked to state whether they have smart phones with internet access. Seventy five point eight per cent (75.8%) agreed that they had a smart phone that they could use to access the internet, while only 24.2 per cent did not. This implies that the respondents have access to important communication that can improve their learning.

The learners were further asked to state whether computers at their educational institutions were networked. Cross-tabulation was performed on the responses to determine whether computers at the various learning institutions were networked and whether a system administrator managed the networked computers and/or assisted with troubleshooting. Table 2 shows that majority of the computers at the institutions of learning were networked (51.3%), while the remaining 48.7 per cent were not. Fifty three per cent (53.6%) of respondents reported having a systems administrator who assisted with computer management, while 46.4 per cent had none. According to the findings, majority of computers at higher education institutions were networked, though a significant number were not. Educational institutions are expected to have operational ICT infrastructure, with fully networked systems.

Table 2: Networking of computers in Educational Institutions (n=442)

		Computer Networked		Total
		Yes	No	
Does systems administrator manage the networked computers and/or help with trouble shooting	Yes	38.9	14.7	53.6
	No	12.4	34.0	46.4
Total		**51.3**	**48.7**	**100.0**

According to Tusubira (2005) and Getao and Wausi (2009), any modern institution of higher learning is critically dependent on the smooth operation of new innovations in student management information system, and hence ICT facilities put in place can result in effective communication. Having a systems administrator also ensures that computers are maintained and that problems are identified early on, resulting in the smooth operation of the various students information systems.

4. Hypothesis test on availability of ICT infrastructure

In order to establish the level of association between the independent and the dependent variables the null hypothesis of the study was tested using chi square test of independence ($\chi 2$). The hypothesis was stated as:

H_0: Availability of ICT infrastructure is independent of the use of student management information systems

H_1: Availability of ICT infrastructure is not independent of the use of student management information systems

The level of significance was set at $\alpha=0.05$.

Results of the test are presented in Table 3

Table 3: Chi-square test on association between Availability of ICT infrastructure and Use of SMIS (n=442)

	Value	Df	Assymp.Sig(2sided)
Pearson Chi-Square	62.609[a]	4	0.000
Likelihood Ratio	69.294	4	0.000
Linear-by-Linear Association	55.208	1	0.000
n of Valid Cases	442		

a. 0.cells (0.0%) have expected count less than 5. The minimum expected count is 25.50

Table 3 shows the chi-squire value for availability of ICT infrastructure where $\chi 2$ (4), n=442 =62.609, p=0.000, indicating a significant relationship between availability of ICT infrastructure and use of SMIS in teacher education programme by distance learning. The null hypothesis was rejected because the *p* value is less than 0.05, and the alternative hypothesis was accepted. As a result, the study concluded that availability of ICT infrastructure as an institutional factor has a significant influence on the use of SMIS in teacher education programme by distance learning in selected universities in Kenya.

The phi Crammer's V test was also performed in this study to assess the strength and direction of the relationship between availability of ICT infrastructure and use of SMIS in the teacher education programme by distance learning. The results are presented in Table 4

Table 4: Symmetric measures on availability of ICT infrastructure and (n=442)

			Approx. Sig.
Nominal by Nominal	Phi	0.379	0.000
	Crammer's V	0.379	0.000

n of Valid Cases	442

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

The results in Table 4 clearly demonstrate that phi=.379, indicating a medium to strong positive influence between availability of ICT infrastructure and use of SMIS in the teacher education.

The lecturers interviewed also reported that access to SMIS was limited, owing to the fact that the majority of the students came from rural and remote regions in Kenya where ICT infrastructure is poor or non-existent, making access to SMIS very difficult.

5. Discussion of Findings

The overall mean and standard deviation for availability of ICT Infrastructure was 4.40 and 0.304 respectively, implying that majority of the respondents had the view that availability of ICT infrastructure influences the use of Student Management Information systems. This is supported by Livingstone (2012), who contends that students who have access to a computer at home for educational purposes outperform their peers who do not have access to computers at home.

The overall Chi-square test results revealed that there was a significant relationship between availability of ICT infrastructure and use of Student Management Information systems (Chi-Square value = 62.609; P-value=0.000<0.05) leading to rejection of the null hypothesis that here is no significant relationship between availability of ICT Infrastructure and use of Student Management Information System and acceptance of the alternative hypothesis. Tusubira (2005) and Getao & Wausi (2009) concur that any modern institution of higher learning is critically dependent on the smooth operation of new innovations in student management information system, and hence ICT facilities put in place can result in effective communication.

This study would recommend that the money should be diverted to improve networked computer laboratories and increase ICT infrastructure so that access to SMIS, ICT skills and knowledge of

SMIS, could be enhanced for learners and tutors. The study also discovered that some learners do not use SMIS as much as they should due to distance and lack of ICT infrastructure. They could not really easily get access to computers in the rural areas. This is supported by Noor-Ul-Amin (2013), who contends that ICTs have the potential to innovate, accelerate, enrich, and deepen skills, motivate and engage students, help relate school experience to work practices, create economic viability for tomorrow's teachers, strengthen teaching, and assist schools in changing their methods of delivery.

6. Conclusion and Recommendations

The objective was to establish the influence of availability of ICT Infrastructure on the use of student management information system. It was established that there is a significant relationship between availability of ICT infrastructure and use of student management information system. It was, therefore concluded that availability of ICT infrastructure as a key factor in the use of SMIS among teacher education programmes by distance learners. Attention should be paid by SMIS stakeholders to its key indicators comprising internet connection, reliable power supply and ICT equipment.

It is recommended that mechanisms should be devised to provide ICT infrastructure to universities offering teacher education programme by distance learning, with training on the use of information technology, particularly computer systems which enables the learners and teachers to use SMIS and have access to other ICT resources in the form of materials, human capability and finances. The government can provide an enabling environment through favourable policies while private service providers can take advantage of the policies to establish and expand their services throughout the country. The Government should put in place a mechanism that eliminates frequent power disruptions that limit access and use of SMIS by ensuring that there is adequate technical support in all institutions of higher learning, including stand-by power generators. In addition, the government of Kenya should ensure that all primary schools in the country are connected to the national electricity grid. Universities should also partner with schools and other learning institutions situated in remote and rural regions where most of the distance learning students live or work, so that the students can use internet in those premises for free in order to access SMIS.

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