Challenges in the Implementation of ICT in Public Secondary Schools in Kenya

By

Laaria Mingaine
School of Management, Shanghai University, 99 Shangda Road, Shanghai, China,

Abstract

Implementation of ICT in schools in Kenya is a recent activity that has elicited a lot of interest. However, there are many challenges that hamper efficient implementation including cost of infrastructure, electricity, teachers' skills and leadership. This study explored how these challenges influenced its implementation. A descriptive survey research design was adopted. Out of 350 public secondary schools in Meru County, 105 (30%) were sampled for the study. A total of 315 respondents were sampled through stratified and simple random sampling. Questionnaires were used as main instruments for data collection. Validity of the questionnaires was ensured through judgment of experts, while reliability was established through test and re-tests method during pilot study. Out of 315 questionnaires distributed, 220 (69.8%) were properly filled and returned. Data analysis employed both inferential and descriptive statistical techniques after which the results were presented in tables supported by some discussions. The result of study indicated that limited supply of qualified teachers and high cost of infrastructure were impediments to implementation of ICT. Generally, power supply was not an impediment, while school leadership supported ICT. The cost of infrastructure should be reduced by adopting measures such as locally assembling as well as exploiting alternative technologies to avoid reliance on imported one. Qualified teachers with ICT skills should be employed and in-service courses design to train the ones already in profession.

Keywords: Cost, electricity, skills, leadership, ICT, schools, Kenya

1. Introduction

Since the 1980s implementation of ICT in schools has been compulsory in the developed nations. This is not so in developing nations such as Kenya, where implementation is considerably more recent, small-scale and experimental. It is however, universally acknowledged that implementation of ICT in schools has progressed in nearly identical pattern, from formulation of policies, attainment of basic computer skills, computer aided teaching and learning, communications and research, to usage in every subject.

The government of Kenya recognizes implementation of ICT in secondary schools will contribute to knowledge production, information and communication sharing among the school community. This view stems from assertions in the literature regarding the importance of ICT in schools (Manduku, Kosgey &sang, 2010,). The government through sessional paper no. 1 of 2005 noted that ICT has a direct role to play in schools and if used properly, it can bring many benefits to school as well as to the community. It was noted that ICT will present new opportunities for teaching and learning by providing opportunities for teacher-to-learners, teacher-to-teacher and learner-to-learner communication and cooperation, enhanced opportunities for several technologies delivered by teachers, creating superior keenness for learning among students and presenting access to a wider variety of courses (GOK, 2005).

To this end, the government formulated national ICT policy on education in 2006 with a vision "A prosperous ICT-driven Kenya society" and mission "To improve the livelihood of Kenyans by ensuring the availability of efficient, accessible, reliable and affordable ICT services" (GOK, 2006). The policy highlighted that the government will encourage implementation and use of ICT by schools in order to improve quality of teaching and learning. Key highlights in the policy on ICT in secondary schools were:
- Provide affordable ICT infrastructure to facilitate dissemination of knowledge and skills through e-learning platform;

- Promote the development of integrated e-learning curriculum to support ICT in schools;
- Promote the establishment of a National ICT centre of excellence;
- Promote the development of content to address educational needs of secondary schools;
- Create awareness of opportunities offered by ICT as an educational tool to education sector;
- Facilitate sharing of ICT resources between schools;
- Integrate ICT infrastructure with other existing infrastructure in schools and;
- Exploit ICT opportunities to offer Kenyan education programs for export

According to Farrell (2007) the government of Kenya placed considerable emphasis on the importance of ICT in schools. The Ministry of Education has taken steps to support the implementation of the strategy either by direct actions or through the various organizations and agencies it works with. There are also other institutions and organizations that continue to be active in implementing and supporting projects involving ICT in public secondary schools.

A study by Kwake & Adigun, (2008) observed that the government was working towards establishing a master plan for e-government and e-commerce strategies to make public administration efficient, transparent and more democratic. The study noted that the government planned to spend US $5.84 billion (Ksh.497.25 billion) by 2015 on connecting rural areas with electricity and fixed telephone lines. These efforts are made in order to make ICT accessible to large population in rural areas and to extension schools.

Implementation of ICT in schools has remained elusive since most of them are not connected to electricity grid, has no capacity to buy the required infrastructure, and has school leaders and teachers who are either computer illiterate or technology ignorant, though the current global technology changes puts emphasis on digitalization and modernization of all sectors including schools. Despite the apparent benefits of the use of ICT in schools, research shows that many schools are not implementing it, thus depriving learners and the school community from accessing the potential of ICT (Manduku et al, 2010). It is with this background that study on challenges in the implementation of ICT in public secondary schools in Meru County was conceptualized.

Statement of the problem: Research shows that ICT plays a leading role in promoting the economy of a country. Studies have shown that the rapid development of economies in countries like China, Brazil, India, Russia and other developed economies can be attributed to the impacts of ICT. Kenya vision 2030, which was formulated to make Kenya a middle-level economy by lowering cost of doing business, improving security and providing Kenyans with a friendly working environment, recognized this, by placing implementation of ICT in schools at center of achieving the vision (GOK, 2007).

While other countries have achieved over 41% implementation of ICT in secondary schools, the percentage in Kenyan schools remains very small (Laaria, 2013). ICT is important in school because it performs various school functions such as; record keeping, research work, instructional uses like PowerPoint presentations, financial analysis, examination results analysis, communication, supervision and general school management functions.

To successfully implement ICT in schools, access to good quality electricity is a primordial provision. Secondly, equipping school with relevant infrastructure like building, retrofitting physical facilities, purchases of hardware and software and the like must be considered. Thirdly, professional development of teachers through in-service courses should be well planned. Lastly, school leaders should have interest, committed and champion the implementation. To achieve this, the government has partnered with private sector and other stakeholders in the process of implementing ICT in schools. Further, the Ministry of Education has been conducting in-service courses to equip teachers and school leaders with necessary ICT skills.

Despite the importance of ICT in schools and the strategies developed by the government and other stakeholders, as formulated in sessional paper no. 1 of 2005, research has revealed that several schools were not efficiently implementing ICT to support teaching, learning and management in school. Manduku et al (2010) observed that despite the benefits of ICT, the school management had not fully implemented the policies developed by the Ministry of Education. Laaria, (2013) assert that some schools had developed guidelines on how to implement ICT but no attempt was made to implement them. This prompted an investigation of challenges that hindered efficient implementation of ICT in public secondary schools in Meru County.

Purpose of the study: This study sought to explore the challenges that hindered sustainable implementation of Information Communication Technology (ICT) in public secondary schools in Meru County, Kenya.

Objectives of the study: This study was guided by the following four objectives;
1. To investigate whether cost is a hindrance to implementation of ICT in schools
2. To establish whether availability of electricity influenced implementation of ICT
3. To establish whether teachers' skills available had impacts in the implementation of ICT
4. To establish whether school leadership influenced implementation of ICT

Significance of the study: The results of the study will be expected to provide a framework and process which will assist school managers in implementation of ICT in schools. The government officials in various ministries will find the results beneficial in making policies that will assist Kenya to meet her goal of being an ICT compliant state by the year 2030, through effective allocation of resources. The results are expected to guide donors in identifying the critical areas to support regarding ICT. The study findings are expected to open areas for further research to academicians and research institutes and overall, the community will benefit from a knowledge based society.

Scope of the study: This study was carried out in Meru County in Kenya. The study confined itself on challenges faced during implementation of ICT in public secondary schools, that is, cost of ICT tools, availability of electricity, school leadership and teachers' skills in the sampled schools. The study was concerned with the views of BOG chairpersons, Head teachers, and ICT/curriculum teachers. The findings of the study are expected to replicate what is happening in all Public Secondary Schools in Kenya as they operate within the same guidelines lay down by Ministry of Education.

2. Benefits of implementing ICT in schools

Several studies in the last two decades confirm the positive effects that ICT have on teaching and learning in schools. According to Peeraer, & Petergem, (2011) ICT benefits schools in several ways: (i) enhancing learning in classroom (ii) improves management of school (for example, it helps in timetabling, record storage, secretarial work like, typing staff meeting minutes, examinations and letters) (iii) improves accountability, efficiency and effectiveness in school activities. (iv) use of PowerPoint presentations and internet. Hennessey (2010) takes a cautionary view by stating that putting ICT infrastructure in school does not itself create stimulating new learning environment that are about shifting the culture of classroom teaching and the ethos of schools.

By implementing ICT, schools can present high quality teaching and learning. Keengwe, & Onchwari, (2011) identifies four different ways schools can offer quality education supported by ICT: real time conversation, learning by doing, directed instruction and delayed time conversation. Higgins, & Moseley, (2011) observed use of ICT could improve teaching, learning, performance and management, improves impact on school as a whole, and develop significant skills in the marginalized communities (hence helping in liberation and their transformation). EFA Global monitoring Report, (2012) observed that use of ICT could help in achieving 'Education For All' (EFA) goals. The report recommends that ICT should

be harnessed to sustain EFA goals at affordable cost. The report went further to note that these technologies have great potential for effective learning, knowledge and development of more efficient school services.

According to Hennessy, (2010) ICT should be used as a tool to support school objectives like cooperation in school, problem solving, communication, developing skills, assessing and searching information- which are essential in preparation of students for knowledge society. A study by Higgins, & Moseley, (2011) found that teachers who use ICT in classroom perceived it as useful for personal work and for teaching and were prepared to continue using it due to its usefulness. Some of usefulness of ICT by teachers this study found were: making teaching more interesting, easier, and more diverse, more fun for them and students, more enjoyable and motivating to students. Additional personal usefulness were found to be: allowing larger access to computer for personal use, improving presentation of materials in class, giving more prestige to teachers, giving more power to teachers in school, providing professional support through the internet and making management in school more efficient and effective.

Literature shows that if ICT is well-utilized in schools it has a potential to enhance the teaching and learning process in many ways, such as engaging students in learning since it is generally learner centered. Research shows that students are motivated when learning activities are challenging, authentic, multi-sensorial and multi-disciplinary. Dzidonu, (2010) established that students report higher attendance, motivation and academic accomplishment as a result of ICT programs.

To address the challenge of high school drop-out rates experienced in sub-Sahara Africa, ICT can be used to make school curriculum more interesting. Studies have established that children enjoy learning using technology. This motivation may discourage students from dropping out of school. Rebecca, & Marshall, (2012) described how using internet in school for street children in Colombia enticed a higher than usual number back to classroom.

Research show that ICT if fully utilized can reduce the cost of education and increase efficiency. Aguyo (2010) point out that ICT in school can be viewed as a cost effective especially in terms of manpower as one teacher can reach many learners through internet, interactive white board and video conference technologies. Parents are also spared the agony of buying many textbooks because many of them would be available online. Study and teaching materials are very sparse in many schools in developing countries; ICTs can play a significant role in providing teachers and students with access to educational content and up to date resources. The usage of ICT by students helps develop future workforce that can effectively participate in the increasingly networked world and the emerging knowledge economy.

3. Hypothesis supporting ICT implementation in schools

H1. Effective school leadership has a positive influence in the implementation of ICT in schools
Effective leadership is important in coordinating and supporting ICT implementation in school. As key leaders of school transformation, school leaders can facilitate and support the idea of implementing ICT in their school. To achieve this, school leaders need to appreciate that, the idea to implement ICT is not only about ICT use, but also about transformation of learning, teaching and management of their schools (Laaria, 2012).

By being role model in ICT use, visionary, planners and custodian of ICT infrastructure, school leaders should be committed, champion and have interest in the implementation of ICT in their school. They should lead transformation of the school through being passionate, active and enthusiastic (Laaria, 2012). They should be involved, concerned and supervise the whole process, through promoting staff professional development, sharing decision making with other teachers, delegating responsibilities and maintaining clear vision of the school. To be able to lead the implementation, they should be dedicated to

performance, creative thinker, people centered, maintenance of professionalism and standard in the school.

Laaria, (2012) argue that in many instances, school leaders supports implementation of the technology in their school through acquiring the needed infrastructure. However, very few, if any, used these facilities in significant way with students, therefore lacked necessary vision and knowledge to lead transformation of the school through implementation of ICT. The fear that the infrastructure can be damaged during the process of learning and teaching curtailed innovative exploit of the ICT potential by the school community. Implementation of ICT is becoming more essential to schools and success of such implementation is often due to existence of effective school leadership.

H2. Cost of ICT Infrastructure is a hindrance to implementation of ICT in schools
Despite a typical claim that investing in ICT is cost-effective, as well as the continuous decline in ICT prices, the entire cost of possession of ICT including software, hardware, upgrading, maintenance, development and acquiring right skills remains high. Investing in ICT for schools might be perceived as an additional cost, and supporting significant ICT implementation is a problem experienced by many schools in developing countries, mainly those that rely on donor support.

Farrell (2007) argues that high costs for acquisition and maintenance of ICT infrastructure is a challenge that has continued to hamper adoption and implementation of ICT in schools. Hennessy, (2010) observes that one of the greatest challenges in implementation of ICT in school is balancing educational goals with economic realities. Because implementing ICT requires large capital investments, schools need to be prudent in making decisions about what models of ICT will be implemented and be conscious of maintaining economies of scale. Ultimately it is an issue of whether the value added by implementing ICT offsets the cost, relative to the cost of alternatives.

Several researchers and authors have argued that lack of physical educational facilities, like buildings, is the major hindrance to implementation of ICT in schools in Africa, (Hennessy, 2010). ICTs do require supporting physical infrastructure to be in place before they can be implemented. However, for many schools in developing countries like Kenya, there is seldom free room and in some schools, no suitable building at all. For these schools, the implementation of ICTs often requires the construction of special ICT rooms (computer lab) which can be costly.

The implementation of ICT usually calls for the purchase of new, and sometimes, specialized furniture's. These furniture's are costly and most of schools cannot meet the expenses. The way forward is for schools to explore ways of providing these facilities through re-cycling the old and broken furniture's. This could be done by collecting old and broken desks and simply replace the worktops with cheap blocks of wood to transform to computer desks. This would prolong the life of the broken desks and reduce the costs of acquiring new furniture for ICT.

In many schools, access to internet service for more utilization of ICT for teaching and learning is particularly expensive. More to this is licensing fees charged to education software. While in some cases open-sourcing systems have been adopted, nearly 90% of education software in use in Kenya requires licensing and annual renewal at considerable high costs (Aguyo, 2010).

There are limited resources to equip schools with ICT infrastructure and this has been a barrier in implementation of ICT to support curriculum delivery. Standard software for use in schools for learning and administration are not widely available. The key challenge has been failure to customize or develop education software to meet the local education requirements in teaching, learning and administration.

H3. Availability of electricity has a positive influence in the implementation of ICT in schools

Access to good quality electricity is a primordial provision for implementation of ICT to schools. Research has shown that electrical energy is intrinsically linked to development and use of ICT in developing countries. Electricity is not only a main source and efficient energy, but also, a guarantor to the enhancement of quality of life (for cooking, heating, lighting, without smoke) as well as for better access of the population to necessary communal services such as health and education. It is also the answer to development of national industries and therefore powerfully impacts economic growth and employment in countries such as Kenya. The demand for electricity in schools is likely to increase, both as a result of increase in population and demands to implement ICT.

Since the introduction of rural electrification in Kenya, the government has extended electricity to many rural areas in the country. However, most schools are yet to be connected to National Electricity grid and those that are connected, often experience frequent and long electricity outages. This unreliability is also present in several urban centers, like Nairobi, where electricity frequently fails. Most of schools in informal settlements in cities are often not connected to electricity grid. It remains an increasing challenge for these schools to acquire and set in place available, secure and reliable electricity supplies, for implementing ICT and to put efforts in achieving sustainability.

Lack of other infrastructures like roads, constructions and transportation has barred the extension of power grid to remote rural schools. Even where these schools have access, actual power use is unreliable, especially if not accompanied by a generator. In such schools, the idea of implementing ICT will require more financial backing from the government and donors. In recent studies done in Kenya (Aguyo, 2010,) it is apparent that providing electricity is a major challenge to implementing ICT in schools.

This lack or unreliability of grid electricity is a serious impediment to the implementation of ICT in schools. Any plans to implement ICT in these schools should include a careful consideration of alternative power sources or power backup sources which mostly are expensive for schools. Alternative power sources such as solar panels, batteries and even hand or bicycle cranks can be used to provide power for small technologies like charging phones and laptops in schools. Rebecca & Marshall (2012) observed that in India, solar panels were used to power community computer terminals located in slum areas that were not connected to electricity grid.

H4. Teacher skills as a positive impact in implementation of ICT in schools
Teachers' ICT skills and access to professional development play a significant part in implementation of ICT in schools. Many studies show that if teachers view ICT programs are either satisfying their own needs or their students' needs, it is likely they would implement it in school. Research suggests teachers' attitudes, beliefs, adequacy, and skills influence successful implementation of ICT in schools (Hennessy 2010).

Unfortunately, in many African countries, lack of well trained teachers and low levels of teachers' ICT skill and knowledge has been recognized as major obstacle in implementation of ICT in schools (Dzidonu, 2010). For efficient implementation of ICT in schools, there should be adequate personnel that have correct skills. Where such skills are missing, it would be difficult to fully implement the technology in schools.

In Africa, rise in student population, lack of funding for teachers salaries due to growing poverty and the rising number of teachers affected by HIV/AID has complicated implementation of ICT in schools. Research shows that meeting the severe deficit of skilled, competent and qualified teachers is the most challenging factor affecting most schools in the continent (Hennessy, 2010).

To successfully implement ICT in schools, there should have comprehensive pre-service courses on ICT that equips teacher trainees with the required skills. A study by Higgins, & Moseley, (2011) revealed that inability of teachers to understand why they should implement ICT in teaching and how exactly to

implement was an impediment to its implementation. Unfortunately, many teachers' training institutions in Africa continue to teach more about what is ICT rather than teaching how to use it during teaching and learning in classroom.

In addition, in-service courses for subject teachers already in the professional should be developed that will guide them on how to use ICT during teaching and offer them basic skills needed for its implementation. Many authors believe that a continued professional development of teachers can help to successfully implement ICT in schools (Higgins, & Moseley, (2011), Dzidonu, 2010). A promising way forward should be a sustained professional development that draws on teachers local professional capabilities, supports reflective classroom performance, and encourages peer learning by teachers of same age group and similar subjects. Teachers need to become constant learners, while teaching and even learning from students.

Theoretical framework: This paper is informed by the Technology, Organization and Environment (TOE) model developed by Oliveira & Martins, (2011). This model emphasizes internal and external characteristics of organization as drivers for organizations adoption of technology. It includes environment context that presents both constraints and opportunities to organizations in implementation of technology. The model suggests those organization factors such as; formal and informal linking structures and communication processes within the organization determine readiness to adopt technology. Environment factors like technology support infrastructures and government regulations will determines the speed of technology uptake by organization. Further, technology availability and cost will have effects on the way technology is implemented by organizations as shown by figure 1.

Figure1. Technology, Organization and Environment model (TOE)
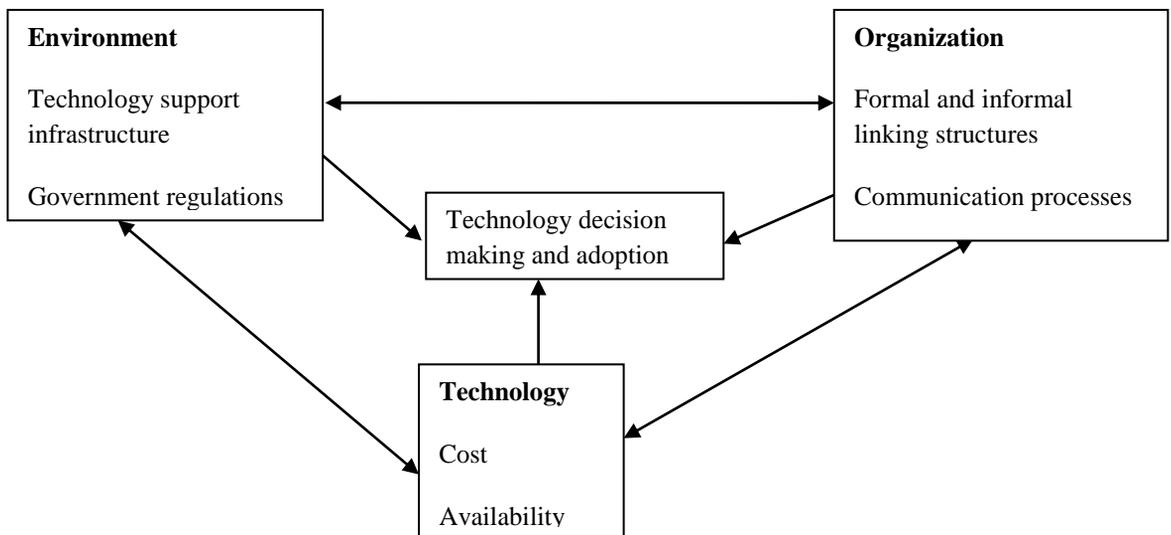
Source: Oliveira & Martins, (2011)

Conceptual framework: This paper adopted a conceptual framework important in identifying the factors that were behind implementation of ICT in schools. School leadership, cost of ICT infrastructure, availability of electricity and teachers skills available in school were identified as independent variables that determined the success of implementation of ICT in schools as shown in figure 2.

Figure2. Challenges in implementation of ICT in schools
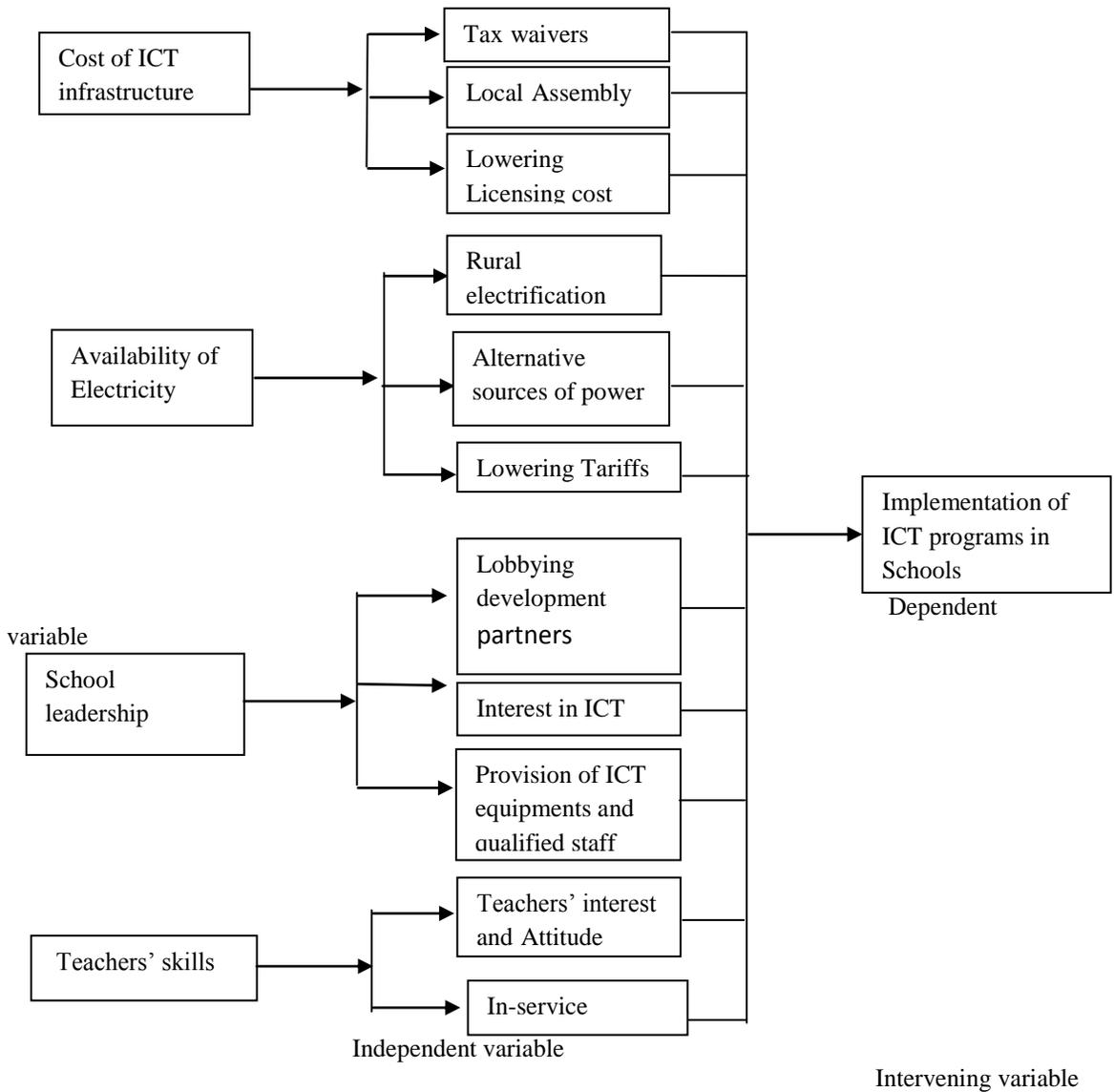
Source: Conceptualized by the researcher (2013)

This model shows relationship between the independent variables and dependent variable. The environment factors, technology support infrastructure and government regulations relate to cost of ICT infrastructure and availability of electricity. Organization factors, formal and informal linking structures and communication processes relates to school leadership and teachers skill available in school. These factors when put in place determine the school readiness to implement ICT.

4. Methodology

Orodho (2008) defines research methodology as the framework within which facts are placed so that meaning can be extracted from them. It gives the direction that a researcher must follow in order to get the answers to issues with which he or she is concerned. This study employed a survey research methodology. According to Mugenda (2003) survey research methodology is useful not only in securing

evidence concerning an existing situation or current conditions but also identifies standards or norms with which to compare present conditions in order to plan the next step. Mugenda (2003) notes that survey research methodology is intended to produce statistical information about aspects of education that interest policy makers and educators.

Target population: Orodho (2008) states that specification of the population, to which the inquiry was addressed, affected decisions that researchers make both about sampling and resources. The target population for this study consisted of all public secondary schools in Meru County. The County had 350 public secondary schools which were categorized as Boys schools, Girls schools and mixed day/boarding schools. In the three hundred and fifty schools there are 350 Head teachers, 350 BOG chairpersons and 350 ICT/curriculum teachers, making a target population of 1050.

Sampling procedures and sample size: Mugenda (2003) observed that researchers select a sample due to various limitations that may not allow researching the whole population. First, stratified random sampling method was used to select schools from each subgroup, and then simple random sampling method used to select schools from various strata. There were 56 mixed day/boarding schools, 28 girls' schools and 21 boys' schools making a total of 105 schools. All the head teachers, BOG chairpersons, ICT/curriculum teachers were included in the study. A total of three hundred fifteen respondents were sampled using the formula:

Target population = Number of schools in County × 3 (350 × 3 = 1050)

$$School\ sample\ size = \frac{Number\ of\ schools\ in\ the\ County \times 30}{100}$$

$$(105 = \frac{350 \times 30}{100})$$

Respondents Number = sample size × 3 (105 ×3 = 315)

Research instruments: Questionnaires were used as main instruments for data collection. According to Orodho (2008) questionnaires are extensively used to gather data on current conditions, practices, opinions and attitudes quickly and in a precise way. Mugenda (2003) argue questionnaires provide a cheap way of obtaining information from a large number of populations.

Validity and reliability of research instruments: Validity is the degree to which a test measures what is supposed to measure (Mugenda, 2003). Validity was ensured through judgment of experts in ICT, teaching, learning and research techniques. According to Orodho (2008), researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. Reliability is the degree to which a test consistently measure whatever it measures (Mugenda, 2003). Test and re-test method was used during pilot study to establish reliability of the instruments.

Data Analysis: According to Orodho (2008), data analysis involves carrying out some type of grouping of data collected, thereafter placing the data in common categories and computing a number or a percentage of each division. Data collected was analyzed quantitatively and qualitatively using descriptive and inferential statistics.

Response rate: In any research, starting response rate of respondents is important as it reflects the in-depth of data collected. Out of three hundred fifteen questionnaires distributed, two hundred twenty (69.8%) were properly filled and returned. The remaining ninety five (30.2%) were either partially filled or not returned and therefore were discarded during analysis. Mugenda (2003) argue that return of 50% and above is satisfactory for data analysis. Therefore, a return of two hundred twenty (69.8%) was considered acceptable for this study. Table 1 shows respondents' response rate.

Table 1 Respondents response data

Respondents	No.	%
ICT/curriculum teachers	92	41.8
Head teachers	84	38.2
BOG chairpersons	44	20.0
Total	220	100

As shown by table 1, response by ICT/curriculum teachers was highest followed by head teachers. This could be attributed to the fact that during data collection, research had a personal contact with them. Response by BOG chairpersons was lowest at 20.0%. This could be attributed to the fact that they do not run day-to-day activities in school. Head teachers were requested to e-mail/post the questionnaires to BOG chairpersons. In this case, some head teachers might have not e-mailed/posted or returned filled questionnaires from BOG chairpersons.

Gender of the Respondents: Research shows that there are disparities in education between genders, especially in Africa where more emphasis is put to boy-child than girl-child. EFA Global Monitoring Report (2012) indicates that girls face large obstacles to entering school than boys. Data collected showed that majority 150 (68.2%) of respondents were males while 70 (31.8%) were females. This indicated that most of school leaders and ICT/curriculum teachers in schools in Kenya were men. Further it revealed that most of teachers who were involved in ICT in schools were males than females. This agreed with observation by Jimoyiannis and Komis, (2007) that male teachers are more positive about ICT in school while female teachers are neutral or negative.

Age of respondents: Implementation of ICT in Kenya universities/colleges and school is moderately recent activity, therefore understanding age of respondents is importance in determining the challenges in its implementation. The data collected shows that majority of respondents were between 41-50 years, 92 (41.8%), followed by 31-40 years at 56 (25.5%). Age group 30 and below were 22 (10%) while over 50 years were 50 (22.7%). These data revealed that majority of ICT/curriculum teachers were below age of 41years indicating that the introduction of ICT studies to Kenyan universities/colleges is moderately recent activity and by extension to schools. Further analysis of age revealed that most head teachers were more than 45 years old, indicating that without in-service, they had no considerable ICT skills necessary in implementation of ICT in their schools.

Respondents stay in school: Duration of stay in school was important in explaining the experience gained. Many respondents had worked in the same school for a long period of time.180 (81.8%) had worked for more than 3 years, while 40 (18.2%) had worked for less than 3 years in the same school. This indicated that most had witnessed major changes that had occurred in school and they were in position to report on challenges in implementation of ICT in their school. Andoh, (2012) argue that quality of implementation of ICT in schools is linked to teachers experience.

Respondents' academic qualifications: Qualification of respondents is of interest as it reflects on their performance in school affairs. Most of the respondents were degree holders as illustrated by table 2.

Table2. Respondents' academic qualifications

Respondent	Master	%	Degree	%	Diploma	%	Others	%	Total	%
ICT/curriculum teachers	14	6.4	62	28.2	13	5.9	3	1.3	92	41.8
Head teachers	16	7.3	58	26.4	8	3.6	2	0.9	84	38.2
BOG chairpersons	8	3.6	13	5.9	14	6.4	9	4.1	44	20.0
Totals	38	17.3	133	60.5	35	15.9	14	6.3	220	100

5. Study findings and Discussion

Number of schools implementing ICT: From a sample of 105 schools understudy, 25 (23.8%) were implementing ICT in their school activities. It was found that these schools had adopted and used modern ICT related aspects in financial accounting analysis, internet, storage of student records, timetabling and PowerPoint presentations in classroom and meetings. The rest 80 (76.2%) were not implementing ICT. Few of these schools had one computer in secretary office which was used mainly for typing staff meeting minutes and letters. For schools implementing ICT, it was found that boarding schools had higher number than mixed day/boarding schools as shown by table 3.

Table3. Type of schools implementing ICT

School	No.	%
Boys	12	11.4
Girls	10	9.5
Mixed day/boarding	3	2.9
Total	25	23.8

The findings imply that boarding schools (boys and girls) had adopted modern ICT in their school activities as compared to mixed day/boarding schools. The findings were in agreement with a study by Manduku et al (2010) which established that more boarding secondary schools had embraced modern ICT as compared to day schools.

Challenges in implementing ICT in schools: T-test was used to give the difference of the means for each of the independent variable in relation to the dependent variable. It helped in determining those variables that were significant as shown in table 4.

Table4. Results of the t-test

Challenges experienced	Implementing Respondents No. =52	Not implementing Respondents No. =168
Number of staff who are ICT literate	7.43	2.17*
Problem of high cost of acquisition and maintenance of ICT equipment (1= Yes 2= No)	1.41	1.14**
Limited supply of qualified ICT teachers (1= Yes 2= No)	1.34	1.04**
Power supply problem (1= Yes 2= No)	2.00	1.66**
Commitment of school management to implementation of ICT (5 level)	4.58	3.77**
ICT teachers are fully trained (5 level)	3.72	2.64*
School management lobbying stakeholders to support ICT Programs in school (5 level)	4.65	3.76**
Administrators using ICT in making results Analysis, preparing payroll, etc (1=Yes 2= No)	1.02	1.34**

Key
* --- means 5% level of significance
** --- means 10% level of significance

Generally all the factors were significance at 10% level of significance and below, which means that there is a 10% chance that the relationship emerged randomly and a 90% chance that the relationship was real. From the t-test, variables that turned out to be significant are discussed as under:

Availability of electricity: The data for power supply sought to determine whether availability of power supply was a challenge facing implementation of ICT programs in schools. The measuring scale used was (1) for respondents who believed that power supply was a barrier to implementation of ICT and (2) for

respondents who felt that power supply was not a barrier to implementation of ICT programs in schools. From table 4, respondents in schools which were implementing ICT programs had a mean of (2.00) while the mean of respondents in schools which were not implementing the programs was 1.66, this tending towards (2). This give an indication that respondents in both categories were generally in agreement that power supply was not an impediment to ICT implementation in schools at 10% level of significance. The reason for this agreement may have been as a result of rural electrification program that the government was embarking on or schools having had an alternative source of power supply. This was found to be in line with figures from the Ministry of Education which indicated that 75% of the secondary schools in Kenya had a source of electrical power which could be from the grid lines or from generators and 25% of the primary schools had access to electrical power (GOK, 2010). If this was the case, then it meant that there was another impending factor other than the power supply.

However in schools which were not implementing ICT programs there were some respondents 34 (15.5%) who felt that limited power supply was a barrier to ICT implementation in schools. These schools were observed to be located on the semi-arid part of the county. This was in agreement with the sessional paper No. 1 of 2005 on policy framework for education training and research where it was indicated that among the challenges faced in the implementation of ICT in Kenya was limited rural electrification and frequent power disruptions. Given the situation of power shortages in rural areas, and the effect of power shortage on the usage of computers and other technologies in schools, the Governments should actively promote the usage of alternative sources of power, like solar power. This ecologically friendly solution will also ensure a steady power supply to schools in rural areas.

Cost of ICT infrastructure: The data for cost sought to establish whether high cost was an impediment to implementation of ICT programs in schools. From table 4, the measuring scale was (1) for respondents who felt that high cost of acquisition and maintenance of ICT equipments was a hindrance to implementation of ICT programs in schools and (2) for respondents who felt that cost was not a barrier to its implementation. The mean of responses in schools which were implementing ICT programs was 1.41 thus tending towards (1) implying that to them, high cost was a problem. On the other hand, the mean of responses in schools which were not implementing ICT programs was 1.14 thus tending towards (1) implying that high cost was a hindrance at 10% level of significance. This indicated that the two categories viewed cost a challenge in implementing ICT in schools.

Previous works had a bearing in this direction as sessional paper No. 1 of 2005 pointed out that high cost of ICT equipment, maintenance and internet services constrained adoption and integration of ICT in education. It also confirms observation made by Dzidonu (2010) that in most countries of Sub-Saharan Africa, inadequate technological infrastructure, such as lack of hardware, software and internet, limit individual and community access to ICT and also poses a barrier to its implementation in schools. In addition to the cost of infrastructure, other costs like electricity tariffs, import duties, software licensing, transportation of imported equipments adds to the cost thus making ICT unaffordable to many schools.

School leadership: The study also sought to find out whether school management was committed in the implementation of ICT. A five level Likert scale was used where (5) strongly agree (4) agree (3) undecided (2) disagree and (1) strongly disagree. As shown in table 4, in schools which were implementing ICT, the mean of responses was 4.58 which tended towards (5), that stood for strongly agree. In schools which were not implementing, the mean was 3.77 which tended towards (4) that stood for agree at 10% level of significance. These results imply the two categories of respondents agreed that school management was committed in implementing ICT.

Respondents were asked to state whether they felt school management was lobbing stakeholders to support ICT in schools. In a five level Likert scale, in schools which were implementing ICT the mean was 4.65 which tended towards (5) meaning they strongly agreed school management was lobbing stakeholders. In schools which were not implementing, the mean of responses stood at 3.76 which tended

towards (4) meaning they also agreed that the school management was lobbing for implementation of ICT in their schools. From these results, it can be argued that school management was actively lobbing stakeholders to support ICT in schools.

The respondents were further asked to give their opinion in regards to school management interest in implementing ICT in school through their use of ICTs in management tasks like results analysis, preparing payrolls, etc, responses were 1 for (Yes) and 2 for (No). In schools which were implementing ICT, the mean of responses was 1.02 which was approximately (1), while the mean of responses in schools which were not implementing was 1.34 at 10% level of significance. These results implied that school management had interest in using ICT in their management tasks. However, this contradicts views of authors (Manduku et al, 2010, Laaria, 2012) that school managers of public secondary schools in Kenya were not giving attention to the use of ICT hence allocating low operational budgets to its implementation.

Teacher skills available: In regards to teachers' skills, the study sought to determine the number of staff who was ICT literate. From table 4, the average number of teachers who were ICT literate in schools which were implementing ICT was 7.43 while in schools which were not implementing was 2.17 at 5% level of significance. This indicated that in schools which were implementing ICT had a higher number of staff qualified in ICT compared to schools which were not implementing. This agreed with observation that in schools which were implementing ICT had considerable ICT infrastructure, consequently teachers who were in those schools and not competent in ICT had a chance to train on.

 Respondents were asked to state whether limited supply of ICT qualified teachers was hindrance in implementation of ICT in school. From table 4, measuring scale (1) was for respondents who felt that limited supply of ICT qualified teachers was hindrance and (2) for those who felt that limited supply was not hindrance to its implementation. In schools which were implementing ICT, the mean of responses was 1.34 which was approximately (1). This meant to them, limited supply of ICT qualified teachers was hindrance. In schools which were not implementing ICT, the mean of responses was 1.04 which was approximately (1), indicating to them also limited supply of ICT qualified teachers was hindrance in implementation of ICT in schools at 5% level of significance. Limited number of teachers who were qualified in ICT use was found to be a challenge in implementation of ICT in schools. The findings are in agreement with Manduku et al, (2010) who asserted that majority of teachers in public secondary schools in Kenya had no skills and competencies needed in implementation of ICT in schools.

The study sought the views of respondents on whether ICT teachers were fully trained. On a five point Likert scale level, in schools implementing ICT, the mean of responses was 3.42 which were approximately (3). The mean of (3) meant that respondents were undecided as to whether ICT teachers were fully trained. In schools which were not implementing ICT, the mean of responses was 2.24 which was approximately (2) at 5% level of significance. The mean of (2) meant that respondents disagreed teachers were fully trained on use of ICT. The findings are in agreement with report by Ministry of Education, (GOK, 2010), that majority of teachers trained during school holidays through in-service courses and given the short period they were exposed to the training, few developed the required ICT skills. To effectively implement ICT in schools, teachers need to be well trained on how to use ICT in the process of teaching and learning. Where such skills are lacking, it would be difficult to fully implement ICT in schools.

6. Conclusions and Recommendations

The study found that high cost of acquisition and maintenance of ICT equipment was a barrier that had continued to constrain adoption and integration of ICT in schools in Kenya. This was in line with existing literature, Farrell (2007), where it was pointed out that transportation of imported equipments, tariffs charged for electricity added to the cost thus making ICT unaffordable to many schools. Access to

internet services for more utilization of computers in the learning process was particularly expensive for many schools.

The study, therefore, recommends that such costs should be reduced by adopting measures such as locally assembling education software as well as exploiting alternative technologies to avoid over reliance on costly imported software and hardware. Investments in custom-made digital materials with highly relevant content for Kenyan schools in rural and urban contexts are required. The Ministry of Education should take full responsibility for funding broadband internet connectivity in schools. Equally, the government should come in and subsidize ICT equipments that are used in schools. The government should consider waving import tax for ICT equipments for schools.

From the study, it was evident that generally, electricity supply was not a barrier to ICT implementation in schools. However, there were instances where respondents felt that limited supply of power was an impediment to ICT implementation. In such situations there was a likelihood of limited rural electrification or frequent power disruptions and this could slow down the pace of ICT implementation in schools. In this end it is recommended that such schools should be supplied with electrical power to enable them effectively harness the use of ICT in education and training. Alternative sources of power such as generators, solar technology and batteries should be explored in the absence of the electric power.

The school management recognized the benefits of implementing ICT in their schools. However, some of them did not prioritize ICT in school as evidenced by respondents who did not strongly agree management was supporting implementation of ICT through allocating adequate funds to its implementation. It is therefore recommended, apart from lobbying stakeholders support and waiting for their contributions, school managers should prioritize ICT through allocating enough funds for its implementation. They should consider applying basic ICT skills in management of their schools. Refresher courses should be arranged regularly for school managers in order to update them with new development in ICT and education in general.

Supply of qualified ICT teachers was found to be a major challenge in the process of implementing ICT in schools. Most of schools did not have enough staff competent in ICT and therefore were not able to effectively implement ICT. More ICT teachers should be employed and be trained on basics of ICT use in teaching and learning. In-service courses should be arranged regularly, to enable teachers acquire necessary ICT skills that are important in the process of teaching and learning.

References

Aguyo, S (2010), *Real cost of computer in schools: power up with information Technology* Archry Technology Management Ltd, Nairobi, Kenya.

Andoh, C. (2012) Factors influencing teachers' adoption and integration of Information Communication Technology into teaching: A review of the literature. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)* 8(1) 136-155

Dzidonu (2010), The role of ICTs to achieving the MDGs in education: An Analysis of the Case of African Countries, Accra Ghana.

EFA Global monitoring Report, (2012) *Youth and Skills: Putting education to work*, Paris France (UNESCO) **http://unesdoc.unesco.org/images/0021/002175/217509e.pdf**

Farrell G. (2007) ICT in education in Kenya http://www.infodev.org

GOK, (2010) *National ICT Policy*, Government printers, Nairobi, Kenya

GOK (2007) *National ICT strategy for Education and Training*, Government printer, Nairobi Kenya

GOK (2005) *Session Paper No.1 of 2005 on a policy Framework for Education, Training and Research*; Government printer, Nairobi Kenya

Hennessy S (2010) Developing the use of Information and Communication Technology to enhance teaching and learning in East African schools: Review of the Literature. Aga Khan University, Nairobi Kenya

Higgins, S. & Moseley, D. (2011) Teachers' thinking about ICT and learning: believes and outcomes. *Journal of Teacher Development* 5 (2) 191-210 http://dx.doi.org/10.1080/13664530100200138

Jimoyiannis, A. & Komis, v. (2007) Examining teachers' beliefs about ICT in education: implications of a teacher preparation program, Teacher Development, *An international journal of teachers' professional development*,11:2,149-173 http://dx.doi.org/10.1080/13664530701414779

Keengwe, J. & Onchwari, G. (2011) Computer Technology integration and student learning: Barriers and promise, *Journal of Science Education and Technology* 17(2011) 560-570 http://dx.doi.org/10.1007/s10956-   008-9123-5

Kwake, A. & Adigun, M. (2008) Analyzing ICT use and access amongst rural women in Kenya, *International Journal of education and Development using ICT* Vol.4 No.4 (2008)

Laaria, M. (2013) Leadership challenges in the implementation of ICT in public secondary schools, Kenya, *Journal of Education and Learning* Vol. 2 No. 1:2013 32-43 http://dx.doi.org/10.5539/jel.v2n1p32

Manduku, J, Kosgey, A. & Sang, H. (2012) Adoption and use of ICT in enhancing management of public secondary schools: A survey of Kesses zone secondary schools in Wareng District of Wasin Gishu County, Kenya

Mugenda, M. (2003), Research methods, African centre for Technology studies, Nairobi Kenya

Oliveira, T. & Martins, M. (2011) Literature Review of Information Technology Adoption models at firm level, *The electronic journal information systems evaluation* 1(14) 110-121

Orodho, J. A. (2008). *Techniques of writing Research Proposals and Reports in Education and Social Sciences*, second Edition, Maseno, Kanezja HP Enterprises.

Peeraer, J, & Petergem, P. (2011) ICT in teacher education in an emerging developing country: Vietnam's baseline situation at the start of the year of ICT. *Journal of Computers & Education* 56 (2011) 974-982   http://dx.doi.org/10.1016/j.compedu.2010.11.015

Rebecca, W. & Marshall, S. (2012) A new face of Education: Bring Technology into the classroom   in the developing world, *Global Economy and Development*, Brookings.