Internet Utilization: A Case of Connected Rural and Urban Secondary Schools in Kenya

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Abstract

This paper looks at the utilization of the Internet among teachers and students in connected rural and urban secondary schools in Kenya. A conceptual framework composed of variables which can explain Internet utilization in Kenyan secondary schools is established and measured. Instruments based on this framework were used in the survey and covered 11 schools with school principals, teachers and students as respondents. Findings show that use of the Internet and its integration in teaching and learning in secondary education is increasing with its use more pervasive among students and teachers as a means of communication and for information searching. Internet access rates for teachers and students have been observed to be much higher in educational institutions that have made effective ICT investments in education, translating into better utilization of ICT related technologies. Strategies are suggested on how to utilize the Internet to improve educational outcomes, and recommendations given on issues that touch on ICT access and infrastructure; human resources and training; policy environment; financing and ICT investment; curriculum development and locally relevant content.

Categories and Subject Descriptors: K.3.0 [Computing Milieux]: Computers and Education
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1. INTRODUCTION

There is lack of cross-country evidence on the utilization of Internet in different sectors of the economy in African countries. In some cases the evidence is non-existent due to recent developments, the rapid revolution of ICTs and methodological challenges that include a deficiency of assessment variables and models of causality. Attempts to measure or assess the utilization and impacts of ICT in Africa have

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been hampered by insufficient empirical data to indicate any impact of ICT on sector productivity. Most of the research and projects have tended to focus on information infrastructure issues, while few have been undertaken to measure the extent of Internet utilization as well as ICTs in Africa, particularly in education [Kenya SchoolNet, 2003].

In this paper, the concept Internet "utilization" is preferred as it considers the actual use of the Internet as compared to the availability of resources. Utilization of the Internet depends on the capacity to use the available services. Such capacity may be measured in terms of the number of years in experience one has using computers, the number of computer applications one has mastery over, as well as general levels of education and intelligence.

The conceptual framework was adapted from the National Research Council [National Research Council, 1998] and is based on the utilization of the Internet rather than its penetration and the resultant impacts. This adapted framework uses modified indicators and sub-indicators that have been derived from an e-readiness assessment tool originally developed by the Centre for International Development (CID) at Harvard University, and which was modified for use in assessing the e-readiness of higher education institutions in Kenya [Kashorda et al., 2007]. The tool organizes the assessment of numerous factors that determine the Networked Readiness of a community in the developing world. It makes use of the Networked Readiness Index (NRI) that measures not only the regulatory and national infrastructure but also usage by government, businesses and individuals. The indicators and sub-indicators are categorized into four domains: accessibility; usage; individual and society; and policy and strategy. The resulting framework is in the form of Internet supply and demand, in which impacts of the Internet can best be understood by measuring the extent of Internet usage. Indicators are then offered as tools to help measure the direct and indirect usage of Internet.

The use of ICT in education has the potential to enhance the quality of teaching and learning, the research productivity of the faculty and students, and the management and effectiveness of institutions [Kashorda et al., 2007]. However opportunities for realizing the benefits of using ICT in education face a number of challenges in the developing countries. Access to ICT facilities is a major challenge facing most African countries, with a ratio of one computer to 150 students against the ratio of 1:15 students in the developed countries. In Kenya, the ratio for universities and colleges is 1:45 while access at the primary school level is much more limited at 1:250 [Ministry of Education, Kenya, 2006]. The Education Management Information System (EMIS) survey of 2003/2004 indicated that over 70 per cent of the secondary schools in Kenya required functional telephones. Furthermore 90 per cent of such schools needed to establish Local Area Networks (LANs) in order to improve sharing of learning resources. As of 2008, there were 6,566 secondary schools in Kenya, of which 4,261 were publicly funded and the rest 2,305 privately funded with a total student enrolment of 1,382,211 and total teaching staff of 43,016 [Kenya National Bureau of Statistics , 2009].

With regard to the status of ICT in Kenyan secondary schools one of the earliest ICT projects in the education sector was implemented by the Aga Khan Foundation (AKF), which was responsible for introduction of computers in Kenya's secondary schools through the Computers in Education Project in Kenya (CEPAK) in 1983. The first phase began with the Aga Khan Academy receiving five computers and the necessary software from AKF [Makau & IDRC, 1990]. The second phase introduced computers to four public secondary schools in Nairobi. During the three year period of this second phase, the project was studied by an independent research team [Makau & IDRC, 1990]. This large-scale study on the use of computers in secondary schools in Kenya found that most computer-assisted lessons were observed to be in mathematics and the sciences. However, it was also found that in the majority of computer-assisted lessons teachers tended to be passive, thus leaving students to do whatever they chose. It found that some students regarded both formal and informal sessions on the computer as time for relaxation as opposed to serious learning. This approach to computer-assisted lessons was explained as being a result of the perception of the computer as an object of study; more exciting and potentially more rewarding than integration of the technology into the existing curriculum. The research also found that computer studies lessons were conducted in the computer laboratory, thus they seemed to have priority over computer-assisted lessons in other subjects. With regard to gender, female students were more disadvantaged than their male counterparts when exposure outside the school (i.e. at home or elsewhere) was considered. The proportion

of males that claimed to come from a home which owned a computer was nearly twice that of females, while 21% more boys than girls claimed to have used a computer outside school. In mixed schools surveyed female students claimed to have received less in-school exposure than the males.

A large scale study by SchoolNet in which 69 secondary schools responded found that only 46 per cent of the sampled schools had computers, with availability of Internet and facsimile rare in these schools [Kenya SchoolNet, 2003]. The findings also indicated that email was yet to be recognised as a tool for collaboration among students and teachers, and only one school had a website while another two reported having networked all their computers to the Internet. It went on to affirm that in these schools, access to the Internet was severely limited and when available was only for administrative use. The study found that almost 40% of schools had less than 10 computers, and therefore inadequate for teaching and learning. More than 20 per cent had less than 5 computers, indicating that the computers were mostly for administrative use. Only a third of schools studied had dedicated computer laboratories. The study also found that some schools were making use of very old equipment and there was dependency on donations of computers as opposed to sourcing locally. Similar to findings of the CEPAK study, the SchoolNet Kenya study revealed a significant difference in the quality and use of the computers in schools, depending on the gender of students there. Girls' schools were found to have the lowest numbers of computers, almost a third of that of boys' schools. Furthermore, there were fewer computers located in a computer laboratory in girls' schools, indicating their use predominantly in administration in girls' schools. The study concluded that fewer girls were being exposed to computers than boys. Consequently, the research concluded that girls would be marginal players in the emerging information society.

Another study by Pádraig Wims and Mark Lawler studied the implementation of ICT projects in selected educational institutions with a view to making recommendations on how such projects can be deployed and supported. The findings were from two secondary schools – St. Patrick's High School and Singore Girls' Secondary School – and an agriculture training college, Baraka Agricultural College. The findings reported that half of Keiyo District's 32 secondary schools had at least some computer equipment installed, with over half of these schools offering computer lessons to their students [Wims & Lawler, 2007]. The average number of computers in the schools that offered computer lessons was 15, the highest recorded being 21, and the lowest at 10. The ratios of students to computers in the institution surveyed were: St. Patrick's, 25:1; Singore, 32:1 and Baraka, 4:1. In St. Patrick's, the computer laboratory had 16 working computers, with an average of 1.5 students per computer. Singore had a laboratory of 10 computers, and an average class size of 15, or a ratio of 1.5 students per computer. In Baraka Agricultural College, students had access to a computer laboratory of 12 computers. Only 12 students attended classes at any given time, allowing for a ratio of 1:1. Of the institutions studied, it was only Baraka Agricultural College that was served by a fixed line. Though the institutions had email addresses, it seemed this was only available for administrative use. And as regards website, it was St. Patrick's and Baraka that had websites, with the former appearing not to be updated regularly. Funding for the deployment of the ICT infrastructure was locally for the secondary schools, with considerable donor support for the training college. It was found that half of the students surveyed in St. Patrick's had used a computer before joining the school; however the figure for the girls at Singore was much lower at 30 per cent.

These studies used different conceptual models to understand the extent of ICT utilization, and in turn inform on the benefits and impacts of ICTs in Kenya. There is very limited information available on the experiences of African learners, teachers and school managers on the use of ICTs. Very limited information is available too, on the supply chain of the ICTs in schools – the nature and extent of government ministry involvement, the involvement of the parent and residential communities in which the schools are located and the role of the private sector. While noting the underlying common theme of understanding the dynamics of supply and demand to explain the benefits of ICTs in education, often overlooked is the usage of such technologies that are likely to play a major role in determining the benefits and impacts being studies.

2. METHODOLOGY

The study was a cross sectional descriptive survey using quantitative approaches to data collection, analyses and reporting. A survey design was used to guide the research process and participants

were drawn from 11 secondary schools that were connected to the Internet, and were from rural and urban areas of Kenya. The study involved secondary schools from Nairobi and Rift Valley provinces.

The respondents were selected using the linear simple sampling approach and required the class register as sampling frame which was available in these schools.

Since there were no estimates available of the target population using the Internet in these schools, 50 per cent was used as recommended by Fisher [Fisher et.al, 1999].

The following equation was used to obtain the estimate (see equation 1 and 2).

$$n=Z^2pq/d^2 \qquad ...eq.1$$

Where:

n=the desired sample size (when population is greater than 10,000)
z=the standard normal deviate at the required confidence level, set at 1.96
p=the proportion in the target population estimated to have characteristics being measured. Since there is not available estimate, we will use 50 per cent (0.5)
q=1-p
d=the level of statistical set

$$n=1.96^2(0.5)(0.5)/(0.05)^2 \qquad ...eq.2$$

n=384

But since the entire population (N) is less than 10,000, the required sample size will be smaller. We got the final sample estimate (n_f) by using the following equation (see equation 3):

$$n_f=\frac{384}{1}+\frac{384}{1020}=385 \qquad ...eq.3$$

However a final sample of 752 (11.3%) students was randomly selected from the eleven schools with a student population of 6,681 to take into account the different categories of schools and Internet accessibility. Also selected for random sampling were 132 (28.2%) teachers respondents from of a total population of 468 teachers and all 11 (100%) principals from the 11 schools sampled. The response rates were 100% for principals (n=11), 74.2% for the teachers (n=98) and 91.9% for the students (n=691). There were 6,566 secondary schools (4,261 public and 2,305 private secondary schools), with student enrolment of 1,382,211 (635,698 girls and 746,513 boys) and 43,016 teachers employed (15,761 female teachers and 27,838 male teachers) as at 31 December 2008 [Kenya National Bureau of Statistics, 2009].

Table 1 Profile of the students and teachers

			Research Group	
			Frequency	%
Students	**Gender**	Female	469	67.9
		Male	222	32.1
	Form	Pre 1	16	2.3
		1	164	23.7
		2	167	24.2
		3	152	22.0
		4	143	20.7
		5	31	4.5
		6	18	2.6
	Area	Rural	280	40.5
		Urban	411	59.5
Teachers	**Gender**	Female	58	59.2
		Male	40	40.8
	Age	< 30 years	17	17.3
		30-40 years	57	58.2
		40-50 years	21	21.4
		50 years +	3	3.1
	Educational qualifications	Postgraduate	17	17.3
		Undergraduate	51	52
		Diploma	30	30.6
	Area	Rural	41	41.8
		Urban	57	58.2

Table 1 shows the profile of the students and teachers. Of the 11 schools sampled, 2 were girls' only; 6 boys' only and the remaining 3 mixed gender schools. Girls were the majority of the students sampled at 67.9% (469) with 32.1% (222) boys. Students from the rural based schools were 40.5% (280) compared to 59.5% (411) from urban based schools. Among the teachers in the research group 59.2% (58) were female and 40.8% (40) male. Majority of the teachers were in the 30-40 years age group with 58.2% (57) teachers. This was followed by 21.4% in the 40-50 years age group; 17.3% in the under 30 years age group and finally the least represented with 3.1% teachers in the 50 years + age group. Fifty two per cent teachers had an undergraduate degree as their highest educational qualification; followed by 30.6% with a diploma qualification and 17.3% with a postgraduate qualification.

Data was collected from the principals, teachers and students using an interviewer-administered standardized questionnaire measuring ICT indicators for each of the target populations in the secondary schools. The questionnaire used twelve indicators grouped into four domains as developed in the conceptual framework -accessibility; utilization; individuals and society; and policy and strategy. Information on the characteristics of the populations was collected. Other information collected included accessibility to ICT facilities, pattern of ICT and related facilities, level of skills in computer applications, and purposes and extent of use of the Internet.

3. FINDINGS

3.1 Accessibility

3.1.1 Internet Availability

Figure 1 shows that schools with access to the Internet for more than 40 hours in a month were 82% while another 18% reported less than 20 hours in a month of Internet access and this was attributed to non-networked computers in the school laboratories.

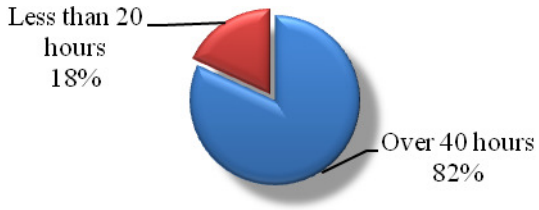

Figure 1 Hours in a month of Internet access among schools

Table 2 shows proportions of students with Internet accessibility at school. At school, 435 (63.7%) students had access to the Internet, with students from private schools having higher access rates compared to students from public schools as shown in Figure 2. However, there did not seem to be any significant difference when Internet access rates were compared between students from rural and urban based schools. However, when gender was considered, there were significant differences observed among girls from public and rural based schools who had lower access rates at 41.2% compared to boys from the same schools at 89.2%.

Table 2 Internet accessibility students at school (n=683)

Area	**Gender**	**Internet access**	**School category**		**Sub-Total**
			Private	**Public**	
Rural	**Male**	Yes	11 (73.3%)	58 (89.2%)	69 (86.3%)
		No	4 (26.7%)	7 (10.8%)	11 (13.8%)
		Sub-Total	**15 (100.0%)**	**65 (100.0%)**	**80 (100.0%)**
	Female	Yes	11 (73.3%)	75 (41.2%)	86 (43.7%)
		No	4 (26.7%)	107 (58.8%)	111(56.3%)
		Sub-Total	**15 (100.0%)**	**182 (100.0%)**	**197 (100.0%)**
Urban	**Male**	Yes	68 (100.0%)	36 (50.7%)	104 (74.8%)
		No	0 (0%)	35 (49.3%)	35 (25.2%)
		Sub-Total	**68 (100.0%)**	**71(100.0%)**	**139 (100.0%)**
	Female	Yes	57 (100.0%)	119 (56.7%)	176 (65.9%)
		No	0 (0.0%)	91 (43.3%)	91 (34.1%)
		Sub-Total	**57 (100.0%)**	**210 (100.0%)**	**267 (100.0%)**
		Total	**155 (22.7%)**	**528 (77.3%)**	**683 (100.0%0**
Internet access		**Yes**	435 (63.7%		
		No	248 (36.3%)		
Total			683 (100.0%)		
Internet access (Private schools)		**Yes**	147 (94.8%)		
		No	8 (5.2%)		
Total			155 (100.0%)		
Internet access (Public schools)		**Yes**	288 (67.3%)		
		No	240 (32.7%)		
Total			428		

(100.0%)

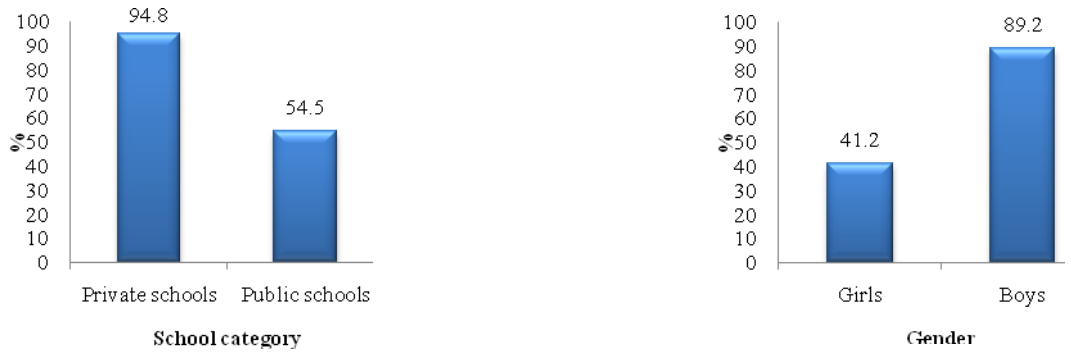

Figure 2 Students' Internet access rates

Similarly, Table 3 shows proportions of teachers with Internet access at school and home. Like the students, there did not seem to be any significant difference when Internet access rates were compared between teachers from rural and urban based schools. At schools, 96 (98%) teachers had access to the Internet while at home; only 23 (23.5%) teachers had access to the Internet access as shown in Figure 3. Teachers from urban-based schools had higher Internet access rates at home at 35.1%, compared to their counterparts from rural-based at only 8.8%.

Table 3 Internet accessibility for teachers at school and home (n=98)

	Area	Gender	Internet access	School category		Sub-Total
				Private	Public	
At school	**Rural**	**Male**	Yes	2 (100.0%)	11 (100.0%)	13 (100.0%)
			Sub-Total	**2 (100.0%)**	**11 (100.0%)**	**13 (100.0%)**
		Female	Yes	6 (100.0%)	21 (95.5%)	27 (96.4%)
			No	0 (0.0%)	1 (4.5%)	1 (3.6%)
			Sub-Total	**6 (100.0%)**	**22 (100.0%)**	**28 (100.0%)**
	Urban	**Male**	Yes	7 (100.0%)	19 (95.0%)	26 (96.3%)
			No	0 (0.0%)	1 (5.0%)	1 (3.7%)
			Sub-Total	**7 (100.0%)**	**20 (100.0%)**	**27 (100.0%)**
		Female	Yes	10 (100.0%)	20 (100.0%)	30 (100.0%)
			Sub-Total	**10 (100.0%)**	**20 (100.0%)**	**30 (100.0%)**
	At school		**Yes**	**96 (98.0%)**		
			No	**2 (2.0%)**		
			Total	**98 (100.0%)**		
At home	**Rural**	**Male**	Yes	0 (0.0%)	1 (10.0%)	1 (9.1%)
			No	2 (100.0%)	9 (90.00%)	11 (90.9%)
			Sub-Total	**2 (100.0%)**	**10 (100.0%)**	**12 (100.0%)**
		Female	Yes	2 (33.3%)	0 (0.0%)	2 (8.0%)

		No	4 (66.7%)	19 (100.0%)	23 (92.0%)
		Sub-Total	**6 (100.0%)**	**19 (100.0%)**	**25 (100.0%)**
Urban	**Male**	Yes	5 (71.4%)	4 (20.0%)	9 (33.3%)
		No	2 (28.6%)	16 (80.0%)	18 (66.7%)
		Sub-Total	**7 (100.0%)**	**20 (100.0%)**	**27 (100.0%)**
	Female	Yes	5 (50.0%)	6 (30.0%)	11 (36.7%)
		No	5 (50.0%)	14 (70.0%)	19 (63.3%)
		Sub-Total	**10 (100.0%)**	**20 (100.0%)**	**30 (100.0%)**
At home		**Yes**	**23 (23.5%)**		
		No	**71 (76.5%)**		
		Total	**98 (100.0%)**		
Rural schools		**Yes**	**3 (8.8%)**		
		No	**34 (91.2%)**		
		Total	**37 (100.0%)**		
Urban schools		**Yes**	**20 (35.1%)**		
		No	**37 (64.9%)**		
		Total	**57 (100.0%)**		

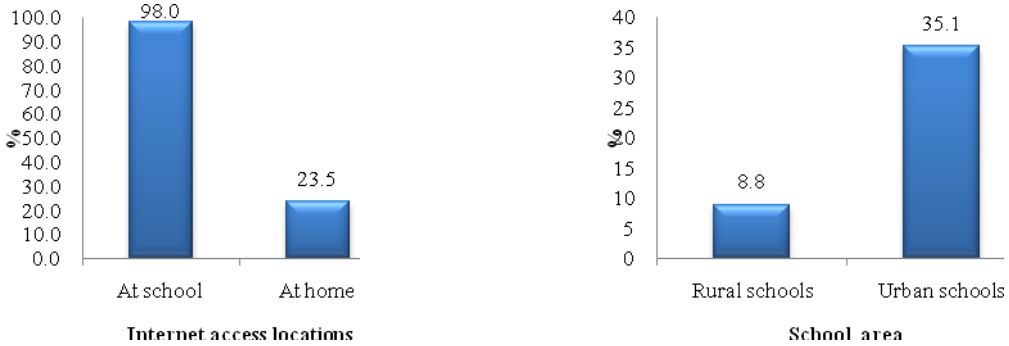

Figure 3 Teacher's Internet access rates

3.1.2 Internet Affordability and Financing

As can be seen from Table 4 all private schools and some public schools spent less than 5% of their annual expenditure on maintaining Internet connectivity, and schools which spent up to 20% of the school expenditure for the purpose were publicly funded. These schools were low cost and cited tuition fee as their main source of financing Internet connectivity.

Table 4 Proportion of costs on Internet connectivity on schools' annual total expenditure

Area	Proportion of Internet costs / Annual total expenditure	Category		Sub-Total
		Private	Public	
Rural	Less than 5%	1 (100.0%)	1 (25.0%)	2 (40.0%)
	5-10%	0 (0.0%)	1 (25.0%)	1 (20.0%)
	11-15%	0 (0.0%)	1 (25.0%)	1 (20.0%)
	16-20%	0 (0.0%)	1 (25.0%)	1 (20.0%)
	Sub-Total	**1 (100.0%)**	**4 (100.0%)**	**5 (100.0%)**
Urban	Less than 5%	2 (100.0%)	1 (25.0%)	3 (50.0%)
	5-10%	0 (0.0%)	1 (25.0%)	1 (16.7%)
	11-15%	0 (0.0%)	2 (50.0%)	2 (33.3%)
	Sub-Total	**2 (100.0%)**	**4 (100.0%)**	**6 (100.0%)**

The study also showed that all the schools relied on tuition fees paid by students to maintain Internet connectivity, and for some public schools this was a challenge as reflected in their spending proportions of the annual school expenditure due to the ceiling set on what they could collect from the students. As Table 5 illustrates, the schools were classified as low, medium or high cost based on the tuition fee collected.

Table 5 Classification of schools based on annual school fees charged

Classification of schools	Annual school fees range
Low cost	Less than Ksh. 50,000 (< USD 625)
Medium cost	Ksh. 50,000-150,000 (USD 625-1,875)
High cost	More than Ksh. 150,000 (USD 1,875 +)

However, private schools were able to install, equip and maintain better ICT facilities as compared to public schools due to the high fees they charged (which ranged from Ksh. 120,000-1,150,000 or US $ 1,500-14,375). Most of the public schools were reliant on donor support through non-governmental support initiatives such as Computers for Schools-Kenya (CfS-K) and NEPAD, with little or lack of financial support from the government to support the ICT initiatives in these schools.

3.2 Usage

3.2.1 Access to ICTs

All the schools' ICT facilities were available and accessible to both teachers and students. It was observed that private schools surveyed had purchased lap top computers for their teachers. Students to computer ratios were 5:1 in private schools and 20:1 in public schools, with average number of computers available for student use in both rural and urban based private schools being 60, and in both rural and urban based public schools being 40. These findings suggested that accessibility to ICT facilities at schools that are connected were much higher than those schools which are not connected to Internet [Ministry of Education, Science & Technology, 2005].

The findings of the study also suggested that there was a positive correlation between accessibilities proportions of teachers and students with access to computers as shown in Table 6 (a); and a

negative correlation among schools based on their rural and urban settings, and access to the Internet as shown in Table 6 (b), and below.

Table 6(a) Pearson correlation coefficient between students' and teachers' access to computers among schools

		Proportion of student with access to computers	**Proportion of teachers with access to computers**
Proportion of students with access to computers	Pearson Correlation	1	0.623(*)
	Sig. (2-tailed)	0.000	0.040
	N	11	11
Proportion of teachers with access to computers	Pearson Correlation	0.623(*)	1
	Sig. (2-tailed)	0.040	0.000
	N	11	11

* Correlation is significant at the 0.05 level (2-tailed)

Table 6(b) Pearson correlation coefficient between schools' area setting and students' access to Internet

		Area setting	**Access to Internet**
Area setting	Pearson Correlation	1	-0.133(**)
	Sig. (2-tailed)	.	0.001
	N	691	683
Access to Internet	Pearson Correlation	-0.133(**)	1
	Sig. (2-tailed)	0.001	.
	N	683	683

** Correlation is significant at the 0.01 level (2-tailed)

As found in previous studies [Makau & IDRC, 1990] accessibility to ICT facilities by students is still predominantly in the school laboratories, though this study has shown that private schools are installing ICT facilities in school libraries, teachers' lounges, dormitories and even in the school health centres. Overall, more than 75% of the students had access to ICT facilities and this is a departure from the previous studies that indicated low rates of accessibility [Kenya SchoolNet, 2003].

3.2.2 Enhancing Education with ICTs

Responses from the school principals showed high levels of ICT integration in subjects taught at the schools. Using a weighted usage index, the study suggested that ICT and its related components have been integrated into subjects such as ICT, Sciences, English, Mathematics and Music for teaching and learning as shown in Table 7. The most popular subject taught using ICTs are the ICT related subjects in both rural and urban based schools. Teachers from urban based schools appeared to place more emphasis on the humanities as compared to teachers from rural based schools with more emphasis on the sciences.

Table 7 Ranking of teachers' ICT usage index in subjects among schools

Area	**Classes or subjects**	**Usage Index**	**Variance**
Rural	ICT subjects	4.00	0.00

	Sciences	2.40	0.80
	English	2.20	1.20
	Mathematics	2.00	0.00
	Social sciences	1.80	2.20
	Art	1.20	1.20
	Music	1.00	1.50
Urban	ICT subjects	3.83	0.167
	Music	2.83	2.17
	Art	2.50	0.70
	Sciences	2.00	0.40
	English	2.00	1.20
	Mathematics	2.00	0.40
	Social sciences	1.67	1.07

The same observation was made as regards the purposes of Internet usage among teachers, with 75-87.5% of teachers from both rural and urban based schools indicating that Internet was most used for finding and accessing information as shown in Table 8. Unlike their counterparts from the rural schools, 79.3% of teachers from urban schools used Internet for communication as compared to only 60% of teachers from rural schools. Internet use for teaching and learning for specific subjects was the least cited use among teachers from rural schools. The findings thus demonstrate that among teachers surveyed there were differences on use of ICT in specific subjects, and on use of Internet based on whether the school was rural or urban based.

Table 8 Ranking of teachers' purposive index in descending order

Area	**Purpose of Internet usage**	**Purposive Index**	**Variance**
Rural	Finding/accessing information	3.00	0.50
	Learning enrichment or learning new things	2.80	1.20
	Communicating with others	2.40	0.80
	Regular instruction and training for developing computer skills	2.40	1.30
	As teaching/learning tool for specific subjects	2.20	1.70
Urban	Finding/accessing information	3.50	0.30
	Communicating with others	3.17	0.97
	As teaching/learning tool for specific subjects	2.67	1.07
	Learning enrichment or learning new things	2.60	1.80
	Regular instruction and training for developing computer skills	2.50	1.10

3.2.3 Developing the ICT Workforce

Table 9 shows that 44% of the teachers had more than 6 years of using computer, with 11% stating they had less than 1 year using computers. However, there was gender disparity especially among female teachers with more than 4 years of computer usage who were 52% as compared to male teachers who were 70% of their populations. The study also found that 55% of the teachers did not receive any ICT training prior to joining the teaching profession, but nevertheless noted that half of them had had training in the past 3 years. This is supported by the view from the school principals that over 75% of their teachers could be regarded as having basic ICT literacy skills.

Table 9 Years of computer usage among teachers

Area	Gender	Years using computers	Area Private	Public	Sub-Total
Rural	**Male**	< 1 yr	0 (0.0%)	1 (9.1%)	1 (7.7%)
		1-2 yrs	1 (50.0%)	1 (9.1%)	2 (15.4%)
		2-4 yrs	0 (0.0%)	1 (9.1%)	1 (7.7%)
		4-6 yrs	0 (0.0%)	5 (45.5%)	5 (38.5%)
		6 yrs +	1 (50.0%)	3 (27.3%)	4 (30.8%)
		Sub-Total	**2 (100.0%)**	**11 (100.0%)**	**13 (100.0%)**
	Female	< 1 yr	0 (0.0%)	4 (18.2%)	4 (14.3%)
		1-2 yrs	0 (0.0%)	7 (31.8%)	7 (25.0%)
		2-4 yrs	0 (0.0%)	5 (22.7%)	5 (17.9%)
		4-6 yrs	2 (33.3%)	2 (9.1%)	4 (14.3%)
		6 yrs +	4 (66.7%)	4 (18.2%)	8 (28.6%)
		Sub-Total	**6 (100.0%)**	**22 (100.0%)**	**28 (100.0%)**
Urban	**Male**	< 1 yr	0 (0.0%)	3 (15.0%)	3 (11.1%)
		1-2 yrs	0 (0.0%)	2 (10.0%)	2 (7.4%)
		2-4 yrs	0 (0. 0%)	3 (15.0%)	3 (11.1%)
		4-6 yrs	2 (28.6%)	1 (5.0%)	3 (11.1%)
		6 yrs +	5 (71.4%)	11 (55.0%)	16 (59.3%)
		Sub-Total	**7 (100.0%)**	**20 (100.0%)**	**27 (100.0%)**
	Female	< 1 yr	0 (0.0%)	3 (15.0%)	3 (10.0%)
		1-2 yrs	0 (0.0%)	2 (10.0%)	2 (6.7%)
		2-4 yrs	2 (20.0%)	5 (25.0%)	7 (23.3%)
		4-6 yrs	1 (10.0%)	2 (10.0%)	3 (10.0%)
		6 yrs +	7 (70.0%)	8 (40.0%)	15 (50.0%)
		Sub-Total	**10 (100.0%)**	**20 (100.0%)**	**30 100.0%)**

3.3 Individuals and Society

3.3.1 People and Organizations Online

Almost all the teachers (about 92%) in these connected schools had functional email addresses, with 64% of the students also indicating use of a functional email address as shown in Table 10. Interestingly 7.5% of the students said they had a personal webpage or blog, and references were made to social networking sites such as Facebook®. A high proportion of students (73%) said they owned a mobile phone, with 52% of these students using the mobile phones for accessing Internet and sending and receiving emails.

Table 10 Student's ownership-mobile phones, email addresses and personal websites

Area	Do you:	Do you own a mobile phone?		Do you have an email address?		Do you have a personal webpage	
		Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Rural	**Yes**	203	72.4%	158	56.4%	24	8.6%

	No	77	27.6%	122	43.6%	256	91.4%
Urban	**Yes**	297	72.3%	286	69.6%	28	6.8%
	No	114	27.7%	125	30.4%	383	93.2%

3.3.2 Locally Relevant Content

The findings of the study suggest that there were low proportions of teachers (18.4%) with access to local web-based training programmes, and 24.5% of teachers with access to local web portals. This is attributed to the lack of locally relevant material online especially for ICT related courses and which is also reflected in the approved school curricula for ICT courses.

3.4 Policy, Strategy and Financing

3.4.1 ICT Strategy

About 64% of the schools had an ICT code of conduct to regulate use of computers and Internet among their users. But it was observed that not all the schools had adopted the national ICT strategy implemented by the Ministry of Education in 2002 so as to guide the process of ICT integration into education.

4. DISCUSSION AND CONCLUSION

The objective of the study was to help policy makers, decision makers and investors to make well informed decisions about public policy and investments in ICT as regards education at the secondary school level by understanding how the Internet and its related components (and by extension ICT in general) are utilized. The study has shown the extent to which the Internet is being utilized and has identified the factors that enhances or impedes its utilization at secondary schools, and which can be used to explain the integration of Internet into the teaching and learning.

The findings of the study has shown that use of Internet and its integration in the teaching and learning in secondary education is getting more widespread; and its use more pervasive students and teachers as a means of communication and for information searching being common. Access rates for teachers and students have been observed to be much higher in educational institutions that have made effective ICT investments in education, translating into better utilization of ICT related technologies with assumed positive impacts which another study can attempt to measure by better understanding the linkages between utilization of the Internet and its impacts in education.

The study also found that most of the schools are actually expending a substantial part of their annual budget on maintaining Internet connectivity, and this explains why it is estimated by the Ministry of Education that only 3% of the 6,566 secondary schools in Kenya have any form of Internet connectivity. But this could change with the enhancement of the competition regulatory framework as well as operationalization of the National Fibre Optic cable through the East African Submarine System (EASSY) project expected to boost Internet penetration and bring the cost of Internet connectivity down in the third quarter of 2009, with subsidized costs of USD 10 per megabyte being envisaged for educational, health and research institutions.

It was also found that there was a positive correlation between proportions of students and teachers accessing the schools' computers, and this was evident in girls only schools where it appeared that investments in ICT was low and resulting in gender disparity disadvantaging the girl child. This does not portend good news for the girls in the secondary schools, considering that there are 635,698 girls enrolled, constituting 46% of the country's 1,382,211 total student enrolment in secondary schools [Kenya National Bureau of Statistics , 2009]. Though the study focussed on schools with Internet connectivity, the proportion of teachers with access to computers and internet at schools and homes was respectively 98% and 53% of the teachers sampled, implying that the affordable bundle rates and increased access to the mobile wireless broadband services is having an impact. According to the Communications Commission of Kenya (CCK) there were 392,964 mobile broadband users as at 31 December 2008 [Communications Commission of Kenya, 2009]. Some of the schools sampled are addressing the issue of accessibility to computers by teachers and students through use of Wi-Fi in the school localities. This is also reflected at the proportion of teachers and students with email addresses which are at 92% and 64% respectively, with

72% of the students owning mobile phones. Related to this findings, it has always been assumed that the most common place for students to access the computers has been the computer laboratories, though it appears that some schools, especially privately sponsored schools are focussing on the libraries with the intention of extending traditional libraries services to support digital resources.

The study also found that majority of the teachers did not receive ICT training at the teachers' training colleges or universities where they trained, with 55% getting into the teaching profession with no experience of computers and its related technologies. But it is reassuring to note that 51% of the teachers indicated that they have undergone ICT training in the past 3 years, with some schools supporting the training programmes.

The study also investigated use of ICT and the Internet in schools, and like the study conducted in Malaysia on extent of ICT adoption among secondary school teachers [Lau & Sim, 2008] the findings suggest most of the teachers are positive with uses of the Internet, and appreciate the use of ICT in enhancing teaching and learning. The findings also showed that there is integration of ICT in classroom teaching.

The levels of ICT literacy skills were found to high in both students and teachers than was expected in the schools with Internet connectivity. The index levels that were computed for the expertise levels in the most commonly used software applications also supported this finding, and the same was noted for the purpose of Internet in the school work among students with weighted ratings of above 75%.

Thus it can be concluded that use of ICT and its related technologies is still at its early stages of its development and implementation. There is also use of inadequate and divergent curricula in secondary schools depending on the system of education and which was not responsive to the fast changing ICT landscape, for instance, like examining students in open source software like Ubuntu®. Though it is worth noting that in some instances there is evidence of development of e-content with the relevant local material content by the Kenya Institute of Education (KIE) in use for the Form 1s and 2s students.

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