

**SUSTAINABLE IMPLEMENTATION OF INFORMATION
COMMUNICATION TECHNOLOGIES (ICTs) IN SECONDARY SCHOOLS
IN NAIROBI COUNTY, KENYA**

BY

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DECLARATION

Declaration by candidate

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DEDICATION

This thesis is dedicated to my loving family. This includes the late Mzee Gachara for his love for education, my husband Stanley Irura, our children Rachel , Keith, Mark and Catherine for their support, encouragement and patience during the entire period of my study and continued prayers towards successful completion of this course.

And to all those who supported me; I say: May God bless you all abundantly!

ABSTRACT

Although the Ministry of Education has developed the National ICT Strategy for Education and Training, there is insufficient well spelt out programmes to address the implementation of Information and Communication Technologies (ICTs) in the secondary school sector. The aim of this study was to investigate the level of ICTs implementation in secondary schools in Nairobi County in order to propose for sustainable implementation in secondary schools in Kenya. The objectives of the study were to: establish the human capital in the secondary schools; establish the level of infrastructure and the existing e-readiness supporting ICTs implementation in the secondary schools; assess the levels of ICTs application in administrative and instructional functions; examine the policy guidelines for ICTs implementation within the secondary schools and the Ministry of Education; analyse the challenges experienced in the implementation of ICTs; and, recommend measures for improvement and propose a model for sustainable implementation of ICTs in secondary schools. The study was informed by Diffusion of Innovations Theory (DoI) and Information Technology Assimilation Framework for Schools (ITAF). It employed mixed methods research design, and used multiple sampling methods including systematic, simple random and purposive sampling to select a sample size of 1,380 respondents. The respondents comprised school principals/head teachers, students, computer and subject teachers, and non-teaching staff such as the school bursar, secretary, technician and the librarian, drawn from forty four (44) public and private secondary schools in Nairobi County. Guided interview schedule, self-administered questionnaire, and observation methods were used for data collection. Descriptive statistics, such as computation of frequencies, percentages and means were used for closed ended questions. Qualitative data was analysed according to themes based on the objectives and research questions and discussions reported. Quantitative data was presented using frequency distribution tables and bar charts. Findings revealed that there is no uniformity in the adoption approach addressing ICTs needs and disparities in the secondary schools. The schools lacked programmes to address the implementation of ICTs. They were insufficiently prepared for ICTs integration, lacked digital content and standardized application programs. Teachers were not adequately trained to exploit the facilities to integrate ICTs into education. E-learning was found to be limited to computer-based training for KCSE examinations. The study recommends that the Ministry of Education, Science and Technology (MoEST) takes up a supervisory role, guidance and research in ICTs implementation as it is currently not well coordinated. Teacher training institutions need to introduce ICTs integration curriculum to assist new graduate teachers and in-service courses for practising teachers. The study has proposed a model to assist in the adoption and implementation of ICTs in secondary schools in Nairobi County.

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LIST OF ABBREVIATIONS AND ACRONYMS

AED	-	Academy for Educational Development
AISI	-	African Information Society Initiative
ASAL	-	Arid and Semi-Arid Lands
CAI	-	Computer Aided Instruction
CDLS	-	Computer Laboratory Design and Standards
CEMATSEA	-	Center for Mathematics, Science and Technology in East Africa
CSFK	-	Computers for Schools Kenya
EDC	-	Education Development Centre
EFA	-	Education for All
EPF	-	Education Policy Framework
EMIS	-	Educational Management Information System
EMS	-	Education Media Services
FPE	-	Free Primary Education
ICTs	-	Information Communication Technologies
IDRC	-	International Development Regional Cooperation
IRI	-	Interactive Radio Instruction
ISPs	-	Internet Service Providers
ITAF	-	Information Technology Assimilation Framework
KENET	-	Kenya Education Network
KESSP	-	Kenya Education Sector Support Programme
KIE	-	Kenya Institute of Education
KISE	-	Kenya Institute of Special Education
KNBS	-	Kenya National Bureau of Statistics

LAN	-	Local Area Network
MDGs	-	Millennium Development Goals
ME & MEST	-	Ministry of Education and the Ministry of Higher Education, Science and Technology
MOE	-	Ministry of Education
MOEST	-	Ministry of Science, Education and Technology
MOHEST	-	Ministry of Higher Education, Science and Technology
NEP	-	National Education Portal
NEPAD	-	New Partnerships for Africa Development
NICT	-	National Information and Communication Technology
PDA	-	Personal Digital Assistant
PPP	-	Public Private Partnerships
PTR	-	Pupil Teacher Ratios
STI	-	Science, Technology and Innovation
TIVET	-	Technical Industrial Vocational and Entrepreneurship Training
UPS	-	Uninterruptable Power Supply
VCR	-	Video Cassette Recorder
VSAT	-	Very Small Aperture Terminals
WAN	-	Wide Area Networks

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CHAPTER ONE

INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction

This Chapter contains the introduction to the study on sustainable implementation of ICTs in Nairobi County. The problem statement, aims and objectives of the study, the research questions informing the study, the significance of the study is discussed.

1.2 Background to the Study

Education is a core component of any kind of development, formal or informal (Waibochi, 2002, p. 4). It influences all sectors of the economy as a foundation of specialized skills and professions. The incorporation of Information and Communication Technologies (ICTs) into the educational curriculum is considered a key step in bridging the digital divide; hence, they play a major role in social, economic and political development of any country.

Due to advancement in ICTs, the world is undergoing a fundamental transformation as the industrial society of the 20th century gives way to the information society of the 21st century. The information and knowledge society promises fundamental change in all aspects of life, including knowledge dissemination, social interaction, economic and business practices, education and even political engagements. It is recognized globally that social economic growth of any country is a result of the transformation of knowledge, science and technology into goods and services (MoE Taskforce 2012, p. 226). Development of scientific and technological infrastructure as well as technical and entrepreneurial skills is essential to the transformation of Kenya into a knowledge based society. To be successful, economies must harness ICTs to create

new knowledge (Dutton 1996, p. 281). This is the only way to tap fully the energies and abilities of all the people, each of whom needs to discover ways of learning, creating and selling new skills, which will help them survive in the advanced global economy.

The Government of Kenya recognizes that information, education and knowledge are the core of human progress, endeavour and well-being, and that ICTs are creating immense impact on the way services are delivered (Kenya ICT Policy, 2004). It also recognizes that a combination of ICTs, knowledge and communication comprises essential resources for social and economic development, and that an ICT-literate workforce is the foundation on which Kenya can acquire the status of a knowledge economy (MoHEST, 2012, p. 51). Rapid development of ICTs accompanied by the convergence of telecommunications, broadcasting and computer technologies is creating additional and new ways of learning, entertainment, and social and professional opportunities. However, like most Sub-Saharan countries, the Kenya Government is still grappling with issues of ICTs such as wide-scale access, formulation of policies, understanding ethical aspects and use of the technologies to enhance the quality of life and impact on poverty reduction (Kenya Government 2004 p. 1; KENET, 2014, P. 43). According to the policy document, the government is committed to optimizing the potential of ICTs to generate economic growth and promote dialogue among people so as to increase productivity and to improve quality of life. The *National Information and Communications Technology Policy* (2004) recognizes young people as the workforce and leading creators as well as the earliest adaptors of ICTs. They must, therefore, be empowered as learners, developers, contributors, future entrepreneurs and decision-makers through the education systems.

1.3 Information and Communication Technologies in the Education Sector

Education is seen as the primary means of social mobility, national cohesion and social economic development, (MoHEST, 2012, p. 1). Like other parts of the world, Kenya has experienced the impact of globalization while human capital requirements have experienced rapid growth especially as a result of the ICT revolution. *The Constitution of Kenya* (2010) has the Bill of Rights at its core. In addition, the Vision 2030 acknowledges the need for reform to offer direction in modernizing and re-branding the country's education and training system, (MoEST, 2012, p. 1). ICTs are proposed as the teaching-learning tools that will be used to address the quality, service delivery, curriculum, relevance, teacher development, and education management at all levels of education.

ICT is used as a major vehicle for teaching and learning where learners acquire digital skills which they increasingly use to explore the world of information and to craft it into knowledge. Young people who have been brought up within the digital environment often exhibit great excitement, willingness to learn and ability to move into the new worlds of electronic information and experience (Dutton 1996, p.282). A study carried out in Kenya established that younger teachers were more positive to adoption of computer-assisted learning than older teachers, while majority of teachers were willing to adopt the use of computers to enhance learning (Omondi, 2010, p. 65). Making technology acceptable and friendly to those who are resistant to change, or those who find it difficult to adapt is a vital objective. It should be integrated into the school institutions to allow students and teachers exploit the potential of ICTs in learning environments.

Since the 1980s, integration of ICTs in education has been compulsory in the developed nations (MoEST, 2006, MoE/NICT 2006, p. 1). Adoption of computers in the education sector in Kenya has progressed in nearly identical pattern; from the acquisition of basic computer skills, computer aided teaching, communications and research, to usage in every subject. This has been accelerated by the convergence of computer and telecommunication technologies, particularly the Internet. The progression is due to the various efforts, resulting in a wide variation in the levels of ICTs integration to education curriculum, as determined by social and economic conditions.

African Information Society Initiative (AISI), a framework set up to build Africa's information and communication infrastructure, has the mandate to deal with the continent's delay in entering the information age and the need to sensitize policy makers on improvement of information communication technologies (AISI 2012). Its mandate is to realize a sustainable information society in Africa where information and decision support systems are used in all the major sectors of the economy, including education policies and decisions (Opoku-Mensah, 2012). Its intentions are that every man, woman and school child access information and knowledge resources through computers and telecommunications facilities.

In Kenya, the Ministry of Education and Ministry of Higher Education, Science and Technology recognize ICT as a major vehicle for teaching and learning, (MoE 2010 & MoEST 2012, p. 51). According to the government policy document, learners start to acquire digital skills, which they increasingly use to explore and exploit the world of information and to craft it into knowledge. ICTs facilitate the opportunity for more student centred teaching, more self-learning, and more peer teaching. They can also

play a role in preparing students to acquire skills, competencies and social skills that are fundamental for competing in the emerging global “knowledge” economy (Kenya, Vision 2030, p. 216). Therefore, ICT has the potential to play a more powerful role in increasing resources and improving the environment for learning.

Access to ICT facilities is currently one of the major challenges in Africa, and Kenya is no exception (MoE, 2006, p.1; Kiptalam, p. 50). While the ratio of 1 computer to 15 students is the norm in most developed countries, in Africa it stands at 1 to 150. In Kenya, access to ICTs varies in the education sub-sectors; the ratio of access to computers in universities and colleges is 1 to 45 students, at secondary school level it is 1 to 120 students, and at the primary school level it 1 to 250 students, (MoE, 2006, p. 1). However, a survey carried out in 2008/2009 showed that students in secondary schools across Kenya shared computers at a ratio of 40 students to 1 computer (MoHEST/NCST 2010, p. 19). This ratio was even wider in disadvantaged regions and rural areas.

The Millennium Development Goals (MDGs) set out in 2000 as part of the Millennium Declaration set clear targets for reducing poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women by 2015 (Info Dev., 2005, p. 5). The MDGs and the strong political will that backs them have placed development at the heart of the global agenda through the next decade. It contains initiatives that are concerned with measuring the impact of ICTs on the MDGs. Some initiatives have seen the need to connect ICT-based e-strategies with the development goals and have adapted the “e-readiness” concept to tackle specific social and economic targets, assisting developing countries put ICTs to work towards the MDGs (InfoDev, 2005, p. 5). MDG No. 8 Target 15 deals with measurement and benefits of

ICT technologies. It encourages the developing nations in the expansion of telephone lines and cellular phones as well as subscriber increase in personal computers and use, availability of Internet connectivity, and increase in Internet users.

The assessment that gauged Kenya's adoption of ICT objectives for measuring e-readiness concentrated on ICT infrastructure readiness, capacity, education and content development (Info Dev. 2005, p. 129). The government's stipulated ICT policy implementation in secondary schools was responsible for setting up of the National ICT strategy for education and training, which formulated the guidelines (MoHEST, Sessional Paper, 2012, p. 33). Kenya Vision 2030 outlines the education sector as a major player that will provide skills to steer Kenyans to the economic and social goals for the country's sustainable development. The first and immediate challenge facing the education sector in Kenya's transformation to 2030 is how to meet the human resource requirements for the rapidly changing more diverse economy. The second challenge is to ensure that the education provided meets high quality standards and that its contents are relevant to the needs of the economy and the society (Kenya Vision 2030, p. 118). The vision for education is, "A globally competitive quality education, training and research for sustainable development". To achieve this vision, six strategic areas have been identified for support based on their impact on the economic, social and political pillars. These areas are: access, quality, equity, science and technology, and innovation (Kenya Vision 2030, p. 126). Through the education system, learning will inculcate the use of knowledge in science, technology and innovation (STI) to create wealth, improve social welfare and promote democratic governance.

Appreciation of the critical role of STI to the Vision is based on the understanding of today's Knowledge-Based Economies (KBEs) and the role that innovation plays in such economies. In order to meet the human recourse needs of Vision 2030, the policy intent is to incorporate STI in education curriculum; this is the overall education goals as outlined in Kenya Vision 2030. The training curricula will be reformed at length to ensure that the creation, adoption, and adaptation and usage of STI will become an integral part of the country's education. This will in turn drive the economic, rural and political transformation that the vision aims at (Kenya Vision 2030, p. 127).

The government would like to make education and training the platform for equipping the nation with ICT skills in order to create a dynamic and sustainable economic growth, (MoEST, USAID/Kenya, 2005, p. 135). The limited and uncoordinated approach to imparting appropriate ICT skills and competencies to teachers remains a major barrier in the integration of ICT in education. As the overall goal is to provide adequate and the necessary resources to deliver and incorporate STI into the curriculum, this suggests that a coordinated approach to training and retraining of the teachers will be necessary if the strategy of mainstreaming ICT into the curriculum is to be met.

Gender disparities and equal opportunities for access to ICT in Kenya show that girls are still disadvantaged through a wide range of constraints that include choice of subjects, limited computers, and increasing attrition at various levels of education (Kenya Vision 2030, p. 119). The first study carried out on ICT in secondary schools in Kenya (Makau & IDRC, 1990) revealed that female students were more disadvantaged than their male counterparts in exposure to ICTs outside the school (at home or elsewhere). A similar study carried out by Kiptalam (2010) indicated that the

situation had not changed much; the proportion of males that claimed to come from a home that owned a computer was nearly twice that of females, while 21 per cent more boys than girls claimed to have used a computer outside school. In mixed schools, female students claimed to have received less in-school exposure than their male counterparts (Kiptalam, 2010). A large-scale study by SchoolNet found that of the 69 schools sampled, only 46 per cent had computers (Kenya SchoolNet, 2003).

The study also revealed a significant difference in the quality and use of computers in schools, depending on the gender of the students. Girls' schools were found to have the lowest number of computers, almost a third of the number for boys' schools. Furthermore, there were fewer computers in the computer laboratories in girls' schools indicating that their use was predominantly in administration (Kiptalam, 2010, p. 51). The research concluded that girls would be marginal players in the emerging information society, since fewer girls than boys were being exposed to computers. Gender mainstreaming issues in education and training is seen as a step towards securing parity in key sectors, education included (Kenya Vision 2030, p. 118). Recent observations, however, indicate that ICT facilities, notably email and Internet, have had the effect of reducing gender disparities leading to increased interest in computer education by girls (MoEST, 2006).

Besides limited access, unavailability of ICT teachers, high costs of ICT components and limited access to electricity are other challenges that continue to hamper adoption of ICTs in most parts of Africa particularly in the education sector. A survey by Digital International (InfoDev, 2005, p.5) indicated that the proportion of schools without electrical power range from 58 per cent to 96 per cent in some rural areas. This makes the use of available ICTs considerably difficult.

Familiarity with computers is becoming a prerequisite for most jobs (Eisenberg, 2004, p. 154). Educators must prepare students for the future by teaching them computer skills. In the developed world, educators and the general public accept the premise that students must be technologically competent to be successful today and in the future. However, competence with technology must be set within the context of information literacy. The U.S. Department of Labour Secretary Commission on Achieving Necessary Skills (SCANS, 1991), states that the competencies for all entry-level employees must include the ability to (1) acquire and use information, and (2) work with a variety of technologies. The same can be said of many other organisations today.

Information technology affects everyone. Today's successful companies focus on meaningful uses of information technology and hire employees who are able to apply technology to a range of situations (Eisenberg, 1994, p. 154). Therefore, the education sector must make deliberate efforts to provide the necessary human resource with the right ICT skills necessary to steer Kenyans to the economic and social goals of Vision 2030. The education provided must meet high quality standards with content relevant to the needs of the economy and society (Kenya Vision 2030, p. 221). It is therefore the responsibility of the educational system to develop students who are not only technologically literate, but who are also information literate. They must know how to use technology to solve information related problems.

Information literacy is a survival skill in the information age. Instead of drowning in the abundance of information that floods their lives, information literate people know how to find, evaluate and use information effectively to solve a particular problem or make a decision, whether the information they select comes from a computer, a book,

a government agency or any other resource, (Breivik & Gee 1989, p. 12). In a research carried out among high school students, Kuthlau (1987) states that information literacy involves the ability to use information. It also involves recognizing an information need and seeking information to make informed decisions. Information literacy requires abilities to manage complex masses of information generated by computers and mass media, and to learn throughout life, as technical and social changes demand new skills and knowledge (Kuthlau, 1987). While, students have long relied on knowledge of the teachers, there is need for a new educational philosophy based on fuller understanding on how they can exploit potential of ICTs in learning and acquiring information literacy.

1.4 Education Policy Framework in Kenya

According to *Sessional Paper No. 1 of 2005*, titled “A Policy Framework for Education, Training and Research”, the overall goal of education is to achieve Education for All (EFA) by 2015 in tandem with national and international commitments to the MDG for education, which requires countries to provide complete primary education for all children by 2015, reduce adult illiteracy and achieve gender parity at all levels of education. As a result of government initiatives and the introduction of Free Primary Education (FPE) in 2002, there was great expansion in primary school education. The number of primary schools rose by 9.4 per cent from 26, 104 in 2007 to 28,567 in 2011(KNBS, 2011, p. 41). Also, primary school enrolment rose by 19.4 per cent from 8.2 million in 2007 to 9.9 million in 2011 (KNBS 2011, p. 43). The FPE saw to increase in the number of Kenya Certificate of Primary Education (KCPE) candidates increased by 10.1 per cent from 704,708 in 2007 to 776,214 in 2011. In 2007, records from the Ministry of Education showed

that there were 1.2 million students in secondary schools across the country. The continued implementation of Free Tuition Secondary School (FTSE) in 2008, together with government initiatives such as the Constituency Development Fund (CDF), has increased access to secondary education. Total enrolment in secondary school rose by 49.9 per cent from 1.2 million in 2007 to 1.8 million in 2011. In addition, the number of Kenya Certificate of Secondary Education (KCSE) candidates increased by 51.1 per cent from 271,691 in 2007 to 410,586 in 2011 (KNBS 2012, p. 49). This translates to a transition rate of 72.5 per cent, an increase of 26.3 per cent from the year 2003. Also, the primary to secondary school transition rate increased from 59.9 per cent in 2007 to 73.3 per cent in 2011. The transition rate is beyond the expected MDG target of 70 per cent for countries. During the 2011/12 academic year, there was a double intake of students who sat KCSE in 2009 and 2010, which increased the overall enrolment in all universities by 11.6 per cent from 177,618 in 2010/11 to 198,260 in 2011/2012.

The education policy provides commitment for enhancement of access, quality and equity in delivery of education services at all levels. Equally important, the policy provides for commitment to ensure that learning needs for all are met through appropriate learning and lifelong skills by 2015. In order to realize these policy objectives, commitment is made to integrate ICTs in the delivery of the education curricula, to strengthen Open and Distance Education (ODE), and to promote effective and efficient administration at all levels of education (MoE, 2006 p.2). However, there are challenges arising from the increased enrolment rates, which include overcrowded classrooms and high Pupil Teacher Ratios (PTRs) particularly in densely populated and semi-arid areas, (MoE, 2006 p.2).

Although not adequately equipped in all subjects, teachers are required to teach seven (7) subjects of the primary school curriculum. ICTs can contribute considerably to addressing these challenges. A limited transition rate from primary to secondary schools remains a major challenge. While there are 28,567 primary schools, there were only 7,279 secondary schools in 2011 (KNBS Economic Survey 2012, p. 40). This has limited the transition rate, which is less than 47 per cent.

The other challenge is the high cost of learning and teaching materials amid persistent poverty in some areas. Furthermore, the student-textbook ratio remains substantially high in most areas. Poor performance in mathematics and science has also been observed in the national examinations. One of the objectives of the Ministry of Education Taskforce in the re-alignment of the education sector to the Constitution of Kenya 2010 (MoE 2012 p. xxii) is to promotion of innovativeness, inventiveness, creativity, technology transfer and an entrepreneurial culture. This has been emphasized in the mission of the Government of Kenya to create an education and training environment that equips learners with the desired values, attitudes, knowledge, skills and competencies in technology, innovation and entrepreneurship that is globally competitive(MoE and MoHEST, Sessional Paper of 2012, p. 12). ICT has potential to address these and other challenges.

Secondary schools in Kenya are categorized by type, namely public funded and privately funded. The Basic Education Act (No. 14, 2013) recognizes the role played by private institutions in the provision of education at primary, secondary and post-secondary levels. According to KNBS (2012, p.41), there were 7,297 secondary schools in Kenya in 2011, while there were 28,567 primary schools. Although there has been major increase of secondary school Gross Enrolment Rate (GER) from 38.0

per cent in 2007 to 48.8 per cent in 2011 as a result of FTSE as well as expansion of school facilities, there is still need for further expansion to embrace the large number of primary school graduates who are not able to get secondary school placement. The government has encouraged public-private partnership (PPP) to meet the increasing demand for education, Republic of Kenya, Policy Framework for Education (2012, p. 72). Out of the 7,297 secondary schools, 5,311 were publicly funded. The remaining 1,986 were privately funded with a teaching staff of 43,016. Currently, the total enrolment in secondary schools stands at 1.9 million students, while that of primary school is 9.9 million students 2011 (KNBS 2011, p. 43). The recent massive increase in primary school enrolment is putting pressure on the demand for and access to secondary schools (MoEST 2005, p. 3). In 2008, the government introduced free secondary education to cater for the increase in primary school enrolment. As a result, the primary to secondary schools transition increased from 59.9 per cent in 2007 to 73.3 per cent in 2011 (KNBS, 2012, p. 39). However, the MoEST remains concerned with the quality of secondary education, which is characterized by poor performance in core subjects such as mathematics and science.

1.5 Applications of ICTs in Secondary Schools in Kenya

According to Picciano (2011, p. 23), computer applications in education can be divided into two major categories: administrative and instructional. Administrative applications support the administrative functions of the school such as database management and transaction-processing systems involving student demographics, grading, budgeting, payroll, personnel, scheduling and inventory control, all of which are designed for and used primarily by the administrative staff. Administrative systems are similar to the data processing applications in industry and public offices.

Customer and product database management systems in private business also resemble student course systems in schools, while personnel, payroll and financial database systems designed for public agencies are identical to those used in schools. Instructional applications support teaching and learning activities that are designed for and are used by teachers, school library, media specialists and students. The background implementation and planning for these two major categories of applications are different and need to be distinguished.

There are obvious benefits for integrating computers into secondary schools as students at this age need to focus on subject-specific content, greater critical thinking skills, scientific inquiry, and mathematics, science and languages. Students will benefit greatly with the analytical, creative and collaborative power of computers to map out and analyse assumptions, present ideas and participate in projects with peers from around the country and around the world (MoEST, 2006). Enhanced ICT in education may ensure that the younger generation has the basic knowledge and skills at secondary school level, aiming at developing an enabled workforce vital to remain competitive and to continually create an enabling environment for innovative ways of working (MoHEST, 2012, p. 1).

As noted above, foundation skills should be a stepping-stone to using ICTs for the enhancement of teaching and learning objectives. The same ICT integration concepts can be adapted for secondary school teachers and students. ICT integration will take teachers and students beyond seeing ICTs as computer studies and computer literacy skills. Although these are important skill sets, they are not sufficient in leveraging the true potential of ICTs to improve creativity, innovation and collaboration, the key capabilities in the new knowledge economy. The assessment criteria should be made

explicit to new users and opportunities to experiment and work with the ICT tools availed towards achieving these criteria. This will ensure that their new knowledge and skills are not only conceptualized, but they are more likely to be retained (MoEST, 2005, p. 7).

With the advent of the Internet and other technologies, which are changing the way people operate locally and globally, the MoEST's goal should be to demystify and leverage these tools to provide deeper conceptual knowledge of the world around. Although the Internet provides a vast number of resources, most are not relevant to the Kenyan student curriculum needs and may need to be reviewed. This requires that local content be uploaded on the Internet.

While technicians can be employed to fix and maintain the computers, teachers and educators must know how to exploit ICT for what they do best – opening learners up to the world of knowledge. Computers themselves, however, do not come pre-packaged with relevant teaching content. Investments in custom-made digital materials with highly relevant content for Kenyan classrooms in rural and urban contexts are important if the MoEST wants to tap into the real potential of ICTs for learning.

Building capacity in Kenya to create instructional materials for an increasingly digital world is an investment that will pay dividends for improving the quality of education. The MoEST and Kenya Institute of Curriculum Development Education (KICD)) can start to develop and deliver educational content for delivery through a variety of digital media. This is stipulated in Kenya Vision 2030 where KICD is required to develop e-content materials for the secondary school level and in addition a digital laboratory and broadband Internet connectivity (Kenya Vision 2030, p. 89).

Kenya is on the path to establishing digital learning in schools to boost education quality and access countrywide (Ratemo, 2011, p. 2). The integration of ICTs is a global concern. The use of computers promises better and improved methods of content delivery as well as expanding the available teaching and learning resources. KICD is mandated to integrate ICTs into curriculum implementation and the Institute has an educational TV channel under brand name EDU, in addition to radio broadcasting station for both teachers and students, an online teacher training portal known as Elimika, and is in the process of providing digital content for secondary schools, Kenya Institute of Curriculum Development (KICD, 2012). The Institute is transforming the curriculum support materials to digital format in order to facilitate integration of ICT delivery of education programmes. However, there is limited technical expertise and infrastructure for the e transformation of the national curricula to digital education formats. Educational software is also varied and is obtained from various manufacturers. Furthermore, most textbooks by local publishers are not available in digital formats and therefore are not available for use in a digitized curriculum. KICD is expected not only to support capacity building of technical expertise, but also to provide digital content to schools in various formats such as interactive CDs for teaching and learning and to standardize, develop and localize educational software.

As noted above, KICD is the institution that is mandated to develop the curricula; hence, it is the core player in the digitization of the national curricula. Other organizations that have partnered with MoE and/or KICD in support of implementation of e-learning in secondary schools include Televic, Intel Corporation, New Partnership for Africa's Development (NEPAD), Kenya Education Sector Support Programme (MoEST/KESSP, 2005), National Innovation and Integration

Centre (NI³C), ICT for Education Unit (ICT4E), and the Centre for Mathematics, Sciences and Technology Education in Africa (CEMASTEIA).

An evaluation of MoEST/KESSP 1 implementation period (2005 to 2010) was carried out for the NEPAD E-Schools project. The project had been initiated by the heads of African states in 2003 with aim of having all education institutions equipped with modern ICT tools for increased access and quality education and training by 2013. Six demonstration schools were identified in Kenya, which were expected to have a roll out by 2008. However, nothing had been achieved as the project had become moribund (MoE Taskforce 2012, p. 228).

The other challenge is the high cost of learning and teaching materials amid persistent poverty in some areas. Furthermore, the student-textbook ratio remains substantially high in most areas. Poor performance in mathematics and science has also been observed in the national examinations. ICT has potential to address these and other challenges.

1.6 Statement of the Problem

Article 40 (a) of the new Constitution of Kenya (2010) indicates that the youth should have access to quality and relevant education and training. The MoE has developed the National ICT Strategy for Education and Training through a collaboration effort with all the stakeholders. This has been exemplified by the government's declared interest in removing the barriers to ICT integration and the development of ICTs in all secondary schools in the country (The National ICT Policy Development, 2003). This has been extended to education management and administration as outlined in MoEST and Kenya Education Sector Support Programme (MoE KESSP 2005, p. 29, MoE/NICT, MoEST/Task Force 2010, p. 78).

There are two dimensions to ICT in education. First, teachers and learners learn about ICT, and second teachers and learners learn with ICT (MoE Taskforce 2012, p. 227). Learning about ICT allows learners to contribute to its development and also become ICT literate. Learning with ICT is aimed at enabling learners to acquire knowledge and skills that they can use effectively. The main structure for implementing ICT policy and strategy is proposed for an education sector that will provide the skills required to steer secondary school students to meet the economic goals of Vision 2030 (MoEST Taskforce 2010, p. 221). The MoE policy is to integrate ICT in education and training in order to prepare learners for the 21st century education and knowledge economy.

It has however been established that there has not been uniformity in the adoption approach addressing the various needs and disparities in the secondary schools in Kenya (MoE/NICT, 2006 p. vi). MoEST attributes this to lack of well spelt out programmes to address the implementation of ICTs in the secondary school sector. Kenya Vision 2030 stresses on the need to mainstream information technology and a computer supply programme in the secondary school sector as a means of equipping students with modern ICT skills (Kenya Vision 2030, p. 93). The ICT implementation policy framework (MoEST 2006, p. 20) has given a benchmark of the inputs such as equipment, training and possible costing. The extent to which the implementation is achieved has not been assessed and documented. There is no specific evidence showing curriculum interventions and instructional means on whether ICTs have been integrated into teaching and learning in all subjects.

Similarly, the extent to which ICT has been deployed in secondary school managerial systems needs to be assessed. ICT introduction as outlined in MoEST and KESSP

(MoE/KESSP 2005-2010), and the Constitution of Kenya emphasizes that the youth should have access to quality and relevant education and training. There is need therefore to explore how ICTs would be sustainably implemented in secondary schools in Nairobi County.

1.7 Aim of the Study

The aim of the study was to investigate the level of Information Communication Technologies (ICTs) implementation in secondary schools in Nairobi County with a view to proposing a model of sustainable ICT implementation that could be adapted in secondary schools in Kenya.

1.7.1 Objectives of the Study

The objectives of the study were to:

1. Determine the training and ICT skills needed for ICT implementation in the secondary schools.
2. Establish the level of e-readiness and how it supported ICTs implementation in secondary schools in Nairobi County.
3. Assess the level of ICTs application in administrative and instructional activities in the secondary schools and how this had transformed the work process.
4. Examine the policy guidelines for ICTs implementation within the secondary schools and the Ministry of Education.
5. Analyze the challenges experienced in the implementation of ICTs in secondary schools in Nairobi County and map possible solutions.

6. Recommend measures for improvement and develop a model for sustainable implementation of ICTs in secondary schools Nairobi County.

1.7.2 Research Questions

The study was informed by the following research questions:

1. What were the training needs for ICTs implementation in secondary schools?
2. What was the range of hardware, software and other technological devices that support ICT in secondary schools in Nairobi County?
3. In what ways and to what extent were ICTs applied for both administrative and instructional use in secondary schools in Nairobi County?
4. What were the legal frameworks and policies for ICTs implementation within the secondary schools and the Ministry of Education at large? How adequate were they in addressing ICTs integration in schools?
5. What were the factors that hampered implementation of ICTs in secondary schools in Nairobi County?
6. How could ICTs be enhanced/sustainably implemented in secondary schools in Nairobi County?

1.7.3 Assumptions of the Study

The study was based on the assumptions that:

- i) There was lack of adequate resources for ICT implementation in secondary schools in Kenya
- ii) There was inadequate ICT training of teachers, students and other personnel in secondary schools in Kenya.

- iii) There was low level of ICTs application in both administrative and instructional activities in the schools.
- iv) There were inadequate policy guidelines for ICTs implementation within the secondary schools and the MoE.

1.8 Significance of the Study

This study was conducted out of the realization for the need to find out ICTs implementation in secondary schools. Although there are studies that have been carried out on the implementation of ICTs in the education sector in the developed world and also in African countries, such as Namibia, Nigeria and Kenya, none of the studies in the literature reviewed addressed the variables that are covered in this study, addressing the local situation where gaps were found. This study aimed at investigating sustainable implementation of ICTs in secondary schools in Nairobi County and the findings revealed a need for sustainable ICTs implementation in secondary schools. Furthermore, it was found necessary to propose a plausible model that would be used to address ICT implementation in Nairobi County and in the education sector in Kenya as a whole.

The study is hoped to benefit policy makers at the Ministry of Education, which is a major stakeholder in ICTs implementation. The proposed model is expected to assist the Ministry in guiding the factors to be considered at the government level so as to set standards for ICT implementation. The study will be useful to the Kenya Institute of Curriculum Development (KICD) as it continues to strive for ICTs curriculum for implementation in the secondary education sector. The study is significant in that the information generated and the knowledge can form a basis for future ICT policy implementation in the education sector.

Secondary schools are expected to benefit from the study findings as problems and challenges faced in ICTs integration and use are identified and discussed. Various solutions to the challenges have been proposed by the principals, teachers, students and the non-teaching staff, and are expected to be useful not only to secondary schools, but also to other educational institutions.

1.9 Scope and Limitations of the Study

1.9.1 Scope

The aim of this study was to investigate the diffusion of ICTs in secondary school education in Nairobi County. The schools under investigation were both public and private secondary schools with focus on the integration of ICTs for instruction, learning and teaching as well as in school administration functions.

1.9.2 Limitations

The study is limited to secondary schools in Nairobi County. Since schools in the County are many and endowed differently in respect of resources, the study did not cover the rest of the country; Nairobi was considered as adequately representative. However, for a school to participate, it depended on the goodwill of the principal or class teacher of the students. For some of the schools, the principals refused to allow students to participate in the research as the fieldwork was done just after the post-election violence in 2008. The schools were very sensitive to any outsider and feared that anything new would trigger student riots. This interfered with the original plan and the researcher, on such occasions, took longer time than stipulated to collect the data in the field.

1.10 Organization of the Study

The study is organized into six chapters. This chapter contains introductory and background information of the state of ICTs in Kenya, particularly in the secondary school sector. The objectives and research questions guiding the study, assumptions, significance, scope, and limitations are covered. Chapter Two is a review of the literature related to the study. It presents the theories and a theoretical framework for the study. The literature review is generally guided by the research objectives on issues of staff training, ICT policies, e-readiness and challenges facing ICT implementation. Chapter Three is on research methodology and research design. Chapter Four is data presentation, analysis and interpretation. Chapter Five is the discussion of findings, while Chapter Six contains the summary of findings, and conclusions and recommendations of the study.

1.11 Definition of Significant Terms

Connectivity: Availability of telecommunications, Internet, computers, hardware and software that is used for ICTs.

Curriculum integration: This was done at two levels; use of local content in design and development of course materials, and the integration and use of ICTs in teaching in all subject areas.

Diffusion: The process by which adaption of ICTs as an innovation is embraced and used to transform teaching and learning as well as administration for improvement in the secondary schools in Nairobi County.

Digital divide: The divide between those people who have access to ICTs and those who do not. The digital divide is in the context of the schools that had ICTs and Internet connectivity and the ones that did not have any.

Fiscal resources: The means for purchasing and/or obtaining the supplies, materials, equipment, services and personnel required to provide and support programmes for ICT integration into school systems.

Information communication technologies (ICTs): Equipment such as computer, CD ROM; Internet, radio and television, video and digital cameras, and other equipment that can be used by teachers to support teaching and learning.

Information literacy: A person's ability to access and understand a variety of information sources. An information literate student is one who is an avid reader, a critical thinker, a creative thinker, an interested learner, an organized investigator, an effective communicator, a responsible information user, and a skilled user of technology tools. An information literate person finds information, translates it into some meaning and understanding, and creates new ideas that can be used.

Infrastructure: Hardware, software and other technological devices that support ICT.

Information Superhighway Technology: Digital communication systems; also defined as a route or network for the high-speed transfer of information especially through the fibre-optic network and the Internet.

Interactive education: Allowing a continuous two-way transfer of information between the computer and the person using it. This applies in education when students use computers and computer programs for learning purposes.

Knowledge: Expertise and skills acquired by a person through experience or education; what is known in a particular field or in total facts and information; and awareness of familiarity gained by experience of a fact or a situation

Knowledge economy: A knowledge driven economy is one in which the generation and exploitation of knowledge play a predominant part.

Multimedia: Use of online access, CDs for storage of information for teaching and learning, video, electronic libraries and Internet.

Partnerships: Need for collaboration with stakeholders for funding, equipment and other infrastructure for ICTs provision in secondary schools.

Pedagogical approaches: Accepted methods of teaching and testing students.

Praxis level: Practice of ICTs as distinguished from theories, application and use as well as imparting knowledge and skills; translating ideas of ICTs into action and productivity.

Resource mobilization: Pooling together human, technological and financial resources for implementation of ICT in education projects and programmes.

Serendipity: Discovering something by chance while browsing paper based library, museum or gallery. Electronic libraries can achieve similar benefits by use of multimedia for example, video, added sound, animation and modelling.

Sustainable implementation of ICTs: Using ICTs effectively to improve and change the landscape of educational provision and management in secondary schools; ensuring financial and technological sustainability for ICT integration in teaching and learning.

Technological devices: Devices that include networked computers, and use of external modems and any other gadgets that improved access and use of ICTs.

VSAT: (Very Small Aperture Terminal): Communication systems that provide mobile satellite Internet services, and can handle data, voice and video signals.

Wi-Fi: Short for 'Wireless Fidelity'. The technology is used to help people access networks and the Internet without using wires. It is often found in smart phones, laptops and newer computers.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter discusses and reviews the literature relevant to the topic under study. Literature reviews provide a background for the study, what has been written on the topic, the theories and objectives guiding the research (Anson & Schwegler, 2010, p. 260). This study aimed at investigating a sustainable implementation of ICTs in secondary schools in Nairobi County; hence, the theories that were used to guide the study as well as the related literature form the content of the chapter. The conceptual framework of the study is also presented.

Diffusion of Innovations Theory (DoI) by Rogers (2005, p. 35) and Information Technology Assimilation Framework (ITAF), (Telem & Barta 2007, p. 128) provides an understanding of the issues to be addressed in ICTs implementation in schools. ITAF was advanced from Systems Theory by Kast & Rosenzweig (1985, p. 114), and it deals with change management in organizations. ICTs implementation by UNESCO views ICT integration as a continuum. The three theories were considered important in contribution to sustainable implementation of ICTs in secondary schools in Nairobi County.

The other areas under review included e-leadership factors such as ICT policies; availability of adequate equipment; use of ICTs for administration and learning; training; and the ICT skills needed in sustainable implementation of ICTs; and the challenges faced. A general overview of the status of ICTs in schools in Africa and Kenya is also reviewed.

2.2 Theoretical Framework

A theory is defined as an explanation of a phenomenon or an abstract generalization that systematically explains the relationship among a given phenomenon for purposes of explaining, predicting and directing the research, (Torraco 2002, p. 114). Theoretical framework consists of theories that are interrelated. It determines and defines the focus and goal of the research problem. Its purpose is to test theories, to make research findings meaningful and generalizable, to establish orderly connections between observations and facts and to stimulate research, (Trochin, 2008, p. 5)

The theories discussed in relation to ICT implementation are DoI (Rogers 2005) and ITAF (Telem and Barta 2007, p. 128); the latter deals with technology assimilation framework, an advancement of Open Systems Theory by Kast & Rosenzweig (1985, p. 114). This theory views schools as dynamic organizations. The UNESCO model for ICT implementation in schools is also discussed. The three theories contributed to the theoretical framework and informed the study.

2.2.1 Diffusion of Innovations (DoI)

This theory is concerned with the manner in which a new technological idea, artifact or technique, or a new use of an old one, migrates from creation to use (Rogers 2005, p. 35). According to the theory, technological innovation is communicated through particular channels, over time, among the members of a social system, where communication is regarded as a process in which participants share information with one another to reach a mutual understanding (Rogers, 2005p. 5). This definition implies that communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move towards meanings that they

give to certain events. The main elements of diffusion are innovation, communication channels, time and the social system.

Orr (2003), reviewing Rogers' DoI theory, identifies five stages of diffusion as indicated below:

1. **Knowledge** – it occurs when an individual is exposed to an innovation's existence and gains some understanding of how it functions.
2. **Persuasion** – it occurs when an individual forms a favourable or unfavourable attitude towards the innovation.
3. **Decision** – it occurs when an individual engages in activities that lead to a choice to adopt or reject innovation.
4. **Implementation** – it occurs when an individual puts an innovation into use.
5. **Confirmation** – it occurs when an individual seeks reinforcement of an innovation decision already made, or reverses a previous decision to adopt or reject the innovation if exposed to conflicting messages about the innovation.

DoI theory is applicable to any situation where something new is introduced; hence, it presents the five stages of ICTs diffusion in Kenya's education sector. The sector will have to pass through them before confirmation is reached. Knowledge occurs when schools are exposed to computers and they understand how they are used. Persuasion comes when schools decide to adopt use of ICTs. Decision comes as activities towards use of ICTs are introduced to the schools system. Implementation comes when schools put ICTs into use, and confirmation comes as schools seek better ways of integrating the use of ICTs into learning, instruction and school administration.

This theory though favourable in all social aspects of introducing a new innovation was found lacking in technology and was used together with the other theories.

2.2.2 IT Assimilation Framework for Schools (ITAF)

Information Technology (IT) assimilation constitutes a big challenge for schools (Telem & Barta, 1995, p. 9); hence, ITAF is recommended in schools as a means of sustainable implementation of ICTs (Forkosh-Baruch 2007, p. 3). In the following sections, the main elements in each of its components are presented and the framework's potential as a tool for effective and successful implementation, operation and usage of IT in schools is discussed.

With the computerization process taking place in schools, Management Information Systems (MIS) are designed and implemented. MIS are designed to provide educational administrators with new tools to support them in a variety of activities. These activities include grade and attendance reporting, placement in classes, construction of school time-tables and examination schedules; assignment and disbursement of resources; follow-up on the implementation of decisions; analysis of teacher and school achievements; and, management of financial records. At the same time, automated office tools (such as, electronic mail, electronic archives, spread sheets, automatic follow-up of decisions, electronic appointment books, automatic dialling, and desk-top publishing) are rapidly becoming routine. However, some schools lack IT professionals and are not well prepared to cope with technological change (Telem, 1989, p. 443-452). Consequently, ICT introduction into the traditional school structure has run into difficulties (Fainmesser & Mendel, 1989, p.13). Situations where computers installed into such structures are not fully and effectively used have been reported (Beare, Caldwell & Milikan 1989, p.60). Hence, the absence

of an overall integrated approach for ICT assimilation in schools is often a dominant factor in failure, resulting in the faulty perception that ICT introduction is merely the purchase and installation of hardware and software, accompanied by some introductory training. ITAF fits into

2.2.2.1 ICT Assimilation Framework

Incorporation of ICTs into the day-to-day functions of schools has a marked impact on every aspect of management structures and dynamics advocated in the open systems theory by Kast & Rosenzweig (1985, p. 115). In this theory, schools are viewed like any organization composed of five major partly overlapping subsystems namely (1) managerial, (2) structural, (3) psychosocial, (4) goals and values, and (5) technical. Introducing a change in one of them would lead to changes in the other four.

As in any organization, the main elements of the school's **managerial subsystem** are: goal-setting, planning, organizing, assembling resources, staffing, directing, coordinating, budgeting, evaluating, implementing and controlling (Kast & Rosenzweig, 1985, p. 115). Each of these elements is affected by the introduction of ICT; hence, assimilation activities should relate to the implications that ICT introduction would have on each of them and to the strategies needed to cope with them. Such activities and strategies include the school's computerization policy formulation, specific information requirements, ICT assimilation master-plan preparation, ICT introduction and performance evaluation, re-definition of resource allocation, staffing and recruiting of IT professionals or changing existing roles for this purpose, and redefining schools computerized control and procedures. These are amongst the key issues to be addressed at the managerial subsystem.

ICT introduction may result in the addition of new roles in the school (e.g., the school computer administrator) as well as changes in the school's work flow, authority, information flow, procedures and rules. Within the school environment assimilation activities should relate to issues such as change in the school's formal organizational structure including both within the school and the external environment. This is the **structural subsystem**.

In the **psychosocial subsystem**, the main elements include attitudes, perceptions, motivation, group dynamics, leadership, communication and interpersonal relations of the human resources (Kast & Rosenzweig, 1985, p. 114 – 115). Thus, ICT assimilation results in the school's need to confront a cluster of psychosocial issues associated with IT assimilation and aggravated by computer literacy levels of its instructional and administrative staff (Telem, 1987, p. 187-193). ICT factors for consideration under this subsystem include identification of potential barriers to ICT introduction into the school, and development of standards for professional development programmes for the school administrators and teachers. Change management in communication patterns and relationships between school employees, (teacher-teacher, teacher-counsellor, counsellor-principal among others), and the relationship with the external environments such as the Ministry of Education will need to be established (Telem and Barta, 1995, p.10).

The main elements of the **goals and values subsystem** are culture, philosophy, overall goals, group goals and individual goals (Kast & Rosenzweig, 1985, p. 114). These require formulation of a new "school philosophy" for the computerized school and ICT introduction goals for administrators and teachers, detection of changes occurring in the school's interrelations with its environment, ethical use of IT for

educational purposes, and handling of legal aspects of ICT (such as, security and data confidentiality in school) amongst others.

The school's **technical subsystem** is shaped by the following elements: knowledge, techniques, facilities and equipment (Kast & Rozenzweig, 1985, p. 114). Each of these elements should be adapted selectively to suit the special requirements of the school and to make appropriate use of technology, technology “as a process and not as a product” (Bozemann, 1979, p. 3-8). Examples of appropriate activities within this subsystem are: the preparation of computer sites; and, the purchase, introduction, operation and maintenance of hardware and software for the adaptation of new knowledge and techniques. All these concepts (knowledge base and the technology innovation) are important in framing ICT diffusion in schools.

2.2.3 Modelling ICT Development: A Continuum of Approaches

UNESCO (2002, p. 15) has developed a model that depicts four approaches to ICT developments in educational institutions and individual schools based on studies in both developed and developing countries. These approaches are in a continuum and are termed as *emerging, applying, infusing and transforming* (see Fig. 1). The schools are at the beginning of ICTs continuum when they are just learning the basics and are at the end of the continuum where they have adopted ICT in learning and are able to perform innovative tasks using ICT. Diffusion of innovations (Rogers, 2005, p. 199), open systems theory (Kast & Rosenzweig, 1985, p. 115) advanced as ITAF by Forkish-Baruch (2007), and the model of ICTs integration by UNESCO underlie the conceptual framework of this study and each of them has guided it.

- (i) **The emerging approach** - At the beginning stages of ICT development, schools demonstrate the emerging approach. They begin to purchase, or receive

donated computing equipment and software. During this initial phase, administrators and teachers are just starting to explore the possibilities and consequences of using ICT for school management and adding ICT to the curriculum. The schools are still grounded in traditional teacher-centred practice. The curriculum reflects an increase in basic skills and there is an awareness of the uses of ICTs. This curriculum assists movement to the next approach.

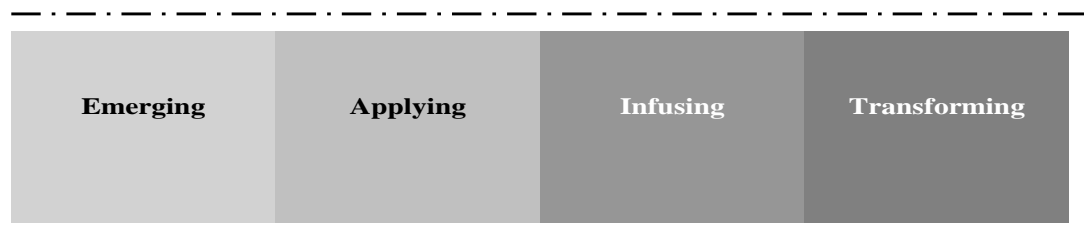


Figure 1: Model depicting a continuum of approaches to ICT development in schools

Source, UNESCO (2002, p. 15)

- (ii) **The applying approach** - This second stage of the continuum consists of schools understanding the contribution of ICT to the learning process. The administrators and teachers use ICT for tasks already carried out in school management and in the curriculum; however, teachers largely dominate the learning environment. At the applying, phase schools adapt the curriculum in order to increase the use of ICT in various subject areas with specific tools and software. This curriculum assists movement into the next approach.
- (iii) **The infusing approach** - The infusing approach involves integrating or embedding ICT across the curriculum. It is seen in those schools that employ a

range of computer-based technologies in laboratories, classrooms and administrative offices. At this stage, teachers explore new ways in which ICT changes their personal productivity and professional practice. The curriculum begins to merge subject areas to reflect real-world applications.

- (iv) **The transforming approach** - Schools that use ICT to rethink and renew school organization in creative ways are at the transforming stage. ICT becomes an integral, though invisible, part of daily personal productivity and professional practice. The focus of the curriculum is now learner-centred and integrates subject areas in real-world applications. ICT is taught as a separate subject at the professional level and is incorporated into all vocational areas. At this stage, schools have become centres of learning for their communities.

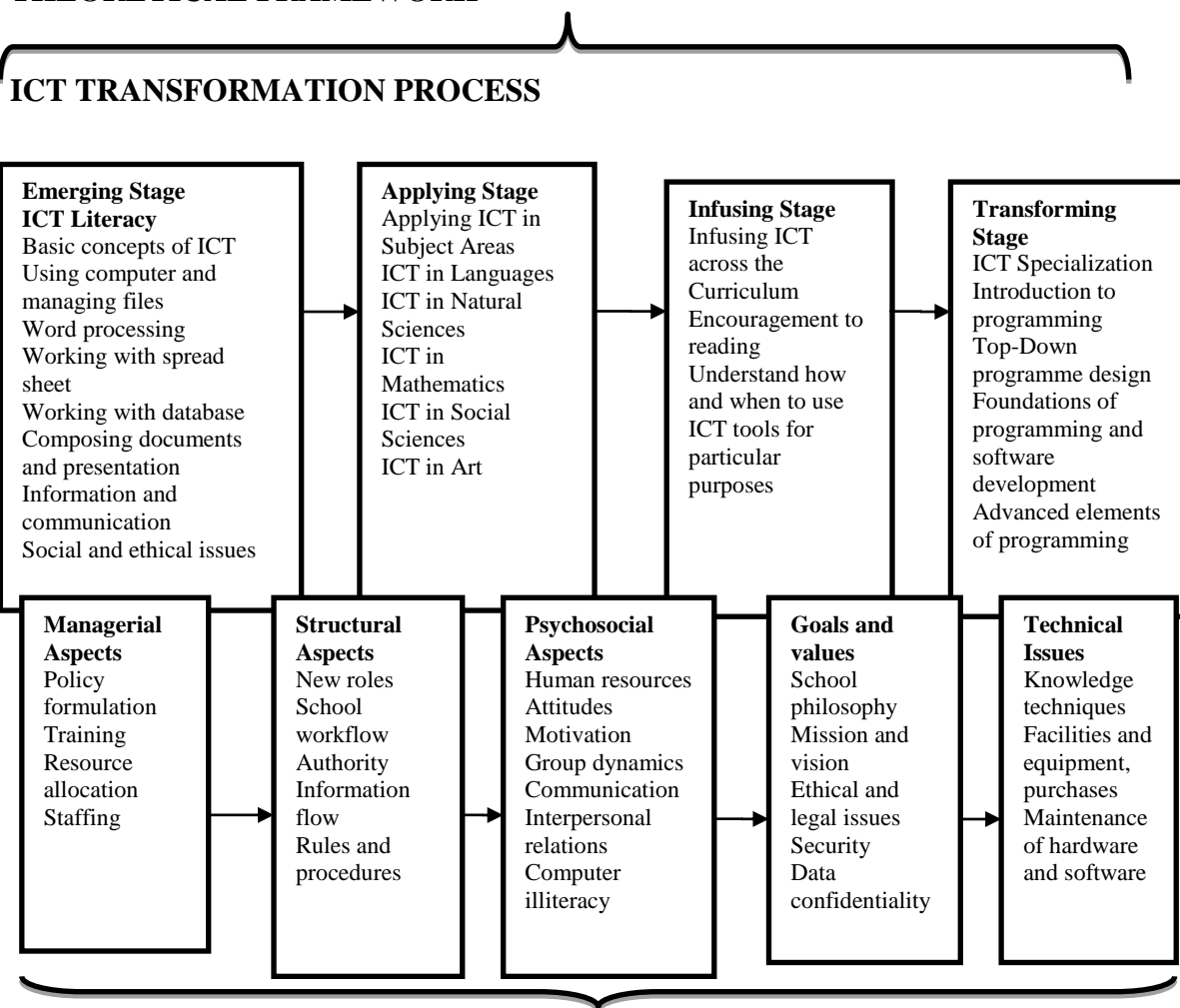
2.2.4 Theoretical Framework

Figure 2 demonstrates the theoretical framework for the study. This consists of a model by UNESCO (2002) and the interrelationships of theories and concepts of technological changes in organizations deduced from the *literature* that cater for diffusion of ICTs in the secondary schools. It shows ICTs integration as a continuum.

Schools emphasize ICT literacy at the emerging stage. Students and staff are to learn basic concepts and use of word processing as well as spread sheets. In the second applying stage, schools start to use ICTs in subject areas. At the third infusing stage, they are using ICTs across the curriculum and are able to use particular ICT tools. Finally at the fourth transforming stage, students and staff are at an advanced level of programming and software development. The second level depicts the open systems theory that looks at the managerial aspects such as policy formulation, training and resources allocation. The school's management structures change and affect work

flow, rules and procedures; workflow authority as well as delegating new roles to staff are also affected. Psychosocial approach deals with human resources, motivation, attitudes, interpersonal relationships and group dynamics. Goals and values approach deals with school philosophy, vision, mission and legal and ethical issues. Technical issues involve facilities and equipment as well as maintenance of hardware and software. All these aspects correlate with the different ICT transformation stages as depicted in Figure 2.

THEORETICAL FRAMEWORK



ORGANIZATIONAL TRANSFORMATION

Figure 2: ICTs assimilation framework for secondary schools in Kenya

Source, Author

2.3 E-readiness Tools

The number of tools that are readily available for assessing e-readiness is limited because few organizations have presented their tools for use by others (InfoDev 2005). Digital Divide Reports look at e-readiness through the lens of who is not benefiting from ICT, and which societies are not e-ready. Digital divide tools are concerned with distribution of technology and its impact on people, and there were several e-readiness tools that were considered. Harvard University's Centre for International Development (CID) Readiness for the Networked World was found to be covering use of ICTs in the work place. Another tool was CSPP's Readiness Guide for Living in the Networked World that measured the prevalence and integration of ICTs in homes, businesses and schools, but was considered not adequate for the current research. McConnells International (MI) was found suitable for the current study as it measures connectivity in form of infrastructure and access. It further considers e-leadership, government policies and regulations that include curriculum and content development, security, as well as human capital in form of training and personal characteristics of workers. It emphasizes on ICT education and availability of a skilled workforce. McConnells International (MI) was found suitable for measuring human capital; ICTs connectivity (infrastructure, access), e-leadership, government policies and regulations (including curriculum and content development), and ICT security.

2.4 Training, Capacity Building and Professional Development

According to the government, the teaching staff force comprising 38,000 secondary school teachers was to be trained in ICT literacy and integration (MoEST/KSSP, 2006). The training had the following strategic objectives: to build basic capacity in

ICT skills for all players in the education sector; to build capacity of education sector managers to use ICT tools to enable better delivery of educational services; to sensitize all stakeholders on ICT-integration; and to build capacity for use and maintenance of ICT equipment. For ICT teachers and trainers, the plan was to build capacity for at least one teacher in each school to teach ICT, support ICT literacy and integration, support basic maintenance of ICT equipment; and, build the capacity of universities and colleges to equip teachers with ICT skills up to certificate, diploma and degree level. Curriculum and content developers plan was to develop sufficient capacity for curriculum and content, where the developers will have to appropriately infuse ICT in the curriculum and develop digital content to support the curriculum. Universities and colleges plan was to build the capacity of Technical, Industrial, Vocational and Entrepreneurship Training (TIVET) trainers and university lecturers, and to promote the development, adoption and use of ICT tools of production in all sectors of the economy. For ICT implementation to succeed in the educational sector, training of teachers and other intermediaries has to be carried out so that students are assured of the total benefits. Without adequate training and preparation of teachers, ICTs will remain a pipe dream in the schools. Training programmes for the education management sector comprising the entire MOEST, its agencies and institutional managers, will all require training in Educational Management Information System (EMIS). Moreover, rapid change in ICT demands continuous training at all levels.

2.4.1 Research and Development

There is limited research in Africa, specifically in Kenya, to identify and address key challenges that stand in the way of adoption and use of ICT in general and in the education sector in particular (MoEST 2006, p. 4). There is also need to promote local contexts and adopt global solutions. The objectives are: to facilitate research and

development in ICTs in education and training; to facilitate dissemination of research and development outcomes; and, to facilitate development of a legal framework for innovations and related intellectual property rights issues. There will be a link between the public and the private sector to promote local solutions to contextualize global innovations to the local challenges. The creation of a legal framework to protect innovations will motivate people to invest in research and development. Using a research portal for sharing research findings, the outcomes will be more readily available to the public.

Research, monitoring and evaluation are also critical in the process of introducing and implementing ICTs in the educational sector in developing countries. Without enough research and evaluation of the implemented programmes countries cannot make informed judgements on best practices.

2.4.2 Partnerships and Resource Mobilization

Public Private Partnership (PPP) in rolling out a comprehensive ICT strategy with substantial impact. The overall objective for ICT development in this component is to foster a favourable environment and provide leadership for public/private/development partner collaboration. This would lead to effective sector-wide ICT initiatives and coordination.

- **Resource mobilization:** Mobilize human, technological and financial resources for the implementation of ICT in education projects and programmes.
- **Linkages and global initiatives:** Align national ICT in education initiatives with regional and global initiatives to achieve relevancy with the following strategic objectives to promote public and private sector investment in ICT (education subsector); to facilitate annual budgetary provisions for ICT in

education activities so as to help a resource the mobilization strategy for provision of ICT projects and initiatives; to develop modalities for cost reduction of ICT product services; to align ICT initiatives in education within the MDGs under the World Summit for the Information Society (WSIS) plan of action and NEPAD e-schools; and, to encourage cost sharing in which parents and communities contribute in establishing digital infrastructure in schools.

Increased level of resource availability through government allocation for ICTs in education and partner contributions will be achieved. Also clear coordination of ICT initiatives in the education sector will lead to efficiency in service provision. In addition, a strong partnership of public and private sectors will lead to efficiency in service provision and will be enhanced through ownership of ICT initiatives in education (MoE Taskforce 2012, p. 224).

EMIS was developed for collecting and analyzing educational data. Its strategic objectives are: to develop an electronic-based infrastructure to support processing, use, sharing and dissemination of available data and information at all levels; to procure and customize specialized data processing and analysis software; to improve access to education data for effective planning and interventions; and, to avail education indicators for monitoring and evaluation of educational goals and programmes. It should be noted that ICT integration at all levels in the education sector is capital intensive requiring participation of other partners for tangible impact to be felt.

2.4.3 Legal and Regulatory Framework

Education and training in Kenya is governed by the Education Act (1968) and other related legislation including the Teachers Service Commission (TSC) Act, Kenya

National Examinations Council (KNEC) Act, Adult Education Act and Universities Act, as well as respective university charters. The recent Basic Education Act of 2013 established the National Education Board and County Education Boards and stipulates the right of every child to compulsory primary and secondary education and will therefore bring about more expansion and enrolment in primary, secondary and tertiary education. The Cabinet secretary is responsible for the overall governance and management of basic education, (Kenya, Basic Education Act, 2013, p. 248). It is widely understood that ICT has three pillars: e-government, implementation, EMIS support system and ICT integration in teaching and learning. Policy implementation has failed to recognise this and its interrelatedness, (MoE Taskforce 2012, p. 229). Confidence and security are among the main pillars of ICT. MoE aims to promote cooperation with all stakeholders at appropriate forums to enhance user confidence, build trust and protect both data and network integrity.

MoE, in collaboration with other government departments such as Directorate of e-government, Government Information Technology Services (GITS) and the private sector, is expected to direct, respond to and prevent cyber-crime and misuse of ICT. It has the following strategic objects: to establish guidelines governing acquisition and use of ICT resources in education (for instance equipment, privacy, copyright laws, patents and licences); to develop mechanisms for disaster recovery with regard to information/data and for sensitizing the staff at all levels in the Ministry on legal, safety, privacy and security of ICT equipment, data and information; to establish standards for protection of user privacy and community values; to stipulate minimum hardware specifications adequate for educational use; to evaluate and assess appropriate software and related applications that meet basic education needs; and, to

regulate accreditation of institutions offering examinations and certification of ICT learning programmes in all relevant institutions.

Legal, safety, security and strategies to protect ICT systems at all levels of education should be well documented in addition to developing a specification manual for use in deployment of ICT equipment. A uniform platform that allows integration and interoperability of most applications useful in the content delivery of ICT education ought also to be developed. Institutions offering ICT training should be accredited and a clear strategy for course transitions from one level to other needs to be followed, (MoE & MoHEST, Sessional Paper 19th June, 2012).

2.4.4 Technical Support and Maintenance

MoEST (2006) indicates that there is limited capability for effective use and maintenance of ICT infrastructure in educational institutions. Most schools use less than 40 per cent of the available infrastructure and, therefore, there is need to ensure optimum use of ICT resources by students, teachers and administrators in order to exploit their educational potential. Furthermore, few schools are using ICT as an alternative method for the delivery of the education curriculum. Technical support and maintenance has the following strategic objectives: to facilitate and support establishment of the national ICT support centre where technical support will be provided to educational institutions; and, to set up regional ICT support centres equipped with necessary tools addressing issues related to technical support, maintenance and related capacity building at educational institutions (MoEST 2006). The recommended measures will improve institutional and professional capacity for use and adaptation of ICT resources. It will also improve use of ICT infrastructure to over 70 per cent in educational institutions and ensure expanded use

of ICT as an alternative method for delivery of the education curriculum and administration. In addition, there will be improved access and sustainability to ICT support services.

Within the development community there is a strong focus on results, which helps to explain the growing interest in monitoring and evaluation (M&E). Hence, there is need for systematic M&E of all activities. This will assist in learning from past experience, improve service delivery, plan and allocate resources, and demonstrate results as part of accountability to key stakeholders. The objectives will be to check the progress of implementation, to assess if performance indicators are accomplished, and to improve on the implementation. Annual and quarterly performance reports on ICT interventions will indicate whether or not the performance indicators are being achieved. An impact evaluation will help assess the transformation in the educational sector to embrace ICTs.

2.4.5 Computers in Secondary Schools in Kenya

According to *Sessional Paper No.1 of 2005* (MoEST, 2005, p. 3) there are over 4,000 public secondary schools in Kenya. The recent massive increase in primary school enrolment has put pressure on the demand for and access to secondary schools. MoEST remains concerned with the quality of secondary education, which is characterized by poor performance in core subjects such as mathematics and science. Hence, there are obvious benefits for integrating computers into secondary schools as students at this age need to focus on subject-specific content, greater critical thinking skills, scientific enquiry, mathematics, science and languages. They will benefit greatly with the analytical, creative and collaborative power of computers to map out

and analyse assumptions, present ideas and participate in projects with peers from around the country and the world at large.

At the simplest level, ICTs allow for storage and display of information. Foundation skills should be a stepping stone to using ICTs to enhance teaching and learning objectives, while ICT integration concepts can be adapted for secondary school teachers and students. At the highest level ICTs are used to foster designs or construction of integrating projects, whereby students must explore wide range of ideas and resources, analyse and evaluate them, and synthesize them in a project. Using ICTs also fosters exploration of materials and ideas. They allow learners to apply a concept or understanding to a new situation, to analyse ideas by organizing them, and to learn how to evaluate and solve a problem. ICTs can fully utilize the multimedia environment to support this process.

ICT integration will take teachers and students beyond seeing ICTs as computer studies and computer literacy skills. Although these are important skill sets, they are not sufficient in leveraging the true potential of ICTs to improve creativity, innovation and collaboration, the key capabilities in the new knowledge economy. The new assessment criteria should be made explicit to new users as well as the opportunities to experiment and work with the tools towards achieving these criteria. This will ensure that their new knowledge and skills are conceptualized and that they will be more likely retained (MoEST 2005, p. 7).

2.5 Connectivity and Infrastructure Supporting ICT Implementation

Another fundamental issue to consider in development of ICTs in education in developing countries is the availability and access to technologies (Beukes-Amiss 2006, p. 5). While developed countries are past the hurdles of building the necessary

ICT infrastructure, this is a major area to be addressed in developing countries. The telecommunications infrastructure is poor in many African countries; fixed dial-up connectivity is not a viable solution to many countries and especially to schools in rural areas (Hawkins, 2004). Available data which are not as recent or as detailed as needed for many African countries suggest that majority of poor countries in sub-Saharan Africa are lagging behind in the information revolution. Although all the 54 African countries now have Internet (Beukes-Amiss, 2006, p. 5), few are able to keep pace with the developed countries. Basic infrastructure such as telecommunications (digital and satellite) and the availability of computers and other hardware and software is critical.

2.5.1 Connectivity and Network Infrastructure in Kenya

Inadequate connectivity and network infrastructure is a major challenge. Reports indicate that one of the main problems is limited penetration of the physical telecommunication infrastructure in rural and low-income areas. Specifically, limited access to dedicated phone lines and high-speed systems or connectivity to access e-mail and Internet resources is a key challenge. The Educational Management Information System (EMIS) survey (2003/2004) indicated that over 70 per cent of secondary schools require functional telephones as many parts of Kenya cannot easily get Internet services because of the poor telephone networks. About 90 per cent of secondary schools need to establish standard Local Area Networks (LANs) in order to improve sharing of resources. While a small proportion of schools have direct access through Internet Service Providers (ISPs), to high-speed data and communication systems, alternative and appropriate technologies for access to Internet resources, including wireless systems, remain quite expensive.

Furthermore, few schools in the rural areas use wireless technology such as Very Small Aperture Terminal (VSAT) to access e-mail and Internet resources. Nearly all of the 6 NEPAD e-schools are in the rural areas and have connectivity through VSAT technology (MoEST, 2006). The objectives of improving connectivity and network infrastructure : to encourage establishment of cost effective and functional networked computer laboratories in educational institutions; to develop and administer Computer Laboratory Design and Standards (CLDS); to facilitate provision of connectivity to education and training institutions through an e-rate established with service providers; to support sharing of connectivity infrastructure and costs by educational institutions and communities in order to ensure sustainability; and. to leverage the e-government initiative of networking public institutions countrywide to facilitate connectivity for the educational sector. These measures are supposed to improve connectivity and network infrastructure in secondary schools with functional telephone reaching over 70 per cent, and in primary schools to at least 10 per cent. In addition 90 per cent of the secondary schools will have established standard LANS. There will also be improved compliance to CLDS and economies of scale will be achieved by leveraging the use of high-end connectivity and network systems.

2.5.2 Digital Equipment

Literature indicates that a range of ICTs that has been used in the delivery of education to improve access, teaching, learning and administration. This includes electric board, audio cassette and radio for Interactive Radio Instructions (IRI), video/TV learning, computer integrated ICT infrastructure, and Support Application Systems (SAS). These systems are in use at various degrees in most parts of Africa (MoEST, 2006, p. 5).

In the Education Policy Framework (EPF), a number of challenges concerning access and use of ICT in Kenya can be noted (MoEST, 2006, p. 5). These include high levels of poverty that hinder access to ICT facilities, limited rural electrification and frequent power disruptions. Where there is electricity, hindrances to application of ICT include high costs of Internet provision, costs associated with digital equipment, and inadequate infrastructure and support. The policy makes a commitment for provision of digital equipment to educational institutions, particularly colleges, and secondary and primary schools (MoEST, 2006, p. 6).

Literature shows that whereas most secondary schools in Kenya have some computer equipment, only a small fraction is equipped with basic ICT infrastructure. In most cases, the equipment in schools with ICT infrastructure has been through initiatives and support by the parents, government, development agencies and the private sector; this includes the NEPAD E-Schools programme (MoEST, 2006). The strategic objectives for the initiatives are the following: to equip education institutions with digital equipment to stimulate integration of ICT in education in various regions of the country; to support initiatives that provides digital equipment to educational institutions with priority to secondary and primary schools; to establish a national PC assembly centre in Kenya to build computers specifically designed and earmarked for educational institutions; to support refurbishment of ICT equipment; and, to support established mechanisms for disposal of obsolete digital equipment taking into consideration environmental concerns and regulations. These are expected to improve equipping of educational institutions with digital infrastructure in secondary schools up to 80 per cent, and up to at least 10 per cent in primary schools (MoE, 2006).

2.5.3 Digital Content Development

According to the e-government strategy, a timeline was set for implementing e-learning in secondary schools (MoEST 2005, P. 21). In an effort to realizing this goal, MoE partnered with both public (KIE, KESSP, National ICT Innovation and Integration Centre (NI3C), CEMASTEVA) and private (Televic, Intel Corporation, NEPAD, FinExpo) institutions. KIE's role was digitization of the curriculum alongside training of technical expertise needed in these schools (MoEST 2005, p. 24). Although the targeted rollout was 2012, evidence of distribution of digitized curriculum, content and tests had not taken place by that time. However, major contributions had been recognized; the digitization of content for Forms 1 and 2 in secondary schools, which could be accessed via TV, radio, DVDs, computers and mobile phones had taken place. It was also noted that education software are varied and obtained from various manufacturers. The principal challenge therefore is to customize or develop education software to meet local education requirements in teaching, learning and administration.

A more important and critical component is the licensing of education software and related costs which are prohibitive given the high levels of poverty in the country. Furthermore, most textbooks, particularly locally published ones are not available in a digital format and are consequently not available for use in digital media (MoE, 2006). The strategic objectives set by the National Information and Communication Technology for Education and Training (NICT, 2006) to support capacity building of technical expertise to address the digitization of the entire curricula in order to supplement the efforts of KIE secondary education digitization were; to provide digital content to schools in various forms, including interactive CDs for the purposes of integration with the teaching and learning; to establish a mechanism for

development, localization and standardization of educational software; and, to pursue concession on software licences for education institutions (MoEST, 2006).

The above mentioned measures are supposed to facilitate the transformation of the national curricula into a digital format, which will support integration of ICT in education. It is expected that quality and performance of teaching will improve considerably particularly, in mathematics, science and technology subjects.

2.5.4 Harnessing Emerging Technologies

In a study by MoEST (2006), findings indicate that while there is a wide range of innovations in ICTs to support effective and quality delivery of education services and curricula, there is a considerable technology lag in educational institutions. Most institutions still use nearly obsolete systems, which are unable to exploit the educational potential of the emerging technologies. There will be need to come up with mechanisms to encourage these institutions to keep abreast with and to harness emerging technologies to improve effective delivery and quality of educational services and curricula by promoting the establishment of centres of excellence, education and science congress.

The proposed objective of the centres of excellence is to establish an education, innovation and technology centre that will maintain a database for emerging ICT technologies, inventory costs, suppliers and appropriate use. It is proposed that the centres of excellence will carry out sensitization on benefits such as effective teaching and learning emerging from the use of ICT in education, and create and maintain a quarterly ICTs education magazine that will inform educators, especially those in rural areas, about emerging trends and use of new technologies in schools.

2.5.5 Access and Equity

It has been reported that Kenya is characterized by a wide variation in resource endowment, which leads to attendant disparities, (MoE, 2006, p. 7). Use of ICT will expand access and equity in the delivery of education services and curricula. According to MoE (2006, p. 8) the objective of the Ministry of Education is to give priority to disadvantaged areas, communities, educational institutions, teachers and learners. The report outlines the efforts to be made to establish mechanisms to support development of infrastructure in remote areas, the implementation of policies that are favourable to special needs groups, and the budgetary provisions for adequate supply of ICT equipment and facilities. In addition, the strategy contained in the report by the Ministry of Education (NICT, 2006 p, 6) will establish cost effective capacity building for teachers and learners and facilitate ICT centres that allow youth groups to access learning resources. The Ministry of Education objectives are to facilitate use of ICT to access learning resources to disadvantaged areas, communities, educational institutions, teachers and learners; to facilitate universal access and equitable distribution of ICT infrastructure in both the formal and non-formal education sectors, which includes affirmative action for gender and youth, arid and semi-arid lands (ASAL) areas, islands, rural and urban-poor schools, as well as institutions with special needs; to promote access to ICT infrastructure by connecting all remote educational institutions through the Internet; and to support establishment of a National Education Portal (NEP). The main outcome will be the extension of ICT facilities to disadvantaged areas, communities, educational institutions, teachers and learners.

2.5.6 ICTs in Educational Institutions in Kenya

Kenya experiences many of the problems typical of sub-Saharan Africa as enumerated by Langmia (2006, p. 8) in that it is lagging behind in information superhighway technology. In terms of telecommunications infrastructural development, the growth of the fixed telephone network throughout the country has been below expectations (CBS, 2006); the fixed line tele-density (described as the number of fixed lines per 100 people) was 1.02 per cent in 2003. Most of the fixed line subscribers are concentrated in urban areas, which account for 94 per cent, compared to 6 per cent for rural areas (CBS, 2006).

In 2004, the Ministry of Information published the draft national ICT policy aimed at creating an enabled knowledge society by using ICTs to improve the livelihoods of Kenyans (<http://www.information.go.ke>). Thereafter, the Communications Commission of Kenya (CCK) was established by an Act of Parliament in 2009 to facilitate the development of the information and communications sectors and electronic commerce through proper regulations.. Through the licensing of 30 ISPs Kenya has one largest Internet sectors in Africa. The Internet is available in Universities, Internet Cafes, community information centres, and public libraries. Since its inception CCK liberalized the telecommunication sector as a whole and there are private companies entering the market. Currently, there are four private telecommunications companies, Safaricom, Celtel (K) Ltd, Telkom Kenya (Orange), and Eco net Kenya (YU). This eventuality increased telephone penetration dramatically. Cellular services have expanded rapidly from under 15,000 customers in June 1999 to over 30.7 million by March 2013. (<http://www.cck.go.ke/resc/statcs.html>). The government sees education as the natural platform for equipping the nation with ICT skills in order to create dynamic and

sustainable growth (Kenya, Ministry of Information & Communications, 2004, p. 67). In so doing, it believes that use of ICT in education and training institutions can play a major role in disseminating skills to the wider society and thus create positive impacts in the growth of the economy (Kenya, 2004, Ministry of Information & Communications, p. 67-68).

2.6 Application of ICTs in Instructional and Administrative Activities in Secondary Schools

The modern way in which business is conducted, economies driven, and education delivered has changed dramatically as more people are able to choose where and with whom they carry out these activities (Gell & Cochrane, 1996, p. 249). ‘Virtual teams’ can be located around the globe while working together through networked interactions. ICTs have opened windows of opportunity in all areas of life including learning, an area that is continuing to grow. Whereas results indicate that ICT has penetrated many sectors including banking, transportation, communications and medical services, the Kenyan educational system seems to lag behind (Kiptalam, 2010, p. 8). Furthermore, a report by the National Council for Science and Technology (MoEST/NCST, 2010, p. 10) indicates that computer use in Kenyan classrooms is still in its early phases. The report concludes that the perceptions and experiences of teachers and administrators do play an important role in the use of computers in the classrooms so that the student community benefits when the school leadership is keen and participates on ICT implementation.

2.6.1 ICT Curriculum for Secondary School Students and Teachers

ICTs’ potential for school administration and instruction enhances professional productivity. Telem and Barta (1995, p. 13) indicate that the school principals should

be trained to prepare contingency frameworks for ICT assimilation in their specific school situation. Others to be trained were teaching staff, non-teaching staff (the bursar, secretary and librarian) and the students.

The module of ICT literacy is the first stage that is designed for discovering ICT tools, their functions and uses (UNESCO, 2002, p. 37). It comprises the following modules: Basic Concepts of ICTs; Using the Computer and Managing Files; Word Processing; Working with a Spreadsheet; Working with a Database; Composing Documents and Presentations; Information and Communication; Social and Ethical Issues; and, Performing Jobs and/with ICTs. The objectives of the first module, Basic Concepts of ICT, is for students to be able to identify and understand the functions of the main components of a typical information and communication system as well as identify and understand the functions of various peripherals. The second module will help the students use the main functions of the system software environment and to utilise its features in relation to the main applications software being used. They will be able to show competence in using a computer to generate simple things such as posters, banners, signs, invitation cards, calendars and drawings. Module Three, Word Processing, is where students train to use a word processor skilfully and intelligently to produce various readable and structured documents in the subjects they are studying; the ability to use a word processor is necessary in today's society as keyboard skills and knowledge of word processing are an advantage when seeking employment. In Module Four, they should be able to understand and make use of a prepared Spreadsheet; Spreadsheets are useful tools for individual or group work, and are widely used in industry and commerce. Students should understand what a Spreadsheet is and how to manipulate variables. Module Five is on how to use a prepared database in a competent manner, while Module Six is instruction on the use

and composition of graphical representations; a large variety of reports can be illustrated by different graphic representations such as line graphs, or bar charts and pie charts. Module Seven on Computers and Communications trains students on how to use online sources of information as well as the Internet, the World Wide Web and e-mail. For Module Eight, students are to understand social, economic and ethical issues associated with use of computers. The last module is on the awareness of the nature of jobs in ICT and the role ICT plays in the changing job market.

The importance of ICT for education has increased over the past few decades. There have been major transformations occurring in formal education sector as well as in other areas that are important for enabling new capabilities necessary for the knowledge society (Mansell & Wehn, 1999; Butcher 2003, p. 74). These changes are partly due to the development of ICTs as well as the forms of networking, knowledge sharing and interactive learning that ICTs facilitate. Haddad & Draxler (2002) note that change is required for schools and education systems that were originally developed in the context of the industrial age and which must now meet the educational needs of the current global knowledge environment.

2.6.2 Benefits of ICT in Schools

The high expectation of the role that ICT plays in schools places both opportunities and challenges for those involved in its implementation and application for teaching and learning. A case study was carried out on the integration of ICTs into schools in the United Kingdom (Tearle, 2003, p. 568). It set to find out why some schools had managed to embrace the use of ICT in teaching and learning within many subject areas, while others with the same resource allocation and determination had struggled without much success. The research findings established the following as factors that

influence ICT implementation: external influences; the characteristics of the whole school, its staff and internal processes; the ICT implementation process; and, the model.

In the findings of the above study, *external influence* featured strongly. This referred to the way the school reacted and responded to available opportunities. Schools with a strong lead from the principal were found to be at the forefront of implementing the ICT British National Curriculum positively, and adjusting the necessary budgets, support structures, development plans and teaching programmes.

Another finding was the *characteristics of the whole school, its staff and internal processes*. The culture that the school aimed to promote came out strongly from paper and Web-based documentation as well as discussion with staff. There was a balance between the extrinsic and intrinsic motivation of individual staff members who had a strong sense of 'social obligation'. The strength of awareness of the high expectations of each member of staff could not be overemphasized. In parallel to this was the equally strong feeling that the individual staff wanted to keep striving for excellence, including the application of ICT in their own context.

Further, the study established that ICT implementation is a process with important characteristics. These characteristics included *preparation and planning, quality management and leadership*. It encompassed access to resources, training and support. It also recognized that development takes time and cannot be hurried and that it builds the need for a shared responsibility and ownership.

Consequently, the model for the implementation was one where ICT development started off in a small way and gradually built up (Tearle, 2003 p. 567). This was achieved through the use of the natural grouping of departments. Within each

department, an ICT link person was identified to move the process forward at a local level. ICT implementation was built on the interest and expertise of the existing ICT users in the school. This was important in the terms of the progression to meet the changing needs of those involved and to ensure the process was well embedded in its own specific context. Ownership and responsibility was also a key feature with departments being given access to resources and training to meet their requirements.

The issues that characterized the ICT development process and influenced the way in which events collectively or individually impacted on the use of ICT for teaching and learning were quality of people, resources, training and support. *Quality of people* was mentioned repeatedly in connection with various members of the ICT teams, in particular the ICT coordinator and network manager. *Resources* featured in all aspects of data collection. There was also need for subject specific software. *Training* was described as a continuum of learning, mainly achieved through working with colleagues in the department. *Support*, especially from the department, was very important, while other forms of support, such as encouragement from senior management and practical help from students with ICT skills, were noted. However, of these forms of support, the support of colleagues in the department came out the most strongly.

What emerged in the literature reviewed suggests that ICT implementation has more in common with the implementation of any new educational initiative than is commonly credited. While ICT has its own unique properties and additional requirements, the need to address the fundamental requirements of change management is inescapable. The studies addressed 'implementation' of ICT into 'working practices'. The question raised was, 'Does implementing ICT suggest that

this is just adding an extra tool for teachers to call on, like using an overhead projector (OHP) or whiteboard instead of a blackboard or being able to find information from a computer as well as the library?’ The literature revealed the notion of change as a staged process that is emphasized. The study findings (Tearle, 2003) bring out a model which allows emphasis to be on the learning culture and vision of the school organization as a whole. Built into this whole school culture is the recognition that change provides positive learning opportunities, but it takes time and makes demands on people and resources.

2.6.3 Distance Learning

It has been established that ICTs remove the constraints of distance, time and location (Gell and Cochrane, 1996, p. 252). ‘Micro- hybridisation’ of detailed educational activities is evidenced by the widespread introduction of modular courses which allow the integration of previously separate subjects to meet specific industry, business and lifestyle needs. Online self-learning packages give students greater individual control since effective learning can be realized by providing a student with a computer and loading the educational software. Dutton (1996, p. 254) further states that developments in multimedia, increased communication and other ICT innovations are key components of the information society prompting Drucker (2009) to suggest that in this era, managers, educationists, teachers and researchers, students and policy makers have to adapt to ICTs. Distance learning, including lifelong learning, has an important advantage over traditional educational instructions because the operating environment compels them to develop forward-looking and responsive capabilities. The synergistic relationship of education, training, knowledge and business has become essential for their mutual survival and prosperity. The transformation of

education and training will bring together numerous opportunities to those active in building the new flexible learning and creativity structures.

2.6.4 Multimedia and Enhancement of Education

It is evident that there are many libraries and information resources accessible online, creating opportunity for ICTs availability in schools and for learning purposes. CDs also provide vast stores of information. There are single discs containing thousands of works of classical literatures including the complete works of William Shakespeare or comprehensive encyclopaedias. Interactive CDs can also allow students to ‘visit’ virtual museums, zoos and landscapes so that they can make their own video-diaries of what they see. Such electronic capabilities continue to expand inexorably. Traditional libraries based on the world of paper trying to keep pace with volumes and shelving space can no longer be sustained (Dutton, 1996). In most libraries, information is out of date, outmoded, disorganized and irretrievable. Online electronic libraries and CDs are faster and cheaper to use.

Literature findings indicate that the most useful feature of a paper-based library, museum or gallery is serendipity (the possibility of discovering something by chance), and cross-correlation of thoughts and ideas. There is opinion that electronic libraries are capable of achieving similar benefits, and also making it possible to view multiple documents and pages simultaneously. The libraries of old are eclipsed as the traditional paradigm of the printed page is expanded into virtual ‘hyperspace’ in which documents have layers of detail, extensive and flexible cross-linking and great adaptability. Multimedia such as video, added sound, animation, modelling and technologies of tele-presence and virtual reality introduce richness needed to move from world of information to an ‘experience world’.

Deducing from the above, it can be noted that, since the industrial revolution, education has moved through three lines of an old Chinese proverb:

I hear and I forget

I see and I remember

I do and I understand (Dutton 1996, p. 260).

Literatures reviewed indicate that it has become important for lectures to be supported by physical demonstrations and hands-on sessions as classes become larger. Since the introduction of free primary education in Kenya, classes have become large, some having as many as 80 students. Furthermore, the introduction of free secondary school education with effect from year 2008 showed that secondary school classes become even larger (KNBS, 2012. P. 39). ICT allows a wide range of information to be on the screen. Simulation software and multimedia products as well as animation are interactive and offer capabilities which can help students understand and analyze complex issues. Dutton (1996, p. 260) points out that experimentation and interaction with simulations on the screen reduce the need for expensive physical laboratories. In addition, Artificial Intelligence (AI) techniques can be used to build systems that provide built-in expertise and knowledge to assist the students to learn or to create 'software agents' that anticipate their needs and are pro-active on their behalf.

Literature reviewed indicates that there is widespread belief that ICTs will empower teachers and learners, transforming teaching and learning processes from being highly teacher-dominated to student-centred. This transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills, communication skills and other higher-order thinking skills. There are other several

reported benefits of introducing and using ICT as part of teaching and learning process. Laferriere, Breuleux and Bracewell (1999, p. 2) argue that there are significant benefits in using ICT as part of teaching and learning process as long as teachers recognize the relationship between the use of ICT and the overall curriculum. Beukes-Amiss and Chiware (2007) further indicate that there is need for integrating ICT across the curriculum unlike the old version of teaching about it. For this to be successful, there must a thorough curriculum planning on adoption of the ICTs in learning processes. Roberts (2000) points out that use of technology enhances teaching and learning while at the same time creating access to a variety of educational materials. The above as well as other potentials of ICTs cannot be fully achieved if there is no effective educational policy in place which has enough and relevant content. This calls for ICTs' friendly policy which prioritizes professional development and decides how ICT will be integrated into the educational institutions (Haddad and Draxler, 2005).

In an attempt to highlight some of the negative aspects, Haddad and Draxler (2005) caution about the demands that ICT use places on teachers in that they need to cope with new technology use in their classrooms and know how to use various applications to enhance the teaching and learning process. The Canadian Teachers Federation (CTF 2005) urges education to take the 'why' into account before introducing technology into classrooms, implying that technology is not the answer to all educational problems, and that it should be critically appraised before implementation. Roberts (2002) also warns about the role of technology in the classroom in that "nobody should believe that technology is the quick-fix for what ails education." Although the Ministry of education, Kenya has developed policies and guidelines for ICT implementation that will assist in making ICT implementation a

success, a lot of co ordination still needs to be done, (MoE 2005 MoEST 2006, Kenya National ICT Policy, 2006. Kenya Constitution 2010, and MoE Task Force 2010,).

The impact of the diffusion of ICTs into educational practices in a review carried out in Namibia secondary schools, (Beukes-Amiss and Chiware, 2007) reported valuable benefits that educational planners in Kenya can benefit from, but also reveals several challenges during the process of ICT integration into educational practices that need to be addressed. The findings indicate that many ICT education initiatives in developing countries seek to place ICTs as central to teaching and learning (Beukes-Amiss and Chiware, 2007, p. 14).

Other difficulties of technology use in education are that people think of the technology first and then investigate educational applications of the technology only later (Info-Dev., 2005). It is believed that specific uses of ICT can have positive effects on student achievement when ICTs are used appropriately to complement a teacher's existing pedagogical philosophies. Computer Aided Instruction (CAI), which refers to student self-study or tutorials on PCs, has been shown to improve student test scores on reading and mathematics skills.

Literature indicates that ICTs are seen to be less effective when goals for their use are not clear. Uses of ICTs for simulation and modelling in science and mathematics have been shown to be effective as well as word processing and communication software (e-mail) in the development of student language and communication skills. In studies that rely on self-reporting, most users feel that using ICTs make them more effective learners (Info-Dev., 2005).

Deducing from the literature reviewed, there is a general consensus that both teachers and students feel that ICTs use greatly contributes to student motivation for learning. Students who use computers at home also use them in school more frequently and with more confidence than pupils who have no home access (Info-Dev., 2005).

2.6.5 Contribution of ICT to Development

The literature reviewed indicated that education is a prerequisite for achieving several development goals. Research has shown that education is positively associated with a wide variety of human welfare issues that are seen as development goals (GeSCI, 2004, Info-Dev 2005,). For instance, Lockheed et al (1980, p. 36) found that in a modernizing environment, four years of education improved agricultural productivity by 10 per cent. If used correctly, ICTs can encourage and support two-way informational flow between teachers and learners, moving away from the method of teaching where knowledge is simply transferred from teacher to student without any space for critical analysis on the part of the learner (Wims and Lawler, 2007, p. 2). Using ICTs in education to produce ICT literate students and a versatile, adaptable workforce is also consistent with the human capital theory of education (Hawkins, 2002, p. 39).

Findings indicate that there are several ways in which ICT can contribute to solving education problems in developing countries, the most pertinent of which include shortage of qualified teachers. GeSCI (2004) estimated that as many as 25 per cent of teachers in sub-Sahara Africa are not adequately qualified. It indicates that ICTs can accelerate teacher training.

Introducing ICTs can help to counter some of the negative factors that are endemic in many schools in developing countries, such as high pupil teacher ratios, shortage of

basic instructional materials, and poor physical infrastructure. Research on the Digital Education Enhancement Project in the Eastern Cape of South Africa (Leach, 2003) found that ICTs had a positive impact on pupil achievement and classroom practices. There is also opinion that ICTs can be used to make the school curriculum more interesting. It has been established that children enjoy learning using technology (Hepp et al., 2004; Osin, 1998). This motivation may deter children from dropping out of school.

Distance learning can help to overcome the problems associated with geographical isolation and is invaluable for students in remote areas. ICTs serve to counteract physical distances as teachers can maintain contact with students, family and friends through telephone and e-mail. Literature reviewed indicates that study and teaching materials are very sparse in many schools in developing countries; hence, ICTs can play a significant role in providing teachers and students with access to educational content and up-to-date resources (AIS, 2012, Beukes-Amissand Chiware, 2007, Chiware, 2002, Forkosh-Baruck, Mioduse & Tubin, 2005, Info-Dev, 2005)).

The issues raised above lead to the conclusion that education is one of the avenues that result in development. This relationship was summarized by Kofi Annan, former Secretary-General of the United Nations (cited in Wims & Lawler, 2007, p. 3) when he asserted that: “While education unlocks the door to development, increasingly it is information technologies that can unlock the door to education.”

2.7 ICT Policy Framework for Education

Literature reviewed indicates that, while many ministries of education around the world have made commitment to computerize schools, few have developed coherent strategies to fully integrate the use of computers as pedagogical tools in the classroom

(Hawkins, 2004, p. 3; Beukes-Amiss, 2006, p. 5) The main impediment to the sound development and implementation of ICTs in education in developing countries, and Africa in particular, remain lack of policy frameworks to guide the whole process (Beukes-Amiss, 2006, p. 4). Nevertheless, some countries have formulated broad ICT policies to cover a number of areas in which ICTs are seen to be important in sectoral applications such as health, tourism, mining, education and e-government. In Southern Africa, Mozambique and Namibia are examples of countries that have instituted ICT policy processes in which education and skills development are covered in the ICT policy. Establishing such policies has clear implications for use of ICTs in education. It has potential to set up an environment in which effective educational applications can evolve, as well as eliminating duplication. However, if such policies are not carefully integrated within existing educational policies, they run the risk of leading to educational choices that are driven by technological preference rather than educational need (Beukes-Amiss, 2006, p. 5).

ICTs are a big burden on any educational establishment especially in developing countries. For governments to succeed there is need to create the necessary partnerships with stakeholders who have funds, and are willing to support the initiatives. The experience coming from developing countries indicate that such partnerships are indeed possible and have worked where bold steps have been taken to initiate such partnerships.

2.7.1 ICT Policy Framework for Education and Training in Kenya

According to the National Information and Communication Technology (NICT) Strategy for Education and Training (2006) prepared by the MoE, ICTs will be adopted and utilized to improve access, quality and equity in the delivery of education

services in Kenya. The strategy is based on the vision that “ICT is a universal tool in education and training.” The mission statement that inspires it is, “To integrate ICTs in education and training to improve access, learning and administration” (MoE, 2006, vii). The overall objective of the strategic plan is to ensure that systematic efforts are made towards strengthening adoption and use of ICT in the education sector with appropriate attention given to education development priorities as outlined in the Economic Recovery Strategy for Wealth and Employment Creation (Kenya, *Sessional Paper No. 1 of 2005*). The plan proposes that ICT can address issues of access, quality, equity and relevance of education at all levels. In addition, it has potential to support the implementation of Free Primary Education (FPE) and to address emerging issues such as overcrowded classrooms, high pupil teacher ratios (PTRs), particularly in the densely populated and semi-arid areas, shortage of teachers, and high cost of learning and teaching materials (MoE, 2006, p. vii).

The *Strategic Components of the Policy Framework for Education in Kenya* outlines areas for integration of ICT in education in order to address the above-mentioned challenges and to secure the position of the nation as concerns the rapidly expanding education requirements and the global economy. These areas are: establishment of policy framework; digital equipment; connectivity and network infrastructure; technical support; harnessing of emerging technology; digital content development; integration of ICTs in education; training (capacity building); research and development (R & D); and, partnerships and resource mobilization.

The vision of MoEST Kenya is to facilitate ICT as a universal tool for education and training (MoEST, 2006). In order to achieve this vision, every educational institution, teacher, learner and the respective community should be equipped with appropriate

ICT infrastructure, competencies and policies for usage and progress. It calls for recognition of the fact that ICT provides capabilities and skills needed for a knowledge-based economy. It also calls for transforming teaching and learning to incorporate new pedagogies that are appropriate for the 21st century. The objective of MoEST is to integrate ICT in the delivery of education and training curricula.

2.7.2 The Need for Planning

Research findings indicate that the major impediment in establishing successful computer based applications in schools is lack of careful planning (Picciano, 1998, p. 7). The research carried out in US schools indicated that a substantial percentage of teachers made little or no use of computers in teaching (Becker, 1994, p. 10). Although a lot of equipment had been acquired, its effectiveness in the classroom was in question. While problems of hardware cost and software development and acquisition were being resolved, other problems such as curricular integration and staff development remained unaddressed (Maddux & Harlow 1992, p. 10).

There is opinion that planning for computer technology in schools requires concentrating on a total application. By choosing an application and asking what is needed to make it successful, educators will naturally have to consider some questions regarding hardware and software as well as other components such as staff development, curricular integration, facilities and maintenance (Picciano, 1998, p. 10).

Another important aspect in planning is evaluation and feedback. Although schools have implemented computer applications, few have evaluated them in terms of achieving the intended goals and objectives (Picciano, 1998). Evaluation in education is not easy, given the variability of human conditions and skills. Since diffusion of

ICTs is a new approach to education, administrators need to assess what works or does not work in their schools. Furthermore, what is successful in one school may not be successful in another. Evaluation will identify strengths and weaknesses in all the various components of an application within a specific operating environment; for example, excellent hardware with poor software will likely not result in a successful application, nor will excellent hardware and software assure success without staff who knows how to use them properly. All components depend on each other and a weakness in one affects all the others.

2.7.3 Integration of ICTs in Education

While other countries have reported up to 41 per cent of integration of ICT to teaching and learning, the proportion remains substantially low in Africa Kenya included (MoEST, 2006). Integration aims at the use of ICT in supporting teaching and learning in the delivery of various curriculums to achieve improved education outcomes. Because ICT is interactive media, it facilitates students to develop diversified skills needed for industrialization and a knowledge-based economy. It allows teachers and learners to proceed at different paces depending on the prevailing circumstances.

The strategic plan recognises that integration of ICT to teaching and learning will also play an important role in preparing students for the demanding job market. It further recognizes that the education sector needs to be proactive in meeting the requirements for ICT skills. The strategic objectives outlined are: to establish model institutions that will be used to demonstrate integration of ICT to teaching and learning; to train at least 20 master integrators to support integration at the national and district levels; and, to train teachers on integration techniques and sensitize education managers on

ICT integration, (MoEST, 2006 p. 6). The expected outcome includes an increased rate of educational institutions that have integrated ICT in the delivery of educational curriculums. There will be improved performance in education and examinations as well as enhanced transition rates at all levels of education.

The teacher/student learning pedagogy paradigms have shifted in the 21st century where learning has changed from being teacher centred to being learner focused (Anderson, 2005, 4). The workplace will need people who can analyze, transform and create information to solve complex problems using ICT (Bereiter and Scardamalia, 2008). Introduction of, ICT in schools will result in a new learning environment with some changes in student and teacher roles in the emerging learning environments (Intel, 2008, 11). In effect, ICT is contributing to changing the whole structure of the school. 'Closed door' classrooms are stretching their walls to embrace instructional emphasis that is moving from memorizing facts to inquiry based learning. The rigid classroom timetables are becoming less rigid (Intel, 2008) demanding that students learn by other means such as reading, research and project work that encourages enquiry based learning, problem solving and critical thinking.

The 21st century workplaces demand workers who will be able to analyze, transform and create information, which will collaborate with co-workers to solve problems and make decisions, as well as perform a variety of complex tasks using sophisticated technology (Intel, 2008, p. 12). Hence, 21st century school students are those who work on complex challenging tasks that require them to think deeply about subject matter and manage their own learning, collaborate with peers, teachers and experts on meaningful tasks using higher order thinking. They will use technology to make decisions, solve problems and create new ideas. To help them achieve levels of full

participation in their communities, teachers must focus on contemporary skills that will help them adapt to the changing society and technology. Teachers must help students to develop the following skills that are needed for success in the 21st century as listed below, according to Intel, (2008) who have been dealing ICT integration in schools in Africa:

- Accountability and adaptability – Exercising personal responsibility and flexibility in personal, workplace and community contexts, setting and meeting high standards and goals for one's self and others.
- Communication skills – Understanding, managing, and creating effective oral, written and multimedia communication in a variety of forms and contexts.
- Creativity and intellectual curiosity – Developing, implementing and communicating new ideas to others, staying open and responsive to new and diverse perspectives.
- Critical thinking and systems thinking – Exercising sound reasoning in understanding and making complex choices, understanding the interconnections among systems.
- Information and media skills – Analyzing, accessing, managing, integrating, evaluating, and creating information in a variety of forms and media.
- Interpersonal and collaborative skills – Demonstrating teamwork and leadership, adapting to varied roles and responsibilities, working productively with others, exercising empathy, respecting diverse perspectives.

- Problem identification, formulation and solution – Ability to frame, analyze and solve problems.
- Self-direction – Monitoring one’s own understanding and learning needs; locating appropriate resources, transferring learning from one domain to another.
- Social responsibility – Acting responsibly with interests of the larger community in mind, demonstrating ethical behaviour in personal, workplace and community contexts. (Intel, 2008, p. 13)

2.7.4 ICTs and Education in Africa

The development of local content is a goal expressed under SchoolNet Africa. The design and development of course materials must be seen as prerequisites. Although they are costly, they can be updated frequently and delivered rapidly, besides reducing paper costs. Development of local content is posited for political, social and pedagogical reasons. Apart from new knowledge, capacity building includes development in the use of critical thinking skills through both developing and critiquing local and international content.

Reviewed literature shows that uses of ICTs in education in both developed and developing countries are seen as increasingly widespread and continually growing (Beukes-Amis and Chiware, 2007). While there is a great deal of knowledge about how ICTs are used in developed countries, there is not much information on how they are being introduced in schools in developing countries. However, from the literature available, there is a digital divide between Africa and the developed world.

The establishment of school networking projects in Africa is an opportunity of addressing education problems in the continent and bringing the youth into the global information society. Beukes -Amiss and Chiware (2007, p. 3) see the evolution of school networking initiatives in more than 23 African countries as a potential for reducing the digital divide. Two ICT initiatives that cut across and have been outstanding in introduction and implementation of ICTs are SchoolNet Africa and NEPAD E-schools Initiative. SchoolNet Africa (SNA) is an African-based non-governmental organization, which promotes learning and teaching through the use of ICTs in partnership with national SchoolNets in 28 African countries (Beukes-Amiss and Chiware, 2007, p. 3). The aim of SNA interventions vary across projects and regions. For some, the aim is to increase exposure to computers through leisure and social use. Others require tangible changes to content and curriculum. Most of initiatives however aim to improve communication and access to information through connectivity.

Application of ICTs in African schools range from offering optional courses in computer studies to a plan to introduce ICT as compulsory, non-promotional subjects for all learners from grades 1 to 12 as is the case in Namibia. In some countries, SNA works towards national education goals for the development of the curriculum to include computer education; for example, the application of ICTs in schools and rural training centres in Lesotho (IDRC, 2003, p. 17).

SNA believes in the right of all African youth to education and lifelong learning possibilities. To affirm this, it supports the right of every African child to have access to education, information and knowledge, affordable and sustainable ICT access, and the creation of locally developed and digitized education content that can be accessed

online through the Internet. In its Global Teenager Project, pupils and teachers in schools are actively involved in online discussions on issues such as the impact of globalization, the impact of HIV and AIDS, and other topics that cover the objectives of the MDGs, targeting the provision of ICT skills. These result in a virtual network of secondary schools in both developing and developed world in creating an upcoming generation of information literate, knowledge oriented, culturally awareness individuals (Were & Ouko, 2007, p. 33-34).

NEPAD E-Schools Initiative was introduced to address challenges facing African countries and has identified ICT infrastructure as a priority area of action for inducement of conditions for sustainable development (MoE, 2006, p. 4). In 2003, NEPAD prioritized efforts towards reducing the digital divide between Africa and the developed world. One of the areas identified is the NEPAD E-Schools Programme whose objective is to integrate ICT in the delivery of education curriculum at secondary and primary school levels in order to improve access, quality and equity in education among member states. The NEPAD initiative is represented in 20 African countries, each with 6 schools (NEPAD, 2003). The major objective of the project, which is run under the auspices of the e-Africa Commission, is to convert the over 600,000 schools on the African continent into e-schools with the aim of ensuring that each youth graduating from an African high school would be ICT literate by 2008 and each child graduating from an African primary school would be ICT literate by 2013. The e-Africa Commission spelt out the specific objectives of the initiative as: to provide ICT skills and knowledge to primary and secondary school students that will enable them to function in the emerging information society and knowledge economy: to provide teachers with ICT skills to enable them use ICTs tools to enhance teaching and learning; and, to provide school managers with ICTs skills so as to facilitate

efficient management and administration in the schools. Key areas identified were computerization of the schools, including administration and management, connectivity, curriculum and content development, and training of trainers.

A typical NEPAD e-school has the following attributes: is connected to NEPAD e-school network, is equipped with ICT (computers, TV sets, radio sets, telephone and telephone lines, fax machines and digital cameras, VCRs, scanners, photocopiers, communication terminals, etc.), conducts teaching of ICTs skills in accordance with a given curriculum content; enhances the teaching and learning of all subjects by use of ICT tools; accesses the World Wide Web; has teachers who have been trained to teach and use ICT skills; and, employs ICT for management and administrative tasks (e-Africa Commission, 2003). NEPAD e-School initiative provides a school with a minimum set of ICT tools necessary to improve and accelerate the provision of education (Were and Ouko, 2007). Kenya is still at a stage where not much has been achieved.

2.8 Challenges Facing ICTs in Kenyan Schools

While ICT continues to advance in Western and Asian countries, African countries still experience a lag in its implementation and thus continue to widen the digital divide. The challenges that prevent schools in Africa from using computers as tools for teaching and learning have been documented as lack of ICT policies, insufficient funds, lack of enough computers, lack of computer literate teachers, lack of teacher competence in integrating computers into different areas of learning, and absence of properly developed curriculums for teaching computer skills (Beukes-Amiss, 2006). Similarly, Kenya as a developing nation has continued to lag behind in ICT implementation in secondary schools as documented by the Ministry of Education

Taskforce (2012). Mungai (2011) highlighted some of the challenges experienced as follows:

- **Lack of computers:** Cost of computers is still very high despite the efforts by the government agencies, corporate organizations and individuals to donate them to schools. There still remain a big percentage of schools that is unable to purchase computers for use by teachers and pupils. Majority of schools and individuals cannot afford to buy a computer and consider it as a luxury item; it is more expensive than a TV set.
- **Lack of qualified teachers for ICT in schools:** The demand for ICT learning has been tremendous such that teachers trained to teach ICT cannot meet the demand. There are more students willing to be taught computing skills than the teachers.
- **Lack of electricity:** Many schools are still not yet connected to electricity. The government has not been able to connect all parts of the country to the national electricity grid. Consequently, the schools that fall under such areas are handicapped and are not able to offer computer studies.
- **Fear by the administrators:** There is still a strong perception, especially by older generation, that computers require highly skilled personnel to operate them. Moreover, some school administrators fear that their students will be exposed to adult and other undesired sites through the use of the Internet. Some also fear infection of their computers by viruses, which could lead to data loss.
- **Fear by the teachers:** the teacher may fear being rendered irrelevant by the introduction of computers in the classroom.

- **Lack of Internet or slow connectivity:** Most schools are not able to connect to the World Wide Web due to the high cost of connectivity.
- **Broken down computers:** While some of the schools have benefited from donated used computers, they have not been provided with adequate maintenance and repair facilities. It is common to find a school computer lab full of broken down computer. The government has however put in strict measures against any person, NGO or corporate bodies that donate second-hand computers, which is seen as dumping of e-waste.
- **Obsolete computers:** It is common to find schools using very old computers (e.g., running on Win98 or Win95). These lower the morale of both teachers and students.
- **Burglary:** Since computers are still very expensive in Kenya, they are targeted by thieves who usually have ready markets. This has made schools incur extra expenses to burglar proof the computer labs.
- **Increased moral degradation:** Internet pornography, cyber bullying and other antisocial behaviour is a worrying emerging problem.

2.9 Conceptual Framework

A conceptual framework is a diagram that represents and interprets the underlying theory and concepts of a research (Ludy, 2000). It is a presentation of variables that interrelate with one another as perceived by the researcher to highlight the relationships. In addition, a conceptual framework is a written or visual presentation that explains graphically or in narrative form the main things to be studied, the key factors, concepts or variables, (Miles and Huberman, 1994, p. 18).

McConnell's E-Readiness tool was found suitable for establishing five interrelated attributes for the study. These were identified as (1) human capital, (2) ICT infrastructure and connectivity, (3) e-leadership, (4) ICT policies, and (5) information security. The study established those variables that boosted capacity for a sustainable ICTs implementation. The objectives formulated to meet the set out goals were: the training of staff; connectivity and infrastructure; establishing level of e-readiness and access to ICTs; and, attributes that supported ICTs implementation in the secondary schools. E- Leadership was explored through policies on ICT from the Ministry of Education (MoE) and interviews with the school principals. There was also need to establish the human capital, which was measured by the level of education and of the principals, computer teachers, and teachers, and the ICT training that they had received. The conceptual framework is presented in Figure 3.

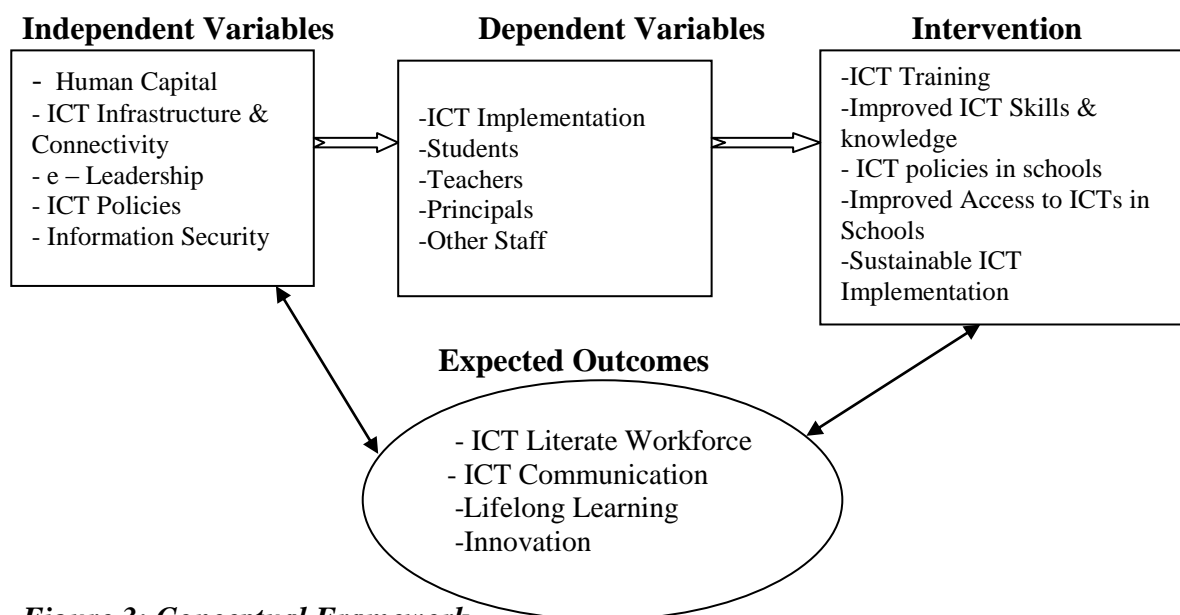


Figure 3: Conceptual Framework

2.10 Conclusion

The literature reviewed indicates that sustainable implementation of ICTs in secondary school education is complex and involves many factors. No one theory can

adequately cover or explain diffusion of ICTs in the secondary school sector. Advocated theories tend to emphasize and address certain factors while neglecting others. Based on this, it is inevitable to examine these theories and use a combination of them to address ICTs integration into secondary schools in Nairobi County.

Diffusion of Innovations (DOI) was used to depict ICTs implementation as a new idea in secondary school education. The ITAF assimilation framework (Forkish-Baruch, 2007), which caters for ICT integration in the education, has been advanced from Open Systems Theory (Kast and Rosenzweig, 1985) which includes the managerial, structural, psychosocial, goals and values, and technical issues. This theory was advanced to cater for ICT integration in the education sector (Forkish-Baruch, 2007). Some of the factors in managerial functions are the policies from the Ministry of Education direct ICT implementation and the school management. School structures include e-readiness, involving ICTs infrastructure, roles of staff and students and their contributions, information workflows, and rules and procedures. Psychosocial factors deal with human resources, communication and group dynamics including peer influences. Goals and values include the vision, mission, ethical and legal considerations as well as security issues. Technical issues that come into play are the facilities, purchases and maintenance of the facilities and equipment.

The ICT implementation model developed by UNESCO provides an integrated framework that explains ICT assimilation in secondary schools into different integration frameworks starting from the emerging stage at the beginner's level, to applying, infusing and finally transformation when students, subject teachers and the school systems have fully integrated ICT in every aspect of teaching, learning and school administration.

The literature reviewed explored the objectives set out for the study. The first objective was the factors that determine the e-readiness that included infrastructure and connectivity, digital equipment, content development and availability of ICTs that make ICT implementation in the schools a reality. The second objective was an exploration of application of ICTs for instruction and administrative activities. The first stage involves ICT literacy when students and teachers learn basic concepts (i.e., the main functions of information systems). They progressively learn to utilize the application software to produce documents, use word processing and Spreadsheet, and prepare databases and graphical representations. Third objective was on the ICT policies globally and nationally. The Kenya, Sessional Paper No 1 of 2005 set out policies and guidelines, while Strategy and Training (2006) proposed integration of ICT to the education systems. Recent guidelines are outlined in Kenya Vision 2030, the *Kenya Constitution, 2010* and the Taskforce on the Education Sector (MoE, 2012).

The fourth objective was on training and capacity building, which is an integral part for sustainability of ICT implementation in schools. Technical support and maintenance is an important factor for back-up for ICT in the schools. The last objective was on the various challenges facing use of ICTs in secondary schools. Computers are still very expensive, there is lack of qualified teachers and other personnel, technophobia by school administration and teachers, and computer theft. Chapter three describes the research methodology, population, sampling and data collection procedures for the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The aim of the research was to investigate a sustainable implementation of ICTs) in secondary schools in Nairobi County. The main focus of the study was on levels of e-readiness of the schools, application of ICTs, governing policy frameworks, training and capacity building, and the challenges experienced. This chapter discusses the research designs adopted, their suitability and application, and data collection and analysis

3.2 Research Design

Mixed method research design was adopted for the study. This is a design with philosophical assumptions as well as methods of enquiry (Creswell & Plano Clark 2007, p. 5). This approach has been identified as a multi strategy research (Bryman, 2004, p. 454-455) and multiple methods of data collection (Denzin, 2009; Stake, 1995; Yin, 2003). It was found necessary to elicit information needed from different categories of informants. It focuses on collecting, analyzing and mixing both quantitative and qualitative data in a single study or series of studies. Its central premises are that the use of quantitative and qualitative approaches in a combination provides a better understanding of the research problem. Different but contemporary data on the implementation of ICT programmes in the secondary school sector in Nairobi County was obtained, and was collected from different categories of respondents who were selected based on the proposed objectives of the study. Mixed

methods research, therefore, overcomes the deficiencies presented by one data collection method.

Mixed method was considered suitable because it attempts to make legitimate the multiple uses of approaches rather than restricting or constraining the researchers' choices as Johnson and Onwegbuzie (2007, p. 14) indicate. Philosophically, it is based on pragmatism and is a practical and outcome-oriented method of inquiry that offers methodological mixes that can help the researchers answer many of the research questions.

Mixed methodology evolved as a third methodological movement, or the "third wave", the research movement that moves past the paradigm wars by offering a logical and practical alternative where qualitative and quantitative data are used in the same research (Creswell and Plano Clark, 2007, p. 5). It was found necessary to use both qualitative and quantitative data through use of closed and open ended questionnaires, scheduled interviews and observation of the computer labs and offices where ICT was used for learning, instruction and administrative purposes in the schools. This was to assist in eliciting responses of how ICTs were used by the respondents identified, which comprised school principals, teachers, computer teachers, students and non-teaching staff.

Mixed methods allows for triangulation design. Both quantitative and qualitative data collection methods are employed to address the research problem. The intention of using design was to bring together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends and generalizations) with those of qualitative methods (small *N*, details, in-depth) (Patton, 1990). Survey research method was adopted for 4,559 student respondents. Purposive sampling was

used for other respondents who comprised school principals, teachers, students and some non-teaching staff. From this population, a sample size of 1,380 respondents was selected using the different sampling methods discussed.

Data was obtained in either formal or informal settings and involved verbal (oral or written) or nonverbal responses. Since this research was intended to generate rich data concerning sustainable implementation of ICTs, it was necessary to use multiple methods of data collection as guided by Yin (2003). Data collection methods that yielded qualitative data included structured interviews with the school principals and computer teachers, direct observation of classrooms and computer labs, and participant observation in the staff rooms. In addition, quantitative methods mainly used questionnaires to collect data from teachers, students and non-teaching staff.

3.3 Study Area

The study was conducted in secondary schools in Nairobi County. Nairobi County was selected as it has schools that have similar characteristics with other schools in Kenya. Nairobi County has public and private secondary schools that are differently endowed with facilities. The study considered girls', boys' and mixed secondary schools that are the face of Kenyan secondary schools. There are 126 secondary schools, distributed in three administrative districts of Nairobi East, Nairobi North and Nairobi West, which are further grouped into eight divisions - Embakasi, Makadara, Langata, Dagoretti, Westlands, Starehe, Kamukunji and Kasarani. Figure 4 shows the educational divisions in Nairobi County.



Figure 4: Map of Nairobi County (Educational Divisions)

Source: Nairobi County mapping, 2013

3.4 Study Population

A population is the aggregate of all cases that conform to some designated set of specifications (Nachmias and Nachmias, 2007, 179). The study population consisted of all secondary schools in Nairobi County (126 of them), comprising 55 public schools and 71 private schools (MoE, 2006) as shown in Table 1. It also comprised of School principals, teachers, computer teachers, and students, non-teaching, especially secretaries and bursars who used ICTs in their work. School librarians were also included as libraries support learning and teaching for both staff and students by meeting their information needs. Table 1 presents the number of schools in Nairobi County

Table 1: Study population schools, n=126

Area		No. of Schools		
District/Zone	Division	Public	Private	Total
Nairobi East	Embakasi	5	6	11
	Makadara	9	4	13
Nairobi West	Dagoretti	10	8	18
	Westlands	8	16	24
	Langata	3	2	4
Nairobi North	Starehe	11	17	28
	Kasarani	3	19	22
	Kamukunji	6	-	6
Total		55	71	126

Source: MoE (2008), *The Provincial Director of Education: Kenya Secondary Schools' Heads Association*

A sample comprising girls', boys' and mixed secondary schools was drawn from the population. Table 2 below shows the population by type of school.

Table 2: Target population by gender and type of school (n = 126)

Type/gender of school	N	Percentage (%)
Girls	41	33.6
Boys	35	27.77
Mixed	50	40.98
Total	126	100

3.5 Sampling Procedure

Sampling theory requires that all possible elements or units in the target population be identified so that the probability for selecting a random combination of units, which constitutes the sample can be calculated in advance. Different types of sampling techniques are used for drawing a sample (Mugenda 2008, p. 182). A study can use a

variety of sampling techniques or blend probability and purposive sampling to answer research questions (Tashakkori and Teddlie, 2003, p. 277). To meet this expectation, a comprehensive list of secondary schools in Nairobi County from the Kenya Secondary Schools Heads Association (KSSHA, 2008) was used.

The current research used different sampling methods and they are discussed in this section. In qualitative research, the inquirer purposefully selects individuals and sites that can provide the necessary information. Purposeful sampling means that researchers intentionally select participants who have experience with the central phenomenon or the key concept being explored (Creswell and Plano Clark, 2007, p. 112). The researcher purposefully selected the head teachers, computer teachers, subject teachers, and non-teaching staff (comprising secretaries, computer technicians, librarians, bursar and accountants (some schools had bursars and others had accountants who handled school accounts) of the 44 schools to provide information. The principals were responsible for e-leadership and policy decisions leading to ICTs integration in the secondary schools. The computer teachers implemented both administrative and instructional objectives of ICT. The subject teachers provided instruction and availed information on whether and how they used ICTs. Non-teaching staff duties gave insight as to how ICTs were used in their work as they supported administration work in the school. Students were important in the study the instructional and use of ICT as they determined the success of ICT implementation.

Form Two and Three students were purposively selected to represent the student population. They were randomly picked to represent their school. The intent of sampling individuals in quantitative research is to choose individuals who are

representative of a population so that the results can be generalized to a population. Probabilistic sampling involved randomly choosing individuals based on a systematic procedure of selecting the student participants from the class registers. The student population was thereafter stratified (i.e., males and females) and then randomly sampled within each stratum, specifically students from mixed schools (Creswell and Plano Clark, 2007, p. 112).

The sample was drawn from both public and private secondary schools in Nairobi County. From the three districts that make up the County, the schools were clustered into the eight administrative divisions within which the population was clustered into public and private secondary schools. The schools were again clustered by gender into girls' schools, boys schools and mixed (boys and girls) schools. The study subjects were randomly selected from students in Forms One to Four. Other participants were the principals, subject teachers and non-teaching staff who were selected purposefully. The latter participated in the research to give evidence on the extent to which their various duties had integrated the ICTs. Using cluster sampling procedure, 3 schools were selected from each division representing girls, boys and mixed schools, totalling to 44 schools, out of the 126 schools in Nairobi County. Both public and private schools were considered. The public schools are funded by the government and the private schools are funded by individuals and private investors and religious organizations (MoE Task Force 2012, p. 225). The schools that were in the sample are shown in Table 3.

3.5.1 Probability Sampling

Probability sampling method utilizes some form of random selection. In using this method, every element of the population stood a chance of being included, which was

to achieve representativeness similar to the main strategy in random selection as stipulated by Punch (2003, p. 105). Stratified sampling and simple random sampling was used to select appropriate samples.

Stratified sampling, also called proportional or quota sampling, involves dividing the population into homogeneous subgroups and then taking a sample from each group. The method is used when the population is heterogeneous with respect to the variables or characteristics under study to obtain more efficient and accurate results (Verma and Verma, 2004, p. 69). This was an effective way to represent the schools, which were stratified into boys' public and private schools, girls' public and private schools, mixed public and private schools, and high-cost and low cost private schools, while the universe had a population of school principals, students, teachers and other non-teaching staff. The stratification was conducted in such a way that the items in one stratum were similar, and was used to select a representative sample of the schools in the study area.

Simple random selection was applied to students of the 44 schools, both in Form Two and Three. Form Two students were selected because they were already used to the schools system, while Form Three students were selected because they had picked their examination subjects and were therefore more likely to give the required information. Forms One students were considered too new in the system, while Form Four students were considered as being busy preparing for the end of secondary school examinations and were therefore not available to participate in the research.

The average class size was 40 students in a single stream and went up to about 120 for schools with three streams. The class register was used to randomly select 20 students from both Forms Two and Three in each school.

3.5.2 Non- Probability Sampling

Under non-probabilistic sampling, a desired number of sample units are selected deliberately or purposely depending upon the object of the enquiry so that only the true characteristics of the population are included in the sample (Verma and Verma, 2004, p. 67). Under purposive sampling, there is a deliberate selection of certain units on the judgement of the researcher and nothing is left to chance (Verma and Verma, 2004, p. 73). This method is very useful especially when some of the units are considered very important and their inclusion in the study is necessary. Schools that are members of Computer for Schools Kenya were purposely selected to give the required information. All principals of the 44 secondary schools were purposively selected as key informants since they are the decision-makers in the institutions. The computer teachers were considered because they had the information that was required as they were in charge of ICT facilities in the respective schools.

Purposive or judgemental sampling is acceptable for special situations. Its goal is to focus on particular characteristics of a population of interest which will enable answering of the research questions (Patton, 2001). It uses the judgement of an expert in selecting cases, or selects cases with a specific purpose in mind. Purposive sampling is appropriate in two situations: 1) where the researcher uses it to select unique cases that are especially informative, and 2) where the researcher may use it to select members of a difficult-to-reach specialized population. The method was used to select principals, computer teachers and the librarian since they were considered information rich and were expected to give useful information required for the study.

3.6 Sample Size

A sample is a portion of a population (Ary, 1979, p. 129). The size of the population makes it impractical and uneconomical to involve all its members in a research project (Welman and Kruger, 2004, p. 46). The study population in the research comprised all the secondary schools in Nairobi County. However, since it would not be possible to study all the 126 schools in Nairobi, a representative sample was selected from a list of the total population. The major aim of sampling was to provide accurate estimates of the selected parameters from sample statistics that could be easily calculated (Nachmias and Nachmias, 2005, p. 179). Since the aim of the research was to determine ICT characteristics from the 126 secondary schools in Nairobi County, it was found necessary to draw a representative sample as shown in Table 3.

Table 3: Sample size, n = 44

Area		No. of Schools		
District/Zone	Division	Public	Private	Total
Nairobi East	Embakasi	3	3	6
	Makadara	3	3	6
Nairobi West	Dagoretti	3	3	6
	Westlands	3	3	6
	Langata	3	2	5
Nairobi North	Starehe	3	3	6
	Kasarani	3	3	6
	Kamukunji	3	0	3
Total		24	20	44

Table 4 presents the 44 schools that comprised the sample. Among the schools, there were a total of 24 from the public category and 20 from the private category. As stated before, public schools are funded by the government and the private schools are funded by individuals and private investors and religious organizations (MoE Task Force 2012, p. 225) It was noted that in Langata Division, there were only 2 private schools and there were no private schools in Kamukunji Division. The highlighted schools were supported by Computer for Schools, Kenya (CFSK) and were purposively selected as they had the information that the study was focusing on, as they had been sponsored through a government initiative to model integration of ICTs in schools.

Table 4: Schools Selected for the Study, N = 44

Area		Name of school	
District	Division	Public	Private
Nairobi East	Embakasi	1. Embakasi Girls(G) 2. MuhuriMuchiri (B) 3. <i>Dandora (M)*</i>	1. Brookshine High (B) 2. Welkim (G) 3. St Bernards (M)
	Makadara	4. BuruBuru Girls (G) 5. <i>Aquinas High (B)*</i> 6. Uhuru Sec. (M)	4. Apostolic Carmel (G) 5. NPC Secondary (M) 6. Agbon (G)
Nairobi West	Dagoretti	7. Moi Girls (G) 8. <i>Dagoretti High (B)*</i> 9. <i>LenanaSchool (B)*</i>	7. St Hannahs Prep (B) 8. St Hannah (G) 9. St Peters (M)
	Westlands	10. <i>Nairobi School (B)*</i> 11. <i>St. Georges (G)*</i> 12. <i>Uthiru Girls (G)*</i>	10. Loreto Convent Valley Rd (G) 11. St Mary's (B) 12. Aga Khan High (M)
	Langata	13. Langata High (B) 14. Karen C (M) 15. Olympic (M)	13. Forest View Academy (G) 14. Enna (M)
Nairobi North	Starehe	16. <i>Pangani Girls (G)*</i> 17. <i>Starehe Boys (B)*</i> 18. Pumwani (B)	15. Arya Boys (B) 16. Arya Girls (G) 17. Muslim (M)
	Kasarani	19. Kamiti Sec (M) 20. <i>Kahawa Garisson* (M)</i> 21. Ruaraka (G)	18. Marion Academy (G) 19. Queen of Apostles (B) 20. Karura SDA (M)
	Kamukunji	22. Moi Forces (B) 23. St. Theresa Girls (G) 24. St. Theresa Boys (B)	
Total		24	20

KEY

G – Girls

B – Boys

M – Mixed

The schools in Italics* are supported by the CFSK programme

Table 5 provides a summary of the schools by gender, as this had been discussed as an aspect of ICTs use in schools in the literature reviewed.

Table 5: Summary of schools selected by gender (n = 44)

School type by gender	Public	Private	Total
Girls	8	8	16
Boys	10	5	15
Mixed	6	7	13
Total	24	20	44

3.6.1 Distribution of the Respondents in the Sampled Schools

From the sample population 44 secondary schools in Nairobi County, all the school principals were purposefully selected. Likewise, 44 computer teachers and computer technicians, who were main informants, were selected if they were available in the schools. Also purposively selected were 60 non-teaching staff respondents who included librarians, school bursars (or accountant) and school secretaries if they were available in the respective schools.

With regard to students, 880 in both Forms Two and Three were sampled from a population of 4,559 using the Krejcie and Morgan (2006) sample size guidelines that are used in educational research. 20 students were randomly selected from class registers.

As for teachers, eight were purposively selected from each of the 44 secondary schools, one teacher representing each subject. They represented the eight subjects that are mandatory for KCSE for each candidate. In total, 352 subject teachers were selected. Table 6 shows the distribution of respondents for the study.

Table 6: Population and sample size, n=1380

Respondents	Population	Sample size (n)
Principals	44	44
Computer teachers	44	44
Subject teachers	352	352
Students	4,559	880
Non-teaching Staff	60	60
Total	5,939	1,380

3.7 Data Collection Methods

Qualitative research includes designs, techniques and measures that do not produce discrete numerical data (Mugenda and Mugenda, 1999, p. 155). The study gathered qualitative data using open ended questionnaires, structured interview guides and direct observation. The interview is one of the main data collection instruments in qualitative research and is a good way of accessing people's perceptions, meanings and definitions of situations and constructions of reality (Punch, 1999, p. 175). Hence, the data consisted of open-ended information that the researcher gathered through interviews with participants, open-ended questions in the questionnaire and direct observation. Open ended questions asked during the interviews allowed the participants to supply answers in their own words (Creswell and Plano Clark, 2007, p. 6). Direct non-participant observation was used to get information about the computer labs and other ICTs in the schools.

Quantitative research includes designs, techniques and measures that produce discrete numerical or quantifiable data (Mugenda and Mugenda, 1999, p. 156). Its design shows how variables are seen and organized in respect to each other. Quantitative data

collection is about how the variables are to be measured, while quantitative data analysis is about how the measurements of the variables are to be analysed. Quantitative data consisted of closed-ended information gathered using the questionnaires.

Thus, the data collection methods used in the study was questionnaires, interviews and observation.

3.7.1 The Questionnaire

Self-administered questionnaire was used to gather data from students, subject teachers and non-teaching staff. The questionnaires were close-ended. Such questionnaires are convenient for collecting information from large a population within a short period of time. They were therefore practical in the school situation, especially with regard to the students who were difficult to interview on a one to one basis, as they were in the middle of a busy school term preparing for the end of the year examinations. The teachers and the principals were also preparing for the final Form Four exams.

The questionnaires for teachers were administered with the assistance of Heads of Department (HOD) in each school. The representation was such that one teacher per subject to participated in the research. This method allowed for all subjects to be covered. The school principals and computer teachers were originally all meant to be interviewed, but this was changed when it became impossible to access all the principals. They were given a semi-structured questionnaire followed by an interview for clarification of any particular issues in the research (see Appendix I). However, a semi-structured questionnaire was developed for the deputy principal to elicit in-depth

feedback on major policy decisions and as they were conversant with whole ICTs implementation in the schools (see Appendix II).

During the research, it was found necessary to develop a semi-structured questionnaire for principals and deputy principals. The questionnaires were similar but for a difference in titles as deputies were not comfortable answering the questionnaire labelled for the principal.

Librarians were interviewed because they held a central position in learning and teaching functions for both students and teachers in the schools (see Appendix VI).

3.7.2 The Interview Method

The primary purpose of interviews is to get answers to a specific set of questions. Apart from the information derived from an interview, the researcher is able to notice and record a lot of information from respondents' social and physical environment and to observe the respondents' reactions to the subject under discussion (Mulusa, 1990, p. 126).

Interviews were structured for face-to-face verbal communication between the researcher and the respondents. Information was recorded in a question and answer format in the course of the verbal exchange. Semi-structured interviews offered versatile way of collecting data. Such interviews allow the interviewer to use probe techniques with a view to clearing up vague responses or to ask elaboration of incomplete answers (Welman and Kruger, 2004, p. 161). They were carried out with the school principals, the computer technologist, librarians, and some subject teachers.

It is worth to note that some of the respondents, although they were main informants, preferred filling in the questionnaire to being interviewed on account that they did not

have the time; they preferred to fill it at their own convenience. Others wanted a questionnaire left and an interview would be carried out with an appointment, which helped in getting more in-depth information. Such information would be about the vision and mission of ICT implementation and philosophy of the learning pedagogy as the participants understood it. Other information was about the facilities and resources, the technological devices, and how ICT was being implemented in the curriculum.

3.7.3 Observation

Direct observation is important when some physical process or structures affect results and possess characteristics that make it difficult to simplify them into neat and concise categories (Ngao and Kumsa, 2004, p. 97). Observation in the field involved verifying the facilities in the computer labs, counting the computers, checking the age and models of the computers, and the arrangement of the computer labs. This provided the researcher with an opportunity to see and experience the ICTs facilities that were available in real-life situations in the schools and of the aspects for which data was being collected.

Using this method, the researcher carried out observation to assess the use of ICTs in secondary schools including facilities and equipment available in the schools and how they were being used. The checklist consisted of observation of the computer lab and its set-up, Internet connectivity, number of computers available, and typewriters and other communication equipment that were in use in the schools (see Appendix VIII).

3.7.4 Data Collection Procedure

The respondents filled in the questionnaire that was given to them by the researcher, which was accompanied by an introductory letter. Questionnaires were hand delivered to the respondent and dates agreed on when to collect them.

The researcher visited the schools and talked to the teachers in the staffroom during the 10 o'clock tea break and discussed any issues that they raised about the questionnaires and about the research. As respondents, they needed to be assured that the information they gave would be handled with confidence and would be used for research purposes only.

Interviews with computer teachers and principals were conducted only when they were available. Since it was a busy school term, they were allowed to provide their convenient time, or fill in a questionnaire if this was their preferred method.

Observation took place during visits to the schools. It was important to observe the facilities so as to compare with the information that the respondents gave. Sometimes this method actually gave the true picture of what was on the ground. This allowed for verification and validation of information given through other instruments.

3.8 Pilot Study

A pilot instrument was conducted to establish the validity and reliability of the study. The study was carried out in five selected schools in Kiambu County, namely Alliance Girls High School and Loreto Convent, Kiambu, to represent girls' schools, and Alliance High School and Musa Gitau Secondary School to represent boys' schools, while Kikuyu Day Secondary School represented mixed schools. These

schools are near Nairobi County and are expected to have similar characteristics with the schools in the study. Nevertheless, they were not to be included in the final study.

The piloting addressed six study objectives and research questions:(1) to establish the qualifications and training of the principal, the subject teachers, the computer teachers, and the non-teaching staff on ICTs; (2) to establish the ICTs infrastructure in the schools; (3) to find out how ICTs were used for instruction and school administration; (4) to find out the policies that were in place for guiding ICTs implementation; (5) to find out the challenges that respondents were facing in respect of ICTs in the schools; and, (6) to suggest a plausible model for a sustainable ICT implementation in the schools. The piloting exercise made it clear to the researcher that it was important to have a meeting with the teachers in the staffrooms so as to explain the items of the questionnaire. Most of the teachers in the piloted schools did not use ICT for teaching and therefore thought that the researcher needed responses only from the computer teachers.

The issue of gender came up as most of the female teachers never used the computer lab and neither were they involved in ICT. They said that this was for other people. This information helped the researcher to strategize on how to reach all the subject teachers in the schools. The piloting made the researcher learn that it was important to go to a school and leave a questionnaire for the school principal so that it would make it easy for them to prepare for the structured interview.

3.8.1 Reliability and Validity of the Instruments

The data collection instruments or tools must yield the type of data to accurately answer the research questions (Mugenda and Mugenda, 1999, p. 95). This applies to

the self-developed questionnaire, and the observation and interview schedule. The researcher maximized the reliability and validity of the data collected.

For reliability and validity to exist in the data, the data collection techniques must have information that is not only relevant to the research, but is also correct. Reliability and validity are measures of both relevance and correctness of the data collection procedures (Ngao and Kumsa, 2004, p. 56). Validity differs in quantitative and qualitative research, but in both approaches, it serves the purpose of checking on the quality of the data and the results. In quantitative research, validity means that the researcher can draw meaningful inferences from the results to a population, while reliability means that scores received from participants are consistent and stable over time (Creswell and Plano Clark, 2007). In qualitative research, there is more focus on validity to determine whether the account provided by the researcher and the participants is accurate, can be trusted, and is credible (Lincoln and Guba, 1985).

3.8.1.1 Reliability

Reliability is the central concept in measurement, and it means the consistency of the research instrument. There are two main aspects of this consistency: consistency over time (stability) and internal consistency (Punch, 1998, p. 99). Reliability in research is influenced by random error (Mugenda and Mugenda, 1999, p. 95). Random error is the deviation from a true measurement due to factors that have not been effectively addressed by the research. The reliability of the research instruments was assessed during the piloting. The questionnaire was tested on an all the respondents to find out if the items were understood and if they would bring out the desired responses. If a question was irrelevant to the respondents or if it is too complicated or likely to be misinterpreted by the respondents, it was likely to produce highly unreliable

responses. The questions that were not clear were modified. The aim of developing measured variables was to produce measurements that present material understandable to the respondents; not complicated, but easy to understand.

Consistency over time means the stability of measurement over time. It is expressed in a question, “If the same instrument was given to the same people, under the same circumstances, but at a different time, to what extent would they get the same scores?” To the extent that they would, the measuring instrument is reliable. To the answer that they would not, it is unreliable, (Baker, 1994, p. 128). Stability over time was assessed by administration of the same instrument to the different schools in the pilot study. The schools involved were government sponsored (Alliance Boys and Alliance Girls), privately sponsored (Musa Gitau), and a mixed privately sponsored (Kikuyu Day) as was in the main research. Internal consistency reliability relates to the concept-indicator idea of measurement (Baker, 1994, p. 99). Since multiple items were used to help infer, the questions concerned the extent to which the items were consistent with each other, all working in the same direction. The research instruments were questionnaires, structured interviews and observation for all the respondents.

3.8.1.2 Validity

Validity addresses the question, “How do we know that the instrument measures what we think it measures” (Punch, 1998, p. 100). It is the accuracy and meaningfulness of inferences, which are based on the research results (Mugenda and Mugenda, 1999, p. 99). It is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study and has to do with how accurately the data obtained represents variables of the study. If such data is a true reflection of the

variables, then the inferences based on such data will be accurate and meaningful (Mugenda and Mugenda, 1999, p. 100).

There are two types of validity, namely internal and external validity. To ensure that the research has internal validity, the researcher controls the internal threats such as history effect, maturation effect, selection of participants, and instrumental effects (Slack, 2001, p. 25; *Research Methods*, www.bangor.ac.uk). External validity is concerned with the ability to generalize the study results to other groups and settings beyond the current study. Threats to external validity come from the selection of the sample and the history of the population. Threats to internal and external validity and how they were addressed is shown in Table 7.

Table 7: Threats to Internal and External Validity

Internal Validity	Remedy
<u>History effects</u> Free primary education in 2008 caused congestion in secondary schools	This was countered by using sampled schools from public and private schools so as to get a representative sample.
Threat of independent natural change demographics – location, age, anything natural	The study used students in the secondary schools, teachers, non-teaching staff as well as the school principals.
<u>Selection of participants in the study</u> Students from poorer schools who wanted to appear affluent when questioned about computer use; bursars problem-stating that they used ICT	This was collaborated by observation method. In some schools, there were no computers for use by students and the bursars.
<u>Participant drop out</u> Transfer of teachers; teachers who had questionnaires and they leave school or refused to participate. Sometimes it was difficult to remedy this and lost out on data.	After a group of teachers refused to participate, another sample was taken from other teachers within these institutions.
External Validity	Remedy
<u>Generalizability to participants or subjects (subject selection)</u> Schools were sampled randomly. The schools are private, public, boys', girls' and mixed schools. Also, the teachers are trained in various institutions across the country. (qualitative – was asked as part of the interview)	This was addressed by using random sampling as well as caution on the plausible conclusions from the problem domain and the data sample.

Generalizability to other operationalization's of the intervention. This asks whether the intervention will generalize to other similar forms of the same intervention.	Due to scope of variables, this problem was addressed by samples from Nairobi as well as outside Nairobi from piloting in schools in Kiambu County
<u>Generalizing to other outcome measures</u> This seeks to ascertain that not just one operationalization's of the construct is measured so that the results can be generalized to other operationalization's.	Data was collected from various participants who included students, teachers, non-teaching staff and the school principals to ascertain if the information given was consistent. This was done by using triangulation design

Source: Tredoux (1999)

The pilot study also helped the researcher to refine the data collecting instruments. It was used to assist the investigator develop relevant questions (Yin, 2003) and to improve reliability and validity of the research instruments. A draft measuring instrument was tested before applying the final version testing situation.

Reliability and validity are two main psychometric characteristics of measuring instruments. Reliability was used to characterize stable, consistent and dependable research methods, instruments, data and results. Validity is the essential characteristic of these entities, procedures or devices actually to measure the dimensions that they purport to measure (Bryman, 2004, p. 8).

Objectivity and subjectivity were used to label research data. Objectivity is the capacity of a researcher to see the empirical world as it exists, relatively free of distortions that are often caused by emotional feelings or personal interpretations. Subjectivity is a characteristic of research observations, data or findings that reflect personal and psychological factors (Yin, 2003, p. 9).

3.9 Data Analysis and Interpretation

There were various steps to go through: preparing data for analysis, exploring the data, analyzing the data, representing the analysis, and validating the data. The procedures differed for quantitative and qualitative research.

3.9.1 Preparing the Data for Analysis

After the questionnaires were collected from the respective respondents, they were grouped according to the different categories. The data was then coded for the analysis. For the quantitative data, this meant scoring the data by assigning numeric value to each response, cleaning the data entry errors, and creating the special variables that were needed. A codebook listing variables, their definitions and variable numbers was developed. SPSS statistical program was used. It involved statistically analyzing scores collected on questionnaires based on research objectives and questions.

For qualitative research, preparation of data meant organizing documents and transcribing text from interviews and observations into a word processing file for analysis. During the transcription process, the researcher checked for accuracy and then organized the data into themes that were transcribed to make meaning of the data. The responses from different categories were scrutinized to see similarities' or differences and the conclusions were reported.

3.9.2 Exploring the Data

This was the examination of the data to develop broad trends and the shape of the distribution and by reading through the data, making memos and developing preliminary understanding of the database. In quantitative data, this meant inspecting the data and conducting descriptive analysis to determine the general trends in the

data. Descriptive statistics were generated for the entire major variable in the study. For qualitative data, this involved recording and writing short memos in the margins of transcripts or field notes. All forms of data such as field notes and transcription of interviews were assigned themes and codes.

3.9.3 Analyzing the Data

For the quantitative research, the researcher analysed the data based on the type of questions and used the appropriate statistical test to address the questions. The type of statistical test was based on the type of questions asked. Trends were described using percentages; Mann Whitney U Test was used for ranking groups to compare certain variables from public and private schools. Descriptive statistics was presented in tables and figures.

Qualitative data was coded, divided into small units (phrases, sentences, paragraphs) and labels assigned to each unit, which were developed into themes and categories. Themes, interrelated themes and larger perspectives presented results and findings to the qualitative research questions. Discourse analysis was used for qualitative data and descriptive analysis given, using tables, figures and percentages. Application of both quantitative and qualitative data analysis was used in the research as complementary to bring out the best effects of the research (Makau, 1990, p. 16).

3.9.4 Data Analysis in the Mixed Methods Design

A concurrent form of data analysis was used in the in the Triangulation Design. In this approach, the quantitative and qualitative data was analysed together to supplement each other and to allow comparison. The data was compared through discussion. The researcher made comparisons by examining the similarities of the quantitative and qualitative data results in the discussion section of the study. The statistical

res(descriptive results or inferential results) were reported and then followed by specific information about a theme to confirm or disconfirm quantitative results.

The quantitative data was captured from the questionnaires from student and subject teachers. Quantitative and qualitative data supplemented each other and improved validity and reliability of the research. Qualitative data was collected from the interview schedule and observation. The data were analysed separately.

The combination of the two settings and the two types of responses resulted in the two major forms of data collection: observation methods and survey research (personal interviews and questionnaires). Each of these data collection methods has certain advantages as well as some inherent limitations. In this research, different methods of data collection to answer the research questions and to measure variables were used. This is the essence of methodological triangulation; for example, a structured questionnaire was supplemented with interviewing and observation. If the findings yielded by different data collection methods were consistent, the validity of those findings was increased. In addition as a research strategy, triangulation has the benefit of raising the research results “above the personal biases” that stem from a single methodology. By combining two research methods in the same study, the researcher was able to partially overcome the deficiencies that flow from employing one investigator or one method (Denzin, 2009, p. 236).

The purpose of data triangulation design was to obtain different data on the same topic so as to understand the research problem (Creswell and Plano Clark, 2007, p. 62). This design is used when a researcher wants to compare and contrast directly quantitative statistical results with qualitative findings or to expand qualitative results

with ults quantitative data (Creswell and Plano Clark, 2007, p. 64).The triangulation design adopted for the research is demonstrated in Figure 5.

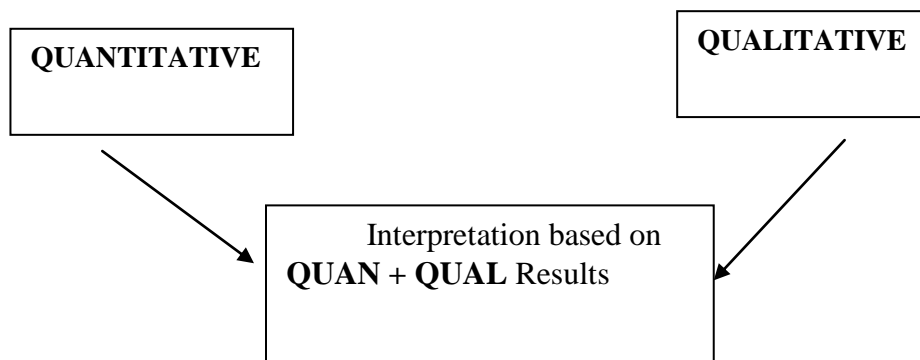


Figure 5: Triangulation design

Adapted from Creswell and Plano Clark (2007, p. 63)

Triangulation is a one-phase design in which the researcher implements the quantitative and qualitative methods during the same time-frame and with equal weight. The single phase timing of this design is the reason it is referred to as concurrent triangulation. It involves concurrent collection and analysis of quantitative and qualitative data to assist the researcher to better understand the research problem (Creswell and Plano Clark, 2007, p. 64).

The results from different data collection methods were combined through triangulation. Data triangulation and interpretation was developed by Denzin (2009) for use in sociological studies. Stake (2002, p. 443) defines it as “a process of using multiple perceptions to clarify meaning, verifying the repeatability of observation and interpretation”, identifying four of its types, namely (1) data triangulation (combining data from different sources), (2) investigator triangulation (combining data collected from multiple researchers), (3) methodological triangulation (combining data

collected through different methods), and (4) theory triangulation (combining data collected from multiple theoretical perspectives) (Denzin, 2009). The current research used data triangulation where data was collected from multiple sources (the school principals and students who were the main informants, the teachers, computer teachers, non-teaching staff, and policy and procedure manuals both from the schools and the Ministry of Education). In terms of methodological triangulation, direct observation of computer labs, interviews with the schools principals and computer teachers and questionnaires were given to students and teachers, and the non-teaching staff. The triangulation method required comparison of findings from each source and method to ensure that the study findings were valid conclusions drawn from the data.

3.11 Conclusion

This chapter discusses the research design, study area, study population, the sample and sampling methods. Mixed methods and triangulation research design were used. The study also involved use of qualitative and quantitative research designs. The two research designs complemented each other in a mixed methods research.

Qualitative data was used to corroborate or disprove quantitative data. The research instruments, mainly the questionnaire for the respondents, had similar items to assist in corroboration of the data and information given. The computer labs, classrooms and the staffrooms and secretary and bursar offices were visited. This assisted in finding out the information facilities such as computer labs and computers and other ICT equipment.

The study population comprised 126 public and private secondary schools in Nairobi County. The study sample consisted of 44 schools purposively selected from the total

population. The respondents were school principals, subject teachers, computer teachers, students and non-teaching members of staff. The research instruments included structured interview for principals and computer teachers, and the librarian. A self-administered questionnaire was given to subject teachers, students, the school bursar (or accountant), and the secretary.

A pilot study was carried out in five schools in Kiambu County, and the results were used to amend the research instruments, to improve the validity and reliability of the research instrument. Data was analysed by use of qualitative and quantitative methods. Both results were compared and presented in tables, figures and statements to show the distribution of the data.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The aim of the study was to investigate sustainable implementation of ICT's in secondary schools in Nairobi County. McConnell's E-Readiness tool was used for establishing five interrelated attributes, which included connectivity, e-leadership, information security and human capital. The data was collected using different instruments and was obtained using qualitative and quantitative techniques, and then it was analysed in line with the research questions.

This chapter presents the data collected, its analysis and interpretation. The presentation is divided into two parts: The first part contains responses from the members of staff, while the second part contains the response from the students.

4.2 Response Rate

Out of the 44 schools that were selected for the study, 37 responded (see Table 6 for the sample size and respondents). This was a high response rate. Personal administration of questionnaires and follow-up with the respondents contributed to the high rate. The students' and teachers' return rate was affected by the busy school schedules and the effects of the post-election violence of early 2008. While the teachers had a low morale, many school principals were sensitive to any research being carried out in the schools for fear of 'outside interference'. It was difficult to motivate and convince some subject teachers to fill the questionnaire and to participate in the study. Thus, the researcher had to settle for subject teachers who

were available and were willing to participate in the study. Table 8 shows the overall response rate.

Table 8: Response rate (n=37)

Respondents	Sample size (n)	Response rate (n)	Percentage response rate %)
Principals	44	37	81.8
Computer teachers	44	37	81.8
Teachers	352	188	53.4
Students	880	556	64.3
Non-teaching staff	60	40	66.7
Total	1,380	866	64.2

From the table, seven schools did not participate in the research. Nevertheless, the general response rate was good (at 64.2%). As Mugenda and Mugenda (1999) state, a response rate of 50 per cent and above is good for analysis. Table 9 shows a summary of zones and schools that participated in the study.

Table 9: Response rate for the schools (n = 37)

Area		No. of Schools		
District	Division	Public	Private	Total
Nairobi East	Embakasi	3	2	5
	Makadara	3	2	5
Nairobi West	Dagoretti	3	3	6
	Westlands	3	3	6
	Langata	2	1	3
Nairobi North	Starehe	3	3	6
	Kasarani	2	1	3
	Kamukunji	3	0	3
Total		22	15	37

The study ensured representation of all types of schools - girls' schools, boys' schools and mixed schools, which account for 15, 14 and 8 respectively.

The analyses of the findings are presented in first section being responses from members of staff in the following sequence: principals, teachers, computer teachers, and the non-teaching staff. The students' data is presented in the second part of the chapter. It was found necessary to separate staff and students because the information sought was meant to complement each other. The following section is the responses from members of staff.

4.3 Training and Skill Requirements for ICT Implementation

This section deals with the first objective of the study: training and skills for implementing ICTs. In this regard, the academic qualification of the respondents and training in ICTs skills were considered.

4.3.1 The Human Capital

The human capital is discussed as determined in McConnell's E-readiness tool. The human capital indicators included the following: academic qualifications of the staff (which was quantified in form of a skilled work force); levels of ICT application (as was applied in instruction and administration functions of the schools); and, ICT literacy levels.

4.3.2 Academic Qualifications of the Staff

The academic qualifications of principals were assessed as this is an indicator of e-readiness. Most of the principals had university level education with 59.4 per cent having undergraduate degrees (B.Ed.) while 16.2 per cent had post-graduate degrees (Masters of Arts and Master of Education qualification). Most of the principals had a

Bachelor's degree, which is the minimum recommended qualification by the Teachers Service Commission (TSC), (MoE Task Force, 2012, p. 194). Table 10 represents the academic qualifications of the principals.

Table 10: Academic qualifications of the Principals (n =37)

Qualifications	School type				Total	
	Public	%	Private	%	No.	%
MA	3	8.1	3	8.1	6	16.2
Med	1	2.7	0	0	1	2.7
B.Ed.	11	29.7	11	29.7	22	59.4
BA/BSc with PGDE	3	8.1	3	8.1	6	16.2
No Response	1	2.7	1	2.8	2	5.4
Total	19	55.35	18	48.54	37	100

The study also revealed that there was a relationship between age and rate of ICT adoption, with younger members of staff having a higher rate of ICTs adoption. The majority of the school principals were aged between 30 and 50 years. Further the findings revealed that 29 principals (78.4%) had been in the schools for less than five years, while eight (21.6%) had been in the school between five and ten years.

4.3.3 Academic Qualification of the ICT Teachers

A majority of the computer teachers in public schools had Bachelors' degree in Computer Science, while in private institutions they had either diploma or degree in Computer Science. This would reflect on the quality of ICT teaching in the schools.

Computer teachers served as opinion leaders; their influence in adoption rate of ICT in the schools was strong among students and teachers. They were consulted regularly

by other teachers, students and the principal. Hence; they were responsible for spearheading the ICT initiatives and programmes in the schools.

Majority of the computer teachers were designated as ‘ICT teacher’, a label that distinguished them from the others. From the interviews conducted, they were highly regarded by the school principal and the other teachers due to their resourcefulness in their area of specialization as they were expected to transform ICT illiterate students in spite of the lack of modern ICT resources and the heavy workload allocated to them. A few ICT teachers were designated as librarians in cases where they handled library work and taught computer lessons. Table 11 indicates the qualifications of ICT teachers.

Table 11: Academic qualifications of Computer Teachers (n =36)

Qualifications	School type				Total	
	Public	%	Private	%	No.	%
Degree in Computer Science	10	27.7	5	13.8	15	41.8
Undergraduate (studying)	3	8.3	0	0	3	8.3
Diploma in Computer Studies	7	19.4	5	13.8	12	33.3
Certificate in Computer Studies	3	8.3	2	5.5	5	13.8
Non Response	1	2.7	0	2.7	1	2.7
Total	24	66.6	12	33.3	36	100

4.3.4 Academic Qualifications of the Teachers

The study sought to establish the qualification of the teachers in the schools under study. Teachers’ academic qualifications are an indicator of performance in the schools (MoEST 2005, Vision 2030, p. 120); better-qualified teachers would be more adaptive to the diffusion of ICT in their subject areas. According to the findings, majority of the teachers had a Bachelor’s degree in education, while 10.6 per cent had

Master's degree in education and 8.0 per cent had Master's degree in Arts. The category labelled 'Undergraduate' were teachers studying for a Bachelor's degree in various universities. There was no disparity in teacher qualifications in public and private schools.

Literature reviewed indicated that there would be a higher rate of ICT adoption among people with high level of education (Rogers, 2005), in this case, better-qualified teachers. The teachers were highly qualified and, therefore, expected to be more adaptive to the diffusion of ICTs in the schools. Table 12 shows the academic qualifications of teachers and indicates that teachers in secondary schools had high academic qualifications that would enable them to participate in ICTs implementation.

Table 12: Academic qualifications of Teachers (n = 188)

Qualifications	School type				Total	
	Public	%	Private	%	No.	%
MA	12	6.4	3	1.6	15	8.0
Med	15	8.0	5	2.7	20	10.6
B.Ed.	65	34.6	43	22.9	105	57.5
BA /B.Sc. with PGDE*	7	3.7	11	5.9	18	9.6
EACE/KACE(A Level) with Diploma)	14	7.4	4	2.1	18	9.6
Undergraduate (studying)	5	2.7	2	1.1	7	3.7
MBA**	1	0.5	1	0.5	2	1.1
Total	119	63.3	69	36.7	188	100

* PGDE – Postgraduate Diploma in Education

** MBA – Masters in Business Administration

4.4 ICTs Training Received by Computer Teachers

Training level was one of the indicators of how members of staff were prepared for ICT integration in the schools. The section below shows the training that had been received by the computer teachers, other subject teachers and non-teaching staff.

The ICT teachers were main informants; hence they were involved in a structured interview and also completed a questionnaire. The teachers explained their ICT training, the computer packages that they had trained in, and their overall computer literacy skills.

According to the findings, the computer teachers had various types of training; they did not have a standardized training in ICT. This indicates that the computer teachers lacked standards of teaching ICT courses in secondary schools in Nairobi County.

The study further found that the computer teachers had trained at the local public and private universities. Table 13 illustrates the type of training the computer teachers had trained in while in college.

Table 13: Type of training received by Computer Teachers in ICTs (n =36)

Training received	School type				Total	
	Public	%	Private	%	No.	%
Computer Application & Electronics	13	36.6	4	11.1	17	47.2
Information Technology	4	11.1	5	13.9	9	25.0
Hardware and Software	3	8.3	1	2.8	4	11.1
Computer Technician	0	0	2	5.6	2	5.6
Management	1	2.8	0	0	1	2.8
No ICT Training Received	3	0	0	0	3	8.3
Total	24	66.6	12	33.4	36	100

Although the Computer Teachers had training in computer applications and electronics, they did not have a teaching qualification. They were however entrusted with the teaching of ICT in the schools and they were the ones who were expected to handle any problem brought up by students, other teachers, non-teaching staff and the principal. They were also responsible for teaching Computer Science to the students who were registered for the subject.

4.4.1 Teachers' training in ICTs

The teachers were asked about their qualification in ICT. Table 14 indicates that only 61 teachers (33.7%) had any training in ICTs. Out of the 181 teachers who responded, 120 teachers (66.3%) had no training in ICT and were therefore not using ICT in teaching.

Table 14: Qualifications of Teachers in ICT Teaching (n =181)

Qualifications ICT Teaching	School type				Total	
	Public	%	Private	%	No.	%
Yes	37	20.44	24	13.25	61	33.7
No	79	43.64	41	22.65	120	66.3
Total	116	64.08	65	35.9	181	100

The teachers were asked about their qualification in ICT. Table 15 below indicates that only 55 teachers (29.3%) out of the 61 teachers (see table 14) were formally trained, 16 (29.1%) had Diploma, while 1.6 per cent had a degree qualification in IT.

Table 15: Level of Qualification for Teachers in ICT training (n =55)

Level of training	School type				Total	
	Public	%	Private	%	No.	%
Degree	2	6.3	1	4.3	3	5.5
Diploma	9	28.1	7	30.4	16	29.1
Certificate	17	53.1	11	47.8	28	50.9
Computer packages	4	12.5	4	17.4	8	14.5
Total	32	58.2	23	41.8	55	100

The study sought to establish the computer packages and other ICT resources that the teachers were conversant with according to the computer programs for which they said they were using. The teachers indicated that they were conversant with more than one computer package. They did not have any formal training in ICT as discussed in Tables 14 and 15 above. Each of the packages is worked out of a total of 188 teachers. This is shown in Table 16.

Table 16: Computer Package for Which Teachers Had Received Training (n =188)

Computer packages	School type				Total	
	Public	%	Private	%	No.	%
Word Processing	69	63.3	40	36.7	109	58
Spreadsheet	45	65.2	24	34.8	69	37
Database	39	73.6	14	26.4	53	28
Publishing	33	64.7	18	35.3	51	27
PowerPoint	40	59.7	17	25.3	67	36
Internet	67	59.8	45	40.2	112	60
Email	35	64.8	19	35.2	54	29

According to the table, 82.6 per cent of the teachers used word processing programs, while 17.4 per cent, (23) in both public and private secondary schools did not use it. The study also discovered that 56.6 per cent (122) of the teachers used Spreadsheet and 42.9 per cent used publishing programs. Among the teachers who used publishing programs, 45 per cent were from private schools while 41.8 per cent were from public schools. Further 47.9 per cent of the teachers used PowerPoint Presentations programs in their teaching, while 88.2 per cent of teachers from private schools and 76.1 per cent of teachers from public schools used Internet making up a combined figure of 80.6 per cent who used Internet. In addition, 44.5 per cent of the teacher-respondents used database programs, 86.4 per cent of the teachers from private schools and 67.3 per cent of teachers from public schools used e-mail making up a combined figure of 73 per cent of the teachers who used e-mail. These proportions are represented in Figure 6.

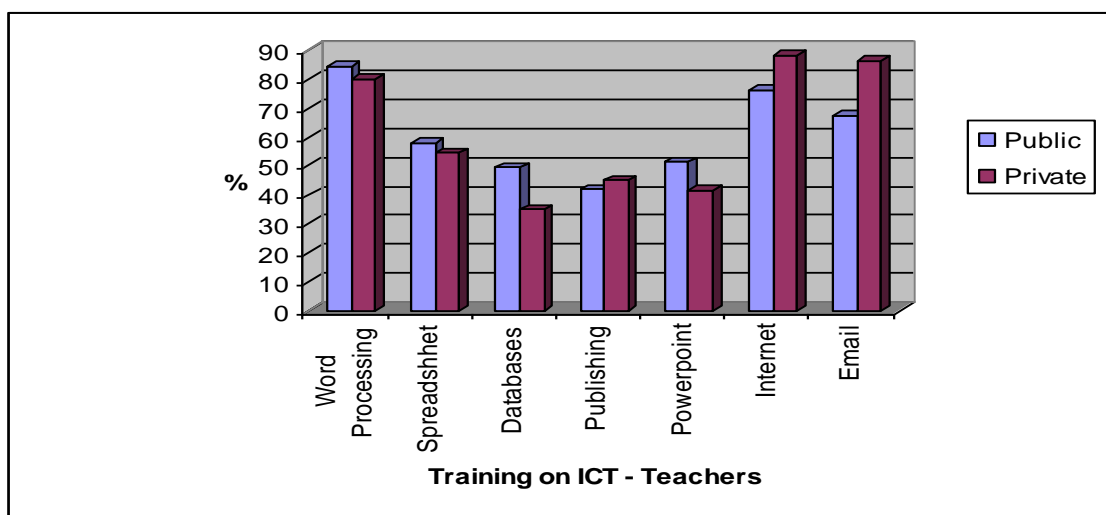


Figure 6: Teachers training in computer packages

Teachers were asked if they had any training and qualification for teaching ICT (Question 8, App. V, p 279). According to the findings, from both public and private schools, majority of the teachers (66.3%) did not have any qualification for teaching ICT. The public schools had 68.1 per cent teachers who did not have qualification, while private schools had 63.1 per cent. The teachers were also asked to rate their level of ICT literacy using the Likert scale, which ranges from proficient to poor (App. V Question 19 p. 279). The results are recorded in Table 17 and Figure 7. From the findings, most of the teachers stated that they had computer literacy and skills levels ranging between poor and average. The teachers will need to improve on computer literacy skills so that they will be able to use ICT skilfully if they have to use ICT for teaching and learning activities in the schools.

Table 17: Level of computer literacy among Teachers (n =173)

Level of ICT literacy	School type				Total	
	Public	%	Private	%	No.	%
Proficient	14	12.4	6	10.0	20	11.6
Above average	16	14.2	15	25.0	31	17.9
Average	46	40.7	22	36.7	68	39.3
Fair	25	22.1	14	23.3	39	22.5
Poor	12	10.6	3	5.0	15	8.7
Total	113	65.3	60	34.7	173	100

The teachers will be effective if they are confident in using ICT skills to assist them deliver content and other information needed to improve teaching and learning in the schools.

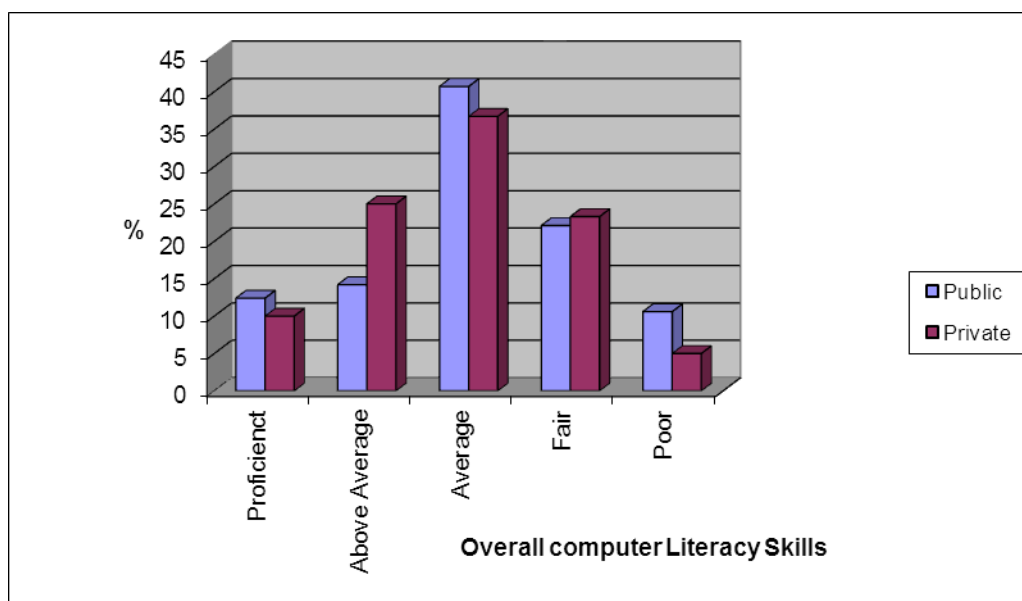


Figure 7: Overall Levels of Computer Literacy and Skills of the Teachers

The study sought to identify the word processing skills among the teachers. The results are recorded in Table 18.

Table 18: Word Processing skills of Teachers (n =169)

Level of Typing skills	School type				Total	
	Public	%	Private	%	No.	%
Proficient	8	7.3	4	6.5	12	7.1
Above average	13	11.8	10	16.9	23	13.6
Average	42	38.2	22	37.3	64	37.9
Fair	28	25.5	15	25.4	43	25.4
Poor	19	17.3	8	13.6	27	16.0
Total	110	65.1	59	34.9	169	100

According to the findings table 18) the majority (37.9 per cent) of teachers had typing skills. Only 25 per cent had above average typing and word processing skills.

From the interviews conducted the teachers indicated that they did not type their school work; they drafted and gave it to the secretary to type. Furthermore, they did not enter marks in the computer but left it to be done by the secretary or the computer teacher in the computer lab. In some of the schools, the school librarian entered the marks, and in some cases included typing of exams and continuous assessment tests. The implication is that the teachers would not be able to use ICT in teaching as they did not have the required ICT knowledge and skills.

4.4.2 ICTs Training of the Non-teaching Staff

Members of the non-teaching staff were asked about the ICT training that they had. From their response, 13 (32.5%) had certificate in computers, 30 per cent had typing and programming qualifications, 8 (20%) had IT certificate, 5 (12.5%) had basic skills in computers, while only 2 of them had higher diploma in computer studies. The responses are shown in Table 19.

Table 19: ICT Training rreceived by Non-Teaching Staff (N=40)

Level of literacy	School type				Total	
	Public	%	Private	%	No.	%
Higher National Diploma (HND)	1	2.5	1	2.5	2	5
Certificate	7	17.5	6	16.25	13	32.5
IT	7	17.5	1	2.5	8	20
Typing and programming	9	22.5	4	10	13	32.5
Basics	2	5	2	5	4	10
Total	25		15		40	100

The findings indicate that the non-teaching staff had basic skills to perform the work that they were entrusted to do. However, it was observed that the school bursars and accountants were not trained in basic computer skills.

The results of computer literacy and skills of the non-teaching staff are shown in Table 20. Most of them non-teaching staff were average and above average in computer literacy skills.

Table 20: Computer Literacy and Skills of the Non-Teaching Members of Staff (N=40)

Level of literacy	School type		Total	
	Public	Private	No.	%
Proficient	4	1	5	14.6
Above average	9	6	15	36.6
Average	10	8	18	43.9
Poor	1	1	2	4.9
Total	25	16	40	100

4.5 Connectivity and Infrastructure Supporting ICT Implementation

The study sought to find out the e-readiness that supported the integration of ICTs in the secondary schools. E-leadership was provided by the principals and computer teachers. Connectivity and ICT infrastructure were indicators of the level of ICTs the school had achieved. The main informants, the principals and computer teachers, were interviewed and the information provided is discussed later in the chapter.

The variables that were investigated were: availability of computers in the schools; acquisition of equipment and maintenance; and hours allocated for use of ICTs in the schools.

4.5.1 Inception of ICT in Schools

Respondents were required to indicate when computers were first installed in the respective schools. According to the findings, the earliest use of ICT in private schools was 1995, while it started in public schools in 1997. Such private schools as St. Marys, and Loreto Convent Valley Road started using computers in 1995. Public schools such as Starehe Boys' and Nairobi School started in 1997. Table 21 summarises the start of use of computers in schools. Five schools did not have information as to when ICT was started in the schools.

Table 21: Summary of Inception of Computer use in Schools (N=37)

Year computers started being used	School type		Total	
	Public	Private	No.	%
1995	0	1	1	2.7
1997	1	2	3	8.1
1998	2	2	4	10.8
1999	1	2	3	8.1
2002	1	4	5	13.5
2004	2	1	3	8.1
2005	2	1	3	8.1
2006	0	3	3	8.1
2007	3	1	4	10.1
2008	1	1	2	5.4
2009	1	0	1	2.7
Missing	4	1	5	14.5
Total	18	19	37	100

Findings in Table 21 imply that ICT inception in private schools started earlier and more schools used computers in private schools.

4.5.2 Time Spent with Computers in the Schools by the Staff

Figure 8 shows the number of hours that were spent using computers in the schools according to the response by the principals most of whom spent 1-5 hours in a week using computers. Majority of subject teachers (66.9%) used computers between 1 and 5 hours, 16.5 per cent between 6 and 10 hours, and 5.3 per cent 36-40 hours per week. The non-teaching staffs used between 26 and 40 hours in a week; these were mainly the secretaries who typed school work and used Internet.

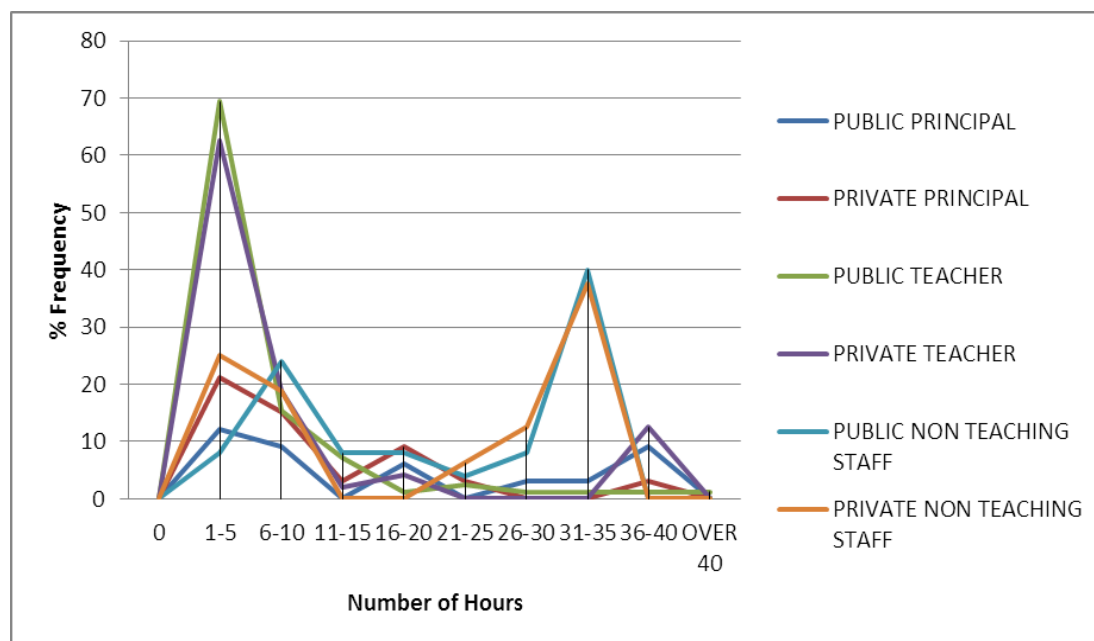


Figure 8: Time (in hours) spent by members of Staff in ICT

Figure 8 implies that subject teachers only use computers for only 1-5 hours in a week. This is not enough time considering that if ICT implementation is to succeed,

they would need to teach and make their teaching notes using ICT. The school principals also will need to spend more time using ICT for administrative purposes.

4.6 ICTs Application for School Administrative and Instructional Purposes

This section deals with ICT access and application for administrative and instructional purposes in the schools. The specific questions sought answers on issues relating to the application of computers, Internet and its charges, local content and the financing of computer lessons and applications. The main informants, comprising the principals and the computer teachers, were interviewed. The other respondents (students, teachers and the non-teaching staff) were given questionnaires. Their responses are discussed and presented in the sub-sections below.

4.6.1 Access to Computers

Table 22 indicates physical access to computers by the principals. The study found out that only four principals (11.1%), all from private schools, had computers in their offices. The same number (11.1%) used the cyber café, 13.9 per cent used the school computer lab, while 5.6 per cent accessed computers at their homes. A significant number (58.3%) of principals did not have access to computers.

Table 22: Physical Access to Computers by the Principals (N=37)

Physical access to computers	School type				Total	
	Public	%	Private	%	No.	%
My office	0		4		4	11.1
Computer lab in the school	1		3		4	11.1
Cyber café	1		4		5	13.9
Own home computer	1		1		2	5.6
No access	11		11		21	58.3
Total	14		23		37	100

4.6.2 Application of ICT in the Schools by the Principals

The study found that ICT was used in 18 public schools and 18 private schools, thus representing 50 per cent of each category. The principals were asked how ICT was applied in school administration work. According to them, ICT was used for teaching in 16 public schools (51.6%) and 14 private schools (45.2%), but was used more for administration purposes than for teaching. This was the case in all the schools visited by the researcher.

The principals were asked how ICT was used for teaching. Out of the 37 schools in the sample, only 22 schools used ICT for teaching English. Of the 24 principals who responded (54.2%) 13 schools used ICT for teaching mathematics of which 8 (33.3%) were public schools and 5 (20.8%) were private schools and 11 schools (45%) did not use ICT in teaching mathematics. 11 (50%) of both private and public schools used ICT, while the rest (50%) did not use ICT. For teaching Kiswahili, only 8 schools used ICT with 63.6 per cent of the principals saying that ICT was not used. In the interview, they said that there was no local content for teaching Kiswahili. About one third of the schools in the sample (consisting of 12 schools) did not respond to this question, and it was assumed that they did not use ICT in teaching mathematics. The implication of this is that there was no consistency of ICT standards used for teaching in the schools. Figure 9 below gives an illustration of how ICT was used in the schools according to the principals. According to the figure, public schools used ICT more in teaching than the private schools with Computer Science being taught in about 50 per cent of the schools in the sample.

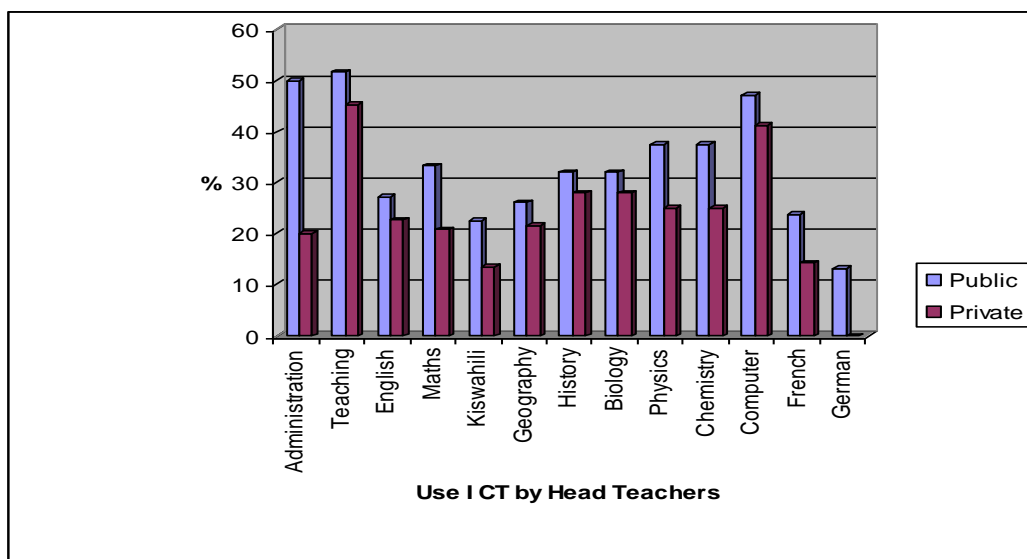


Figure 9: Use of ICT in Subject Areas

The school principals were asked how often they used computers to perform different tasks in the course of their work. Mann Whitney U test was used to test whether there is any significant difference on ranking by school principals in public and private schools on the way they used ICT equipment in their routine work. The data was ranked as 1= Often 2= Sometimes 3 = Rarely and 4 = Never. Table 22 below shows the results of statistical test.

Table 23: The work for which The Principals used Computers

	Public	Private		
	Mean Rank	Mean Rank	U- Value	P-value
Attendance taking	11.90	13.73	64.000	0.517
Finance	14.36	14.64	96.000	0.912
Policy issues	15.65	15.38	108.500	0.927
Curriculum issues	15.63	17.26	114.500	0.578
Data collection	15.67	16.31	115.000	0.832
Teacher evaluation	13.42	15.31	83.000	0.530
Internet search	13.89	17.74	194.500	0.195
Discipline memos	15.12	16.64	105.500	0.609
Newsletter	15.73	17.18	116.000	0.596
Memos to staff	16.71	16.33	123.000	0.892
Letters to students	15.21	16.65	108.000	0.607
Letters to parents	16.50	16.50	127.500	1.000
E-mail	13.08	16.56	79.000	0.239
Leadership	13.69	18.42	87.000	0.116
Planning	13.23	18.74	81.000	0.56
Communication	14.82	18.61	102.500	0.183
Curriculum development	13.71	19.42	87.000	0.68
School Management	12.67	16.65	74.000	0.128

From the table, there is no statistical significant difference between public and private schools concerning statements on the work and ICT use by the principals.

4.6.3 Use of Computer Packages by the School Principals

The principals were asked what programs they used. The results are shown in Figure 10.

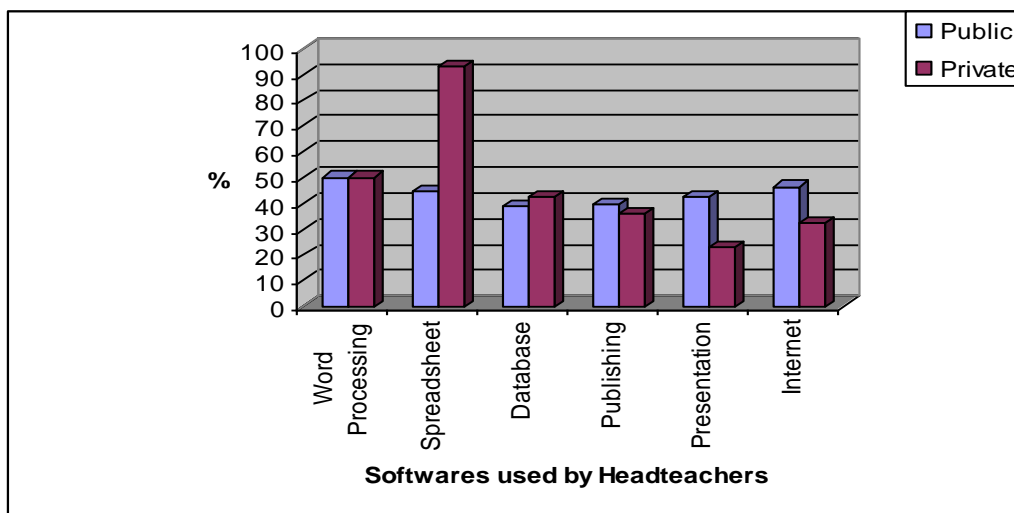


Figure 10: Software used by School Principals

Word processing software was the most highly used by 87 per cent of the principals, while about 90 per cent indicated that they used spread sheets. Internet was used by about 50 per cent of the principals. The principals in both public and private schools used spread sheets to check student fees payments, staff salaries and financial statements. This was used by 90 per cent of the principals in private schools who said that they needed to check fees paid and expenditure keenly since the survival of the schools depended on income. The rest of the principals used different software in their work.

4.6.4 ICT Tools and Services

The principals were asked whether they used networked computers in relation to ICT in the schools. Networking of computers in the school was a measure of how seriously ICTs projects were taken. Table 24 below shows the rate at which the head teachers used networked computers.

Table 24: Use of Networked Computers in the Schools by Principals (N=14)

Networked computers	School type				Total	
	Public	%	Private	%	No.	%
Never	1	7.1	1	7.1	2	14.3
Sometimes	1	7.1	3	21.4	4	28.6
Rarely	1	7.1	3	21.4	4	28.6
Often	2	14.3	2	14.3	4	28.6
Total	5	39.6	9	64.2	14	100

The table shows the use of networked computers in the schools. Only 14 schools responded; discussion with the principals revealed that majority of the schools (23) did not have networked computers. Most of the computers were stand-alone and were to be found at the secretary's office.

The study also revealed that majority of the schools did not use a scanner. Some schools used printers and some were still using the old models of duplicating machines. Very few schools used Uninterrupted Power Supply (UPS) facilities for their computer equipment.

Over 50 per cent of the principals did not use the Internet as the schools were not connected. The schools did not use an external modem. Only one Principal said they used Internet always. The rest said that they rarely used an external modem.

4 6.5 Access and Application of ICTs by the Computer Teachers

Figure 11 below shows the use of computers by the computer teachers. According to the findings, 42.4 per cent of computer teachers used computers for teaching, 27.3 per cent for training, 21.2 per cent for typing exams, 6.1 per cent for research, and only 3

per cent for administration. Comparing computer use in public and private schools, usage was higher in private schools (54.5%) than in public school (36.4%).

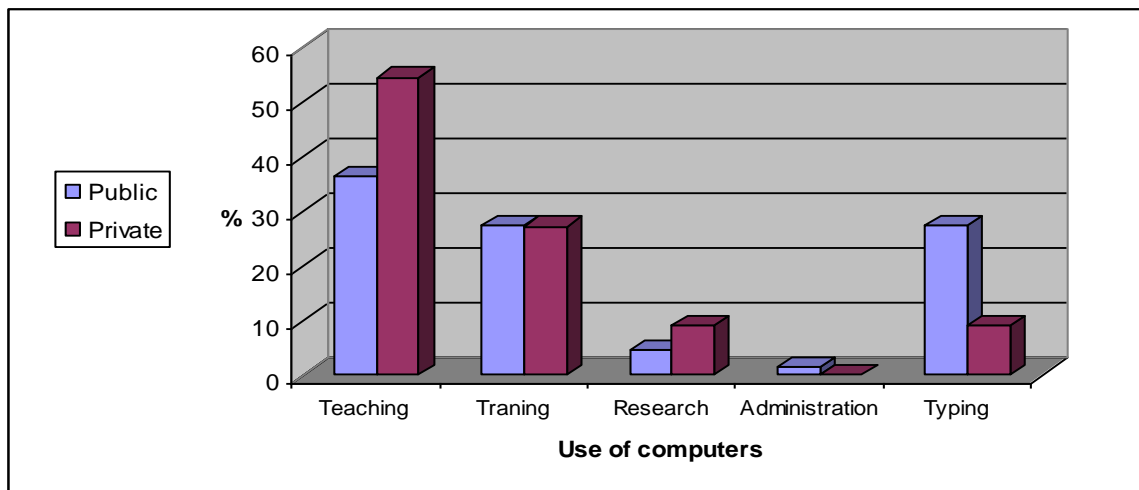


Figure 11: Use of the Computers by the Computer Teachers

4.6.6 Access and Use of ICTs by the Teachers

The teachers were asked the purpose for which they used computers in relation to teaching. Out of the 188 teachers, only 99 (about 50%) responded. The teachers who used computers for lesson preparation were only 61 (65.6%) and were from the public schools. The private school teachers who used computer for lesson preparation were only 34.4 per cent. Only 27 teachers (71.1%) used computers for classroom teaching from the public schools sampled compared to 11 (28.9%) from private schools. This shows that very few teachers used computers for classroom teaching and lesson preparation. Most of the teachers used traditional methods of teaching and writing notes and lesson plans. They did not use a computer for teaching purposes.

With regard to the question on the overall computer literacy skills of the teachers, the response was that the majority (57.2%) had average and above average literacy skills,

while the rest (32.2%) had fair and poor skills respectively. The public schools had better trained teachers in ICT skills.

As for typing and keyboarding skills, the majority of teachers had typing skills ranging from poor to average generally. Only 7.1 per cent of the teaching staff had proficiency in typing skills with 13.6 per cent of the staff having above average typing skills. Those who said that they had average typing skills were 37.9 per cent, while the teachers with fair skills were 25.4 per cent. Overall typing and key boarding skills for teachers' proficiency was low as is illustrated in Figure 12.

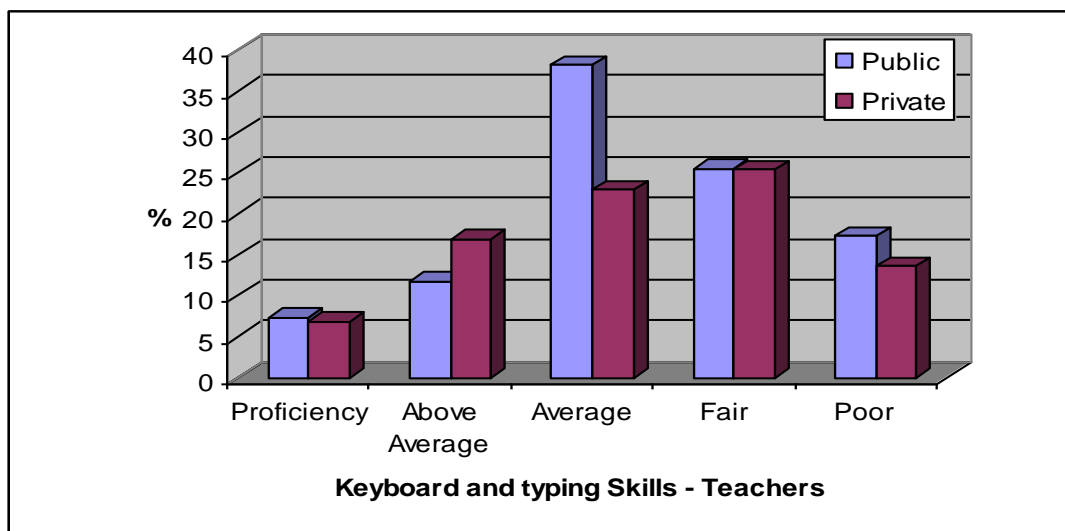


Figure 12: Typing and Keyboarding Skills of Teachers

4.6.7 Access and Use of ICTs at Work by the Non-teaching Staff

This sub-section discusses use of computers by the members of the non-teaching staff, which comprises the secretary, bursar and librarians. In the public secondary schools, 21per cent of the non-teaching staff did not use computers in their work, while in the private schools all the non-teaching staff used computers.

Non-teaching staff on the response to the question on the work the non-teaching staff used computers for; the results are shown in Figure 13 Typing work was 60.5 per cent, while accounting took 23.3 per cent, record keeping 11.6 per cent and programming 4.7per cent.

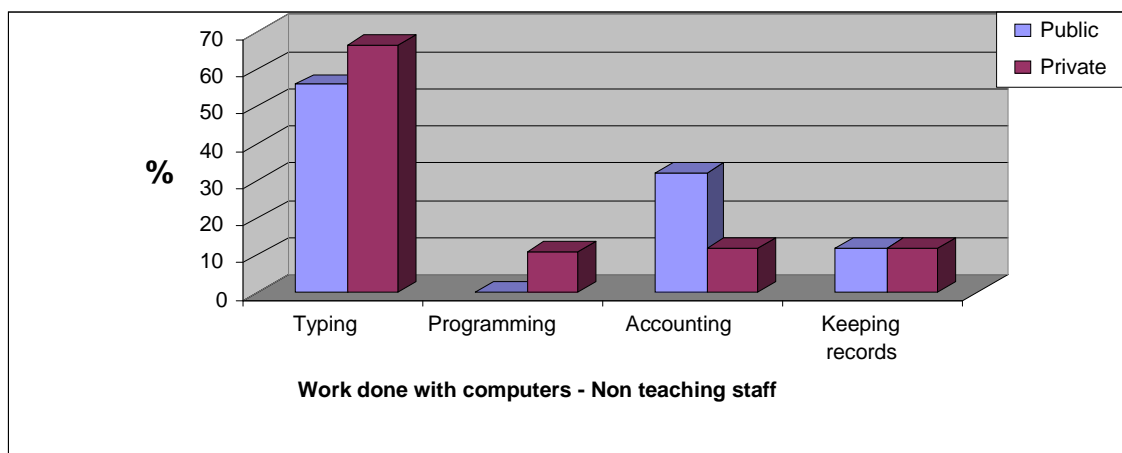


Figure 13: Work done with Computers by the Non-Teaching staff

Overall computer literacy of the non-teaching staff was ascertained. Most of the staff was average and above average in computer literacy skills training. Out of the 41 staff who responded, 6 (14.6%) were proficient and 15 (36.6%) were above average. The majority, 18 staff (43.9%) were fair and 2 (4.9%) were poor. It is worth noting that most of the non-teaching staff was ICT trained.

The non-teaching staffs were asked about competency in typing and keyboarding skills. Most of the 42 who had responded had above average typing and keyboarding skills with 40 (95.2%) non-teaching staff having word processing skills. The non-teaching staff from private schools were 100 per cent competent compared to 92.3 per cent in public schools, especially in word processing skills.

The use of Spreadsheet by the non-teaching staff was at 71.8 per cent with the public schools ahead at 76 per cent compared to 64.3 per cent for the private schools. Only 11 members of staff (28.2%) were not familiar with Spreadsheet.

Database software use by both public and private schools was at 51.5 per cent with the private schools having 69.2 per cent of their staff using different database software when compared to 40 per cent for public schools. From all the staff, 48.5 per cent did not use any other database software apart from the ones prescribed by the school.

Of the respondents, 11 members (34.4%) of the non-teaching staff used publishing programs, 21 members (65.6%) did not use, while 5 members (45.5%) from private schools used the publishing programs more than the 6 members (28.6%) from the public schools.

Presentation software, PowerPoint, was used more in public schools than private schools with 9 members (42.9%) from the former compared to 3 members (30%) from the latter; only 12 members of staff (38.7%) used PowerPoint presentations. The majority of the non-teaching staff respondents (61.3%) did not use PowerPoint presentation software.

Internet was used by 61.8 per cent of the non-teaching staff where 21 members of staff from private schools (71.4%) used Internet more than the public schools with 11 members of staff (55%). Out of the 34 non-teaching staff respondents, 13 (38.2%) non-teaching staff did not use Internet.

There were 33 respondents of the non-teaching staff who answered the questionnaire on e-mail. E-mail was used by 21 members non-teaching staff (63.6%) as compared

to 12 (36.4%) who did not use it. Private schools used e-mail more by a small margin (64.3%) compared to (63.2%) for public schools.

Figure 14 below represents the software as used by the non-teaching staff.

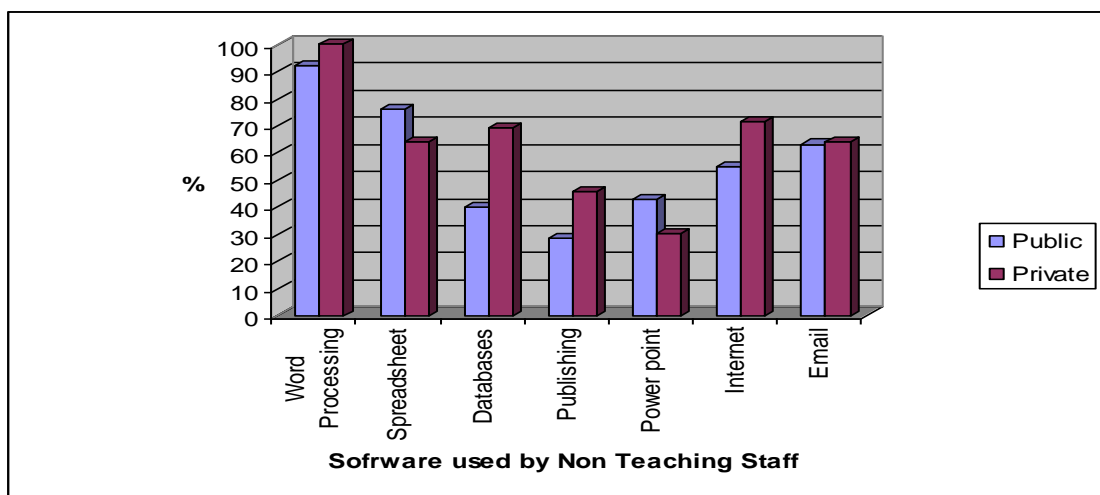


Figure 14: Software used by the non-teaching staff

Members of the non-teaching staff were asked if they had been trained to use the above programs. The response was that, 42 (97.7%) of the respondents (out of the 43) had been trained; only one member of staff had not been trained.

Other programs used by the non-teaching staff were Quick Books, Excel, Windows and Adobe Creative Suite, publishing software.

4.6.8 Application of Other ICTs

The school principals said that radio was used for educational purposes. The research results showed that 66.7 per cent of the schools used or had used a radio for students and only 33.3 per cent did not use. Among the schools where students used radio, 90.5 per cent used it for educational purposes and only 9.5 per cent used it for entertainment. The principals also reported use of television (TV) in the schools

where 60.6 per cent of them said that TV was used in their schools and 39 per cent said it was not used in their schools. Where TV was used, 88.2 per cent said it was used for educational purpose and only 5.9 per cent used it for entertainment.

In 76.9 per cent of the schools, both the telephone extensions and mobile phones were used for communication. A proportion of 23.1 per cent did not have telephones. The mobile phone was used for communication in 90 per cent the schools. Only 5 per cent of the mobile phones were used for educational purposes for both the public and private schools.

Video equipment was used in 68.4 per cent of the schools for educational purposes. The private schools were better equipped with video with 42.1 per cent as compared to public schools with 26.3 per cent.

The subject teachers said that radio was used for educational purposes in both public and private schools. Out of the 150 respondents, 86 (57.3%) used radio for educational purposes. The usage was higher among teachers in the private schools (61.4%) than in the public schools (54.85%). Of the 150 respondents, 46 of the teachers (45.5%) used the radio for teaching languages – English, Kiswahili and French; the use was more by the private schools teachers (55.3%) than by public schools teachers (39.7%). Education programmes were cited as being used by 34 per cent of the teachers in both private and public schools. Only 19 teachers (18.8%) from both public and private secondary schools did not use the radio at school with a higher percentage (23.8%) from public schools as compared to 10.5 per cent from private schools, who also did not use the radio.

Of the 188 teachers sampled, 149 responded to the question on whether TV was used for educational purposes in their schools. The response was that 85 of the teachers (55.7%) said that TV was used. The use was higher in private schools with 62.1 per cent as compared to 51.6 per cent usage in the public secondary schools. On the other side, 66 teachers (44.3%) said that TV was not used in their schools with a higher percentage of non-use (48.4%) being from public schools compared to 37.9 per cent from the private schools. TV was used for educational purposes by 68 per cent of the teachers from both public and private secondary schools who also used it for entertainment.

The use of radio, TV and telephone is shown in Figure 15 with an indication that telephone was used mainly for communication.

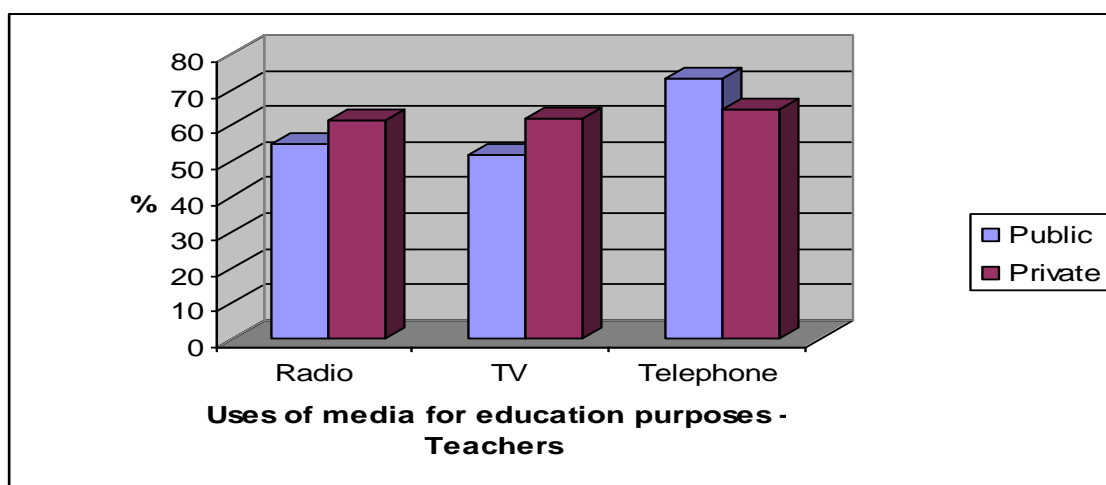


Figure 15: Use of media for educational purposes by the teachers

From the figure, it is apparent that teachers still valued information from radio and TV. Telephone is also valuable for communication, and teachers preferred it over communication through e mail.

Of the teacher respondents, 49 (57%) used video equipment in their schools. The equipment was used for both educational and entertainment purposes. About 33.7 per cent of the schools did not use video equipment.

Also, 36 teachers used audiotapes and cassettes for educational purposes. The media were only used for storage of information and for education by a few teachers. The results indicated that 37.5 per cent of the teachers did not use audiotapes and cassettes.

The teachers were asked whether they used telephone extensions in their schools. Only 87 teachers (46%) out of 188 answered this question. Of the respondents, 70.1 per cent used the extensions for communication, while 29.9 per cent did not use.

Of the teachers who responded to the question on whether they used mobile phones for educational purposes, 53 (57.6%) said that they used it for communication. Those who used mobile phones for browsing Internet were 8.7 per cent and the ones who used for educational purposes were only 4.3 per cent, while 27 (29.3%) did not use mobile phone in the school. This question had a low response rate 92 teachers (49%) out of 188 responded.

Digital microscopes were not used by the teacher respondents much. Only 9 (13.4%) of the 67 respondents used them in the laboratories for educational purposes. Private schools had 7 digital microscopes compared to only 2 in public schools.

With regard to the non-teaching staff respondents, 78.2 per cent did not use video equipment, 13 per cent used it sometimes and only 8.6 per cent used it. Also 92 per cent did not use digital microscopes. Of the respondents, 86.5 per cent said that they used telephone extensions and mobile phones in their work. They rarely used audio

tapes, cassettes and CDs. Finally, 92.7 per cent of the staff found the work they performed using computers in the schools satisfactory.

4.7 Financing of ICTs

Secondary schools had low budget for ICTs and maintenance. When it came to purchase of new computers and maintenance, the computer teachers had challenges; the principals had not put a budget to sustain computerisation programmes in the schools with 45.9 per cent of the schools not having a budget for computers, while 35.1 per cent had only 1-5 per cent of their budget spent on computerisation projects. Thus, they depended on whatever funds that was available as well as donations. Table 25 Illustrates annual budget allocations.

Table 25: Annual budget for ICTs in schools (n=37)

Annual budget for ICTs (in percentage)	School type				Total	
	Public	%	Private	%	No.	%
Less than 1	0	0	1	2.7	1	2.7
1-5	9	24.3	4	10.8	13	35.1
6-10	1	2.7	1	2.7	2	5.4
11-15	0	0	1	2.7	1	2.7
16-20	0	0	2	5.4	2	5.4
Over 30	0	0	1	2.7	1	2.7
No budget	13	35.1	4	10.8	17	45.9
Total	23	62.1	14	37.9	37	100

4.7.1 Procurement and Acquisition of Computers

The study sought to establish the procurement of computer equipment in secondary schools in Nairobi. The methods for acquiring computers were found to be through

the office, suppliers, tendering and donations. The computer teachers were involved in acquiring computers through the office of the principal. The stringent public procurement procedures caused delay in respect of public schools and the schools were not very conversant with the procedures for acquiring the computers and peripherals set-up as outlined in Public Procurement and Disposal Act of 2005. The study found that 47.2 per cent of the schools did not have a procurement plan and 19.5 per cent informed the office of any items they wanted for the computer lab and for the computers. The procedures for acquiring computer and computer equipment are shown in Table 26 below.

Table 26: Procedures for the acquisition of computers (n=37)

Procedure	School type				Total	
	Public	%	Private	%	No.	%
Inform the office	4	11.1	3	8.4	7	19.5
Order from suppliers	3	8.3	1	2.8	4	11.1
Donors	3	8.3	0	8.3	3	8.3
Tender	3	8.3	2	5.6	5	13.9
Others	8	22.3	10	25	18	47.2
Total	21	58.3	16	41.7	37	100

4.7.2 Number of Computers in Public and Private Secondary Schools

The study sought to establish the number of computers in secondary schools. This was necessary in order to establish the number of computers per staff and student. This was a means of assessing the e-readiness and how schools were faring in acquisition of computers. Table 27 summarises the responses that were given by the school principals.

Table 27: Number of computers in schools (n=29)

No of computers	School type				Total	
	Public	%	Private	%	No.	%
1-5	4	13.8	0	0	0	13.8
6-10	0	0	1	3.4	1	3.4
11-15	1	3.4	1	3.4	2	6.8
16-20	2	6.8	1	3.4	3	10.3
21-25	4	13.8	3	10.3	7	24.1
26-30	3	10.3	2	6.8	5	17.2
Over 30 computers	4	13.8	3	10.3	7	24.1
Total	18	62.3	11	37.7	29	100

Findings revealed that 6 per cent of public schools had 1-5 computers, 9.1 per cent had 26-30 computers and 27.2 per cent had over 30 computers. Most of the private schools computers had their numbers evenly spread. Observation in the computer labs showed that the computer equipment had been purchased from local suppliers. The public schools had most of their computers donated and this posed a major problem of having out-dated machines and equipment.

As Table 27 reveals, 4 schools, all in the public category, had between 1 and 5 computers. In such a situation, there was not a single computer assigned to students. One computer was allocated for the secretary, one was in the principal's office, and another one was in the deputy principal's office. Occasionally, there would be a computer in sciences departmental offices. Some schools had a computer lab with less than 10 computers, some of which had broken down or were out-dated. There were only seven schools that had more than 30 computers.

The teachers were asked if they were able to use ICTs in school. Of the teachers who used computers, the majority said they used them for teaching. From the findings, 64 per cent said they used computers to prepare lesson notes and other work. Teachers who used computers at school were 64.2 per cent when compared to 81.3 per cent of students who used computers.

4.8 ICTs Policies and Regulations

E-leadership is a McConnell's e-readiness tool for e readiness and its parameters are policies and regulations that are put in place. The indicators in the current research were assessed at government and school levels. Goals and values and the school mission and vision were considered as indicators of diffusion of ICTs.

4.8.1 ICT Policy Guidelines for Secondary Schools in Nairobi County

This sub-section discusses the legal framework and policies that had been put in place by the Kenya Government through the Ministry of Education Science and Technology (MoEST) to assist and guide secondary schools in the implementation of ICTs. At the operational level, the schools were supposed to have their own guidelines to assist in ICT implementation. One aspect of e-readiness, as contained in the fourth objective of the research, was to find out what legal framework and policies were operational in the schools to assist in this venture.

The study sought to establish the vision and the mission that were guiding ICT implementation and integration into the school. It was important to find out if there were any policies that had been put in place. Some of the principals stated that their vision for ICT in their school for the next five years was to see that all students and teachers were computer literate, that ICT was applied in all subjects, and that they

purchased enough computers for their schools. The mission statement by 85 per cent of the principals was to see the school excel in computers and to have easy ICT coordination in the school systems.

The issue of funding was fundamental to the success of ICT initiatives in the schools. According to the research results, only 37.1 per cent of the schools were members of computer initiatives that supported them in funding for equipment and training; there were only 13 schools that were members of ICT initiatives. Among these schools, 9 were public and only 4 were private. In total, 22 schools (62.9%), comprising 7 public and 15 private schools were not members of any computer initiatives.

It was also found that, 10 public schools had the ICT support from both private and public institutions, while. Only 3 private schools had support from private institutions. Only 6 schools had external financial support for ICT. This was from the government kitty (2 schools) and parents and other donors (4 schools). According to the principals, 31 schools did not have any external financial support.

4.8.2 Vision and Mission of Integration and Implementation

The study also sought to establish what the principals had put in place to guide ICT implementation and integration into the curriculum and other activities in the school. Although they said that their aim was to make all the teachers and students computer literate, this had not been put in any laid out vision, mission or any policy statement. Thus, the guidelines for ICT integration and diffusion into the school had not been put in place. In a majority of the schools, ICT had not been given a priority. Table 28 shows future plans for ICT as stated by the principals.

Table 28: Future plans of ICT as stated by the school principals (n=28)

Future plans	School type				Total	
	Public	%	Private	%	No.	%
Seek donors	-	-	1	3.6	1	3.6
Students & teachers to be computer literate	3	10.7	4	14.3	7	25.0
Introduce computer lab	4	14.3	2	7.1	6	21.4
Expansion of computer lab	5	17.9	5	17.9	10	35.8
Hire qualified teachers	-	-	4	14.3	4	14.3
Total	12	42.9	16	57.1	28	100

The computer teachers did not to have any vision for ICT for the students and the school. Figure 16 below shows how the computer teachers envisaged the vision statement for ICT in the school should have been. According to them, “nobody had ever thought of writing a vision or mission statements for ICT in the schools”. They had not thought that it was important. Neither the computer teachers nor the school management had thought out a mission statement to guide their work they generally wanted more growth in ICT and purchase of more computers.

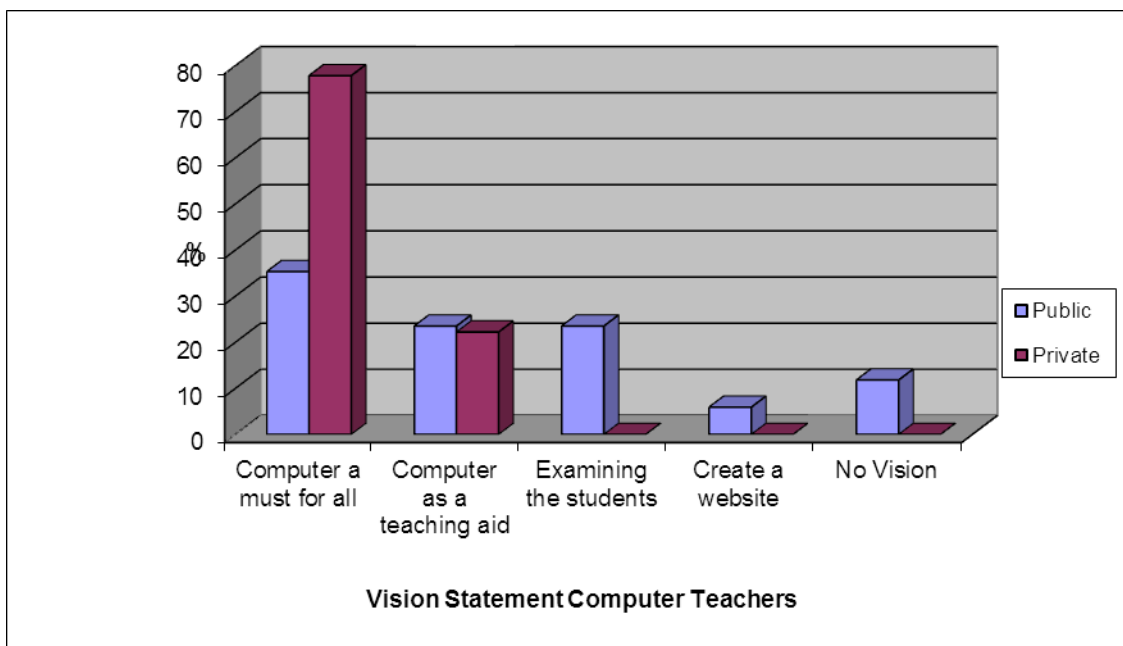


Figure 16: Vision statements for the computer teachers

Teachers were asked about their vision and mission for ICT in the schools where they were teaching. They had the vision that: “All persons in the school to become computer literate”, followed by “Wanting everyone in the school to excel”. About 7 per cent of the teachers said that they did not know and had no vision for ICT in their school. The observation by the researcher was that teachers left the computer teachers alone to take care of ICT and did not get involved in what was going on in the computer labs. Apparently, the school management had not made any attempt to involve subject teachers in ICT and they were not given an opportunity or coerced or persuaded to use ICT to get subject content or improve their teaching skill using ICT. The teacher respondents' vision is presented in Figure 17.

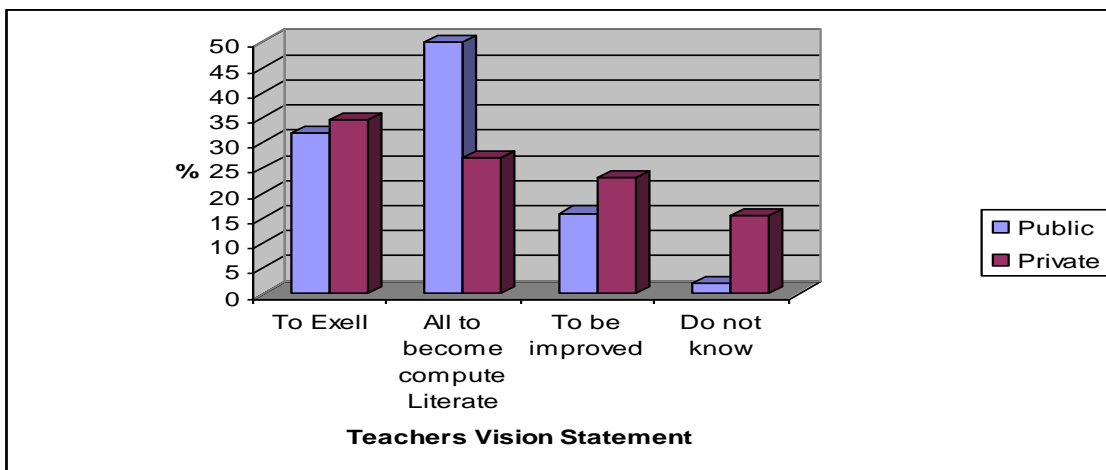


Figure 17: Teachers' vision statement

From the figure, the teachers had the mission statement. However, most of them were not aware of the mission statement for ICT in their school let alone knowing what a mission statement for ICT was meant to be. Some of the responses that they gave were vague and were not well thought out, signifying lack of any ICT awareness or procedures as Figure 18 shows. It captures some of the key elements in the mission statement as presented by the school teachers.

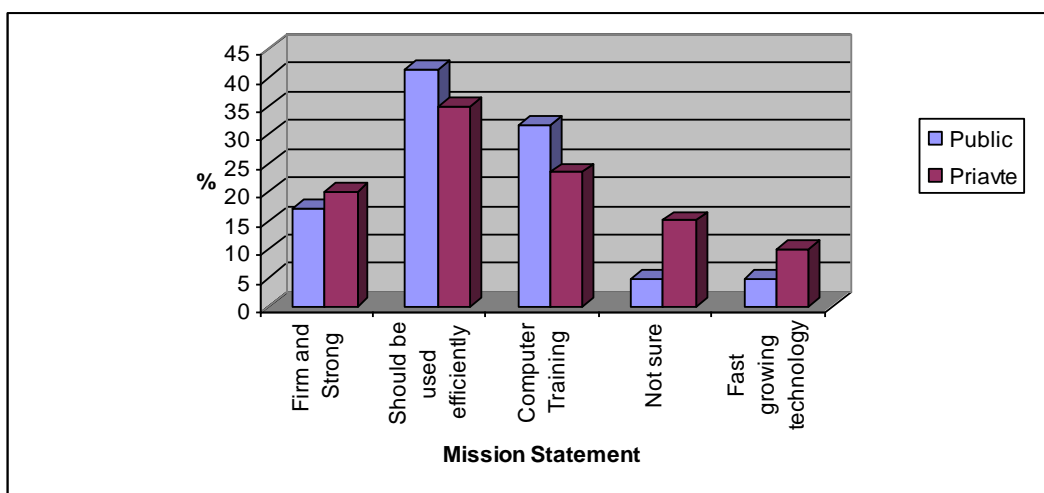


Figure 18: Teachers' mission statement

The teachers viewed their work as teachers in the subjects they had been assigned. To them, ICT use and concerns was for 'other people'. They did not associate use of ICT with their teaching job and were comfortable using textbooks that they had always had. For ICT integration to be meaningful and accepted, teachers need to be involved and retrained so as to accept the changes that are taking place in teaching and learning globally.

4.8.3 Goals and Values

The study sought to find out if there were goals and values that had been spelt out to guide ICT implementation. Research findings indicated that the principals and the teachers were wary of ICTs in the schools, especially the Internet. They feared that if students were to use Internet, there needed to be controls to avoid corruption of their morals through social sites.

When the teachers were asked to comment on what they thought would result if students were allowed to use ICT in the school, especially in regard to e-mail and exposure to the Internet, they said that there should be controls because if there was no proper controls, this would contribute to low morality among the students. It was the same with use of the telephone, especially use of the mobile phone, which was not allowed in all the schools sampled. Teachers also said that allowing the students uncontrolled use of Internet and computers would create some degree of insecurity in the schools, while 25.5 per cent of the teachers said that there would be interference in the learning environment with regard to ethical and legal issues.

Ethical and legal issues had not been addressed in view of ICT implementation in the schools. About 30 per cent of the principals said that the issues had not been

addressed in their school and majority of them said that this could only be addressed in the future.

6 principals (40%) from private schools said that they had not been able to handle the issues of data security and confidentiality, while about 13.3 per cent from public schools had been able to keep confidentiality of the data. Data security was a concern as the principals did not know how to back up their data; while data confidentiality needed to be addressed.

4.8.4 Technical Issues

The study sought to find out what policies or guidelines had been put in place with regard to the technical issues that affected ICT implementation. This sub-section deals with the technical issues that were found to be important and needed to be addressed by the principals in their respective schools. The issues addressed are management of computers and ICT equipment and data security.

4.8.4.1 Data security

In their response, 46.7 per cent of the principals indicated that there was no data confidentiality, and 53.3 per cent said there was need for improvement in data security. On their part, the teachers said that there was need for improvement in the issues of security and data confidentiality. They felt that use of computers had created interference in the way information was stored which led to interference in their privacy; they said that they felt very vulnerable and exposed as far as data confidentiality was concerned. They said they felt insecure as their personal information needed to be kept 'safe and secret'. Of the respondents, 27.1 per cent said that some information needed to be secured.

For maintenance of hardware and software, 41.7 per cent of the principals said this was done annually, while 33.3 per cent said this was done as need arose. On the persons who carried out maintenance, 25 per cent of the principals said that the technicians took care of the hardware and the software and serviced the equipment.

4. 8.4.2 Management and maintenance of computers

It was established that majority (85%) of the schools purchased or hired their computers and ICTs equipment. About 15.4 per cent got their computers from donations.

When it came to replacement of computers and equipment, majority of the principals (70%) replaced the parts and equipment from the school funds. Only 20 per cent of the schools were always able to replace parts, while 10 per cent were unable to replace any computers or computer equipment. The study revealed that majority principals (70%) replaced computer parts as need arose. They did not have a policy on computer maintenance.

Figure 19 shows how the computer equipment is replaced and maintained. It also shows the principals' recommendation for computer parts and equipment to be supplied by external suppliers. Maintenance of ICT equipment was by external personnel in both public and private schools. There were schools that had technicians who repaired and maintained the computers and ICT equipment. In some schools, computers were never repaired and there was no policy regarding maintenance and repairing of ICT equipment.

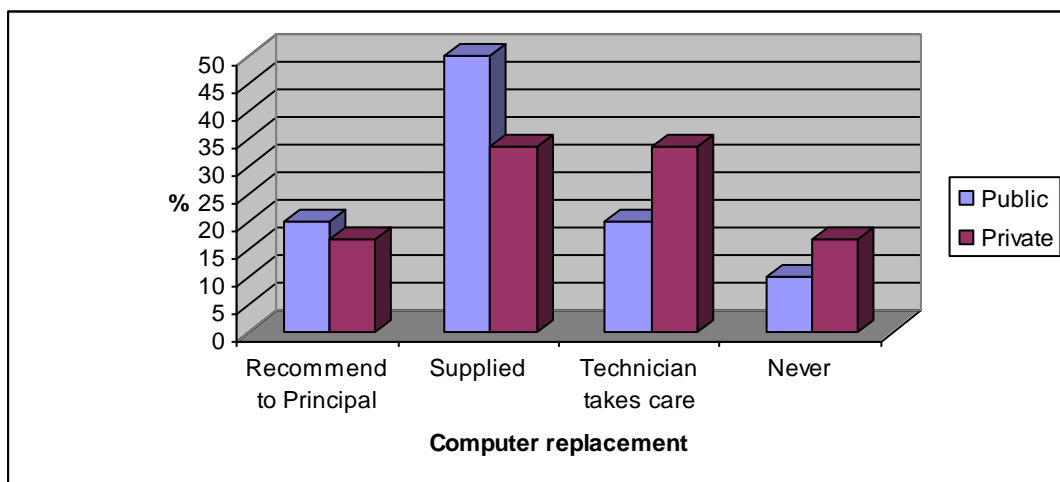


Figure 19: Replacements and maintenance of computers equipment

Response from the computer teachers, teachers and students indicated that computers were repaired by the technician. In most cases, the computer teacher was the technician. The research also revealed that some schools had no one to repair their computers.

Among the computer teachers interviewed 88.2 per cent indicated that they informed the technician about the breakdown of equipment. In most of the institutions surveyed, there was no organized way of computers maintenance and no guidelines or standardized procedure for computer maintenance. In addition, the staffs taking care of computers and other ICT equipment was not trained for the task. They indicated that the equipment repair and maintenance was done on a trial and error basis, leading to constant breakdown of the equipment. The reason behind this was that maintenance contracts with well trained personnel and companies were too expensive and unaffordable.

According to the findings, 60 per cent of the computer teachers in both public and private secondary schools spent five hours repairing the computers in a week. The

researcher observed a lot of computers that were broken down in the schools. In addition, there were no computer disposal mechanisms in place. Figure 20 illustrates the number of hours the computer teacher spent on maintenance of the computers.

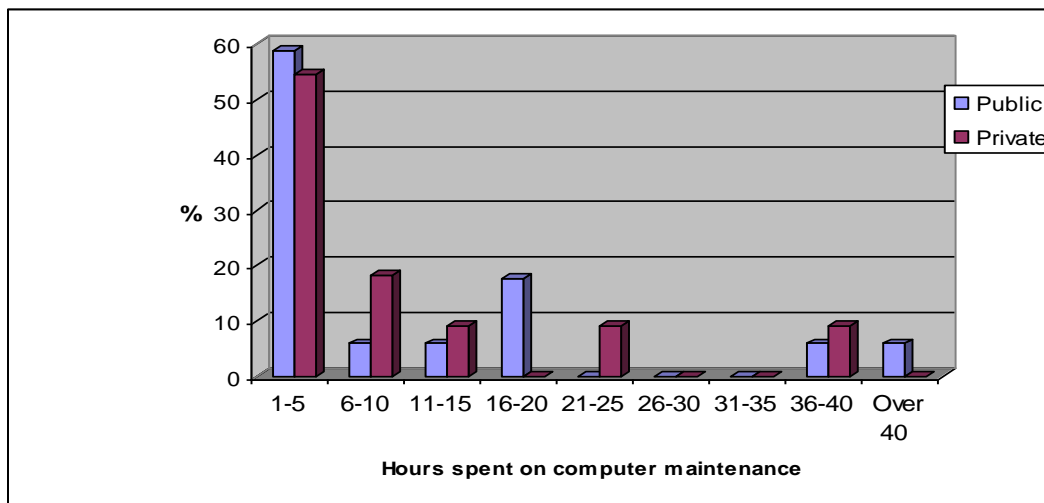


Figure 20: Number of hours spent in a week on maintenance of computers by the computer teachers

4.9 Challenges Experienced in Sustainable ICT Implementation

Objective five set to establish the challenges experienced in ICT implementation in the schools and how the challenges could be addressed. These consist of the challenges that the respondents faced in the schools as far as ICT was concerned. Discussion of these challenges is arranged according to the principals, the teachers, the computer teachers and the non-teaching staff.

4.9.1 Challenges Faced in ICT Implementation

According to the school principals, the challenges faced in ICT implementation were: “the computers were few and the solution was to buy more computers and encourage the students”, and the problem of high computer costs. To solve the problem of costs,

the principals proposed that the government should lower the costs of computers and other ICT equipment.

The principals also faced the challenge of replacing out-dated computers and equipment, and of disposing them. Other challenges were: replacing malfunctioning computer parts and updating the equipment, maintenance of computer equipment, supervision of the use computers, and supervision of the computer laboratories.

The challenges faced by the computer teachers range from lack of enough computers, enough space, power supply, software updates, and antivirus programs, to coping with fast growing technology, mischievous students, computer vandalism and theft, and computer breakdown.

The most common challenges that the teachers faced were: few computers; limited access time; rapidly changing technology; power failure; lack of interest among students; and, overworking of teachers.

Non-teaching staff faced various challenges. They included power blackouts, limited computers, computer viruses, and slow speed of the computers. Lack of qualified teachers and need for training were also major challenges facing the schools. The challenges experienced by staff are summarized in Table 29. There were many challenges facing computer use in the schools that made it difficult for ICT to impact on teaching and learning in the schools.

Table 29: Challenges faced by computer teachers, teachers, and non-teaching staff in ICTs

Challenge	Computer teachers		Teachers		Non-teaching staff	
	(n=31)	%	(n=121)	%	(n=32)	%
Computer and machine breakdown	4	12.9	0	0	1	3.1
Power supply	2	6.5	8	6.6	8	25
Mischievous students	5	16.1	0	0	0	0
Lack of software updates & antivirus	8	25.8	0	0	0	0
Fast Growing Technology	7	22.6	16	13.2	0	0
Lack of enough computers and space	5	16.1	68	56.2	6	18.7
Limited time	0	0	19	15.7	0	0
Lack of motivation among students	0	0	8	6.6	0	0
Over worked	0	0	2	1.7	3	9.3
Slow computers	0	0	0	0	4	12.5
More knowledge	0	0	0	0	3	9.3
Lack of qualified teachers	0	0	0	0	3	9.3
Viruses	0	0	0	0	4	12.5
Total	31	100	121	100	32	100

4.9.2 How the Challenges Facing the Members of Staff Can Be Solved

The teacher respondents in public and private schools said they wanted additional computers and additional time to use computers, especially in the public schools for the latter. Public schools needed training of teachers, while private schools asked for hiring of qualified teachers. Availing affordable computers by the Government, upgrading computers, installing back-ups, and hiring technicians were also cited.

There was also need to supervise students and also to create interest among students in ICT.

Among the non-teaching staff comprising the bursars, the secretaries and the librarians the major challenges were training, attack by viruses and power shortages. They gave the following suggestions on how to solve ICT problems: training more staff, installing antivirus programs and purchasing of back-up generators as illustrated in Table 30.

Table 30: Possible solutions to the challenges as suggested by staff

Suggestions to challenges	Computer teachers		Teachers		Non-teaching staff	
	(n=31)	%	(n=121)	%	(n=32)	%
Supervising the students	3	12	7	6.6	0	0
Installing antivirus	4	16	0	0	2	6.7
Updating the computers & equipment	6	24	6	5.7	0	0
Expanding computer room/purchasing modern computers	3	12	50	47.1	5	16.7
Internet connection	3	12	0	0	0	0
Train all staff on hardware maintenance	6	24	10	9.4	9	30
Qualified teachers	0	0	6	5.7	0	0
Extra lessons	0	0	11	10.4	1	3.3
Avail cheaper computers	0	0	6	5.7	0	0
Attitude towards ICT	0	0	3	2.8	0	0
Installing backups	0	0	6	5.7	6	20
Hire technicians/employ more staff	0	0	1	0.9	4	13.3
Regular service	0	0	0	0	3	9.4
Buy antiglare	0	0	0	0	1	3.3
Reduce workload	0	0	0	0	1	3.3
Total	25	100	106	100	32	100

4.9.3 Principals' Suggestions on How ICT Could Be Improved

The principals were asked how the use of ICT could be improved in their schools with regard to accessing computers, improving skills and training, and management skills.

To improve access to computers, the principals suggested that the government could avail computers and other equipment to both private and public schools. They also suggested that the schools should raise funds to purchase more computers. A third suggestion was to avail more time for computer lessons and for computer practice, which would enable the students and teachers to gain more skills.

To improve skills and training, the principals suggested the hiring of more teachers, and offering more training to both the teachers and the students. In order to improve management skills for ICT in the schools, they said that more training was needed. This was cited as the most needed support for ICT implementation. The principals also said that there was need to install Internet in most of the schools.

4.9.4 Teachers' Suggestion on How ICT Accessibility Can Be Improved

The teachers' response on how the use of ICT can be improved in their school is shown in Figure 21. Lack of accessibility to computers was the most cited problem by the teachers. Access to the computer lab was cited by 22.5%, private schools needing more access. Increasing computers was cited as way to improving access to ICT by 69.8% of teachers from public and private secondary schools. 78.2% teachers in public secondary schools and 52.4% teachers from the private secondary schools thought that access to computers would take place by increasing the number of computers in the schools. One per cent teachers wanted more time allocated and another one per cent wanted Internet to be installed as a way of improving access to computers.

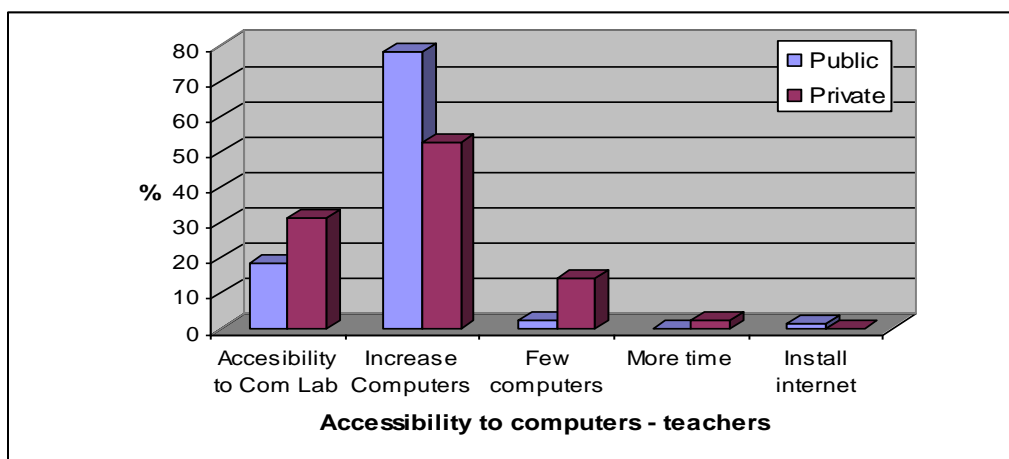


Figure 21: Teachers' suggestions on how accessibility to computers can be improved

4.9.5 Improving Skills and Training

To improve skills and training, teachers cited the need for more training for teachers in both public and private schools. This was cited as the most important factor by 65 per cent of the teacher respondents. Refresher courses for teachers were suggested by 6.5 per cent, while 13 per cent of the respondents suggested the hiring of more teachers. There was still the need for more computers as cited by 15.4 per cent of the teacher respondents. The response from teachers is illustrated in Figure 22.

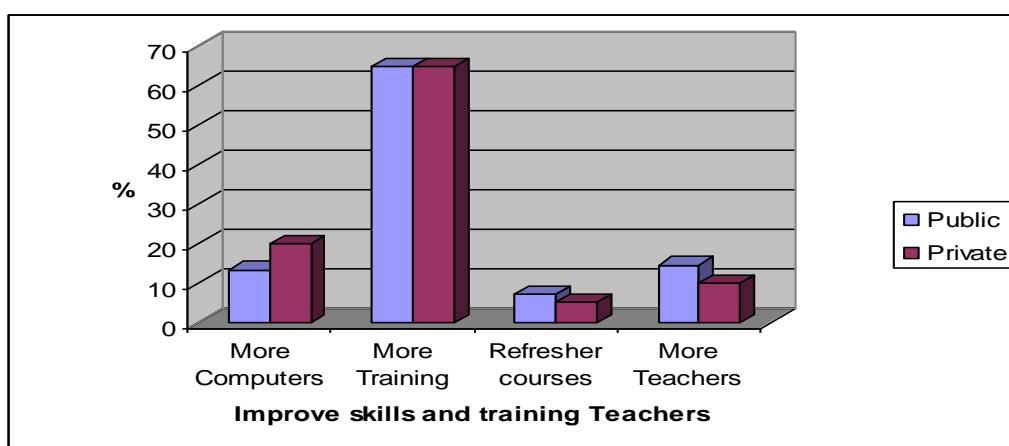


Figure 22: Teachers' response on how skills and training can be improved

Figure 23 below illustrates responses by teachers on how ICT can assist in improving the transmission of skills. About 36 per cent of the respondents cited need for more practice as a way to assist in transmission of skills and competencies in ICT. Other ways of improving skills transmission that were cited include the need for qualified teachers, purchasing latest computer versions, and expanding the computer lab.

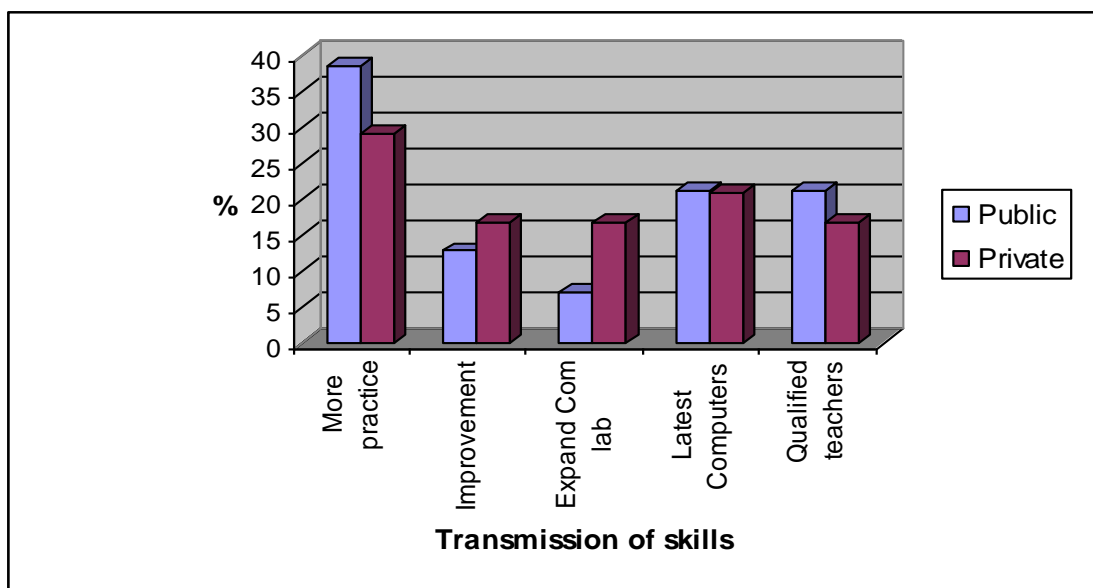


Figure 23: Teachers' response on how ICT skills can be transmitted

4.9.6 How ICT Can Be Used with Regard to Acquisition of Knowledge

Training was cited by more than 65 per cent of the teacher respondents to be a major contributor to acquisition of knowledge. Installing Internet, cheaper charges on ICT, and increasing reading materials were said to be important in increasing acquisition of knowledge. The response is illustrated in Figure 24.

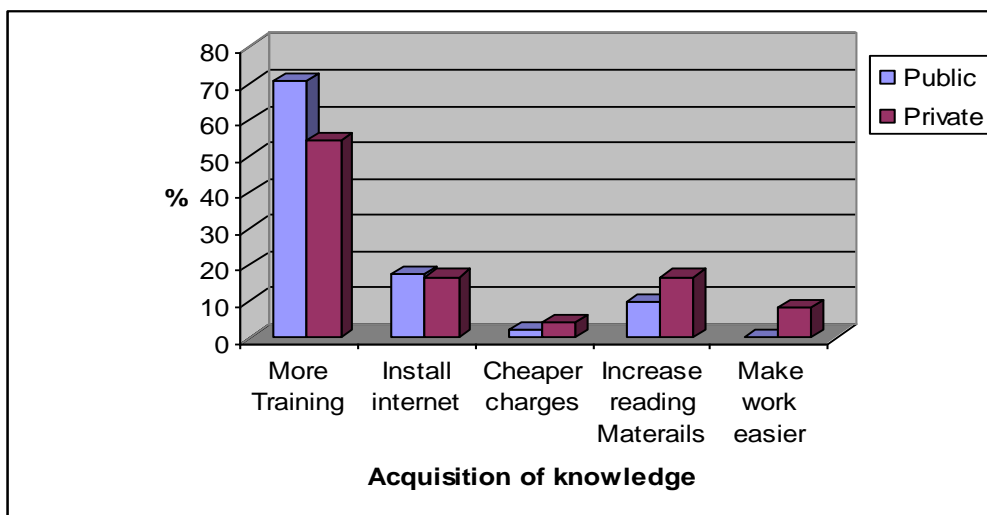


Figure 24: How more knowledge can be acquired by use of ICTs

4.9.7 Suggestions by Staff for Improving ICT Management in the Schools

Members of staff (computer teachers, teachers and non-teaching staff) reported that there was need to improve ICTs management in the schools. All the categories made suggestions on the way forward if ICT implementation was to succeed. Computer teachers suggested the need for refresher courses to be hosted occasionally so as to assist the teachers cope with the changing technology. Purchasing modern computers, upgrading software, and maintenance and servicing of the computers were also seen as ways of improving ICT in the schools.

The subject teachers found the need for employing ICT qualified teachers as a way of improving ICT in the schools, while 15.2 per cent of them wanted improved accessibility to computer labs. Other suggestions include the need for management to improve maintenance and servicing of the available equipment, more access time to be allowed for computers, consultations between teachers and management, and increased remuneration for teachers involved in ICTs instruction.

4.9.8 Suggestions by Staff for Improvements on ICT

The non-teaching staff suggested the need for purchasing the latest computers and modems. They also proposed the upgrading of the computers and the purchasing of more updated accounting software. The suggestions by the staff are shown in Table 31.

Table 31: Suggestions by staff for improving ICT management in the schools

Suggestions to challenges	Computer teachers		Teachers		Non-teaching staff	
	(n=22)	%	(n=93)	%	(n=28)	%
Refresher course	12	54.5	0	0	0	0
Expanding computer lab/more time and materials	1	4.5	9	9.8	0	0
Purchasing modern computers/latest computers and modems	4	18.1	0	0	13	46.4
Maintenance and servicing	2	9.1	13	14.1	1	3.6
Upgrading of software and hardware	3	13.6	-	-	7	25
Consultations	0	0	6	6.5	0	0
Need to improve	0	0	19	20.7	0	0
Easy accessibility/unlimited time	0	0	14	15.2	2	7.1
Qualified teachers	0	0	28	30.4	0	0
Better pay	0	0	3	3.3	0	0
More accounting software	0	0	0	0	4	14.3
Regulations in computer usage	0	0	0	0	1	3.6
Total	22	100	93	100	28	100

The following is a presentation from the students.

4.10 The Students Responses

Students and the school principals were the main informants in the study as they were the recipients and actors in the ICT learning processes in the secondary schools. Figure 25 shows the distribution of the students among the sampled schools. The public schools had more students than the private schools, while the latter had less number of students, which was explained by the high cost and the high fees charged.

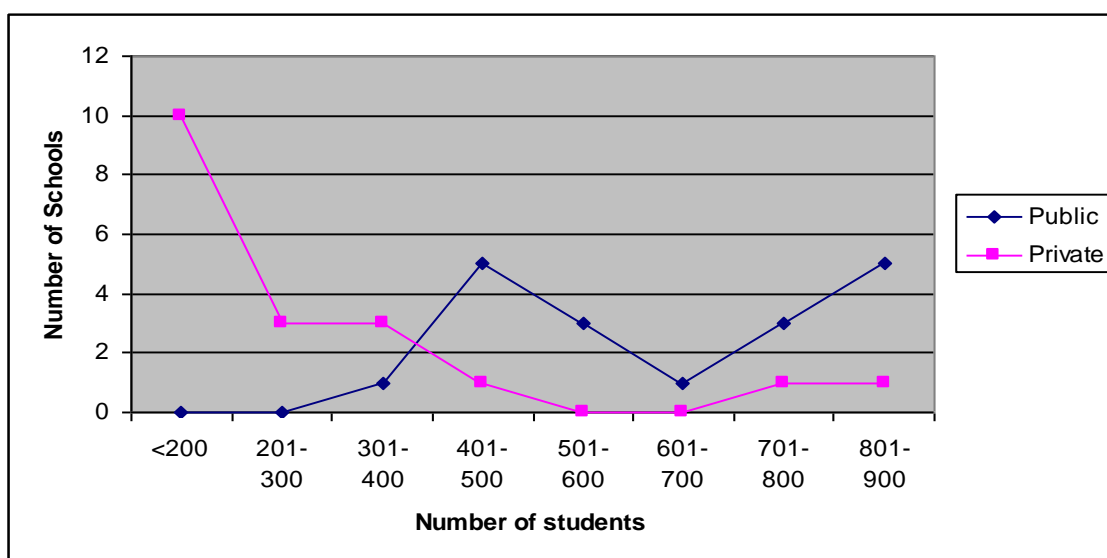


Figure 25: Distribution of students in public and private schools

4:10.1 Demographic Characteristics of the Students

The representative sample comprised 700 students all of whom were given the questionnaire. As mentioned in Chapter Three, the Form Two and Form Three classes were purposefully selected as it was found that the Form Ones were too new in the schools and the Form Four students were busy preparing for the KCSE exams; hence, it was felt that inclusion of Form One students could affect the quality of the data collected. Table 32 shows the distribution of the sampled 700 students out of the population of 4559.

Table 32: Distribution of the student sample ($n=700$)

Students by class	School Type													
	Public Schools						Private Schools						Total	
	Male		Female		Total									
	n	%	N	%	n	%	N	%	n	%	n	%	n	%
Form 2	105	15.0	80	11.4	185	26.4	69	9.9	80	11.4	149	21.3	334	47.7
Form 3	148	21.1	67	9.6	215	30.7	64	9.1	87	12.4	151	21.6	366	48.0
Total	253	36.1	147	21.0	400	57.1	133	19.0	167	23.9	300	42.8	700	100

Table 32 above shows the number of student respondents who actually participated in the research by filling out a questionnaire. They were randomly selected from the class register. The computer teacher or the deputy principal identified the appropriate time to work with the selected students. Form Two students were 46.2 per cent, while Form Three students were 53.7 per cent of the sample showing that, there was not much difference between the classes; the study aimed at getting 50 per cent of each class. Table 33 shows the actual respondents.

Table 33: Actual student respondents ($n = 566$)

Students by class	School Type													
	Public Schools						Private Schools						Total	
	Male		Female		Total									
	n	%	N	%	n	%	N	%	n	%	n	%	n	%
Form 2	87	15.3	62	11.0	149	26.3	51	9.0	63	11.1	114	20.1	262	46.3
Form 3	140	24.7	49	8.7	189	33.3	46	8.1	69	12.1	115	20.3	304	53.7
Total	227	41.1	111	19.6	338	59.7	97	17.1	132	2.3	228	40.4	566	100

Figure 26 shows the schools that participated in the research by type based on gender – girls’ schools, boys’ schools and mixed schools.

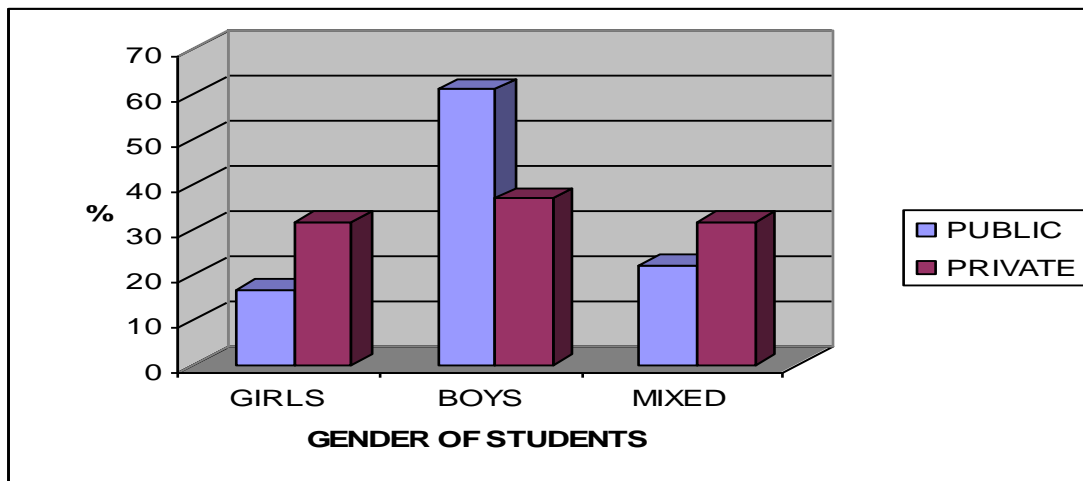


Figure 26: Participating schools by type based on gender

In a scheduled interview the school principals revealed that government funding for various public schools depended on their respective status; hence, there was higher funding for national schools, followed by provincial schools and then the district schools. Also, the level of funding was reflected in the extent of adoption of ICTs in the schools as this indicated the amount of financial resources available to purchase ICT hardware and software. The scenario was different in private school; the extent of adoption of ICTs was determined such other factors as the student enrolment and the fees collected.

4.10.2 Adequacy of Computer Equipment in the Schools

The study sought to find out what the students thought about the adequacy of ICTs. The students were asked if the computers in their respective schools were adequate. The majority of students (60%) from private schools perceived that computers were adequate while 52 per cent in public schools indicated that the computers were not

adequate. The study also found out that 460 students (81.3%) used computers while 106 (18.7%) did not use computers at school.

The students were asked to indicate from where they accessed computers. The majority (98.5%) used computers in the school computer lab; they indicated that there were no computers in the classrooms or the school library. Therefore, if the students were unable to access the computer lab, as it was normally accessible only at allocated times, then they were disadvantaged.

Students were asked if they had a formal computer lesson in school. Majority (59%), in both private and public schools, stated that they had computer lessons. This revealed that about a half of the students had a formal computer lesson in both public and private schools.

4.10.3 Students Training in the Use Computer

The students were asked whether they were trained on how to use computers. The results revealed that 77.4 per cent had been trained; 85 per cent from the private schools had been trained as compared to 73 per cent from public schools. The students were trained in the use of computers at different places as shown in the Figure 27.

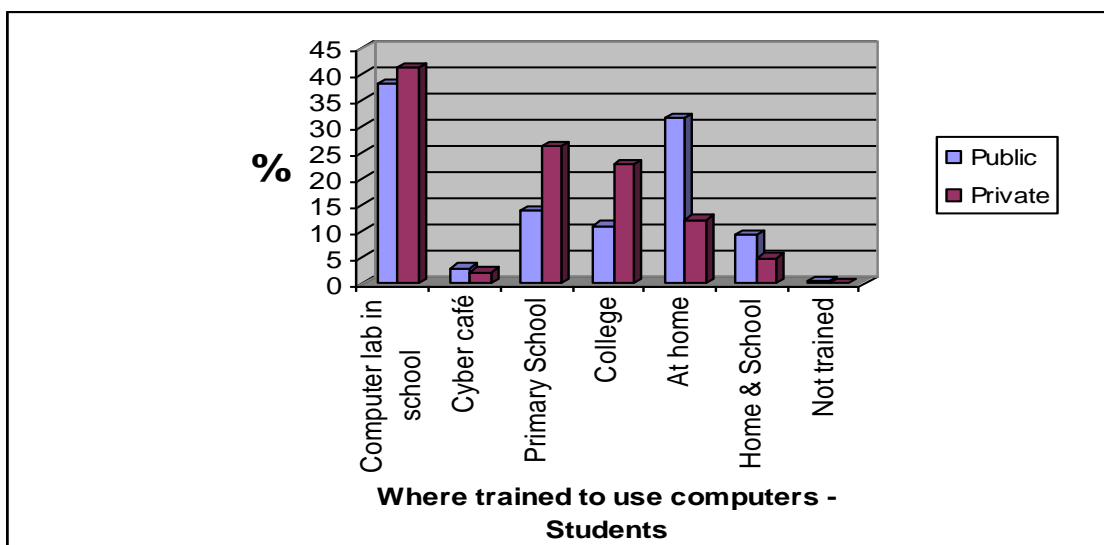


Figure 27: Where students were trained in the use of computers

The research established that private schools had more students who learnt to use computers in the school (41.1%) compared to 38.3 per cent students from public schools. More students from private schools than public schools indicated that they had learnt how to use computers while at the primary school as the figure shows.

The students were asked if they had access to computers away from school. According to the findings, 83.5 per cent of the students had access to computers away from school. They had more access (90%) compared to the students from public schools (80%).

4.10.4 Number of Hours Allocated to Students for Computer Use

The study set to find out the hours spent by the students using computers in a week. It established that, of the students from public schools, 28.5 per cent spent 1 hour, 32.2 per cent spent 2 hours and 20.7 per cent spent 3 hours. For students in private school, 36.3 per cent of spent 1 hour, 28.5 per cent spent 2 hours and 19 per cent spent 3 hours. Table 34 shows the distribution of time and helps to establish that there was no

significant difference between public and private schools for hours allocated for computer use by students.

Table 34: Number of hours in a week allocated for students to use computers (n=408)

No. of hours allocated	School type				Total	
	Public	%	Private	%	No.	%
1 hour	69	16.9	65	15.9	134	32.8
2 hours	78	19.1	51	12.5	129	31.6
3 hours	50	12.3	34	8.3	84	20.6
4 hours	13	3.2	13	3.2	26	6.4
5 hours	21	5.1	10	2.5	31	7.6
6 hours	1	0.2	1	0.2	2	0.5
None	2	0.4	0	0	2	0.5
Total	234	57.2	174	42.6	408	100

As Figure 28 below shows, majority of the students used between 1 and 5 hours for computer work in a week. The hours were usually a spread over 2 lessons of 80 minutes timetabled in the week. Apart from the computer lesson in the lab, students did not use computers after school or in the library.

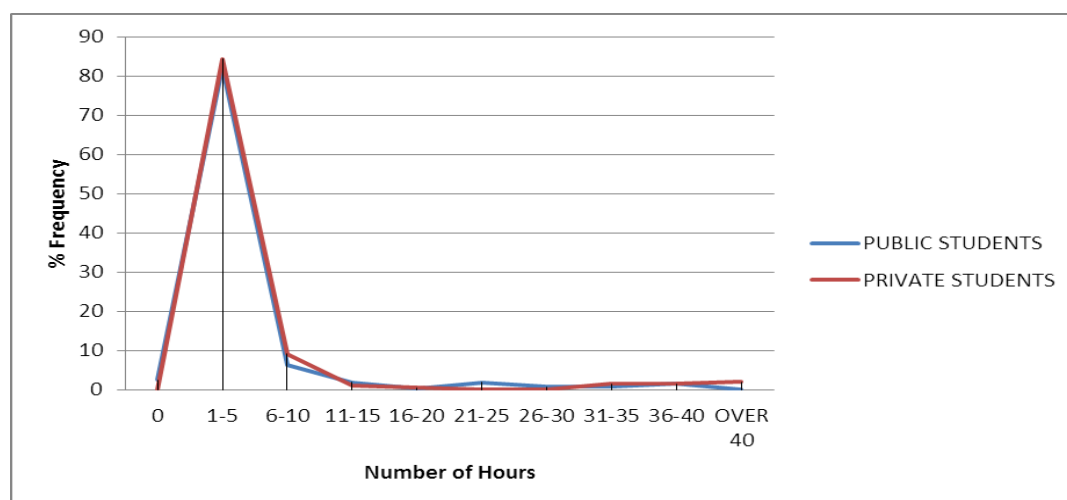


Figure 28: Time (in hours) spent on computers by the students in a week

4.10.5 ICT Application in the Schools by the Students

The students were asked how often they used computers at school. With regard to public schools, 36.6 per cent of the students used computers often as compared to 35.4 per cent of students in private schools. From public schools, 27.9 per cent of the students use computers rarely, as compared to 31.8 per cent of students in private schools as illustrated on Figure 29.

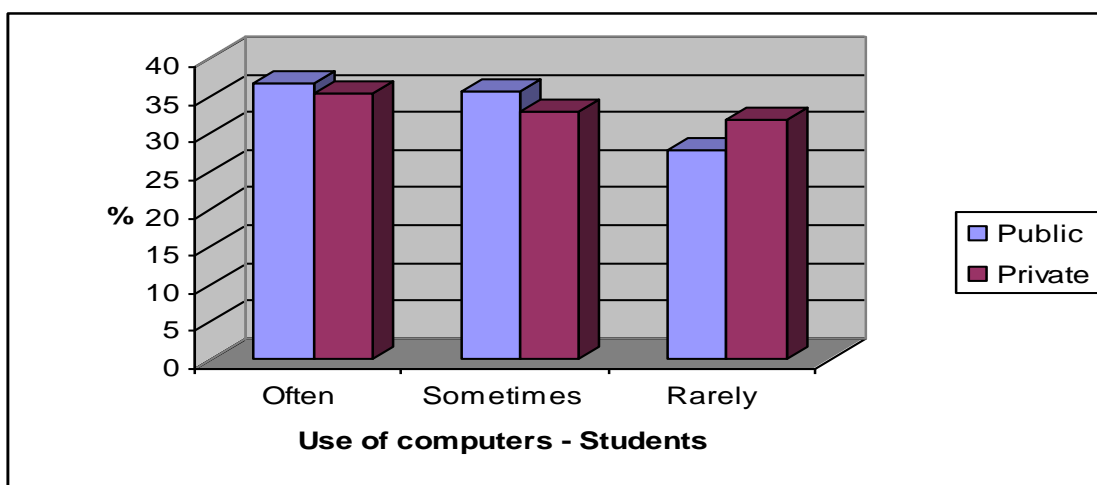


Figure 29: How often students used computers

4.10.6 Use of Computers by the Students in Subject Learning

When the students were answering the question on how ICT was used in the subject areas in their schools, majority opted not to answer or respond. This was the case especially in the schools that did not have any computers for the students. They assumed that if their school did not have any computers for students, then the question was not relevant to them. In the sampled schools, majority of the students who responded to the question were from schools that had a KCSE class in Computer Science.

Where there were computer applications, it favoured the science subjects. The research revealed that students had a belief that social sciences and languages were not favoured by computer applications. From both private and public schools, only 22.2 per cent of the respondents used computers in Kiswahili. The teachers had indicated that there was need to have programs and content for teachers to use ICT in languages, especially Kiswahili.

The research revealed that 53.8 per cent of the students used computer programs for English. A higher student population in the private schools (59.6%) used the programs compared to the 49.8 per cent of the public schools. From both the public and private schools, only 22.2 per cent of the respondents used computers for Kiswahili, while 58.0 per cent used computers for mathematics. There was a feeling in the schools visited by the researcher of the need to use computers more in the languages.

Only 51 per cent from both public and private schools used computers in geography. Private schools used more at 56.2 per cent when compared to public schools at 48.5 per cent. In history, 49.7 per cent used computers with private schools having more students who used computers (54.7%) than in the public schools (46.4%).

In both private and public schools, over half the students (58.1%) used computers for their biology class, while 59.3 per cent said that there was computer application for use in physics in their schools and 57.2 per cent for chemistry. For computer science, 90 per cent of the students said they used computers. However, there were a number of schools that did not offer computer science and had no computer labs. This information corroborated with the information given by school principals, but it did not concur with the teachers' information, as only about 9 per cent of the teachers had indicated that they used ICT for classroom teaching.

For French and German, use of computers stood at 31.6 per cent and 28.7 per cent respectively for both public and private schools. Students in private schools used more computers in French at 34.1 per cent as compared to 29.9 per cent in public schools. Use of computers in German was at 31.1 per cent in private schools compared to 27.0 per cent in public schools.

Figure 30 below shows the use of ICT in the various subjects by students in both public and private schools.

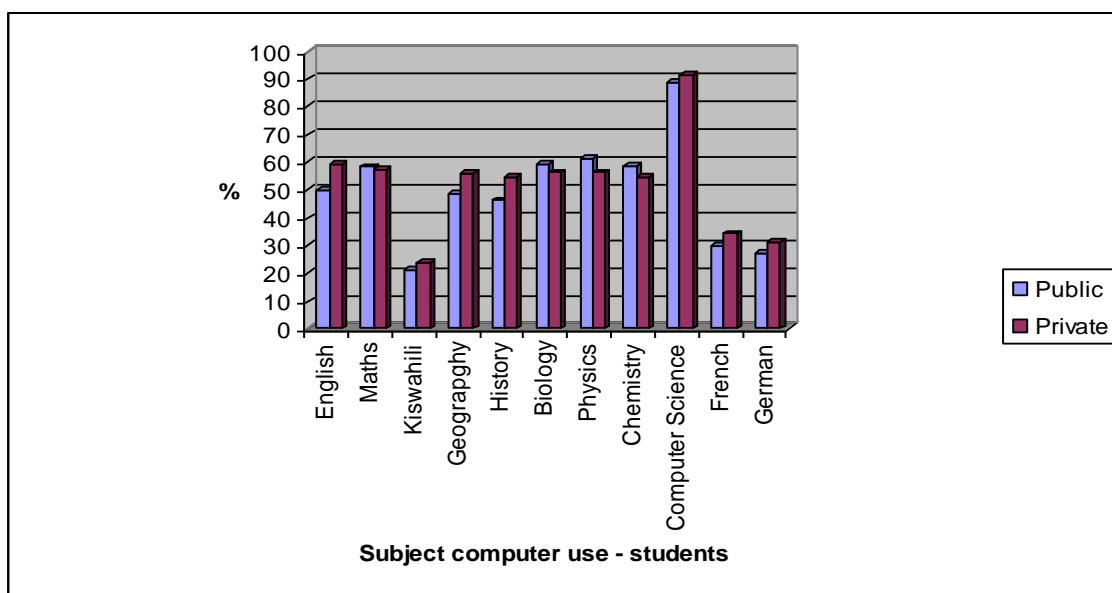


Figure 30: Use of computers by the students for various subjects

4.10.7 Software and Programs Used by Students

The study established that word processing was used by about 85 per cent of the student respondents. The Internet and e-mail was used more by students from the private schools than public schools. According to the responses given by the students, PowerPoint was the least used of the programs; it was used by 53 per cent of the students. The use of the different software by students is shown in Figure 31.

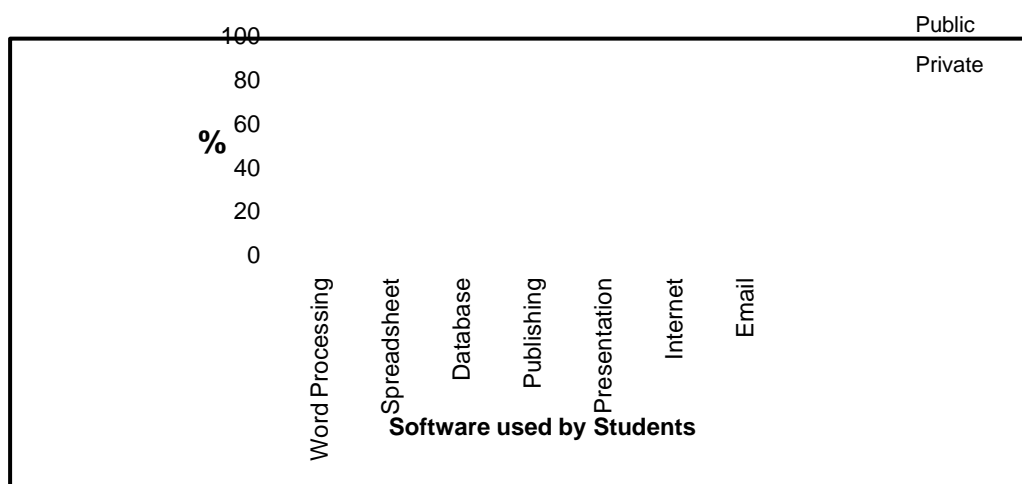


Figure 31: Software used by students

4.10.8 The Value of Computers in the School as Viewed by the Students

Table 35 shows how the students viewed the use of ICT in their respective schools. They responded to statements that were given and measured on a Likert Scale. While the responses given to answer each of the statements by students from public and private schools were ranked and tested for statistical significance, the data was ranked as 1=Strongly agree 2=Agree 3=Disagree and 4=Strongly Disagree.

Table 35: Application of computers in learning

Statement	Public	Private	U- Value	P-Value
	Mean Rank	Mean Rank		
Computers allow to learn at own speed	257.33	277.66	31169.500	0.100
Computers best for revision	255.51	289.36	30203.50	0.009*
Computer learning is more interesting without a teacher	266.48	276.54	33688.00	0.438
Computer explanation easier to understand than teacher	273.74	266.84	34151.500	0.596
Computers takes times from studies	281.33	249.04	30255.500	0.014*
Computer assisted learning not as interesting as ordinary lessons	275.96	227.80	25513.50	0.000*

Overall computer literacy	276.33	253.13	31126.50	0.075
Typing/ Keyboard skills	279.51	249.26	30265.00	0.021*
Access to computers	267.10	242.90	28642	0.064
Skills and training	257.92	251.78	30307.50	0.637
ICT management in school	255.81	244.82	28726.50	0.395
Transmission of skills and competencies	254.77	240.21	27818.00	0.255
Acquisition of knowledge	241.41	253.03	27445.00	0.361

* Statistical significant difference

Mann Whitney U test (a non-parametric statistical hypothesis test for assessing whether one of two samples of independent observations tends to have larger values than the other) was used to test whether there is any significant difference on ranking by students. From Table 32, there is statistical significant difference between public and private concerning the statement: Computers are best for revision; that is, in public schools the students felt significantly that computers are the best for revision.

Majority of students from both private and public secondary schools agreed that computers allowed students to learn at their own speed. The students also agreed that computers make learning more interesting than learning with the teacher; they were excited when they used computers in their work.

While about 60 per cent of students from both private and school still agreed that the teacher played an important role, they said that computer explanation and learning was easier to understand than the teacher, and although computers play a major role in education, they cannot be replaced by computers. Computers and other technologies are complementary tools and would not replace the teacher.

Students agreed that computers take away learning time from studies. Some of the students however did not agree that computers take time that would be used for

studies (Table 35), but they were in agreement that a computer is important as a complementary tool.

With regard to a question on whether computer assisted teaching was not as interesting as ordinary lessons, 75 per cent of the students from both private and public schools agreed that computer assisted learning was interesting. The students were all very keen to see that their school had computers. For the schools with no computer labs, the students felt left out and they faulted their school. The results are as presented in Table 35.

4.10.9 Use of the Internet

Students were asked if they used the Internet. The results showed that 77 per cent of students from both public and private schools used the Internet. It was noted that 84 per cent of the respondents from private schools used Internet as compared to 72.3 per cent of students from public schools. Reasons for not using Internet among the students from both public and private schools ranged from lack of connectivity (51.8%) to lack of knowledge (30%) as is illustrated in Figure 32. Chi- Square test was significant at 0.017.

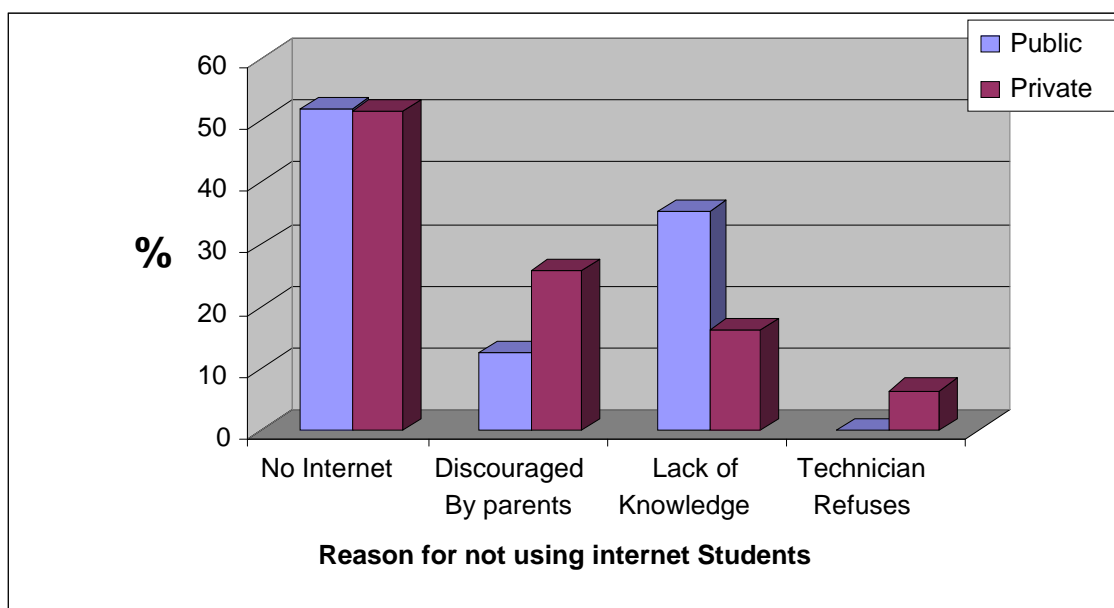


Figure 32: Reasons for students not using Internet

Students with e-mail addresses

The students who had e-mail addresses from both public and private schools were 358 representing 64.9 per cent, while 194 students (35.1%) did not have. More students from the private schools (72.4%) had e-mail addresses as compared to 59.8 per cent from public schools. Chi-Square test was significant at 0.002. Lack of access to computers and lack of Internet connectivity were the main reasons given by 50 per cent of students for not having e-mail addresses as shown in Table 36. Chi square test was significant at 0.05.

Table 36: Reasons given by students for not having e-mail address (n=161)

Reason for not having e-mail address	School type				Total	
	Public	%	Private	%	No.	%
No access to computers	49	30.4	12	7.4	61	37.9
Never bothered	16	9.9	7	4.3	23	14.3
Sharing with a friend	2	1.2	1	0.6	3	1.9
Lack of time and machinery	3	1.9	7	4.3	10	6.2
No Internet connectivity	20	12.4	6	3.7	26	16.1
Not important	8	5	12	7.4	20	12.4
Don't know how to open	10	6.2	5	3.1	15	9.3
Limited time	3	1.9	0	0	3	1.9
Total	111	68.9	50	30.8	161	100

Purposes for which students used the Internet

Students were asked the purposes for which they used the Internet. Figure 33 shows these purposes with 59.3 per cent of the student respondents in private schools using the Internet for class assignment as compared to 40.7 per cent of student in public schools where 58.2 per cent of the students used it for subject content. It is important to note that of the 566 students questioned, only 261 (46%) responded to this question.

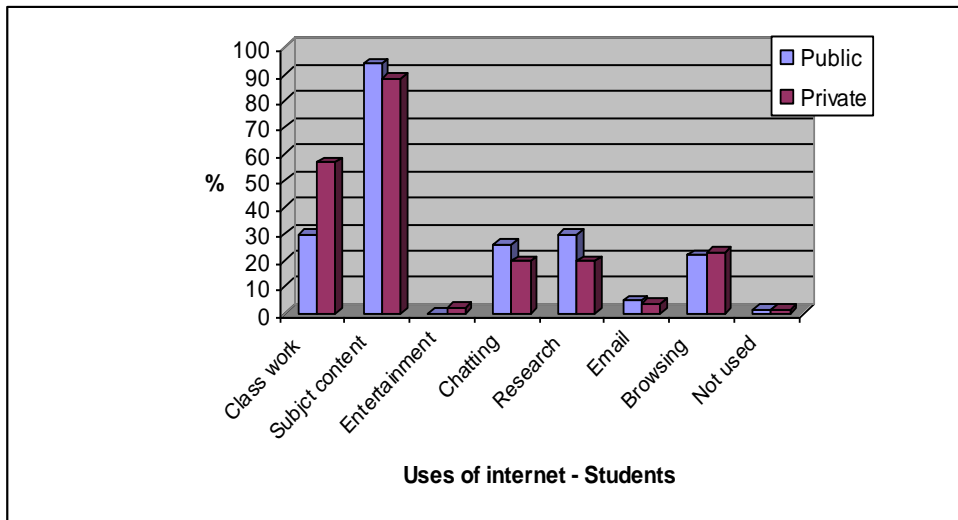


Figure 33: Purpose for which Internet was used by the students

Overall computer literacy skills

The students were asked to state the level of their computer literacy skills. Majority of the respondents had average computer proficiency skills as shown in Figure 34.

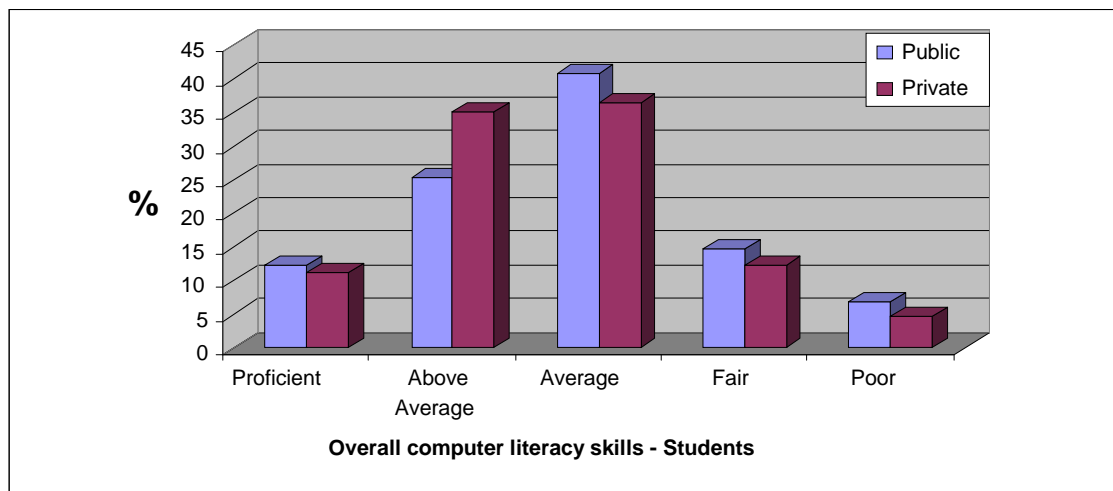


Figure 34: Overall computer literacy skills of the students

Typing and keyboarding skills

The majority of the student respondents had typing and keyboarding skills ranging between fair and above average as shown in Figure 35.

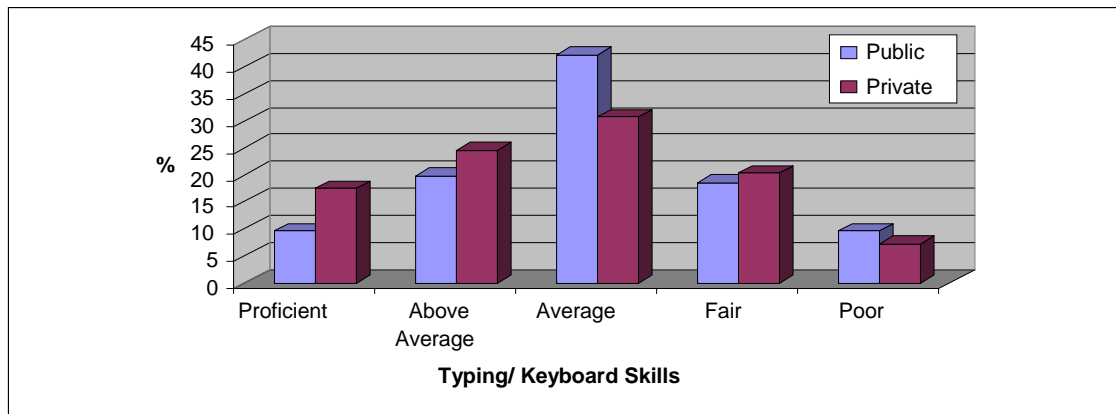


Figure 35: Typing and keyboarding skills of the students

The students were asked about their access to computers. Majority of the respondents found time allocated as average or enough as shown in Figure 36.

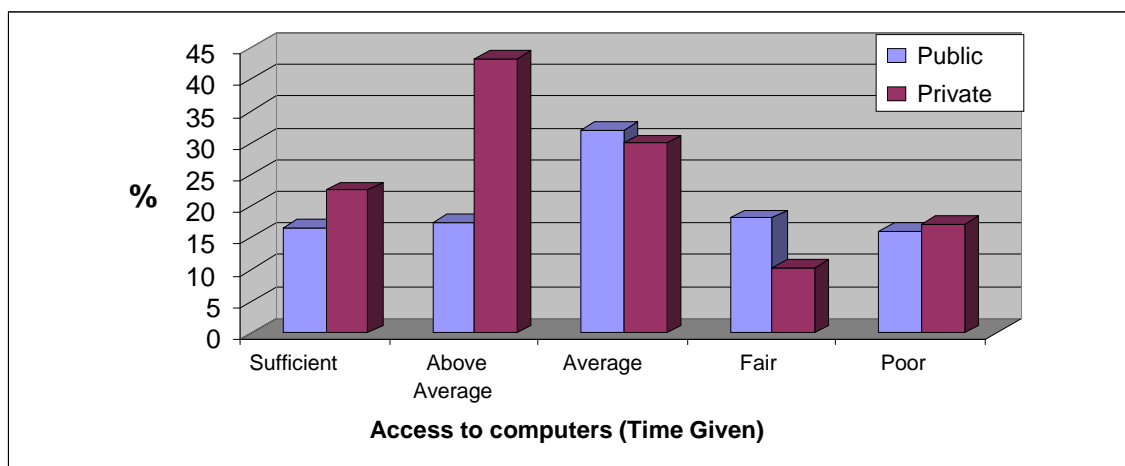


Figure 36: Time allocated for the students to access computers

As the figure shows, the private schools seemed to give more time to the students for access to computers.

4.10.10 Use of ICT Equipment and Software by the Students

A question was asked to students on their use of ICT equipment and software. Table 37 displays their responses.

Table 37: Use of computers and other ICT equipment by students

	Public	Private	U- Value	P-value
Networked computers	41.32	47.02	649.500	0.314
Server	48.68	51.37	964.000	0.650
Scanners	45.75	49.63	866.000	0.483
Printers	51.01	61.19	1066.000	0.100
UPS	46.04	58.28	807.000	0.041
Radio card	47.16	48.19	955.000	0.850
TV card	49.49	42.80	792.500	0.205
External modem/Internet	45.35	55.43	782.000	0.083
Video equipment	13.14	9.86	42.500	0.209
Digital microscope	12.73	11.33	58.000	0.599
Various software/ types	12.89	8.55	28.000	0.084
Telephone extensions and mobile telephones	10.50	8.50	31.500	0.362
Audio tapes and cassettes	11.70	10.36	48.000	0.610

The students who used networked computers at school were 75.8 per cent, while those who did not were 24 per cent. This was a representation of both public and private schools. Students from both public and private schools were asked if they used scanners. From the table, 25 per cent from both public and private schools used a scanner always while 40 per cent had never used it. The students who used a printer always were 28.8 per cent, while those who never used a printer were 35 per cent.

Thus, most of the students did not use a printer. Chi square was 0 .038, and was significant.

The students were also asked whether they had used an external modem whereby 70 per cent said they had used an external modem, while 30 per cent had never used it.

The study found out that the students who were using different types of software always were only 6 per cent. The ones who never used any were 22 per cent and 7.9 per cent had rarely used other software. The public school students were mostly the ones who never used other software in their study. Chi-square test was significant at 0.004.

Only 4 students had ever used projectors and it was also interesting to note that only 3 libraries (4.1%) used ICT in their operations and for storing information.

In public schools, 51.1 per cent of the students do not use audiotapes and cassettes. Chi square was significant at 0.039. Mann Whitney U test was used to test the ranking and results are shown in Table 31. It was also used to test whether there is any significant difference on ranking by students in public and private schools on how often students used the listed ICT equipment. The data was ranked as 1=Always 2=Sometimes 3=At home 4= Rarely 5= Never. Table 29 shows the results of the statistical test. From Table 36, there is no statistical significant difference between public and private schools concerning statement the use of ICT equipment by the students.

4.11 ICT Challenges Experienced by Students

The challenges faced by students include lack of enough time to work on computer assignments where public schools led at 22.2 per cent and private schools had 15.2 per cent. The other problems, which mostly affected public schools, were poor and slow machines, fast growing technology, computer viruses, and lack of power supply. Lack of qualified teachers was a challenge in all the schools with the private schools being the most affected. Some schools had no computers at all. The challenges faced by the students are summarized in Table 38 below.

Table 38: ICT challenges faced by students (n=270)

Challenges	School type				Total	%
	Public	%	Private	%		
Limited time	55	20.4	22	8.1	77	28.5
No computers	32	11.9	21	1.8	53	19.6
Poor slow machines	22	8.1	9	3.3	31	11.5
Addiction	16	5.9	5	1.9	21	7.8
Fast growing technology	15	5.6	3	1.1	18	6.7
Lack of qualified teachers	11	4.1	12	4.4	23	8.5
Lack of computer books	6	2.2	8	3	14	5.2
Computer viruses	5	1.9	1	0.4	6	2.2
Power supply	5	1.9	2	0.7	7	2.6
Spread sheets	0	0	1	0.4	1	0.4
None	10	3.7	9	3.3	19	7
Total	177	65.7	93	28.4	270	100

4.11.1 Proposed Suggestions on Improved Use of ICTs

The problems encountered by students can be solved by increasing the time for use of computers in both private and public schools. The students wanted better computers and modems to be provided. They also wanted more use of the Internet, to have

teachers who were qualified, the purchase of reading materials on computers, and the provision of power back-ups. They also wanted more time to practise and to improve on typing skills, a need that was identified more by students from the private schools. Students from public schools wanted antivirus programs installed in the computers. Chi- square test was significant at 0.043. The findings are presented in Table 39.

Table 39: Suggestions on how ICT challenges faced by students can be solved (n=289)

Proposed suggestion	School type				Total	
	Public	%	Private	%	No.	%
Avail more time	102	35.2.0	46	15.9	148	51.2
Provide computers	19	6.5.1	13	4.5	32	11.1
More computers	37	12.8	18	8.2	55	19.0
Improve the computers	12	4.1	16	5.5	28	9.7
Improve Internet	5	1.7	4	1.4	9	3.1
Buy power back-ups	1	0.3	0	0	1	0.3
Teaching computer science	13	4.5	1	0.3	14	4.8
Don't know	0	0	2	0.7	2	0.7
Total	189	65.4	100	34.6	289	100

4.11.2 Improving Skills and Training in ICT

The students gave suggestions on how skills and training in ICT could be improved in the schools. The need to have qualified teachers was noted by 40 per cent of the students from public schools and 49.3 per cent from private schools. Students from both public and private schools found that there was need for extra lessons as one of ways for improvement. Chi- square test of significance was at 0.148. Table 40 represents the responses that were given by students on how to improve skills and training in ICT.

Table 40: Suggestions by students on how to improve skills and training in ICT (n=236)

Suggestion	School type				Total	
	Public	%	Private	%	No.	%
Qualified teachers	66	28	35	14.8	101	42.8
Re-Introduce computer lessons	19	8	11	4.7	30	12.7
Give extra lessons	60	25.4	18	7.6	78	33
Provide more reading materials	10	4.2	1	0.4	11	4.7
Make computer lessons compulsory	10	4.2	5	2.1	15	6.4
Don't know	0	0	1	0.4	1	0.4
Total	165	69.8	71	30	236	100

The students were asked what needed to be done to improve transmission of ICT skills and competencies in their school. Their suggestions included that they needed more hours to use computers, and the provision of more machines. The other respondents such as teachers and computer teachers had wanted computers to be increased and to have modern equipment. Internet connectivity was a challenge that needed to be addressed. The suggestions by students in respect of improvement of transmission of skills are given in Table 38.

Table 41: Suggestions by students on how to improve transmission of skills and competencies (n=95)

Suggestion	School type				Total	
	Public	%	Private	%	No.	%
More hours	30	31.6	4	4.2	34	35.8
Group discussions	18	18.9	3	3.1	21	22.1
Provide computers	14	14.7	2	2.1	16	16.8
Qualified teachers	13	13.7	2	2.1	15	15.8
Internet connections	6	6.3	2	2.1	8	8.4
Don't know	0	0	1	1.1	1	1.1
Total	81	85.2	14	14.7	95	100

There was a need to allow more hours of practice by students; the computer labs were closed as soon as a computer lesson ended and were also closed in the evenings and weekends. Group work, the need for qualified teachers, Internet connectivity, and providing more computers were identified as important in improving transmission of ICT skills.

4.11.3 Suggestions on How to Acquire ICT Skills and Knowledge

Students' response as to how ICT can be used for improvement of acquisition of knowledge was to increase computer books and Internet access. The activities to enhance acquisition of knowledge using ICTs cited by public schools involved increasing the number of computers. The need for qualified teachers and the introduction of computer science were identified as major requirements for ICT in public secondary schools. The private schools did not have an acute shortage of computer books, qualified teachers and Internet access. However, they needed more activities using ICT to enhance acquisition of knowledge. Teachers' responses are shown in Table 42. Chi- Square test was significant at 0.021.

Table 42: Suggestions by students on the acquisition of ICT skills and knowledge (n=89)

Suggestion	School type				Total	
	Public	%	Private	%	No.	%
Increase computer books	20	22.5	2	2.2	22	24.7
Increase Internet access	14	15.7	4	4.6	18	20.22
More activities	21	23.6	10	11.2	31	34.8
Introduce computer science	7	7.9	0	0	7	7.9
Qualified teachers	10	11.2	0	0	10	11.2
Don't know	0	0	1	1.1	1	1.1
Total	72	80.9	17	19.1	89	100

4.11.4 Suggestions for Improvement of ICT Management

Students gave suggestions on how management of ICT could be improved in the schools. Providing enough materials to support the management of computers was cited as a way of improving ICT management. Servicing of computers, employing teachers who were qualified in ICT, and installing the Internet were cited in both public and private schools as ways for improving ICT. Only a few students gave their response or had way forward as to how improvements could be made. Table 43 shows the suggestions as proposed by students.

Table 43: Suggestions by students on how ICT management can be improved (n=117)

Suggestion	School type				Total	
	Public	%	Private	%	No.	%
Provide enough materials	36	30.8	11	9.4	47	40.2
Service the computers	18	15.4	2	1.7	20	17.1
Allowing more hours	9	7.7	1	0.9	10	8.5
Install Internet	10	8.5	3	2.6	13	11.1
Employ qualified teachers	18	15.4	8	6.8	26	22.2
Don't know	0	0	1	0.9	1	0.9
Total	91	77.8	26	22.3	117	100

4.12 Chapter Summary

Chapter Four has provided data analysis report to meet the objectives that were set out and to answer the research questions. In all, 37 schools participated in the research. The respondents included 37 principals, 37 computer teachers, 566 students, 188 subject teachers, and 40 non-teaching staff. A self-administered questionnaire based on the objectives and research questions was used to get the required information

from the school principals, the computer teachers, the subject teachers, the non-teaching staff, and students. Further information was obtained through a structured interview with the principals and computer teachers who were the main informants since they were involved in the whole implementation. The principals had the managerial and financing aspects, and the computer teachers were involved in the implementation. Students, subject teachers, and the non-teaching staff were the beneficiaries of the computerization projects.

The quantitative data has been summarized in line graphs, bar charts and tables. The qualitative data is summarized in the explanations of responses meant to answer the questions posed in the research. The information from the respondents identified areas of improvement such as the need for more computers as most of the schools lacked enough equipment. It was observed that most schools had old ICTs equipment that needed replacement. It was also found out that there were no policies to guide acquisition of ICTs equipment and guidelines for disposal as the stringent procurement procedures put in by government were too complex for the public schools just as they were time consuming.

Teachers were not trained on how to integrate ICTs into teaching. Also the computers were not accessible to the teachers and this was a major area of concern. There was need to avail more time for both students and staff to access computer labs, thereby asking for better management to allow access to computers and Internet by the students and teachers. A lot of demand was put on the computer teacher, and hence the need for peer support. Chapter five presents the discussions of findings.

CHAPTER FIVE

DISCUSSIONS OF FINDINGS

5.1 Introduction

This chapter discusses the findings of the study, whose objective was to establish sustainable implementation of ICTs in secondary schools in Nairobi County. The significance of the study is to assist policy makers and decision-makers in the secondary school sector and investors to make informed decisions regarding ICTs in secondary schools.

The discussions are based on research objectives, research questions, as well as the assumptions of study. McConnell E-Readiness tool was used to identify and prioritize five interrelated attributes that were used for setting out the objective of the research, namely infrastructure supporting ICT implementation and connectivity, e-leadership that was demonstrated by school principals, equipment, information security, and human capital (explained through training and competencies of the staff and students).

The study assessed how ICT was being exploited for instructional and administrative purposes. The factors that enhance or impede ICTs integration in teaching and learning in the schools were also identified. The major findings are discussed under each objective in this chapter.

5.2 Training and Skill Requirements for ICT Implementation

Academic and ICTs qualifications were indicators of human capital preparedness in the schools. Reviewed literature (MoEST 2012; GeSCI 2004; Beukes-Amiss, 2006) as well as the McConnell's e-readiness tool indicate that there is a relationship between the qualification of the staff in leadership and ICT integration in the schools.

Majority of school principals (59.4.2%) had B. Ed. degrees with over 35 per cent having a post-graduate qualification (refer to Table 10)

Only 41.8 per cent computer teachers had a degree in computer science, while others had diploma, certificate or were undergoing training for ICTs at the time of the study. There were enough graduate Computer Science teachers employed in the schools. Teachers who had a degree in Computer Science had a high turnover as they were not satisfied with the pay. They were always on the lookout for better paying jobs outside the teaching profession at the secondary school level. The computer science graduates were employees of the Board of Governors as they were not employees of the TSC; therefore, they did not enjoy some benefits and did not have job security. There were no B.Ed. graduates who had majored in computer science in the schools, an indication that ICT teachers did not have pedagogical skills.

The teachers had qualifications in teaching with over half of them (57.4%) having B.Ed. and others having Masters Degrees. It was only 29.3 per cent of the teachers who had qualification in ICTs. Some teachers had studied computer packages and were able to perform various tasks using word processing or checking e-mail. However, they did not type their work; it was hand written and some of the work was given to the school secretary for typing. Teachers need to be encouraged to use ICT skills in their work and to use ICT skills for instructional purposes.

All the 33 (100%) computer teachers interviewed were trained in ICT. Only 42.4 per cent of the computer teachers used computers for teaching. The computer teachers also did the maintenance of the equipment as most of the schools did not have a technician. The computer teachers were overloaded with many activities, including teaching the examination classes (i.e., students preparing for KCSE exams), yet they

were expected to maintain the computer labs. Moreover, the research revealed that there were few training opportunities for junior ICT personnel, hence lack of computer technicians. This was a major challenge facing majority of the schools.

The teachers who said they were computer literate were 82.6 per cent and used word processing, with the remaining 17.4 per cent, in both public and private schools, being not computer literate at all. The teachers' slow learning of ICT skills was due to their busy schedule and lack of commitment. In particular, the subject teachers were not keen on using ICT. Also, the older teachers perceived the ICT as a tool for the younger generation teachers; hence, diffusion of ICT was higher among younger teachers.

Computers had not been accepted as part of everyday life. This finding was in agreement with that contained in an ICT e-readiness research report, which confirmed that, for the people who access ICT, they only do it 'if necessary at their workplace' (InfoDev, 2005, p. 13). The research confirmed that teachers did not find it necessary to use ICT in their work and they found the traditional method of teaching, 'chalk and talk' more convenient (Intel, 2008). Thus, there was limited knowledge and skills on the use of ICTs in education, and lack of relevant or standardized curricula from the Ministry of Education to guide the schools, something that is also discussed in Bridges.Org (2005, p. 130).

The research also revealed that there is need for more preparedness of the school principals before ICT integration. There was suggestion by the respondents that the ICT-literate principals should be given an incentive since a lot was expected from them in the ICT integration process; they are to play a central leadership role if ICT integration is to take root into the schools.

Teachers require digital literacy in order to assist the students to look for information (InfoDev, 2005, p. 130). However, the research found that there was limited knowledge and skills among teachers in the use of ICT in education and the classroom. The schools' principals and teachers of the older generation were not exposed to digital technology and had technophobia. There was also lack of a standardized curriculum that exposed teachers to professional use of ICT in their subject areas and for teaching purposes and the school leadership did not demand that teachers and students use computers for their work.

5.3 Connectivity and Infrastructure Supporting ICT Implementation

It was found out that computers have been in use among schools in Nairobi County since 1995; the reviewed literature indicated that schools in developed nations had been using computers since the 1970s (Makau, 1990). It is the private schools that started using computers in 1995, while public schools started in 1997.

In the selected schools, the principals had access to computers, but only 27 per cent had computers in their offices, all of which were in the private schools. The rest used the cyber cafés (33%) and computer labs (27%). Only 13.3 per cent of the principals had computers in their homes. It was observed that all the schools had a computer at the secretary's office where most of the typing work was done. For the schools that had Internet connectivity, the secretary responded to the e-mail under instruction from the principal or the deputy principal.

Only 50 per cent of the students said that the computers they had in the schools were adequate. They used computers in the computer room/lab once in a week; there were no computers in the classrooms. Moreover, students indicated that they were not

aware that computers could be used for learning and teaching in the classrooms. More students from the private schools had been trained to use computers and spent five hours in the computer lab in a week. The computer lessons were skills based. Students learned computer operations, the hardware and the software, and word processing. The computers were not connected to the Internet and students did not perform any computer assisted subject search or research projects. Although it is important for secondary school students to learn how to operate ICT equipment, it is equally important that they learn how to use content and Internet if they are expected to benefit fully from ICTs. Students are expected to meet the 21st century job market requirements and become innovators.

The schools were grouped into three categories according to the commitment of the school principal. The first category comprised schools where the principal was very committed to the use of ICT. Such schools had elaborate computer laboratories and well-trained computer teachers. The second category is where schools had old computers that were not well maintained and were hardly usable by teachers or students. The third category was where there were no computers at all and the only ICT equipment available was found in the secretary's office. Despite lack of facilities in such schools, students were very keen to learn ICTs.

From the observation and discussions with the respondents, it was evident that computers had not been accepted as part of everyday life. Respondents said they were using computers even when evidence showed that they were not using them. It was found out that only the computer teacher and some students accessed the computer labs, a finding confirmed by other researches, for example, InfoDev (2005, p. 131) and Kiptalam (2010, p. 50).

5.3.1 Hardware, Software and other ICT Equipment

The study found out that only 24.1 per cent of schools had 21-25 computers. The private schools had that had over 30 computers were 13.8 per cent compared to 10.3 per cent for public schools. The private schools had more computers as it was one of their strong selling points. Schools, on their part, had higher student population.

In public schools, the computers and computer peripherals were purchased through stringent procurement procedures and tendering as outlined by the Public Procurement and Disposal Act of 2005. While most of the public schools sourced their computers through donations, private schools purchased their computers. Observation of computer labs showed that the computers, especially in public secondary schools, were cheap old equipment that could not support both students' and teachers' activities.

The inappropriate quality of hardware and software is also an indication of weak or lack of IT management in learning institutions. Before purchase of computers, the hardware-software interface needs to be considered to avoid chances of mismatch. Most computer experts argue that the software needed should be determined before buying the hardware (O'leary and O'leary, 2007). The main caution is that some recent versions of application software will not run on older hardware. Kenya Vision 2030 (2007, p. 130) has a strategy of mainstreaming ICTs into the education curriculum. The strategy is meant to integrate instructional technology (IST) into content delivery at all levels in schools and colleges. In this strategy, the government aims at implementing a computer supply programme for educational institutions (Kenya Vision 2030, 2007, p. 130).

Positioning of sockets in old buildings where electric wires are exposed and criss-crossing make it risky for students and teachers when using the computer labs. This was evident in the buildings that had been converted for use as computer labs. Moreover, initial costs for installation and burglar proofing of premises, especially in the schools that had not planned for ICTs, were a challenge. In certain cases even the need for air conditioning (heating and cooling systems) to take care of extreme weather changes was noted.

There was a security challenge for equipment and software in almost all the schools. The source of insecurity was from both within and outside the schools. In some schools students had vandalized ICT equipment so that what stood in some computer labs were empty shells with some parts of the equipment having been removed and taken away. This feature was incidentally realized in the schools that had an intake of the very bright students (who had excelled in KCPE).

There were incidents where the computer labs had been broken into (especially at night) and all the equipment stolen. This was critical in areas bordering the slums where, although there were watchmen employed to take care of the schools, the incidence of theft was high. In other schools, the computers had been stolen from the staffrooms and the principals had not replaced them; hence, most of the teachers were computer illiterate. There is need to employ better security measures for the ICT equipment as the principals became discouraged and gave up on replacing ICT equipment. Measures would include installing security systems such as Closed Circuit Televisions (CCTVs) and hidden cameras to protect the equipment.

Research findings indicated that schools require secure burglar proof rooms to house computers. CFSK requires all schools to undergo pre-installation assessments before

ICTs equipment can be installed. Schools that are unable to secure rooms do not receive equipment. This ensures that ICT equipment installations are demand driven (MoEST 2005, p. 40). This model's drawback is that it does not ensure equitable distribution of resources since poor schools are not able to raise funds to secure computer rooms.

At the national level, EMIS has proposed the implementation of 30 training institutions, 166 model secondary schools and 304 model primary schools to be centres of excellence. The hardware and software requirements for the envisaged computer labs are given in Table 44 below (Kenya/USAID/, 2005, p. 40-41). How the schools will reach those targets is an area for further research.

Table 44: Hardware and software requirements for schools

Hardware requirements	Software requirements
20-40 computer work stations with monitors, keyboards, speakers, DVD/W/CD-ROM & CPUs	Operating System – Linux-based OS and Windows OS should be strongly considered. TCO should determine selection.
Printer	Productivity Tools – word processing; spread sheets, presentations, database(Open Office or Microsoft Office Suite)
Copier	Bundled web development, graphics, and animation software (Dreamweaver MX)
Scanner	Web Browsers (comes with OS)
Overhead projector	Media Player (comes with OS)
Digital video camcorder	Anti-virus
Digital cameras	Keyboarding Software
Webcams	Educational/Curriculum Materials
Microphones for audio recording	Inspiration or Mind Mapping Software
Special needs peripherals	Special Needs software (text to speech)

Source: MoEST (2005)

5.4 ICTs Application for School Administrative and Instructional Purposes

The school principals posited that 50 per cent of the ICT resources were used for administration purposes as well as for teaching. Observation showed that apart from the computer lessons geared towards KNEC examinations, not much computer literacy or learning was done using ICTs. They indicated that 90 per cent of schools used spread sheet and the programs for financial management by accountants and bursars. Also, majority of the principals said that they used word processing. Although the principals said that they used spread sheets and word processing, the study established that the actual work was done by the secretaries and the bursars; it was evident from visits and observation that most principals did not use computers. The secretaries used word processing for writing timetables and reports for the school. The principals from both public and private schools used computers for administrative purposes. They used them to perform such activities as attendance registers, teacher evaluation, memos to staff, letters to parents and students, Internet searches and e-mail. The study found out that the computers in principals' office, the secretary and the staffroom were not networked.

According to the school principals, out of the 37 schools studied, only about 50 per cent used ICT for teaching English and mathematics. However, there was no local content that could be used by students. Some schools had content that had been donated with the computers and teachers were supposed to adapt it to local use. The Kiswahili teachers especially expressed need for development of Kiswahili e-content for use by the schools.

The students used the computer labs for two hours in a week, which were allocated in the timetable. The computer teachers confirmed that Form One and Form Two

students learnt the key board, typing and basic operations of the computer hardware and software.

There was no local content in the schools to support ICT. The research found out that there was no locally relevant educational content and availability of local e-learning courses was very limited, a situation that had not changed since another research on e-readiness was conducted in Kenya (InfoDev, 2005, p. 13). The form three students followed the KNEC syllabus on computer studies. KIE was in the process of producing local content CD for Form One and Form Two, which would be made available for purchase by the schools (KIE, 2010).

Observation showed that there were no computers in the classrooms; hence, the teachers and students did not have an opportunity to use computers in their subject areas. If students and teachers wanted to access computers, they went to the computer lab. In a study carried out in Hong Kong (Lee, 2010, p. 149), teachers perceived suitable teaching resources as an essential factor that affected ICT integration into teaching, a view confirmed in the current research. The computer lab remained closed in the evening and over the weekends and public holidays for security reasons. The students could not do personal studies, projects, and research using computers during their free time as they were not enough or were inaccessible. These restrictions, including the computer lab not being open to students unless they had a class and the students to be supervised by the computer teacher if they were to use the computer lab, slowed down the pace of ICT access and learning.

The students highly valued the time they spent in the computer lab. It was observed that they were very keen to learn and concentrated highly during the computer lesson. Use of e-mail and Internet was limited as schools did not have Internet connectivity;

the Internet was mostly available in the principal's office and the office of the secretary, mostly through a modem. The principals cited high cost as the reason for not having Internet connectivity. The fibre optic cable connection had not yet made much impact in connectivity at the time the research was conducted. The schools were hopeful that there would be improvement once the fibre optic project was completed, which was expected to make Internet connectivity affordable to most schools.

The teachers rarely used computers for teaching purposes, except while preparing for lesson notes. It was observed that in most schools they did not have access to computers even when they were available, as they were used for office work or were locked up in the computer labs.

The majority of the schools visited (over 90%) did not have computers in the staffroom. The computers were in the computer lab, which was located far away from the staffroom and was usually locked when students were not using it, including during evenings and weekends. It was observed that in two schools where some computers had been put in the staffroom to be used by the teachers, they had all been stolen. This had discouraged the principals from equipping staffrooms with computers, as in both cases the police had indicated that the theft had been an "inside job"; the suspects were neither arrested nor were the computers recovered.

The non-teaching staff, including the accountants, the bursar and the secretary used the computers a lot in the schools where they were available. The secretary used the computer for typing, but in cases where they were not available, they used typewriters. Only a few schools used computer packages for accounting purposes. It is to be noted that some schools still used duplicating machines for their operations.

Computer teachers used computers for teaching, typing exams and for administration. Use by computer teachers was more in private schools (54.5%) compared to public schools (36.4%).

The introduction of any technology into education is about improving educational outcomes (MOEST, USAID/Kenya, 2005, p. 21). The research confirmed that the Kenyan secondary schools focus on ICT as a discrete subject area where only the students who are sitting computer applications at KCSE are allowed time and concentration, rather than as an educational tool. This is apparent in the syllabus for teacher training colleges and secondary schools where objective for the former is ICT literacy, which basic word processing, Spreadsheet and database application. In secondary schools, ICT is taught as Computer Studies, an elective for students who are interested in programming and computer networking. This approach leaves many students, teachers and other staff uninterested and unprepared to exploit the learning opportunities inherent in ICT. It leaves many of them outside, viewing ICTs as not applicable in their subject domain (MOEST, USAID/Kenya, 2005, p. 21).

Apart from the inadequacies in infrastructure, there is little educational content available in electronic medium. Content is the clear driver that would justify greater investment in computers by schools and parents. Computers do not come pre-packaged with relevant teaching content. The Internet resources available need to be modified in order to be relevant for Kenyan students and curriculum needs. Investments in custom-made digital materials with relevant content should be developed in the context of Kenyan curriculum and this is important if the MoEST wants to tap into the real potential of ICTs for teaching and learning.

5.4.1 Application of Other ICTs in the Schools

The research investigated how other ICTs were being used by the respondents in the schools. The following are the findings:

- Radio was used for educational purposes as indicated by 66.7 per cent of the principals and only 33.3 per cent of the schools did not use radio. With regard to students, 90.5 per cent used radio for educational purposes with only 9.5 per cent using it for entertainment.
- Majority of the principals (66.6%) said that TV was used for educational purposes with 39 per cent saying that TV was not used in their schools. Where TV was used, 88.2 per cent was for educational purposes and only 5.9 per cent was for entertainment.
- Telephone and mobile phones were used in 75.9 per cent of the cases for communication and 23.1 per cent of schools did not have land line telephone connections. Mobile phones were used in 90 per cent of the schools, but only 5 per cent used mobile phones for educational purposes.
- Video equipment was used in 68.4 per cent of the schools for educational purposes.

5.4.2 Impact of ICTs in the Schools

The introduction of ICT has had an impact in schools. The study found that ICT had an impact on school leadership, communication among all stakeholders, teacher evaluation, planning, school management and curriculum development. The principals said that communication was faster and that ICT-facilitated work was done faster. ICT also created independence on the way teachers worked, and it enhanced

the principal's authority. There was effective monitoring of school records, exams and continuous assessment tests (CATs). Document retrieval was easy due to efficient filing systems.

5.5 ICTs Policy in the Schools

The findings revealed that schools did not have a stated vision and mission for ICT; neither did the public schools have financial support for ICT from the government or any external sources. Apparently, ICT had not been given centre stage in many schools, some of which had benefitted from CPAK or donations. The donated computers were old and could not operate on new software.

In the National Information and Communication Strategy (NICS), the government states that ICTs will be adopted and utilized to improve access, quality and delivery of education services in Kenya and this strategic component of the policy framework have been outlined in the Ministry of Education, Science and Technology (MoEST, 2006). The vision of MoEST is to facilitate ICT as a universal tool for education and training. Although a lot has been outlined in the ICT policies, not much has been achieved. While there is a wide range of innovations in ICT that can support effective quality delivery of education services and curricula in the secondary schools, there is technology lag in the educational institutions (MoEST, 2006). The current research reveals that most schools use out-dated ICT systems that are unable to exploit the educational potential of the emerging technologies.

There are significant benefits in using ICT as part of teaching and learning process as long as teachers are able to use it to implement the curriculum. The ICT policy for education stresses the importance of integrating ICT across the curriculum, rather than

teaching about ICT (Breuleux and Bracewell, 1999). There is need for a thorough curriculum planning for successful integration, and to accommodate the integration into the classroom, there is need to address change of policy that is effectively understood by the stakeholders, the teachers, the school principal and the computer teachers. Purchase of equipment and uncoordinated efforts will not yield the desired results.

The literature reviewed recognized that the various documents that embrace the curricula developed at KICD need to be translated from text to digital formats in order to facilitate integration of ICT in the delivery of education programmes (MoEST, 2006). It is recognized that integration of ICT into teaching and learning will prepare students for the demanding job market. The education sector needs to be proactive in meeting the requirements for ICT skills, and there is need to establish model institutions that will be used to demonstrate the integration. Teachers will need to be trained on integration techniques. The current research found out that skills-based training will not assist both the teachers and the learners in integrating ICT into the learning process, but foundation computer skills should be a stepping stone to enhancing teaching and learning. ICT integration will take teachers and students beyond seeing ICTs as computer studies and computer literacy skills.

The study found that although there are benefits that can be achieved by using ICT in teaching, there was a lot of resistance from teachers. They said that if they were to learn to use ICT, they would be added more responsibility, for example, teaching students, and typing lecture notes and class lists. The principals were not conversant with use of ICT and were not able to provide leadership. For ICT to take off in secondary schools in Kenya there is need for schools' leadership to embrace ICT in

their systems. The teachers said that there was need for the Ministry of Education to come up with policies and guidelines that would enforce integration of ICT into the schools. They said that unless use of ICT was enforced the way HIV/AIDs was integrated into the school systems and curriculum, most of the schools would continue to lag behind.

There was low budget allocated for ICTs in the schools. Only 13 schools (35.1%) had a budget of between 1 and 5 per cent, while 17 schools had no budget at all. Private schools did not have any donor funding for ICTs and they were of the opinion that the government should provide funding for ICTs as it was a challenge. The private schools insisted that since they were guided by the Ministry of education regulations and were providing standardized education to Kenyans, there was need for government intervention; that they be included in ICT initiatives for example CFSK even if they were to pay for specialized ICT the services and training. Further investigations revealed that the Private Secondary Schools Association had been trying to engage the government into recognizing and partnering with associations representing private investors in education; persuading the government to create a revolving fund to be borrowed by members at discounted interest rates((MoE, Taskforce 2012, p. 225). Some selected public secondary schools had funding for ICTs from the government through CFSK while others had donations that consisted of out-dated computers whose upgrading was not considered a viable option.

5.6 Challenges Facing ICT Implementation

Research findings indicated that the introduction of ICTs into the secondary school systems posed many challenges, especially IT management, as evidenced from the sampled schools. None of the schools had ICT policies that guided equipment

acquisition, maintenance and disposal. Maintenance of computers and computer peripherals was particularly a major challenge in both public and private schools. Also, there were no trained technicians employed to maintain ICT equipment.

The schools that had computers employed computer teachers 65 per cent of whom spent about five 5 hours in a week repairing and maintaining ICT equipment. Those teachers were expected to play multiple roles of being computer teachers, technicians and managers in charge of ICT in their respective schools. They were consulted if there were any challenges concerning ICT to the principal, students, teachers and non-teaching staff. In addition, they had a full teaching load; hence, they were overstretched. This was a big challenge that slowed down the rate of ICT diffusion in the secondary schools.

Some schools employed computer teachers who were not qualified (of certificate level) so that they would be paid a low salary. This especially happened where the computer teachers were employed by the school Board of Governors or school management committees and not the TSC. The technicians employed were at the level of laboratory assistants and they were inhibited by their level of education to play IT management roles. The students strictly adhered to the KCSE syllabus. Consequently, innovation and technology were overshadowed by the demand for high grades in KCSE.

Out of the 37 schools that were studied, over two thirds of the teachers, especially in public schools, were computer illiterate. This was the case even where the schools had computer labs. The teachers in public secondary schools, apart from one or two, relied on the secretary, the computer teacher or technician to type exams and enter marks in the database. Some computer teachers were ready to train other teachers to perform

various tasks for themselves by using the computers in the computer lab, but the teachers did not volunteer to be taught. They felt vulnerable if they were to accept to be trained by teachers who were far much younger; recent graduates in computer science or information technology, or diploma and certificate graduates employed by schools were at a much lower scale. Also in some of the institutions, the principals had instructed the computer teachers to organize some training sessions for teachers, especially in the public schools. The teachers did not attend the training since it was not compulsory. Therefore, the subject teachers remained computer illiterate some of whom were not comfortable exposing their ignorance in technology and had technophobia.

Other challenges for extending the benefits of ICTs in secondary schools included the recurring costs of satellite connectivity which are still quite high. Electric power is unreliable in Nairobi schools and is in some cases unavailable in slum areas. Most schools did not have back-up generators. Wireless solutions (modems) were used in some schools, but they were still too expensive for Internet use by teachers and students. In those schools, the modem was used by the secretary to access the school e-mail.

The government has made substantial gains in increasing the enrolment rates through the FPE initiative towards achieving Education for All (EFA) by 2015 (MoEST, USAID /Kenya, 2005, p. 20). The increase in enrolment has posed a challenge as the students are too many, but ICT could be used to meet educational needs through e-learning.

The various challenges experienced in schools are summarised below. The major one, which faced all the schools, was lack of enough computers, where they could not meet

the needs of the students and the teachers. Computers were also found to be too expensive despite the policies and efforts that the government and NGOs had tried to put into place.

Computer teachers cited coping with the fast growing technology as a major challenge. They also found lack of software updates in their schools, lack of antivirus software, lack of enough computers, frequent computer breakdowns, lack of regular power supply, and mischievous students as major challenges. These challenges could be solved by better supervision of students, installing antivirus software, updating computer equipment, expanding computer rooms, and establishing Internet connection. The computer teachers required training on hardware maintenance and servicing.

About 99 per cent of the schools had maintenance and repair of equipment problems. Some schools had benefited from donated computers but the back-up maintenance was lacking. Hence, obsolete computers and equipment were a major issue where most schools had old computers that were slow (running on Windows 95 & Window 98) that could not use modern programs or access Internet. Therefore, government will need to formulate policy on maintenance and disposal of broken down computers as it is one of the major problems facing the schools.

Teachers faced challenges of limited time to train on computer use, as they were overworked. They cited fast technological changes as a challenge. The solution they suggested included purchase of more computers, need for qualified computer teachers, updated computers, supervision of students, installing power back-ups, training teachers, allowing them more time with computers hiring technicians. They asked for prices of computers and Internet connectivity to be reduced.

Non-teaching staff had challenges of need for acquiring modern computers and modems, as well as unlimited Internet connectivity, servicing of computers, modern accounting software, and regulations on computer usage.

As mentioned earlier, burglary and theft of computer parts posed a major challenge. The expense incurred in securing the computers makes schools shy away from equipping the schools with computers, even equipping the staffrooms. As the students are the culprits, this makes it very difficult for computer teachers to manage the labs.

The research established that there was lack of qualified teachers to teach ICT in schools, whereas the demand for learning ICT was high; students were keen to learn, but the teachers were not available. The teachers are not able to use ICT in teaching and learning in their teaching subject either. In addition, the schools did not have technicians to deal with computer breakdowns.

Another challenge was fear, which came in various forms. Some principals feared that students would be exposed to undesirable sites through the Internet, and hence result in antisocial behaviour, such as pornography and cyber bullying. Other fear was to do with data security and spread of viruses for which the administrators were not well equipped to deal with. Teachers had not been trained and they had the fear of appearing ignorant before the students and colleagues.

There were the challenges of lack of Internet and slow connectivity, where many schools could not afford; lack of data confidentiality, and replacement of computers and other equipment (stolen or broken down). Ethical and legal issues in regard to ICT had also not been addressed in the schools.

There was need to find out students' responses on how ICT was being implemented and used in the schools since they were main informants together with the principals. The findings revealed that 83.5 per cent of the students had access to computers away from school, and that 90 per cent of those in private schools had more access to computers away from school compared to 80 per cent of their counterparts in public schools. The findings also showed that 62 per cent of the students used spent one to two hours on computers in a week.

Students who had to sit for a computer science (KCSE) exam used computer labs more. The other students were not using computer labs as much because they were reserved for the KCSE candidates. Among the students, only 50 per cent agreed that ICT contributed to successful learning.

It was also found that 64.9 per cent of the students in both public and private schools had e-mail address, while the 35.1 per cent who did not have cited lack of access to computers and lack of Internet access. With regard to Internet, 84 per cent of student respondents from private schools had access compared to 72.3 per cent from public schools. Among those who had access, 51.2 per cent said that they spent more time trying to access Internet due to slow speed.

Lack of computers and power back-up were cited as key challenges by the students. However, for improvements in the implementation of ICTs in schools, 42.8 per cent of them wanted qualified teachers, 33.1 per cent wanted extra lessons, and 12.5 per cent wanted the re-introduction of computer lessons. With regard to the latter, it was noted that some students had been using computers in Forms One and Two, but had been stopped to give room to KCSE students doing computer science as a subject for the exam. Other improvements suggested by students included employing qualified

teachers, providing enough computer books, ensuring Internet accessibility, and allocating more hours for computer use. They also wanted more learning to be done in the computer lab as well as improving on the servicing of computers.

5.7 Libraries

In spite of the schools having the computer labs, there were no computers in the library; hence, in most of schools libraries not computerized. Most of the schools also did not have a trained librarian and in some, the librarians did typing work for the school (e.g., typing exams) and doing miscellaneous jobs since libraries were not updated. Purchase of new library books and material had been as affected as resources were directed towards improving the computer labs; hence, the trained librarians were underutilized and frustrated, especially because they felt that library and information were not highly valued in the school systems. Those school librarians' who were interviewed said that it would have been important for students to use computers to do their assignments in the library where they would consult online reference materials. It was also noted that the students were not encouraged to use the library, and only one principal out of the 37 interviewed who talked of creating a digital library in one of the rooms in the school library. It is not only important that school libraries are updated with new books, but also imperative that they are computerized and digitized to enable the students use computers outside the labs.

5.7.1 Chapter Summary

The main objective of the study was to investigate the level of ICTs implementation in secondary schools in Nairobi County for administrative and instructional purposes, and to make suggestions for a plausible model for sustainable implementation in the same. The discussions were based on research objectives derived from McConnell's

e-readiness tool that specified training and appropriate skills, connectivity, infrastructure, hardware and software, application of ICTs for school administration and learning instruction, and the set out policies guiding ICTs in the schools.

Training in ICTs for the principals and subject teachers was found to be inadequate. The principals were not prepared for leadership in ICTs integration into the daily activities in administration and learning. It was discovered that although teachers had teaching qualifications and training, only 29.3 per cent had any qualifications in ICTs. The school with a principal who was at the forefront of implementing ICT and led the school towards that goal had a lot of influence and was geared towards success. The culture of the school where teachers were highly motivated, who strived for excellence and who felt individually that application of ICT could push the school to a higher level of excellence was also geared towards success. ICT implementation process required preparation and planning, quality management and leadership, and hence adequate resources, training and support.

It emerged that ICTs equipment, hardware and software support and training were important, but mind-sets, assumptions and values of the individuals and school characteristics would determine whether ICT would be successful and have the desired impact. The challenge facing the schools was lack of enough computers where schools with over 30 computers were only 13.8 per cent compared to 10.3 per cent of public schools. Observation of computer lab revealed an overall poor quality of ICTs equipment and lack of proper management and maintenance especially in public schools.

Out of the 37 schools, only about 50 per cent had used computers in teaching English and mathematics, the major handicap being lack of enough computers, training of

teachers and lack of content. There was limited computer usage as students used computer lab once a week, and Internet connectivity was lacking and not available to students. Over 90 per cent of the schools did not have computers in the staffroom.

ICTs policy was lacking in all the schools. They did not have any mission, vision or strategic plans for ICT implementation and this caused lack of focus on principals, teachers and non-teaching staff as there were no priorities and guidelines to be followed. The Ministry of Education was in the process of making interventions that had not impacted significantly especially on the schools that were not under CFSK.

There were quite a number of challenges facing ICT implementation in the secondary schools, starting with lack of enough equipment, ICT management and policies, and training of teachers on how to use ICTs for teaching and learning and instruction. There was need for interactive content to supplement and support the teaching in all subject areas across the board, especially in languages, particularly in Kiswahili. It also emerged that libraries did not have computers, Internet, or e-learning content and the library personnel were not ICT trained; this was a major handicap as computer labs were closed on evenings and weekends. Chapter six is the summary of major findings, conclusions and recommendations.

CHAPTER SIX

SUMMARY OF MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary of findings, conclusions and recommendations based on the discussions of the study. A brief recapture of the study precedes the summary of major findings. The conclusions, recommendations and the suggested model for sustainable implementation of ICTs in secondary schools are presented later in the chapter.

The data was collected from 37 secondary schools in Nairobi County. The respondents comprised the principals, students, subject teachers, computer teachers and the non-teaching staff. The sampled students were Form Two and Form Three students.

The study was informed by the theory of Diffusion of Innovations (DoI), ICT Assimilation Framework (ITAF) for schools; and the UNESCO model of ICT implementation in education, which are discussed in Chapter 2. ICT is seen as developed in a continuum where schools start at the emerging stage; students learn the basics and complete at the transformation stage where ICT is integrated into the school work, becomes part of productivity and is used for innovations.

The five parameters from McConnell's e-readiness tool included the following: social capital; ICTs infrastructure and connectivity; ICT application for instruction, and school administration; and, the implementation policies. The challenges facing ICT

implementation in schools are discussed and suggestions given on how they can be resolved. A model of ICT implementation for secondary schools is also proposed.

Whereas ICT is a development that has been gaining ground in the information age of the 21st century, its use in education and training has taken longer than other sectors of the economy such as communication and business where the Internet has had a major impact. School principals and teachers as leaders and role models need to be trained in the use of ICTs in order to meet the demands of ICT implementation in the education sector.

6.2 Summary of Major Findings

The study revealed some major findings that provide insight into how a sustainable implementation of ICTs can be enhanced in Nairobi County secondary schools and even in Kenya at large. The findings are summarized according to the research objectives and the research questions that guided the research.

6.2.1 Determining the Training and ICT Skills Needed for Sustainable ICTs

Most school principals had a Bachelors' degree and a number had postgraduate qualification in education. However, they did not have ICT qualifications and, as leaders, they were not well equipped to steer the schools into ICT integration.

The computer teachers were ICT trained, but they did not have teaching qualifications and were mainly employed by the School Board of Governors. They had a lot of responsibility and were overworked. They were not well paid and kept on looking for better paying jobs away from the teaching profession. Therefore, their turnover was high and they left schools without continuity, forcing the schools to employ teachers with low ICT qualification.

Majority of principals relied on the computer teacher to guide ICT activities in the school, so when they left, there was no continuity.

The subject teachers had academic qualifications, but most of them did not have ICT skills did not use ICTs in their subject teaching.

Non-teaching staff, comprising the secretary and the bursar, were ICT competent as they used them in their work. The secretary did all the typing and checked e-mail, while the bursar was responsible for any accounting work involving ICTs. However, most of the schools were still using manual accounting systems, as they did not have computers and accountancy software.

The students who trained in ICT were preparing for KCSE exams and were using the set out books for their studies and exercises. Teachers will need to be trained on how to use and be encouraged to engage ICTs in their subjects and be made aware of many benefits of ICTs in teaching.

6.2.2 Establishing the Range of Hardware, Software and Infrastructure Supporting ICT Implementation in Secondary Schools in Nairobi County

The equipment needed to support ICT implementation and sustain it was the hardware and software as well as other technological devices that are tailor-made to meet educational needs. These include reliable communication lines and networks, reliable power and energy sources (e.g., electricity, solar or wind energy), and buildings and facilities that would be re-modified to cater for safety. The government, through the Ministry of Education, Science and Technology has given policy guidelines for ICT implementation in secondary schools (MoEST, 2005). Since construction of computer

labs, installation telephone lines and purchase of computer equipment is expensive, having written policies is not enough.

Much of the schools initial investment in computers should come from government agencies, international donors or local businesses. After the initial investment, schools would be expected to maintain and expand their computer labs by generating funds, using their own sources and by modifying the school's budget. Funds are needed to maintain the computers, buy needed supplies and additional equipment to meet expanding demand, pay for monthly access fees, replace failed or out-dated equipment, and cover the salary of technical support staff and instructors.

6.2.3 Assessing the Extent to which ICTs Are Applied in Administration and Instructional Purposes in Secondary Schools in Nairobi County

ICTs were used in offices by secretaries for typing memos and other communication in the schools. There was little use of ICTs in teaching and learning apart from the KCSE students who used computer lab to prepare for KCSE exams. E mail was not used for official communication among the teaching staff.

Some private schools use their computers to generate income after normal school hours and during the school vacations. They offer computer training courses, desktop publishing services and business training to the public. Instead of locking the computer rooms especially during school holidays, the public secondary schools could use the well-equipped computer labs to train the community around the school and students from other schools (rural areas) at a fee. The benefits accrued would enable the schools to achieve higher degree of resource utilization and earn from the investment. They would emulate the private schools that use their computer labs as

cyber cafés when not in use by their students. This enables them to raise extra finances to support ICT initiatives and to meet the high costs of ICT implementation. .

6.2.4 Determining the Policy Guidelines for ICT in Secondary Schools in Nairobi County

The study established that there were no ICT policies in the secondary schools. The school principals and computer teachers were all operating without any written-down guidelines. The subject teachers did not associate themselves with ICT implementation, which they saw as a concern for the school principal, the computer teachers and the students. If ICT implementation is to succeed, this has to change.

The students were very much interested in learning with computers. They would have liked to use the computer lab in the evenings and weekends. However, the computer labs were locked up whenever there were no classes going on. If there is an emphasis on schools to give students more time to use computers, there would be policies to cater for students to have extra time in the computer labs.

It is noted that the education and training sector of MOEST has a major role to play in the implementation of the ICT policy. The success in the sustainable ICT implementation will require sufficient and competent human resources that are developed and equipped in the education and training sector.

In the e-Government Strategy and National ICT Policy, considerable attention is given to education, particularly to secondary schools as agents with the greatest potential to address digital divide, expansion of learning opportunities, and e-government, (MoEST, USAID/Kenya, 2005, p. 74). The investment programme was intended to put in place the policy and strategy for ICT in education, development of

e-learning delivery systems, building of the necessary capacity; development of the required ICT infrastructure, and institutional management systems. Although the policies are well articulated, the study revealed that not much had been achieved in the selected secondary schools in Nairobi.

6.2.5 Identifying the Factors that Hamper Implementation of ICTs in Secondary Schools in Nairobi County

The study revealed that respondents encountered various challenges regarding ICT implementation. The principals' major challenges were on financing of the computer projects and their sustenance. Computer projects were expensive and the Ministry of Education did not have policies of financing; they had to depend on donor projects that operated for a certain period and then were discontinued. The schools were required to raise finances for computer projects from parents or other sources such as holding fundraisers. They also faced problems of data security.

There was need to improve the ways in which data was stored. It was established that acquisition of computers was through rigorous procurement procedures. Maintenance and replacement of faulty computers was a challenge as there were no qualified technicians employed by the Ministry of Education.

Computer teachers' major challenge was lack of standardized software updates and antivirus programs. Technology was also so fast changing for them to keep pace.

The teachers' major challenge was lack of enough computers. This challenge was faced by all respondents including the students.

The factors that hampered ICT implementation could be solved by availing more funds to purchase new computers, installing Internet, and maintaining the equipment.

There was need to supervise students and have more qualified teachers. Staff training was cited as an area that needed attention and guiding policy. It was also important to provide power back-ups and generators to cater for unreliable electricity supply and power outages. All the respondents stated requirement for new computers and reliable antivirus.

6.3 Conclusions

The study set out to investigate the implementation of ICTs in secondary schools in Nairobi County and to establish a sustainable model of ICTs implementation. From the study findings, the following conclusions were made:

- The school principals had not trained in ICTs, yet they were the leaders in ICTs implementation. They consulted a lot with the computer teachers. As heads of schools, they faced a challenge because a lot was expected from them. They were supposed to look for finances to fund ICT projects, which were expensive to sustain. The computer teachers did not have teaching certificates and most schools needed technicians. The subject teachers were not trained to use ICT in their subject teaching and the non-teaching staff needed training in new software and new techniques in ICT. Therefore, for ICTs implementation to succeed there is need for continuous training for all cadres of staff.
- The schools did not have the infrastructure to support a sustainable ICTs infrastructure at the time of the study. Financing of computer equipment was not adequate as majority of the schools did not have any budget allocated to ICT projects. A few schools were allocated less than 5 per cent of the school budget. All the respondents stated that there was need for more computers as only 10.3

per cent of the schools had around 20 computers, which would be shared in the ratio of one computer between three students during the computer lesson. Most of the computers were old and slow. They could not support the new software. Students used them for keyboarding purposes only.

- The school principals did not have much training in application of ICTs in school management. Most of the practical work, such as typing and writing memos, was done by the secretaries. The bursars used manual accounting procedures in majority of the schools. The study revealed that majority of subject teachers did not use ICTs for teaching and learning. Therefore, study concluded that it is important to improve school administration and learning instruction by integrating ICTs by training and providing the ICT facilities for those purposes.
- The secondary schools did not have policies to guide ICT implementation. The Ministry of Education's policies were not properly coordinated to achieve positive results in all the schools. Therefore, there is need for the strengthening of ICT policies and evaluation procedures that would reward the schools that performed well in ICT implementation.
- As a result of financial constraints and lack of training, the schools faced various challenges in ICT implementation. Therefore, the challenges needed to be addressed so that a sustainable implementation of ICTs in Nairobi secondary schools could be achieved.

6.4 Recommendations for Sustainable Implementation of ICTs in Secondary Schools in Nairobi County

From the findings and the conclusions, the following recommendations for a sustainable implementation of ICTs in secondary schools in Nairobi County can be made.

The most important change that needs to take place in the schools is transformation in people's attitudes, especially technophobia among the school administration and the teachers. Resistance to change will need intervention by the government by introducing a curriculum that will embrace ICT. Incentives and best practices need to be introduced.

The leadership of secondary schools (Board of Governors, School Committees, etc.) needs to employ strong IT managers who can give advice on the hardware and software procurement to meet the schools' vision and mission. The IT managers will be required to develop the vision and mission of ICTs in the schools together with tailor-made ICT policies for effective and efficient use of procured software and hardware.

The schools, assisted by directives from government, need to provide sufficient and appropriate infrastructure and facilities (computer software and hardware) before emphasizing their use in the learning process.

The successful introduction and use of ICT in education and training institutions will play a critical role in disseminating skills to wider society and thus create positive impact on the economy (MoEST USAID/Kenya, 2005, p. 73).

6.4.1 Training Needs

There is need for continuous training through organized symposia, workshops, in-service training and forming peer study groups to keep them informed and updated in new ICT developments. There is also need for reinvesting the teachers in an environment that demands continuous learning, involving learning with ICTs.

The challenges the teacher faces are dealing with contemporary issues. Teachers will need to be trained on how to use and be encouraged to engage ICTs in their subjects and made aware of many benefits of ICTs in teaching.

The Ministry needs to give out training directives to both the training institutions and the schools. This would ensure that there is trained manpower for ICT implementation so that the piecemeal approach where every school follows its separate direction is stopped. Local content needs to be developed to cater for all the subjects that are taught in the secondary schools, and even in Kiswahili (as a subject) that has limited local content. E-content is expensive to develop and it requires content writing and design, of which teachers need assistance

Human Resource will need to be a priority and will include ICT skills for teachers, technical personnel for technical support, and curriculum for learners so that they can learn what will be beneficial to them. The ICT curriculum will need to be restructured to details such as lesson time and content for each level of students in the secondary schools.

There is need for the local universities to train Bachelor of Education graduates who are able to teach ICT and to manage the computer labs. Providing teachers and other educational professionals with access to technology training is one key component to

developing the necessary human capital which the education sector requires for wide adoption of technology (MoEST, USAID/Kenya. 2005, p. 21). The guidelines will need to be effected and ways of evaluation established to match technological changes taking place.

There is need for schools to plan to embrace changes in the education systems to accommodate technology. Advances in technology will affect the role of the teacher from being an expert to a facilitator. In the pre-planning phase, each school should establish a team that would have instructional designers, subject content experts, expertise in resource discovery, and information management.

The Ministry of Education (MoE) should come up with policy guidelines that are appropriate. The policies should have backing and a follow-up through channels that are empowered for such activities; they should have backing from the Ministry so that they are enforced and even reward the schools and the participants who follow up the set guidelines and requirements.

Figure 37 depicts six players in ICT implementation in secondary school and the inputs and activities that are required.

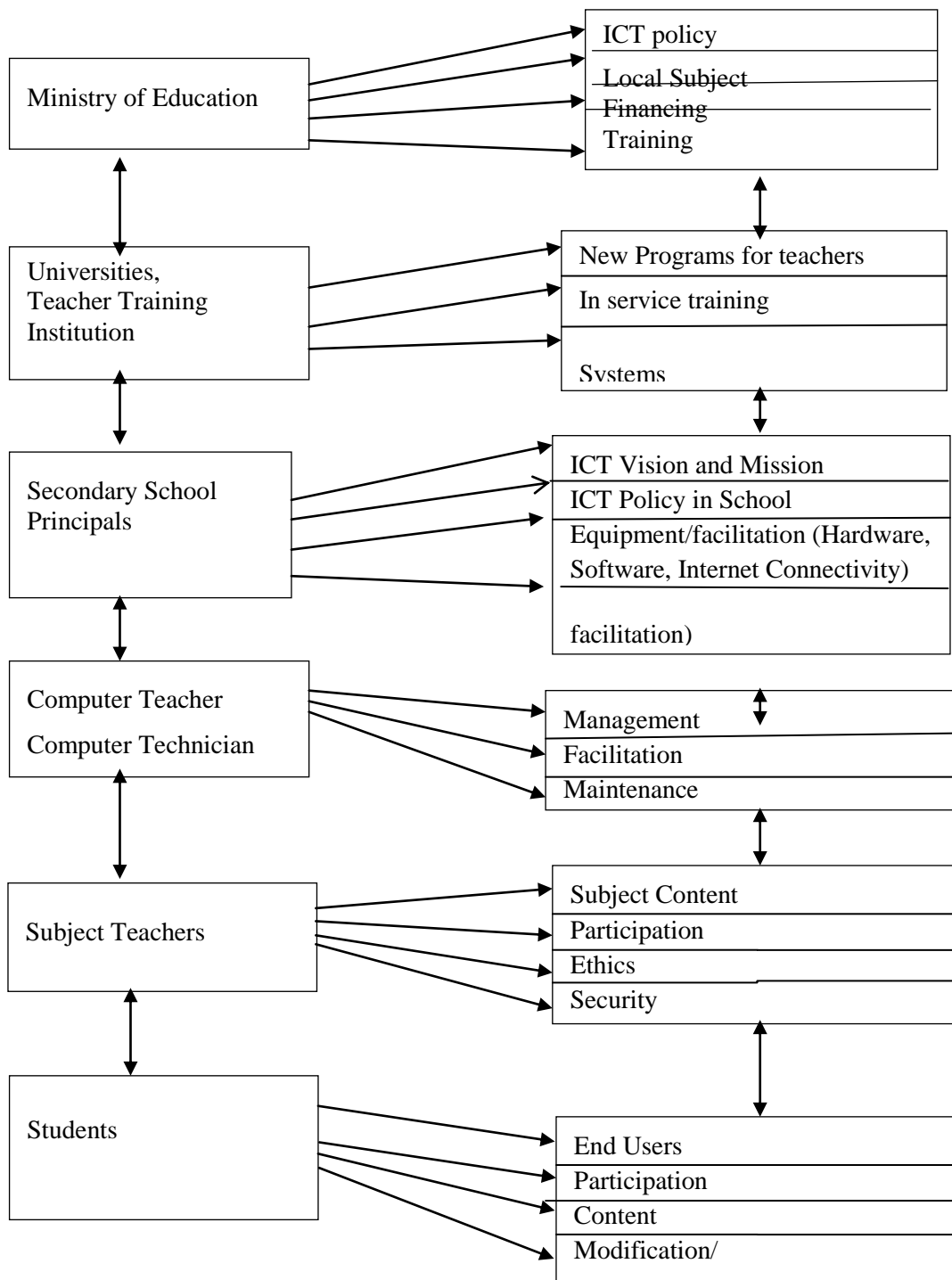


Figure 37: Proposed ICT management structures for secondary schools

The Ministry needs to set up finances to be allocated to each school, as the major challenge that both public and private schools are facing is lack of enough financial

support for ICT implementation. The schools have been getting donated equipment which is in most cases old and they use only for a short time before the computers are obsolete. The schools have been left as a dumping ground for donated equipment that they are not able to dispose of and are left as challenge disposal to the schools.

To enhance the quality of learning through the use of ICTs, the most logical assumption is to improve capacity of teachers and use of ICT to support and facilitate instruction and classroom management. It is important to note that providing access to computers and the Internet is not sufficient in improving the quality of learning and technology and cannot therefore replace teachers. Both Interactive Radio Instruction (IRI) and computer facilitated/enhanced instruction should be in line with national curriculum standards and the focus should be on learning outcomes and not technology (MoEST, USAID/Kenya, 2005, p. 85).

With use of Internet and other technologies, which are changing the way nations operate locally and globally, MoEST should exploit the ICT enhanced opportunities. The Ministry's goal should be to demystify technology and use ICT to provide deeper conceptual knowledge of the globalized world. Technicians should be employed to fix and maintain computers, and the teachers must know how to exploit ICT for opening up the students up to the world of knowledge.

Figure 38 indicates ICT implementation in the school. The school principal is the overall manager and delegates the ICT responsibilities to the ICT manager who works hand in hand with the computer teacher. The school principal will support ICT by availing funds for equipment and maintenance. In-house training and coordination is affected from the ICT office. The training can use coercion; improving ICT literacy by introducing ICT literacy programmes for the whole school. Peer support is

necessary and was found to be the most effective method of upgrading the teachers' ICT skills.

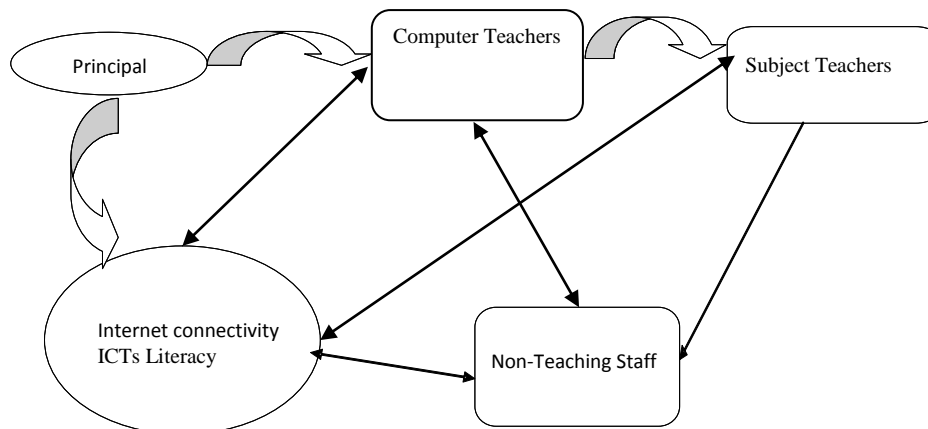


Figure 38: Implementation of ICTS for secondary schools

Dwyer (1990, p. 3) designs five phases of development before teachers become comfortable with technology in the classroom. The entry phase at the beginning, teachers have limited experience and computers are a hassle than a help. The teacher is faced with challenges of classroom discipline and management. At the adoption stage, teachers begin using computers more in class but there is still much lecturing going on. The adaptation stage is marked with productivity as students begin typing and producing more work in a variety of disciplines. During the appropriation phase, teachers understand technology and use it effortlessly as a tool to accomplish work. The teachers' role in the classroom changes from being a knowledge dispenser to a facilitator. Invention is the final stage and students are motivated to solve problems. The teachers understand technology and it is engrained into their studies, their job becomes easier as students begin to educate themselves. Figure 39 is used to illustrate ICT implementation for teacher training and retraining to use on how ICT in the universities and training institutions.

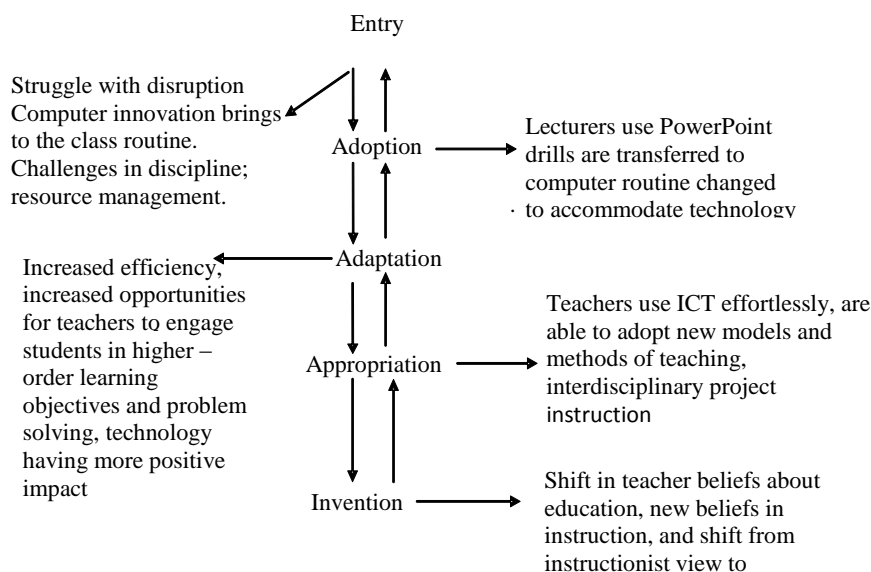


Figure 39: Model developed from Apple Classrooms of Tomorrow (ACOT)

Source: Dwyer et al. (1994)

6.4.2 Infrastructure and Internet Connectivity

In considering the infrastructure connectivity options, a Total Cost Ownership (TCO) will need to be developed to provide for the anticipated investments for ICT in the secondary schools. This stipulates the initial infrastructure costs, utilities costs, consumable costs and staff development costs (MoEST, USAID/Kenya, 2005, p. 66). TCO model captures the following investment costs:

1. **Hardware costs:** New desktops, refurbished PCs, Thin Client Systems, Servers, PDAs, TV, radios, and DVD/VCD/VHS players. There are also display devices comprising projectors, interactive white boards and TV monitors, and peripherals comprising printers, scanners, digital/video

cameras, and photocopiers, the installation costs and associated consumables.

2. Software costs: Operating system (Windows based, Linux based), productivity applications such as MS Office Suite and Open Office Suite; education specific content, class subject content, (on PC/video/radio); teacher training materials (on PC/video/radio); student or teacher support resources software on PC; student or teacher support resources on video/radio; and, basic ICT training software on PC.
3. Connectivity costs: In-school connectivity; LAN wiring for classrooms/labs, Wi-Fi access; to-school connectivity; dial-up connectivity; always-on connectivity; VSAT connectivity; radio/TV broadcast. Installation, support, maintenance as well as monthly usage charges are considered.
4. Service costs: Maintenance; warranty for hardware and software; on-going maintenance for hardware and software; technical support; external support contracts; internal support personnel costs; cost of training internal support personnel; user training; initial user training; recurrent training of staff; new support costs.
5. Infrastructure-utilities costs: Electricity (consumer rates, acquisition and running of generators, solar panels and batteries, UPSs); physical infrastructure (labs, furniture, air conditioner); security (for computer rooms); insurance.

6. National costs: Specific content/applications; development/customisation of class subject content (PC/TV/video); hosting and distribution of content; infrastructure; improvement of telecom infrastructure; improvement of electricity availability; subsidy on affordable infrastructure.

6.4.3 ICTs Application in Administrative and Instructional Functions

In ICT development, there is use of Fuzzy logic and animation for all subjects, including languages such as English, Kiswahili, French and German. ICT will create effective learning that is all inclusive, working together with subject experts to create content that reflects local content and to break barriers of the classroom walls through e-learning. This is a pedagogical paradigm shift of the teacher of the 21st century who will become a facilitator rather than the centre of the learning process. Thus the teacher is key to implementation of the technology, and hence technophobia should be eliminated.

The content for e-learning is to be developed and the philosophy behind it be identified. The traditional system of education recognized the teacher as the source and one to direct classroom activity, but this approach is continuously changing. The challenges the teacher faces are dealing with contemporary issues. E-content is expensive to develop and it requires content writing and design, of which teachers need assistance.

The issues raised by the research were: lack of appropriate pedagogical skills; equity as there were huge disparities in resource generation and public schools having the majority of the students; and, staff and professional development for the teachers as well as capacity building programmes, which will be necessary for ICT integration

into the subjects. Building capacity to create instructional materials for an increasingly digital world is an investment that will pay dividends for improving the quality of education. There is also need to design ICT-based curricula rather than treating ICT as a separate education product. Successful ICT integration will need strong leadership and change management. Allocation of funds will need to be commensurate to the learning outcomes and the resultant technological expertise for ICT implementation.

6.4.4 ICT Policies

ICT is dynamic. In order to create a sustainable ICT growth, there is a need to have an articulated national ICT policy that will lay out the strategies for infrastructure and point out the elements of technology that will be used in the secondary schools, and also point out for what purposes. The ICT technology that was found in the selected schools was radio, television, computers, cell phones and telephone land lines, digital cameras and, in very few cases, digital microscopes. For maximum exploitation of the equipment, there is need for an elaborate policy on how each of the equipment should be used.

The teachers stated that there was need for a radio and TV station that would be government-funded to deliver educational programmes for the benefit of the students. They remembered with nostalgia when Voice of Kenya (VOK) would broadcast educational lessons. Such programmes could be offered online directly to schools. This would assist in lesson and content delivery to the large number of students in the secondary schools who form large classes due to the introduction of free primary education.

With the establishment of the ICT Board, it will be important for it to take the lead in some of the issues that are affecting integration of ICT into the education system such as low bandwidth and high Internet costs.

For subject specialization, teachers should learn to use ICT to enrich their subject knowledge by using online databases to update and improve on subject content. The leadership of the secondary schools could use power-coercive strategies to bring about the desired change (Chin and Benn, 1976) such as making it compulsory for all teachers to attend training sessions in IT. With support from the principal, a competent computer teacher/manager would set IT objectives and targets (desired results) to be achieved at the school level. The government could support such initiatives by availing well-trained ICT personnel to support secondary schools for such ventures. The government would need to give incentives to the school principals who champion use of ICT and the TSC would need introduce ways of incentives for teachers so that they are coerced to start using ICT in teaching and learning.

Education management can be improved by use of ICT, for example, in timetabling, use of email, use of Internet and teacher's notes, where the soft copy can be updated. Local content should be included in the ICT curriculum to make it relevant to local needs. The school principals when given the right training will embrace new management strategies involving use of ICTs for better management of both human and fiscal resources. This will need constant updating of skills and knowledge as technologies are changing all the time

The study recommends that there should be follow-ups to see that the policies are implemented. Every school should have an ICT policy that is publicised. Every school

should have a vision and a mission statement to inform and publicize the need for use of ICT in teaching and learning as well as in school administration

The need for ICT policies was established at three levels, namely the government, training institutions and secondary school. It is important for the government, through the Ministry of Education, to formulating policy guidelines for ICTs in secondary schools to deal with the following:

- Resistance to change: This will need intervention by introducing a curriculum that will embrace ICT. Such intervention will make effective the policies embodied in Kenya Vision 2030 and the Ministry of Education policies.
- ICT training: This should be incorporated in teacher training institutions. Centres of excellence for ICT training should also be established in selected universities (InfoDev, 2005, p. 130).
- ICT outreach: Most respondents did not show acceptance of computers as a way of life. As a way forward, sociological research into the use of ICT should be conducted. Socio-cultural factors that affect use of ICT need to be explored since all respondents using Internet in the schools were the young people. An advisory centre should be established to help communities set up and operate non-profit public computer labs in school libraries and shopping centres (InfoDev 2005, p. 131). This will be a way to encourage students to develop lifelong ICT skills after completing secondary school education. Such approach for promoting effective use of ICT was found to be operational in Muslim Girls' Secondary School in Nairobi, where the youth

and communities were encouraged to use ICT for income generating activities.

- **Financing of ICTs:** There will be need to avail funds for continuous sustenance of the ICT projects. Internet connectivity should be made affordable to schools, as an investment for both government and private sector. There was a lot to be done to update computer and the accompanying software. Funds for computers could also be included in the fees
- **Disposal of ICTs:** Internet connectivity should be zero rated for educational purposes. Funds for computers could be included in the fees. There should be policies to guide the disposal of old computers and other equipment.
- **Fiscal intervention:** Internet connectivity for educational purposes should be zero rated. Tax of ICT equipment and services should be reduced to less than 10 per cent duty (inclusive of VAT) (InfoDev, 2005, p. 130). Local assembly of computers should also be encouraged by zero rating knock down kits.
- **Rules and regulations** would be put in place to cater for students' use of the computer lab when the computer teacher is away. The students would become more responsible and learn to take care of the computer equipment.
- The government, schools and Board of Governors (BoGs) need to come up with proactive ways for raising funds if sustainable ICTs implementation is to succeed.

6.4.4.1 Institutions of Higher Learning

- The institutions of higher learning need to train teachers who will be in a position to integrate ICT in their subject content and embrace change in the ICT curriculum.
- There should be in-service courses for practicing teachers. Teacher training institutions should also include an ICT component to all their students to assist them to be confident in ICT when they start their teaching career. This is in line with Kenya Vision 2030 (p.127) which states that the government will accelerate the pace of training for school heads and other teachers to improve their ICT skills.
- The teacher training curriculum should be redesigned to incorporate ICT skills coupled with use of online searching to inculcate subject content in all institutions.
- The Ministry of Education should introduce compulsory in-service courses for teachers to assist them catch up with the ICT technology and use. This will save the teachers embarrassment in class when they try to use computers, as their students are way ahead of them.
- The institutions of higher learning need to train teachers who will be in a position to integrate ICT in their subject content and change in the curriculum.

6.4.4.2 ICTs in Secondary Schools

The study found that the principals, the computer teachers and the students bore the highest stake in ICT implementation in the schools. Observation and interview with teachers indicated that the teachers were not informed on how they could enrich their

teaching by integrating ICT into teaching. Teachers will need a lot of support and encouragement to overcome technophobia so as to embrace ICT skills. This can only be done through peer support groups where they will not be intimidated and can make mistakes

The current research discovered that students were steps ahead of teachers in ICT skills. Creating an environment for teachers to learn to improve their personal ICT use through peer support has demonstrated benefits (Lee, 2007, p. 170). For example, working together benefits the group as a whole. It was recognized that peer support promoted attitude change among teachers such that they had become more enthusiastic in using ICT. Literature reviewed showed increased professional interaction between peer partners that enabled the teachers to reflect more on the role and purposes of ICT in teaching. The teachers found that their experiences of peer support helped them to expand their perspectives to see a wider role of ICT in teaching.

Teachers teaching in the same subject areas and having similar outlook are the main factors that inform good professional interactions. The current research affirmed that peer support enabled professional interactions. The teachers worked together in departments that were subject-oriented and supported one another in relation to subject content and the curriculum and teaching methods. They agreed that the peer support arrangement helped to form an encouraging environment and promoted professional interactions among them. The peer support arrangement helped to pull teachers together so that they had opportunities to engage in in-depth communications.

Peer support provided an environment for teachers to know each other more deeply so that they could appreciate each other's way of using ICT. It was generally agreed that as the teachers engaged in peer interactions, they were exposed to different perspectives of ICT. In their study on understanding the complexity of teacher technophobia, Lloyd and Albion (2005) argued that the way to encourage teachers with low technical skills was to assist them to work with peer partners. Since they enjoyed the peer conversation, they were more likely to be willing to know and accept different ideas. Hence, peer interactions can lead to a change of attitude.

As noted earlier, skills based training does not give reflection on ICT integration. Critical reflection, which challenges teachers' beliefs with regard to ICT, is believed to be important in changing teachers' practice. Shallow reflection will not bring about change in teaching paradigms and pedagogies. Interaction and interview with principals, computer teachers and teachers for different subjects revealed that peer support motivated the teachers and enhanced their ability to look into their teaching practices further, and more widely and deeply.

Traditional education systems present teachers as centre of knowledge. The research revealed that teachers were embarrassed that they were not able to use a computer. They would not reveal this among students, especially when it came to handling ICT equipment in class. They had a common feeling that peer groups provided a safe and comfortable environment for sharing emotions, weaknesses and problems (Lee, 2007). Peer support helped to boost their confidence in ICT integration.

Pedagogical reasoning is a personal decision-making process through which analysis and interpreting factors that affect teaching and learning practices take place. This process leads to personal ICT integration strategies (paradigm shifts) that are

subsequently translated into practice (pedagogy). Lee (2007) argues that teachers interpret factors through personal lenses, namely personal theories and emotions. Personal theories refer to the teachers' judgements that are based on certain frames, which guide their decision-making and structure classroom teaching activities. These frames of reference constitute a theory, which endows them with a capacity to predict what will work and thus produce desired outcomes in the classroom (Chan, 2001). He further stipulates that personal theories are constructed from teachers' interpretation of past actions and are influenced by their knowledge, beliefs and values. Teachers facing similar external constraints, for example, lack of suitable resources, lack of school support and lack of knowhow, will react differently because they may have different interpretations of the environmental factors due to different theories used. If they consider external factors as the determining elements in ICT integration, they are more likely to perceive the immediate environment as something beyond their control. When they face such external constraints, they are more likely to give up. Also, if teachers believe that ICT competency is the determining factor, then even if they are confronted with limited resources and unreliable equipment, they may respond by trying to acquire more skills to face these challenges (Lee, 2007, 170).

Teachers' interpretation is also influenced by their emotions. To ignore the effect of negative emotions would hinder their development. The negative emotions emerge as a result of, among others, negative experiences of ICT integration, lack of school support and unreliability of equipment. In the absence of appropriate emotional support, negative emotions such as frustration, disappointment, insecurity, anxiety, discouragement and lack of control in the ICT classroom are likely to emerge.

Teachers are likely to feel vulnerable when using ICT for teaching. Some teachers perceive ICT as a threat to their existing role and status. They are likely to become insecure, nervous, passive and hesitant to try something new and work outside their comfort zone (Holland, 2001). As they work in isolation, they are likely to feel lonely and powerless towards ICT integration issues. They can become doubtful about the value of ICT in their work, as they are overwhelmed by the integration problems; they can only consult the computer technician for technical issues. It is, therefore, important to form peer support groups for teachers teaching similar subjects, and these can be networked with other schools in the county. The Ministry of Education and the school management should prepare avenues to support the initiatives of ICT peer support groups for teachers.

Although teachers valued their autonomy in peer support, as a professional practice and as a professional development, it should be accountable to the schools' goals and objectives. It is important that it is included in the school policy and accredited as teachers' professional development. The TSC can formalize and give incentives to head teachers and teachers who champion ICT integration in their schools.

The knowledge-based economy is characterized by rapid change, increased information flow, and decentralized organizations, institutions and systems where boundaries are continually diminishing. There are complex issues such as climate change, hunger, overpopulation, urban decay, pollution and inadequate energy supplies. These are new challenges that need to be addressed by communities, governments and education systems. Secondary school education in Kenya needs to embrace the skills needed for 21st century workplace demands and address the

challenges posed by unemployment, food shortages, HIV/AIDs that are facing developing nations

6.5 Proposed Model for Sustainable Implementation of ICTs in Secondary Schools

The proposed model for sustainable implementation of ICTs in secondary schools was the last objective of the study and is discussed in this section. The model is laid out and organized according to the set out ICTs standards. The school subsystems, progressive diffusion of ICTs in the schools, policy and standards are illustrated and discussed. The procedures and practices spell out specifics of how the policy and the supporting standards and guidelines will actually be implemented in an operating environment (Peltier,2004, p. 26).

The ICT implementation standards and procedures have a hierarchy of requirements of ICT, namely laws and regulations, policy, the set out standards, and the procedures and practices for implementation. The standards are mandatory activities, actions, rules or regulations designed to provide policies with the support structure and specific direction required to be meaningful and effective. Laws, regulations and requirements spell out the activities to be carried out by the government to be translated into policies that need to be enacted by the Ministry of Education with regard to ICTs implementation and integration into the schools' curriculum and input into the ICT infrastructures.

The standards adopted for the model are described by Peltier, (2004) to be used for ITC procedures and practices as outlined in Figure 40.

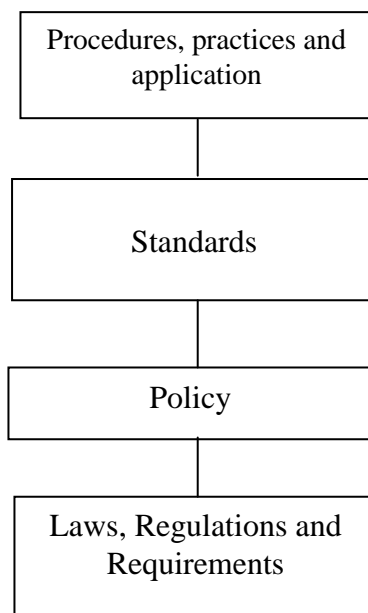


Figure 40: Standards as they appear in the hierarchy

Source: Peltier (2004).

The sustainable model starts with the objectives. Training involves training of all participants of ICTs sustainable implementation in the schools. Infrastructure, hardware and software involve all the ICT requirements. There are government policies to guide, coordinate and regulate ICTs not only in secondary schools, but also in all the education systems in the country. Security of equipment is set at the school level.

The school subsystems encompass the management, structures, and the psychosocial goals and values. ICT diffusion in the secondary schools is progressive. Goals and values stipulate the school philosophy, the vision and the mission. The school vision and mission will have statements and SMART objectives that embrace government and the schools' ICTs policies. The schools start at the basics and move on through

the four progressive subsystems to finally attaining competency at the transforming approach.

The psychosocial level involves the human resources, attitudes, motivation, communication and interpersonal relationships that will assist schools in integration of ICTs. The computer teachers are expected to spearhead the process through heads of departments with the authority given by the principals. Use of peer influence and improved interpersonal relationships will forge improvements against computer illiteracy.

At the structural level, it is recognised that ICTs integration will change management structures by creating new roles for staff, work flow, authority, and information flows where meetings and general communication is carried out through e-mail and teleconferencing. There will be need for new rules, regulations and procedures to be put in place to embrace ICTs. The managerial approach involves policy formulation, training, resource allocation and staffing to embrace planning for ICTs integration. Technical issues will involve knowledge techniques, purchase and maintenance of facilities and equipment, and maintenance of hardware and software.

Sustainable implementation of ICTs in the secondary schools is progressive with schools starting at the emerging approach where they strive to acquire ICT literacy. At the application level there is attempt to use ICTs for administration and in instruction. With regard to instruction, ICT is used across the curriculum and in different subjects; teachers and students are comfortable with extracting and using ICTs in their subjects. At the infusing level, ICTs are integrated across the curriculum and computer-based technologies are evident in classrooms, laboratories and administrative offices. Personal productivity is evident and professional practices in departments are ICT

directed. Finally, the schools are transformed into ICT specialisation, programming and software development, and students are able to interact and become innovators in, which can lead to employment, job creation and self-employment by the time students complete secondary school education. This is the vision of the 21st century education system transformation.

The ICT model is governed by policy, laws and regulations that run throughout the integration and they guide and outline roles of the Ministry of Education, teacher training institutions, and universities in training and in-service training of teachers. The school principals and computer teachers play an important role of at the school level. Subject teachers, students and non-teaching staff have their role. There is need to use peers to influence ICT diffusion in the required way and to bring in innovation into the school systems to the praxis level.

The sustainable model for ICT implementation is relevant for secondary schools in Kenya. The model can be adopted for policy making at the Ministry of Education level as well as at teacher training institutions. The model will be appropriate for adoption of ICT at the schools level; it will be appropriate for schools not only in Nairobi, but also in all secondary schools even outside Nairobi and it can be used for ICT training in primary school teacher trainee colleges. Figure 41 presents the proposed model for a sustainable ICTs implementation for secondary schools.

The sustainable model for ICT implementation would be initiated by the Ministry of Education (MoEST); starting up with policy guidelines for training programs for principals, computer teachers and subject teachers. The programs will be initiated at the universities, as well as teacher training institutions. The training will inculcate not only the policy and managerial aspects but also goals and values, Technical aspects as

well as well as progressive diffusion of ICTs into the schools and the education curriculum. At the end, the schools will be transformed and will adopt ICT as a way of information literacy and lifelong learning for students and teachers.

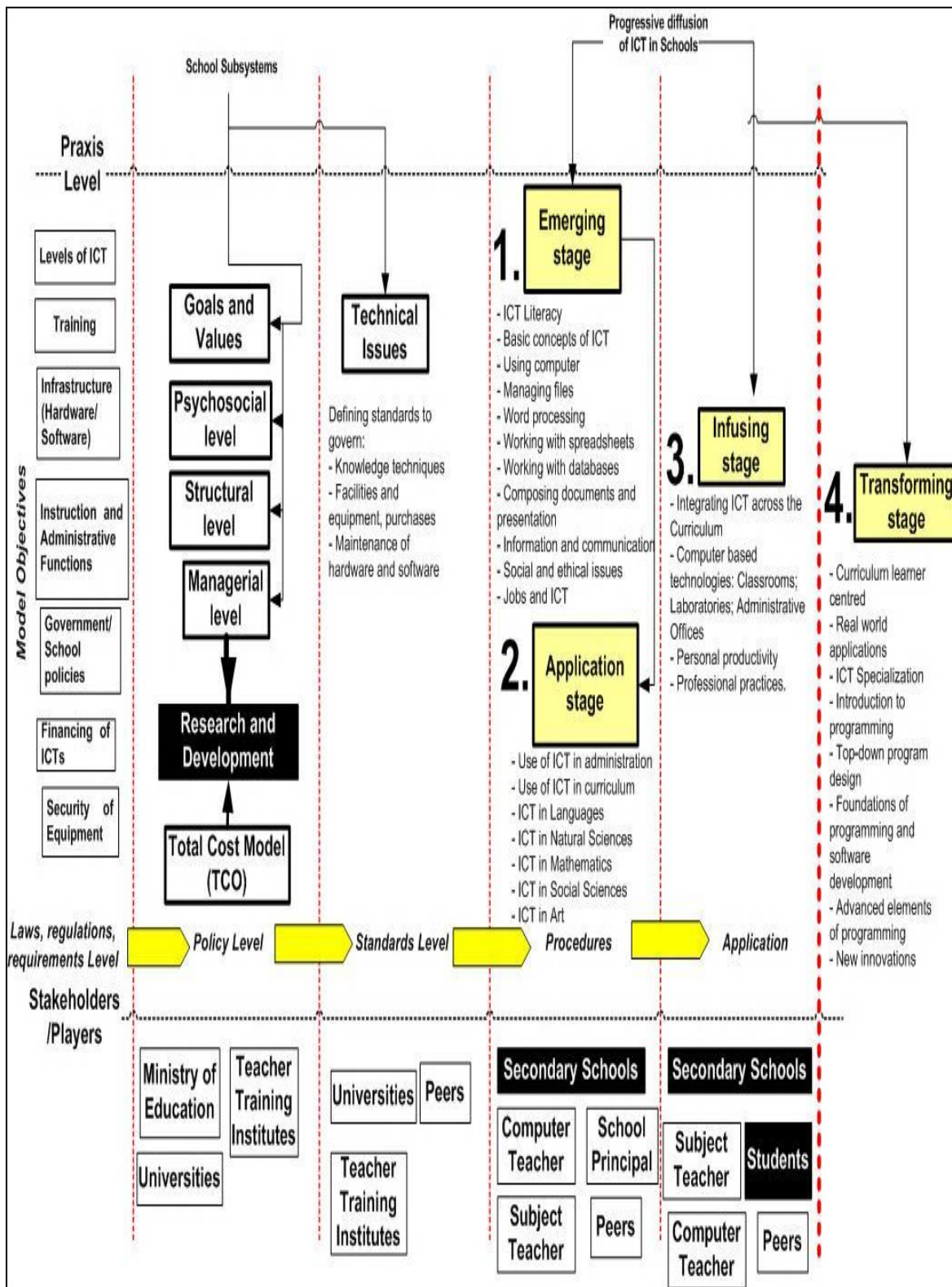


Figure 41: Proposed model of sustainable ICTs implementation in secondary schools in Nairobi County

6.6 Suggestions for Further Research

The study investigated the diffusion of ICTs in secondary schools in Nairobi County, and concentrated on schools in Nairobi only. The areas for further research would be:

1. A study of Kenya's rural schools and ASALs, and map out how ICTs can be established to enhance learning in both primary and secondary schools. There is need for separate research on evaluation of policies that have been rolled out on ICTs in the school curriculum and content development areas that have come up.
2. A comparative study of developed countries where ICT has been used successfully in schools with an idea of modelling the successes, not to be implemented wholesale, but to assist in the understanding of what policies will benefit the Kenya school sector.
3. On the skills needed by the teachers that are suitable for classroom teaching and learning. This research found out that teachers need other skills to be able to integrate ICTs into classroom teaching and learning. Learning computer packages that are usually taught in computer courses, though necessary, is not enough to integrate pedagogical skills and subject content into the classroom.
4. Research on how peer support can be used to hasten ICT competency among teachers and enhance collaboration among teachers involved in teaching similar subjects. This will result in a professional development model where teachers will be encouraged to use ICTs in the classroom. The school principals will need a research that will result in directions on paradigm shift in the schools.

REFERENCES

- Adeya, Catherine Nyaki (2001). *Information Communication Technologies in Africa: Selective Review of Studies and Projects*. Oxford: International Network for the Availability of Scientific Publications (INASP).
- AISI (2012). "An Action Framework to Build Africa's Information and Communication Infrastructure". African Information Society Initiative Available at: <http://www.comminit.com/ict-4-development/node213874>. Retrieved on 6th March, 2012.
- Aldrich, H. (1979). *Organizations and Environments*. Englewood Cliffs, NJ: Prentice-Hall.
- Aldrich, H. (1999). *Organizations Evolving*. London: Sage.
- Anderson, J. (2005). "IT, E-learning and Teacher Development." *International Education Journal*, Special Issue 5, 5 (2004): 1-14. Available at: <http://iej.cjb.net>. Accessed on 8th December, 2011.
- Anson, C. M. and Schwegler, R. A. (2010), *The Longman Handbook for Writers and Readers, 6th Edition*. New York: Longman.
- Argyris, C. and D.A. Schön (1996). *Organizational Learning II: Theory, Method and Practice*. Reading, MA: Addison-Wesley.
- Ary, D. Jacobs, L.C. and A. Razavieh (1979). *Introduction to Research in Education, 2nd ed.* New York: Holt, Rinehart and Winston.
- Baker, T. L. (1994). *Doing Social Research, 2nd ed.* London: McGraw-Hill.
- Basu, I. (2008). "Mobile Phone Payment System Blossoms in Kenya". Available at: <http://www.govtech.com/dc/articles/240801>. Accessed on 19th March 2009.
- Beare, H., B.J. Caldwell, and R.H. Millican (1989). *Creating an Excellent School: Some New Management Techniques*. London: Routledge.
- Becker, H.J. (1994). "Analysis and Trends of School use of New Information Technologies." Irvine: Department of Education, University of California, Irvine.
- Bereiter, C., and M. Scardamalia (2008). "Learning to Work Creatively with Knowledge" In *Unravelling Basic Components and Dimensions of Powerful Learning Environments*, edited by E. De Corte, L. Verschaffel, N. Entwistle, & J. van Merriënboer (eds.), EARLI Advances in Learning and Instruction Series.
- Best, J.W. and J.V. Kahn (1998) *Research in Education*. 8th Ed. Boston, Allyn and Bacon.

- Beukes-Amiss C., M., and E., R., T. Chiware, (2007). "The Impact of the Diffusion of ICTs into Educational Practices: A Review of the Namibian Situation". <http://hdl.handle.net/11070/302>. Accessed on 2nd September, 2013.
- Borg, W.R. and M.D. Gall (1983) *Educational Research Methods: An Introduction*. New York: Longmans.
- Bozemann, W.C. (1979) "Technology and the Design of Decision Support Systems in Education." *UCEA Review*, 20 (1979): 3-8.
- Breivik, P.S. & E.G. Gee (1989). *Information Literacy*. New York: Macmillan.
- Breuleux, A.L.T. and R.J. Bracewell, (1999). "Networked Learning Communities in Teacher Education: Washington DC." Available: at http://www.coe.uh.edu/insitel/elec_pub/HTML1998/ts_breu.htm. Accessed on 8th December, 2011.
- Bryman, A. (2004) *Social Research Methods*. 2nd Ed. Oxford: Oxford University Press.
- Butcher, N. (2003) "Technological Infrastructure and Use of ICT in Education in Africa: An Overview." Association for the Development of Education in Africa (ADEA), International Institute for Educational Planning, Paris, France.
- Campbell, D. (1969). Variation and Selective Retention in Socio-cultural Evolution. *General Systems*, 14, 1 (1969): 69-85.
- CCK (2007). "What You Need to Know About Telecommunication Services". Available at: www.cck.go.ke/what_you_need_to_know/. Retrieved on 22 November, 2012.
- CCK (2013). "Communications Commission of Kenya "Government launches National Broadband Strategy" Available at: <http://www.cck.go.ke/resc/stats.html>). Retrieved 9th August, 2013.
- Central Bureau of Statistics (2006) *Ministry of Planning and Natural Resources*, Republic of Kenya. Available at: <http://www.cbs.go.ke/> Accessed 15th April, 2010.
- Challenges of E-Learning in Schools* (2006). Nairobi: Council for Literacy Development.
- Chan, K.W. (2001) "Validation of a Measure of Personal Theories about Teaching and Learning." Paper presented at the AARE 2001 Conference. Fremantle, Perth. Available at: <http://www.aare.edu.au/01pap/cha01062>. Html. Retrieved on 22 July, 2011
- Chelimo, K.K. and C. Maende (2010). "Re-aligning Management for Results-based Use of Information Technology in Learning Institutions." Paper presented at the First KIE Education Symposium 17th-19th February, 2010.

- Chin, R. and K.D. Benne (1976). "General Strategies for Effecting Changes in Human Systems." In *The Planning of Change*, 3rd Edition, edited by W. G. Bennis, K.D. Benne and R. Chin. New York: Holt, Rinehart and Winston.
- Chiware, E. (2002) "Information and Communication Technologies in Rural Secondary Schools in Africa: Proceedings of a Workshop held in Harare, Zimbabwe 29th Nov. – 3rd Dec. 1999." Uppsala: Uppsala University Library, 2002.
- Clarke, H., M. Wilson, M. Cunnings and A. Hyland (1999). "The Campaign to Enact New York City's Smoke-Free Air Act." *Journal of Public Health Management Practice* 5:1-13.
- The Constitution of Kenya (2010). National Council for Law Reporting Creation(ERWEC),2003-2007: Statement by the Minister for Planning and National Development". Available at: worldbank.org/KENYAEXTN/Resources/ERS.pdf. Accessed on 4th September, 2013.
- Creswell, J.W. and V.L. Plano Clark (2007). *Designing and Conducting Mixed Methods Research*. London: Sage.
- CTF (2005). "The Impact of Technology on Teaching and Learning: Social, Cultural and Political Perspectives." Canadian Teachers Federation. Available at: <http://www.ctf.ca/e/what/restech/introd.html>. Accessed on 15th April, 2011.
- Cuban, L. (2002). *Undersold & Underused: Computers in the Classroom*. Cambridge, MA: Harvard University Press.
- De Freitas, S. and M. Oliver (2005). "Does E-Learning Policy Drive Change in Higher Education? A Case Study Relating Models of Organisational Change to E-Learning Implementation." *Journal of Higher Education Policy and Management* Vol. 27, No. 1 (March 2005):81-95.
- Denzin, N. K. (2009). *The Research Act: A Theoretical Introduction to Sociological Methods*, 3rd ed. Englewood Cliffs, N.J.: Prentice-Hall.
- Drucker, P. (1992). "The New Society of Organizations." *Harvard Business Review*, (September 1992): 95-104.
- Drucker, P. F. (1980) "Innovation and Entrepreneurship – eNotes". Available at: <http://www.enotes.com/people/enotes>. Retrieved on 22 November, 2011.
- Drucker, P.F. (2009). *The Practice of Innovation: Innovation and Entrepreneurship Practice and Principles*. New York: Harper & Row.
- Durrheim (ed.), (2006) *Research in Practice*, pp. 251-268). Cape Town: UCT Press.
- Dutton W.H. (ed) (1996). *Information and Communication Technologies*. Oxford: Oxford University Press.

- Eisenberg, B.M., C. A. Lowe and K. L. Spitzer (eds) (2004). *Information Literacy: Essential Skills for the Information Age, 2nd edition*. London: Libraries Unlimited.
- Export Processing Zones Authority (2005). "Kenya's Information & Communication Technology Sector, 2005." Available at: <http://www.epzkenya.com/UserFiles/File/ictkenya.pdf>. Accessed on 14th June 2012
- Fainmesser, A. and S. Mendel (1989). *Integrating Schools in Educational Information Systems: Pilot Project Conclusions*. Jerusalem: The Israeli Ministry of Education, Culture and Sports.
- Farrel, L. (2001). "Negotiating in the Knowledge Economy: Workplace Educators and the Politics of Codification." *Studies in Continuing Education*, 23, 2: 201-214.
- Ford, P. et al. (1996). *Managing Change in Higher Education: A Learning Environment Architecture*. Buckingham: Open University Press/SRHE.
- Forkosh-Baruch, A., R. Nachmia, D. Mioduser and D. Tubin (2005). "Islands of Innovation' and 'School-wide Implementations': Two Patterns of ICT-based Pedagogical Innovations in Schools." *An interdisciplinary Journal on Humans in ICT Environments*. Vol. 1, 2 (October 2005): 202-215.
- Freire, P. (1970). *Pedagogy of the Oppressed*. New York: Continuum Herder & Herder.
- Freitas, S. and M. Oliver (2005). "Does E-Learning Policy Drive Change in Higher Education?: A Case Study Relating Models of Organisational Change to e-Learning Implementation." *Journal of Higher Education Policy and Management* Vol. 27, No 1 (March 2005): 81-95.
- Fullan, M. (1994). *Change Forces: Probing the Depths of Educational Reform*. London: Taylor and Francis.
- Gell, M. and P. Cochrane (1996). "Learning and Education in an Information Society." In *Information and Communication Technologies: Visions and Realities*, pp 251-262, edited by W. Dutton. Oxford: Oxford University Press.
- GeSCI (2004). "Global e-Schools and Communities Initiative Founded by UN ICT Taskforce." Available at: <http://www.gesci.org>. Retrieved on October, 2007.
- Haddad, W.D. and A. Draxler (2005). "The Dynamics of Technologies for Education." Available at: <http://www.schoolnetafrika/fileadmin/resources/Emerging.> Retrieved on October, 2010.
- Haddad, W.D. and S. Jurich (2005). "ICT for Education: Potential and Potency." Available at: <http://cbdd.wsu.edu/e/dev/Nigeria>. Retrieved on October, 2010.
- Hawkins, R.J. (2004). *Ten Lessons for ICT and Education in the Developing World*. Washington D.C.: World Bank Institute.

- Hepp, P. et al. (2004). *Technology in Schools: Education, ICT and the Knowledge Society*. Temico Instituto de Informatica Educativa. Retrieved on 22 January, 2012 www.sca2006.tic-educa.org/.../ICT_report_oct04a_Pedro_Hepp.pdf
- Holland, P.E. (2001). "Professional Development in Technology: Catalyst for School Reform." *Journal of Technology and Teacher Education*, 9(2): 245-276.
- IDRC (2003) Information and Communication Technologies for development in Africa: Opportunities and Challenges for Community Development
- books.google.co.ke/books?id=_dIRvOF0QbkC&pg=PA116&dq=idrc+2000+kenya&hl=en&sa=X&ei=_fBPVL2QOdjlarC3gLAE&ved=0CB0Q6 retrieved October 2014
- InfoDev (2005). "E-Ready for What? E-Readiness in Developing Countries: Current Status and Prospects Toward the Millennium Development Goals." Available at: www.bridged.org. Retrieved on 1st November, 2011.
- InfoDev (2005). "Knowledge Map: Impact of ICTs on Learning and Achievement." Available at: http://www.infodev.org/section/programs/mainstreaming_icts/education/knowledgemaps_education/km_impact. Retrieved on November, 2011.
- Intel Education (2008). "Intel Teach Program getting Started Course Version 2.0." Available at: www.intel.com/education. Accessed on 2nd November, 2012.
- Johnson, R. B. and A.J. Onwegbuzie (2007). "Mixed Methods Research: A Research Paradigm Whose Time Has Come." *Educational Researcher* Vol. 33, (7) (2007): 14-26. Available at: <https://aera.net/uploadedfiles/journals>. Retrieved on 10th November, 2011. 33(7), 14-26.
- Kashorda, M., T. Waema, M. Omosa and V. Kyalo (2007). *E-Readiness Survey of Higher Education in Kenya*. Nairobi: Kenya Education Network (KENET).
- Kast, F.E. and J.E. Rosenzweig (1985). *Organization and Management: A Systems and Contingency Approach*. Tokyo: McGraw-Hill.
- KENET (2014) Kenya ICT Master Plan: Towards a Digital Kenya 2013/2014-2017/2018
<https://www.kenet.or.ke/.../Final%20ICT%20Masterplan%20Apr%202014>. Accessed on 27th Oct 2014
- Kenya Basic Education ACT (2013) No 14
<http://www.parliament.go.ke/plone/statutory-documents/basic-education-act-no-14-of-2013/view> Accessed on 25th Oct 2014
- Kenya, Government of (2004). "Minister for Education Releases KCSE Examination Results of the Year 2007." Available at: <http://www.communicatio.go.ke/media>. Accessed on 13th March, 2008.

Kenya, Government of (2004). *A Policy Framework for Education, Training and Research*, Ministry of Education, Science and Technology, Nairobi. Available at:

<http://www.elimuyetu.net/downloads/Policy%20Framework%20For%20Education%20Paper.pdf>. Retrieved on 20th January, 2013.

Kenya, Government of (2004). *National Information & Communications Technology (ICT) Policy, 2004*. Nairobi: Government Printer.

Kenya Institute of Education(2010) Digital Content

http://www.kicd.ac.ke/images/dsc_0113.jpg

Kenya Institute of Curriculum Development (KICD 2012) www.elimika.ac.ke

Retrieved on January 15, 2013.

Kenya Vision 2030. Nairobi (2008). Government of Kenya.

Kenya National Information & Communications Technology (ICT) Policy(2006) Ministry of Information January.

Kenya, Republic of (2003) “Economic Recovery Strategy for wealth and Employment Creation(ERWEC),2003-2007: Statement by the Minister for Planning and National Development.” *siteresources.worldbank.org/KENYAEXTN/Resources/ ERS.pdf*. Accessed on 4th September, 2013.

Kenya, Republic of (2006). *Sessional Paper No. 1 of 2005: A Policy Framework for Education, Training and Research, and the United Nations Millennium*

Kenya SchoolNet (2003). *Preparing a Workforce for the Evolving Information Economy: A Survey on ICT Access and Use in Kenya Secondary Schools*. Nairobi: Summit Strategies Limited *Development Goals (MDGs)*. Nairobi: Government Printer.

Kenya Secondary Schools Heads Association, Newsletter (2008)

Kermally, S. (2002). *Effective Knowledge Management: A Best Practice Blueprint*. New York: Wiley & Sons.

Kiptalam, G.K. (2010). “Internet Utilization: A Case of Connected Rural and Urban Secondary Schools in Kenya.” *International Journal of Computing and ICT Research*, Vol. 4 No. 1 (June 2010): 49-63.

KNBS (2009). *Economic Survey 2009*. Nairobi: Kenya National Bureau of Statistics.

KNBS (2011). *Economic Survey 2011*. Nairobi: Kenya National Bureau of Statistics.

KNBS (2012). *Economic Survey 2012*. Nairobi: Kenya National Bureau of Statistics.

- Krejcie, R.V. and D.M. Morgan (2006). "Determining Sample Size for Research Activities." *Educational and Psychological Measurement* 1970, 30 (2006): 607-610. Available at: <http://research-advisors.com>. Accessed on 4th October, 2012.
- Kuthlau, C.C. (1987). *Information Skills for an Information Society: A Review of Research*. Syracuse, NY: ERIC Clearinghouse on Information Resources.
- Laferriere, T., A. Breuleux and R. Bracewell (1999). *Benefits of Using Information Communication Technologies (ICT) for Teaching and Learning in K-12/13 Classrooms*. Ottawa: SchoolNet Advisory Board Working Document.
- Langmia, K. (2006). "The Role of ICT in the Economic Development of Africa: The Case Study of South Africa." *International Journal of Education and Development Using ICT*, Vol. 2, No 4 (2006).
- Lazonick (2004). "Indigenous Innovation and Economic Development: Lessons from China's Leap Into the Information Age." *Industry and Innovation*, 12/04 Issue (2004).
- Leach, J. (2003). "DEEP Impact: Teachers and Technology, ID21 Insights Communicating Development Research." *Insights Education*, Issue No 1. Available at: <http://www.id21.org/insights/insights-ed01-art01.html>. Retrieved on 20th April, 2010.
- Lee, T. (2010). "Professional Development of ICT Integration for Secondary School Teachers in Hong Kong: Towards a Peer Support Enhanced Model." PhD Thesis, University of Waikato. Available at: <http://waikato.researchgateway.ac.nz/>. Accessed on February, 2010.
- Lincoln Y.S. and E.G. Guba (1985). *Naturalistic Inquiry*. Beverly Hills, CA: Sage.
- Lloyd, M. and Albion, P. (2005) "Mistaking the Tool for the Outcome: Using Activity System Theory to understand the Complexity of Teacher Technophobia" *Technology And Teacher Education Annual; 3; 1480-1487*"
- Lockhead, M., D. Jamison and L. Lau (1980). "Farmer Education and Farm Efficiency: A Survey." *Economic Development and Cultural Change* 29 (October 1980): 37-76.
- Ludy M. N. (2000) Presentations on Slide Share <http://www.google.co.ke> URL. Retrieved on 26th March, 2013.
- Maddux, C J. L. and S. Harlow (1992). "The State of the Art in Computer Education." In *Technology and Teacher Education Annual*, pp. 119-122, edited by D. Carey, R. Carey and D.A. Willis. Charlottesville, VA: Association for the Advancement of Computing Education.
- Makau, B.M. & IDRC (1990). *Computers in Kenya's Secondary Schools: A Case Study of an Innovation in Education*. Nairobi: IDRC.

- Mansell, R. and U. Wehn (1998). *Knowledge Societies: Information Technology for Sustainable Development. Prepared for the United Nations Commission on Science and Technology for Development*. Oxford: Oxford University Press.
- Marcovitz, David M. (2006). "Changing Schools with Technology: What Every School Should Know About Innovation." In *Technology and Education: Issues in Administration, Policy, and Applications in K12 Schools (Advances in Educational Administration, Volume 8)*, pp.3-15, edited by Sharon Y. Tettegah, Richard C. Hunter. Bingley, UK: Emerald Group Publishing Limited, Available at: 10.1016/S1479-3660(05)08001-7 Retrieved on 20th September. 2012
- McConnell International (2001). "Ready? Net. Go!: Partnerships Leading the Global Economy." Available at: www.wists.orgwww.mcconnellinternational.com, Retrieved on 24th October 2011.
- McKeown, N. (2008). "ACM SIGCOMM." *Communication Archive* Vol. 38, Issue 2 (April 2008).
- Miles, M.B. and A.M. Huberman (1994). *Qualitative Data Analysis, 2nd ed.* Thousand Oaks, CA: Sage.
- Moahi, K.H. (1996). "Training African Librarians for the New Information Age in Botswana." *Information Development*, 12 No. 2 (1996): 91-96.
- MoE (2007). 2006 KCSE Results Analysis The Provincial Director of Education Nairobi in conjunction with Kenya Secondary Schools Heads Association, Nairobi Branch.
- MoE (2012) "Taskforce on the Re-Alignment of the Education Sector to the Constitution of Kenya 2010: Towards a Globally Competitive Quality Education for Sustainable Development, Feb. 2012." Retrieved on October 25, 2014.
www.vision2030.go.ke/cms/vds/Task_Force_Final_Report_Feb_20123.pdf
- MoE & MoHEST (2012) Ministry of Education and Ministry o Higher Education, Science and Technology: Sessional Paper 19 of 2012
- MoE/NICT (2006). *National Information and Communication Technology Strategy for Education and Training, June 2006*. Nairobi: Government Printer.
- MoEST (2005). *Kenya Education Sector Support Programme, 2005-2010: Delivering Quality Equitable Education and Training to All Kenyans*. Draft, 9 May 2005. Ministry of Education Science and Technology, Nairobi.
- (MoEST, 2006) Ministry of Education, Science and Technology. ICTs in Education Paper

- MoEST/KESSP (2005) *Kenya Education Sector Support Programme:2005-2010: Delivering Quality Equitable Education and Training to All Kenyans*. Available on <http://planipolis.iiep.unesco.org/upload/Kenya/Kenya%20KESSP%20FINAL%202005.pdf>
- MoEST/ USAID/Kenya (2005). "ICT in Education: Options Paper." USAID, EDC, AED. http://ict.aed.org/kenya/ICT_in_Ed_options_paper_Kenya.pdf. Retrieved 31st OCT. 2011.
- MoHEST (2012) Sessional Paper of 2012 on Education, Training, Science Technology and Innovation Policy. www.strathmore.edu/pdf/sessional_paper_19th_june_nqf.pdf. Retrieved on 13th Jan 2013
- MoHEST/NCST (2010) *ICT Capacities and Capabilities in Secondary Schools in Kenya 2008/2009 NCST No 046*. <http://www.elimuyetu.net/downloads/Policy%20Framework%20For%20Education%20Paper.pdf>
- Mugenda O.M. and A.G. Mugenda (1999). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi; ACTS Press.
- Mugenda, A.G. (2008). *Social Science Research*. Nairobi: ACTS Press.
- Mulusa, T. (1990). *Evaluation Research for Beginners: A Practical Guide*. Bonn: German Foundation for International Development for Education.
- Mungai, M. (2011) Challenges Facing Computer Education in Kenyan Schools <http://www.ictworks.org/2011/09/12/12-> retrieved on 15th January, 2012
- Nachmias, F. C. and D. Nachmias (2007). *Research Methods in the Social Sciences, 7th ed.* London: Hodder.
- Nachmias, R. et al. (2004). "Factors Involved in the Implementation of Pedagogical Innovation in Schools Using Technology." *Education and Information Technologies*, 9, (2004): 291-308.
- Nardi, B. and V. O'Day (1999). *Information Ecologies: Using Technology With Heart*. Cambridge. MA: MIT Press.
- Nderitu, J. N. (2004). "The Advancement of Information Technology has not been a Success in Kenya' Secondary Schools: a Case Study of Molo Academy". Unpublished Research Report, Egerton University, Njoro.
- NEPAD (2003). *E-Africa Commission Expert Consultative Meeting on Building e-Governance Capacity on the African Continent*, Tangier, Morocco: New Partnership for African Development.
- NEPAD Dialogue, 24th June, 2003. *The Weekly Electronic Newspaper of NEPAD Secretariat*, No. 6 (2003).
- Neuman, W. L. (1994). *Social Research Methods: Qualitative and Quantitative Approaches, 2nd ed.* London: Allyn and Bacon.

- Ngao, P. and A. Kumsa (eds.) (2004). *Research Design, Data Collection and Analysis: A Training Manual*. UNCRD Textbook Series No. 12. Nairobi: United Nations Centre for Regional Development, Africa Office.
- (NICT, 2006). National Information and Communication Technology for Education and Training. Kenya, Ministry of Education
- Norris, P. (2001). *Digital Divide: Civic Engagement, Information Poverty and the Internet Worldwide*. Cambridge: Cambridge University Press..
- Omondi, A. P. (2010). "Factors Influencing Teachers' Adoption of Computer Assisted Learning in Secondary Schools: A Case of Rarieda District-Kenya." MA Thesis, University of Nairobi. Available at: <http://erepository.uonbi.ac.ke:8080/handle/123456789/5023>. Retrieved on 16th March, 2013.
- O'Leary, Timothy & O'Leary, Linda (2007) Microsoft Office 2007 (The O'Leary) Spiral-bound – August 31, 2007) <http://www.amazon.com/Microsoft-Office> retrieved 27th October 2012
- Omwenga, E.I. (2006). "Pedagogical Issues and E-learning Cases: Integrating ICTs into Teaching and Learning Process." Available at: <http://www.uneca.org/disd/events/2006/ucea-kenya>. Accessed on 10th July 2011
- Opoku-Mensah, A. (2002). "The Communication Initiative: Economic Commission for Africa." Available at: <http://www.comminit.com> (ECA). Retrieved on 6th March, 2012.
- Orr, G. (2003). "Diffusion of Innovations." Available at: <http://www.stanford.edu/class/sybsys205/Diffusion>. Accessed on February, 2012.
- Osin, L. (1998). "Computers in Education in Developing Countries: Why and How?" *Education and Technology Series 3*, (1) (1998): 1-14.
- Partnership for 21st Century Skills. Available at: www.21stcenturyskills.org. Accessed on 9th December, 2011.
- Patton, M.Q. (1990). *Qualitative Evaluation and Research Methods 2nd ed*. Newbury Park, CA: Sage.
- Peltier, T. (2004). *Information Security Policies and Procedures: A Practitioner's Reference, 2nd ed*. Auer Bach: London
- Picciano, A. G. (2011). *Educational Leadership and Planning for Technology, 5nd ed*. New York: Pearson Education.
- Prahalad, C.K. and S.L. Hart (2002). "The Fortune at the Bottom of the Pyramid." *Strategy First Quarter* (2002) Available at: <http://www.strategy-business.com/press/article/11518?pg=all>. Accessed in February, 2011.
- Punch, K. F. (2003). *Introduction to Social Research: Quantitative & Qualitative Approaches*. London: Sage.

- Ratemo, J. (2011). *KIE Shifts Focus to Digital Teaching Aids*. Nairobi: Kenya Institute of Education.
- Republic of Kenya (2012). Policy Framework for Education, Draft Bill, 2012: Aligning Education and Training to the Constitution of Kenya 2010 and Kenya Vision 2030:
- Roberts, L. (2002). "The Role of Technology in the Classroom." Available at: <http://www.4teachers.org/keynotes/roberts/> [2005]. Accessed on 15th February, 2011.
- Rochlin, G. (1997). *Trapped in the Net: The Unanticipated Consequences of Computerization*. Princeton, NJ: Princeton University Press.
- Rogers, E.M. (2005). *Diffusion of Innovations*. 5th ed. New York: Free Press.
- SCANS Report for America 1999. Secretary's Commission on Achieving Necessary Skills. What Work Requires of Schools. Washington, DC: U.S. Government Printing Office.
- Sekaran, U. (1992). *Research Methods for Business: A Skill-Building Approach*. 2nd ed. New York: John Wiley & Sons.
- Shaw, P. (2002). *Changing Conversations in Organizations: A Complexity Approach to Change*. London: Routledge.
- Sizer, T. (1992). "Horace's Compromise: Great Teachers are Not Solo Performers." *Education Week*. April 29, 1993 p. 150. books.google.co.ke/bookisbn=079143506 Accessed on 20th February, 2011.
- Slack, R. 2001, *Research Methods*, www.bangor.ac.uk
- Stake, R.E. (1995). *The Art of Case Study Research*. Thousand Oaks: C.A.: Sage.
- Tashakkori, A and C. Teddlie (eds.) (2003). *Handbook of Mixed Methods in Social and Behavioral Research*. London: Sage.
- Tatnall, A. and B. Davey (2003). "ICT and Training: A Proposal for an Ecological Model of Innovation." *Education Technology and Society* 6, 1 (2003): 14-17.
- Taylor, J. (2006). *Information Literacy and the School Library Media Centre*. London: Libraries Unlimited.
- Tearle, P. (2003). "ICT Implementation: What Makes the Difference?" *British Journal of Educational Technology* Vol. 34, No 5 (2003): 567-583.
- Telem, M. (1987). "Conceptual and Operational Considerations for the Planning and Implementation of a Pedagogical MIS on a National Scale." *Programmed Learning and Educational Technology*, 24 (1987): 187-193.
- Telem, M. (1989). "Managing Information Growth and Implementation in Small Organizations." *Information Processing and Management* 24, 5 (1989): 443-452.

- Telem, M. and B. Ben-Zion (1995). *Information Technology Assimilation in Schools Educational Management*. London: Chapman & Hall.
- Telem, Moshem & Barta, Ben-Zion (2007) *Information Technology Assimilation Schools: in Educational Management* Eds Ben-Zion Barta, Moshe Telem & Yaffa Gev. London: Chapman & Hall.
- Torraco, R. J. (2002). "Theory-Building Research Methods." In *Human Resource Development Handbook: Linking Research and Practice*, 4(3) 114-137, edited by R.A Swanson and E. F. Holton. San Francisco, CA: Berrett-Koehler.
- Tredoux, C. 1999. "Sound Conclusions: Judging Research Designs." In *Research in Practice*, pp. 309-330, edited by M. Terre Blanche and K. Durrheim. Cape Town: UCT Press.
- Trochin W. M.K. (2008). *The Research Methods Knowledge Base 3rd ed.* New York: Cengage.
- Truran, J. (1979). "Reinterpreting Australian Mathematics Curriculum Development Using a Broad-spectrum Ecological Model". Paper presented at the Old Boundaries and New Frontiers in Histories of Education. Australian and New Zealand History of Education Society Conference, 7-11 December, 1979, Newcastle, Australia.
- UK Government (2003) *Towards a Unified E-learning Strategy*, Consultation Document, Department for Education and Skills. London: HMSO.
- UNESCO (2002). *Information and Communication Technology in Education: A Curriculum for Schools and Programme of Teacher Development*. Paris: UNESCO.
- United Nations (2003). "E-Schools and Communities Initiative." Press Release P1/1548 12 December, 2003. Available at: <http://www.un.org/Press/docs/2003/pi1548.doc.html>. Accessed on 5th March, 2012.
- Van Vuuren, D. and A. Maree (1999). "Survey Methods in Market and Media Research.", In *Research in Practice*, pp.309-pp.330, edited by M. Terre-Blanche and K. Durrheim. Cape Town: UCT Press.
- Verma, R.K. and G. Verma (2004). *Research Methodology*, New Delhi: Commonwealth Publishers.
- Waibochi, J.M. (2002). *Application of ICTs in Africa: Development of Knowledge Workers in Centers of Learning*. Nairobi: African Technology Policy Studies (ATPS) Network.
- Wamukoya, J. and S.M. Mutula (2005). E-Records Management and Governance in East and Southern Africa .in *Malaysia Journal of Library & Information Science*, Vol. 10, no. 2, Dec 2005: 67-83.

- Welman J.C. and S.J. Kruger (2004). *Research Methodology*, 2nd ed. Oxford: Oxford University Press.
- Wenger, E. (1998). *Communities of Practice*. Cambridge: Cambridge University Press.
- Were, E. and T. Ouko (2007). "Assessment of the NEPAD E-school Initiative in Promoting Community Health and Poverty Reduction in Kenya and Rwanda." Paper Presented at the Moi University Annual Conference, July 2007. Moi University, Eldoret, Kenya.
- Wims, P. and M. Lawler (2007). "Investing in ICTs in Educational Institutions in Developing Countries: An Evaluation of their Impact in Kenya." *International Journal of Education and Development Using ICT* 3, 1 (2007). Available at: <http://ijedict.dec.uwl.edu/>. Accessed on 15th July, 2007.
- World Bank (1995). *Priorities and Strategies for Education: A World Bank Review*. Washington D.C.: The World Bank.
- Yin, R. K. (1988). *Case Study Research: Design and Methods*, revised edition. London: Sage.
- Yin, R.K. (2003). *Case Study Research: Design and Methods*, 3rd ed. London: Sage.

APPENDIX I**INTRODUCTION LETTER**

Grace G. Irura
University of Nairobi
Library Department
P.O. Box 30197 – 00100
Nairobi, Kenya.

OR

Moi University
School of Information Sciences
P.O. Box 3900
Eldoret, Kenya
E-mail: girura@yahoo.com

Dear Participant,

**RE: DIFFUSION OF INFORMATION COMMUNICATION TECHNOLOGIES (ICTs) IN
SECONDARY SCHOOLS IN NAIROBI PROVINCE QUESTIONNAIRE AND
INTERVIEW SCHEDULE**

I am a research student in the School of Information Sciences at Moi University, Eldoret, Kenya. I am working on a research that will result in a dissertation for submission for partial fulfilment of a doctoral degree.

The questionnaire/ interview schedule is designed to gather information on diffusion of ICTs in the education sector. The research will be carried out in selected secondary schools in Nairobi. The study when completed is expected to reveal the state of how information and communication technologies are being used in secondary school sector. The study will also expose the challenges that the schools are facing so that these challenges can be dealt with. The study will give suggestions that can be used for improvement of application of ICTs in education in secondary schools.

The information that you will give will be treated with utmost confidentiality and will only be used for academic purposes only and you are requested not to include your name. Please feel free to ask any questions directed to the researcher on the address given.

Thanking you in advance for participating in the research.

Yours faithfully



Grace G. Irura

APPENDIX II

INTERVIEW SCHEDULE FOR THE PRINCIPAL/HEADTEACHER

Diffusion of Information Communication Technologies (ICTs) in the Education Sector in Kenya: A Case Study of Secondary Schools in Nairobi Province

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the information given in this questionnaire will be treated with confidentiality.*

Please mark the correct information/choice with a (✓)

SECTION A: DEMOGRAPHIC INFORMATION

1. Please indicate your gender

Male () Female ()

2. What is your age bracket?

Under 25 Years ()

25-30 Years ()

31-35 Years ()

36-40 Years ()

41-45 Years ()

46-50 Years ()

55-60 Years ()

Over 60 years ()

3. How long have you been the Head of this school?

a) 20 – 25 years ()

b) 15 - 20 years ()

c) 10 – 15 years ()

d) 5 – 10 years ()

e) Less than 5 years ()

4. What is your highest academic qualification? (Please (✓) only once against the relevant qualification)

PhD. ----- ()

M.A. ----- ()

M.Ed. ----- ()

B.Ed. ----- ()

B.A./B.SC With PGDE----- ()

- EACE/KACE (A-Levels with Diploma) ----- ()
- Other, Please Specify----- ()
5. What is the number of students currently in your school?
- Below 200----- ()
- 201 – 300----- ()
- 301 - 400----- ()
- 401 - 500----- ()
- 601 – 700----- ()
- 701 – 800----- ()
- 801- 900----- ()
- Over 900, Please state how many-----
6. What is the type of the school you are heading?
- Boarding----- ()
- Day ----- ()
- Day and boarding ----- ()
- Day and private hostels ----- ()
7. What is the gender of the students? ----- ()
- Girls -----()
- Boys ----- ()
- Mixed -----()
- SECTION B COMPUTER USAGE INFORMATION**
8. a) Do you have computers in the school? Yes () No ()
- b) If yes to the above question how many computers are in the school?
-
- c) If no to the above, give reasons -----
9. If there are computers in the school, when was the idea of use of ICTs brought and started in your school?
- Year-----Month/Term-----
10. If No to the above, where do you access computers? Please (√) the appropriate responses
- My office ----- ()
- Computer Lab in the school ----- ()
- Cyber café ----- ()
- School Library ----- ()

Own home computer ----- ()

11. What is the aim of ICT in your school?

12. Please state the ICT vision and/ or policy for your school if any.

13. If yes to Q. 13 above, please provide a copy -----

14. How are the computers used in your school?

a) For administration and office work----- Yes () No ()

b) For Teaching----- Yes () No ()

15. In which subjects are computers used? Please indicate in the table provided below:

	Subject	Applicable	Not applicable	Comments
1	English			
2	Maths			
3	Kiswahili			
4	Geography			
5	History			
6	Biology			
7	Physics			
8	Chemistry			
9	Computer Science			
10	French			
11	German			
12				
13	Other			
14	Other			

16. On average, what percentage of the school's annual budget is spent on ICT and related initiatives?

17. a) Are the computers in the school adequate for the teachers and students? Yes () No ()

b) If no to the above, why not? -----

18. How are the teachers trained on how to use the computers? Please explain

19. Is there a member of staff assigned to take care of the computers? Yes () No ()

20. If (Yes) to the above, what is the designation of the staff member?

Teacher (), Technician (), Librarian (), other, please specify-----

21. a) Is there Internet connectivity in your school? Yes () No ()

b) If no, why? -----

22. If your answer to Q 21 was (yes), how is the speed of using the Internet in your school?

23. What are the challenges that you face in use of ICTs?

24. What future plans do you have for ICT implementation in your school?

25. What is the vision for computers in your school in the next five years?

26. How does the mission statement help the individual members visualise the schools aspirations for the future of the school?

27. Is your school a member of any computer initiatives from the government or the private sector? Yes () No ()
28. If yes to the above question, which initiatives does your school collaborate with?
a) -----
b) -----
29. Do you get any external support, financial or otherwise Yes () No ()
30. If yes to the above, please specify-----

SECTION C: USE OF COMPUTERS TO SUPPORT IN MANAGEMENT ROLES

31. How many hours do you use the computers for school work in a week?
1-5 () 21-25 ()
6 -10 () 26 -30 ()
11 -15 () 31 -35 ()
16 -20 () 36 -40 () Over 40 hours how many? -----
32. Which of the following software applications do you use ?
i) Word Processing----- Yes () No ()
ii) Spread Sheets ----- Yes () No ()
iii) Databases ----- Yes () No ()
iv) Publishing/composing Newsletters-----Yes () No ()
v) Presentations (PowerPoint, etc) -----Yes () No ()
vi) Internet Access ----- Yes () No ()
vii) Other, please state -----

33. How often do you use the following computer management related tasks in your work as the principal in the school?

		Often	Sometimes	Rarely	Never
34	Attendance taking				
35	Finance				
36	Policy issues				
37	Curriculum issues				
38	Data collection				
39	Teacher evaluation				
40	Internet search				
41	Discipline memos				
42	Newsletters				
43	Memos to staff				
44	Letters to students				
45	Letters to parents				
46	E mail				
47	Others, please specify				

48. How has use of ICTs impacted on your work as a principal?

	Scale	High impact	Moderate impact	Little impact	No impact
i)	Leadership				
ii)	Planning				
iii)	Communication				
iv)	Teacher evaluation				
v)	Curriculum development				
vi)	School management				
vii)	Other, please specify				

49. How can use of ICTs be improved in your school in regard to?

- i) Access to computers-----
 ii) Skills and training-----
 iii) Management skills-----

50. PHILOSOPHY OF LEARNING AND PEDAGOGY

Please indicate at what setting your school is in relation to use of computers in teaching and learning

- Setting A – Setting that is dominated by the teacher as the main provider of subject content is adopting a teacher centred approach

Setting B – A learner centred philosophy describes setting where content comes from a variety of resources, and where the projects are chosen and designed by students. ICT Tools and resources are selected by students in ways that match the aims of the projects

Setting C – Where both approaches are used

51. UNDERSTANDING THE CURRICULUM

At what stage do you think your school is? Please indicate with a (√) the correct response.

Stage 1: Awareness stage when students become ICT literate to technology available and how it can be used -----

Stage 2: Students learn basic skills and begin to apply various ICT tools to their regular learning assignments and projects -----

Stage 3: Students become more capable and confident with ICT. They begin to integrate and overlap both subject areas and tools. -----

Stage 4: Applied use of ICT in which students are now enabled to address larger more complex, real-world professional issues. -----

52. TECHNOLOGICAL DEVICES

How often do you use the following? Please explain

- i) Computers with peripherals-----
- ii) Networked computers -----
- iii) Server -----
- iv) Scanners -----
- v) Printers -----
- vi) Uninterrupted power supply (UPS) -----
- vii) Radio card -----
- viii) TV card -----
- ix) External Modem/Internet-----
- ix) Various software types-----
- x) Other, please explain-----

USE OF OTHER ICTS

53. Radio: Is the radio used for educational purposes in your school? Yes () No ()

54. If (Yes) to the above question, please explain how you use the radio for education purposes in the school-----

55. TV : Is television used for educational purposes in your school? Yes () No ()

56. If (Yes) to the above, please explain how you use the TV is used for education purposes in the school -----

57. Explain how you use the following items for educational purposes

- i) Telephone extensions -----
- ii) Mobile phones -----

58. Is the following equipment available or used in your school? If it is available, please explain how it is used for educational purposes.

a) Video equipment-----

59. IMPACT OF ICTS

Explain briefly how use of ICT has affected new role for the following

- a. Staff -----
- b. School work flow -----
- c. Authority -----
- d. Information flow -----
- e. Rules and procedures -----
- f. General evolution of the system i.e. equipment and other facilities including personnel

60. PSYCHOSOCIAL IMPACT OF ICTS

Comment briefly on the impact of ICT on the following:

- a. Human resources -----
- b. Attitudes -----
- c. Motivation -----
- d. Group dynamics-----
- e. Communication -----
- f. Interpersonal relations -----
- g. Computer literacy

61. GOALS AND VALUES

Comment briefly on the following.

- a. Ethical and legal issues-----
- b. Security and data confidentiality. -----

62. TECHNICAL ISSUES

Comment briefly on the procedures in the following

- a. Procedure of acquisition-----
- b. Replacement of equipment, parts -----
- c. Maintenance of hardware and software -----

63. What are the challenges that you experience in use of ICTs in your school and how can they be resolved? -----

THANK YOU FOR TAKING TIME TO ANSWER THE QUESTIONS

SECTION D: OBSERVATION SCHEDULE FOR PRINCIPALS

Where possible with permission from respondents and school authorities, the researcher will request to access certain documents. The researcher will use the following observation schedule:

The researcher will observe/inspect and record the following:

64. Computer rooms bookings -----
65. Records of software and reading materials -----
66. Records of meetings of computer clubs -----
67. Records of how computers are distributed and shared in the school-----
68. Teacher/student computer files and printed products -----
69. School management documents such as notices, correspondence and accounts records ---

70. To inspect the following facilities and resources
 - Electrical wiring-----
 - Internet access-----
 - Lighting-----
 - Air- conditioning-----
 - Space-----
 - Furniture design-----
 - Safety work environment -----
71. USE OF OTHER ICTS
 - a) Computers with peripherals-----
 - i) Networked computers -----
 - ii) Server -----
 - iii) Scanners -----
 - vi) Printers -----
 - v) Uninterrupted power supply (UPS) -----
 - vi) Radio card -----
 - vii) TV card -----
 - viii) External Modem/Internet-----
 - b) Video equipment-----
 - c) Digital microscopes-----
 - d) Various software types-----
 - e) Telephone extensions and mobile phones -----
 - f) Audiotapes and cassettes -----

ENDS

APPENDIX III

INTERVIEW SCHEDULE FOR THE DEPUTY

PRINCIPAL/HEADTEACHER

**Diffusion of Information Communication Technologies (ICTs) in the Education Sector
in Kenya: A Case Study of Secondary Schools in Nairobi Province.**

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the Information Given in this Questionnaire Will be Treated with Confidence*

Please mark the correct information/choice with a (√)

SECTION A: DEMOGRAPHIC INFORMATION

1. Please indicate your gender
Male () Female ()
2. What is your age bracket?
Under 25 Years ()
25-30 Years ()
31-35 Years ()
36-40 Years ()
41-45 Years ()
46-50 Years ()
55-60 Years ()
Over 60 years-----
3. How long have you been the Deputy Head Teacher of this school?
a) 20 - 25 years ()
b) 15 - 20 years ()
c) 10 - 15 years ()
d) 5 - 10 years ()
e) Less than 5 years ()
4. What is your highest academic qualification? (Please (√) only once against the relevant qualification)
PhD. ----- ()
M.A. ----- ()
M.Ed. ----- ()
B.Ed. ----- ()
B.A./B.SC With PGDE----- ()
EACE/KACE (A-Levels with Diploma) ----- ()

Other, Please Specify----- ()

5. What is the number of students currently in your school?
- Below 200----- ()
- 201 - 300----- ()
- 301 - 400----- ()
- 401 - 500----- ()
- 601 - 700----- ()
- 701 - 800----- ()
- 801- 900----- ()
- Over 900, Please state how many-----
6. What is the type of the school you are Deputy Head teacher?
- Boarding----- ()
- Day ----- ()
- Day and boarding ----- ()
- Day and private hostels ----- ()
7. What is the gender of the students? ----- ()
- Girls ----- ()
- Boys ----- ()
- Mixed ----- ()

SECTION B COMPUTER USAGE INFORMATION

8. a) Do you have computers in the school? Yes () No ()
- b) If yes to the above question how many computers are in the school?
-
- c) If no to the above, give reasons -----
9. If there are computers in the school, when was the idea of use of ICTs brought and started in your school?
- Year-----Month/Term-----
10. If No to the above, where do you access computers? Please () the appropriate responses
- My office ----- ()
- Computer Lab in the school ----- ()
- Cyber café ----- ()
- School Library ----- ()
- Own home computer ----- ()
11. What is the aim of ICT in your school?
-

12. Please state the ICT vision and/ or policy for your school if any.

13. If Yes to Q. 12 above, please provide a copy -----

14. How are the computers used in your school?

a) For administration and office work----- Yes () No ()

b) For Teaching----- Yes () No ()

15. In which subjects are computers used? Please indicate in the table provided below

	Subject	Applicable	Not applicable	Comments
	Subject			
1	English			
2	Maths			
3	Kiswahili			
4	Geography			
5	History			
6	Biology			
7	Physics			
8	Chemistry			
9	Computer Science			
10	French			
11	German			
12				
13	Other			
14	Other			

16. On average, what percentage of the school's annual budget is spent on ICT and related initiatives?

17. a) Are the computers in the school adequate for the teachers and students? Yes () No ()

b) If no to the above, why not? -----

18. How are the teachers trained on how to use the computers? Please explain

19. Is there a member of staff assigned to take care of the computers? Yes () No ()

20. If (Yes) to the above, what is the designation of the staff member?

Teacher (), Technician (), Librarian (), other, please specify-----

21. a) Is there Internet connectivity in your school? Yes () No ()

b) If no, why? -----

22. If your answer to Q 21 was (yes), how is the speed of using the Internet in your school?

23. What are the challenges that you face in use of ICTs?

24. What future plans do you have for ICT implementation in your school?

25. What is the vision for computers in your school in the next five years?

26. How does the mission statement help the individual members visualise the schools aspirations for the future of the school?

27. Is your school a member of any computer initiatives from the government or the private sector? Yes () No ()
28. If yes to the above question, which initiatives does your school collaborate with?
a) -----
b) -----
29. Do you get any external support, financial or otherwise Yes () No ()
30. If yes to the above, please specify-----

SECTION C: USE OF COMPUTERS TO SUPPORT IN MANAGEMENT ROLES

31. How many hours do you use the computers for school work in a week?
1-5 () 21-25 ()
6 -10 () 26 -30 ()
11 -15 () 31 -35 ()
16 -20 () 36 -40 ()
Over 40 hours how many? -----
32. Which of the following software applications do you use ?
i) Word Processing-----Yes () No ()
ii) Spread Sheets ----- Yes () No ()
iii) Databases ----- Yes () No ()
iv) Publishing/composing Newsletters-----Yes () No ()
v) Presentations (PowerPoint etc) -----Yes () No ()
vi) Internet Access ----- Yes () No ()
vii) Other, please state -----

33. How often do you use the following computer management related tasks in your work as the principal in the school?

		Often	Sometimes	Rarely	Never
34	Attendance taking				
35	Finance				
36	Policy issues				
37	Curriculum issues				
38	Data collection				
39	Teacher evaluation				
40	Internet search				
41	Discipline memos				
42	Newsletters				
43	Memos to staff				
44	Letters to students				
45	Letters to parents				
46	E mail				
47	Others, please specify				

48. How has use of ICTs impacted on your work as a principal?

	Scale	High impact	Moderate impact	Little impact	No impact
i)	Leadership				
ii)	Planning				
iii)	Communication				
iv)	Teacher evaluation				
v)	Curriculum development				
vi)	School management				
vii)	Other, please specify				

49. How can use of ICTs be improved in your school in regard to?

- i) Access to computers-----
 ii) Skills and training-----
 iii) Management skills-----

50. PHILOSOPHY OF LEARNING AND PEDAGOGY

Please indicate at what setting your school is in relation to use of computers in teaching and learning

Setting A – Setting that is dominated by the teacher as the main provider of subject content is adopting a teacher centred approach -----

Setting B – A learner centred philosophy describes setting where content comes from a variety of resources, and where the projects are chosen and designed by students. ICT Tools and resources are selected by students in ways that match the aims of the projects

Setting C – Where both approaches are used -----

51. UNDERSTANDING THE CURRICULUM

At what stage do you think your school is? Please indicate with a (√) the correct response.

Stage 1 – Awareness stage when students become ICT literate to technology available and how it can be used -----

Stage 2 – Students learn basic skills and begin to apply various ICT tools to their regular learning assignments and projects -----

Stage 3 – Students become more capable and confident with ICT. They begin to integrate and overlap both subject areas and tools. -----

Stage 4 – Applied use of ICT in which students are now enabled to address larger more complex, real-world professional issues. -----

52. TECHNOLOGICAL DEVICES

How often do you use the following? Please explain

Computers with peripherals-----

- i) Networked computers -----
- ii) Server -----
- iii) Scanners -----
- iv) Printers -----
- v) Uninterrupted power supply (UPS) -----
- vi) Radio card -----
- vii) TV card -----
- viii) External Modem/Internet-----
- ix) Various software types-----
- x) Other, please explain-----

USE OF OTHER ICTS

53. Radio: Is the radio used for educational purposes in your school? Yes () No ()

54. If (Yes) to the above question, please explain how you use the radio for education purposes in the school-----

55. TV: Is television used for educational purposes in your school? Yes () No ()

56. If (Yes) to the above, please explain how you use the TV is used for education purposes in the school -----

57. Explain how you use the following items for educational purposes

- i) Telephone extensions -----

ii) Mobile phones -----

58. Is the following equipment available or used in your school? If it is available, please explain how it is used for educational purposes.

a) Video equipment-----

59. IMPACT OF ICTS

Explain briefly how use of ICT has affected new role for the following

a. Staff -----

b. School work flow -----

c. Authority -----

d. Information flow -----

e. Rules and procedures -----

f. General evolution of the system i.e. equipment and other facilities including personnel-----

60. PSYCHOSOCIAL IMPACT OF ICTS

Comment briefly on the impact of ICT on the following:

a. human resources -----

b. attitudes -----

c. motivation -----

d. group dynamics-----

e. communication -----

f. interpersonal relations -----

g. computer literacy

61. GOALS AND VALUES

Comment briefly on the following.

a. Ethical and legal issues-----

b. Security and data confidentiality. -----

62. TECHNICAL ISSUES

Comment briefly on the procedures in the following

a. procedure of acquisition-----

b. replacement of equipment, parts -----

c. maintenance of hardware and software -----

63. What are the challenges that you experience in use of Information and Communication Technologies in your school and how can they be resolved?

THANK YOU FOR TAKING TIME TO ANSWER THE QUESTIONS

APPENDIX IV

STUDENT QUESTIONNAIRE

Diffusion of Information Communication Technologies (ICTs) in the Education Sector in Kenya: A Case Study of Secondary Schools in Nairobi Province.

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the Information Given in this Questionnaire Will be Treated with Confidence*

Please mark the correct information/choice with a (✓)

SECTION A: PERSONAL INFORMATION

1. Please indicate your gender Male () Female ()
2. In which class are you currently? Please tick one (✓)
 - Form 1 ()
 - Form 2 ()
 - Form 3 ()
 - Form 4 ()
3. What is your age bracket?
 - 13-14 Years ()
 - 15-16 Years ()
 - 17-18 Years ()
 - 19-20 Years ()
 - Over 20 Years ()
4. What is the level of education of your parents?
 - a) Mother b) Father
 - Primary School () Primary School ()
 - Secondary School () Secondary School ()
 - Bachelor's Degree () Bachelor's Degree ()
 - Master's Degree () Master's Degree ()
 - Other, please specify ----- Other, please specify-----
5. Do you use computers at school? Yes () No ()
6. If yes to the above where do you use computers in the school?
 - i. Library ()
 - ii. Computer Lab ()
 - iii. Other. Please indicate -----
7. Are the computers in the school adequate? Yes () No ()

8. Do you have a formal Computer Science lesson? Yes () No ()
9. How often do you use the computer in Q 8 above?
a. Often () b. Sometimes () c. Rarely ()
10. What type of computers are used in the school? Please specify-----

11. How many hours do you use on the computer in school related tasks in a week?
1-5 () 21-25 ()
6 -10 () 26 -30 ()
11 -15 () 31 -35 ()
16 -20 () 36 -40 ()
Over 40 hours, how many?-----
12. Have you been trained on how to use computers? Yes () No ()
13. If Yes to the above question, where did you train on how to use computers?

14. If No to question no. 11, how did you learn how to use computers?

15. How many hours are allocated by the school for using computers in a week?
a. 1 hour () b. 2 hours () c. 3 hours () d. 4 hours () e. 5 hours ()
b. Other, Please explain-----
16. Do you have access to a computer away from school?
Yes () No ()
17. If yes, where do you use the computer?
Cyber café ()
Home ()
Other, Please explain -----
18. At what age did you start learning about computers?
0 - 5 years ()
6 - 10 years ()
11 - 15 years ()
16 - 20 years ()

SECTION B: USE OF COMPUTERS

19. What do you use the computers for?
i) Word Processing----- Yes () No ()
ii) Spread Sheets ----- Yes () No ()
iii) Databases ----- Yes () No ()

- iv) Publishing/Composing Newsletters----- Yes () No ()
- v) Presentations (PowerPoint etc) ----- Yes () No ()
- vi) Internet Access ----- Yes () No ()
- vi) E mail ----- Yes () No ()
- vii) Other, please specify -----

20. In which subjects are computers used? Please indicate in the table provided below

	Subject	Applicable	Not applicable	Comments
1	English			
2	Maths			
3	Kiswahili			
4	Geography			
5	History			
6	Biology			
7	Physics			
8	Chemistry			
9	Computer Science			
10	French			
11	German			
12				
13	Other			
14	Other			

21. Using the scale given, please indicate with a (√) your response to the following statements in the appropriate box.

Scale	Strongly agree	Agree	Disagree	Disagree Strongly
A The computer allows you to learn at your own speed				
B. Learning with computers is best for revision				
C Learning with the computer is more interesting than learning with the teacher				
D. Computer program explanations are easier to understand than the teachers				
E. Using computers takes time away from your studies				
F. Computer-assisted lessons are not as interesting as ordinary lessons				

22. Do you have an e mail address? Yes () No ()

23. If No to the above, why not? Please explain -----
24. Do you use the Internet? Yes () No ()
25. If No, why not? Please explain -----
26. If yes to the above, what do use the Internet for? Please indicate with a tick (√)
- Class work assignments -----
 - Looking for subject content-----
 - Other, please explain -----
27. By use of a (√), rate the statements given below.

Scale	a) Proficient	b) Above average	c) Average	d) Fair	e) Poor
i) Your overall computer literacy skills					
ii) Your typing/keyboarding skills					

28. How would you rate the impact you have had in the following areas in regard to ICT in the school?

Scale:	Proficient/enough time given	Above average	Average	Fair	Poor
i) Access to computers					
ii) Skills and training					
iii) ICT Management in the school					
iv) Transmission of skills and competencies					
v) Acquisition of knowledge					

29. How can use of ICTs be improved in your school as regard to?
- Access to computers-----
 - Skills and training-----
 - ICT Management in the school -----
 - Transmission of skills and competencies -----
 - Acquisition of knowledge -----

30. How often do you use the following?
- a) Computers with peripherals-----
 - i) Networked computers -----
 - ii) Server -----
 - iii) Scanners -----
 - vi) Printers -----
 - v) Uninterrupted power supply (UPS) -----
 - vi) External Modem/Internet-----
 - vii) Various software types -----
 - viii) Other, please explain-----
31. What are the challenges you face as a student as far as use of computers are concerned? -

32. How can those challenges be solved? -----

USE OF OTHER ICTS

33. Radio: Is the radio used for educational purposes in your school? Yes () No ()
34. If (Yes) to the above question, please explain how the radio is used for education purposes in the school-----

35. TV: Is television used for educational purposes in your school? Yes () No ()
36. If (Yes) to the above, please explain how the TV is used for education purposes in the school

37. Explain how you use the following items for educational purposes
- i) Telephone extensions -----
 - ii) Mobile phones -----
38. Is the following equipment available or used in your school? If it is available, please explain how it is used for educational purposes
- a) Video equipment-----
 - b) Digital microscopes-----
 - c) Audiotapes and cassettes -----
39. Are there other ICTs that are used in your school? Please explain

APPENDIX V

TEACHING STAFF QUESTIONNAIRE

Diffusion of Information Communication Technologies (ICTs) in the Education Sector in Kenya: A Case Study of Secondary Schools in Nairobi Province.

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the information given in this questionnaire will be treated with confidentiality.*

Please mark the correct information/choice with a (✓)

SECTION A: PERSONAL INFORMATION

1. Please indicate your gender

Male () Female ()

2. What is your age bracket?

Under 25 years ()

25-30 years ()

31-35 years ()

36-40 years ()

41-45 years ()

46-50 years ()

55-60 years ()

Over 60 years-----

3. What is your designation?

Head of Department -----

Class Teacher of -----

Subject Teacher Classes -----

4. What is your highest academic qualification?

PhD. ----- ()

M.A. ----- ()

M.Ed. ----- ()

B.Ed. ----- ()

B.A./B.SC With PGDE----- ()

EACE/KACE (A-Levels with Diploma) ----- ()

Other, Please Specify----- ()

5. What subjects do you teach and what class?

Subject

Class/Form

i. -----

ii. -----

iii. -----

SECTION B: USE OF COMPUTERS

6. Do you use computers in your work? Yes () No ()
7. If YES to the above question, for what purpose do you use the computer?
- Lesson preparation ()
 - Classroom teaching ()
 - Other, please explain-----
8. Do you have training and qualifications for teaching ICT? Yes () No ()
9. If yes to the above question, what are your training /qualifications in ICT?

10. What do you use the computers for?
- Word Processing----- Yes () No ()
 - Spread Sheets ----- Yes () No ()
 - Databases ----- Yes () No ()
 - Publishing/composing Newsletters----- Yes () No ()
 - Presentations (PowerPoint etc) ----- Yes () No ()
 - Internet Access ----- Yes () No ()
 - E-mail -----Yes () No ()
 - Other, please explain-----
11. How many hours do you use on the computer in school related tasks in a week?
- | | |
|-----------|--|
| 1-5 () | 21-25 () |
| 6-10 () | 26 -30 () |
| 11-15 () | 31 -35 () |
| 16-20 () | 36 -40 () Over 40 hours how many? ----- |

Does **use** and **knowledge** of the following areas of computer technology enable you to perform better as a teacher? (Please (√) the appropriate response.)

- Internet access -----Yes () No ()
- E-Mail -----Yes () No ()
- Databases -----Yes () No ()
- Word Processing -----Yes () No ()
- Spreadsheets -----Yes () No ()
- Presentation software (PowerPoint) -----Yes () No ()
- Publishing software (for creating newsletters etc--- ---Yes () No ()
- By use of a (√), rate the statements given below.

Scale:	a) Proficient	b) Above average	c) Average	d) Fair	e) Poor
i) Your overall computer literacy skills					
ii) Your typing/keyboarding skills					

21. How can use of ICTs be improved in your school as regard to?

- i) Access to computers-----
- ii) Skills and training-----
- iii) ICT Management in the school -----
- iv) Transmission of skills and competencies -----
- v) Acquisition of knowledge -----

22. PHILOSOPHY OF LEARNING AND PEDAGOGY

Please indicate at what setting your school is in relation to use of computers in teaching and learning

Setting A – Setting that is dominated by the teacher as the main provider of subject content is adopting a teacher centred approach

Setting B – A learner centred philosophy describes setting where content comes from a variety of resources, and where the projects are chosen and designed by students. ICT Tools and resources are selected by students in ways that match the aims of the projects

Setting C – Where both approaches are used

23. UNDERSTANDING THE CURRICULUM

At what stage do you think your school is? Please indicate with a (√) the correct response.

Stage 1: Awareness stage when students become ICT literate to technology available and how it can be used -----

Stage 2: Students learn basic skills and begin to apply various ICT tools to their regular learning assignments and projects -----

Stage 3: Students become more capable and confident with ICT. They begin to integrate and overlap both subject areas and tools. -----

Stage 4: Applied use of ICT in which students are now enabled to address larger more complex, real-world professional issues. -----

24. TECHNOLOGICAL DEVICES

How often do you use the following? Please explain

- Computers with peripherals-----
- i) Networked computers -----
 - ii) Server -----
 - iii) Scanners -----
 - iv) Printers -----
 - v) Uninterrupted power supply (UPS) -----
 - vi) Radio card -----
 - vii) TV card -----
 - viii) External Modem/Internet-----
 - ix) Various software types-----
 - x) Other, please explain-----

USE OF OTHER ICTS

25. **Radio:** Is the radio used for educational purposes in your school? Yes () No ()
26. If (Yes) to the above question, please explain how you use the radio for education purposes in the school-----

27. **TV:** Is television used for educational purposes in your school? Yes () No ()
28. If (Yes) to the above, please explain how you use the TV is used for education purposes in the school -----
29. Explain how you use the following items for educational purposes
- i) Telephone extensions -----
 - ii) Mobile phones -----
30. Is the following equipment available or used in your school? If it is available, please explain how it is used for educational purposes.
- a) Video equipment-----
 - b) Digital microscopes-----
 - c) Audiotapes and cassettes -----

31. STRUCTURAL IMPACT OF ICTS

Describe briefly how use of ICT has affected new role for the following

- a. Staff -----
- b. School work flow -----
- c. Authority -----
- d. Information flow -----

- e. Rules and procedures -----
- f. General evolution of the system i.e. equipment and other facilities including personnel -----

32. PSYCHOSOCIAL IMPACT OF ICTs

Comment briefly on the impact of ICT on the following:

- a. human resources -----
- b. attitudes -----
- c. motivation -----
- d. group dynamics-----
- e. communication -----
- f. interpersonal relations -----
- g. computer literacy-----

33. GOALS AND VALUES

Comment briefly on the following.

- a. Ethical and legal issues-----
- b. Security and data confidentiality. -----

34. Vision statement

What is the vision of the school as far as ICT is concerned?

35. Mission statement

How does the mission statement help you as a teacher to visualise the schools aspirations for the future of ICTs in the school? -----

36. What are the challenges you face as a teacher as far as use of computers are concerned? -

37. How can those challenges be solved? -----

THANK YOU FOR TAKING TIME TO ANSWER THE QUESTIONNAIRE

APPENDIX VI

INTERVIEW SCHEDULE FOR THE COMPUTER

TEACHER/COORDINATOR/TECHNICIAN AND THE LIBRARIAN

Diffusion of Information Communication Technologies (ICTs) in the Education Sector in Kenya: A Case Study of Secondary Schools in Nairobi Province.

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the information given in this questionnaire will be treated with confidentiality.*

Please mark the correct information/choice with a (√)

SECTION A: PERSONAL INFORMATION

1. Please indicate your gender
Male () Female ()
2. What is your age bracket?
Under 25 years ()
25-30 years ()
31-35 years ()
36-40 years ()
41-45 years ()
46-50 years ()
51-55 years ()
3. What is your designation? -----
4. What is your highest academic qualification?

5. Do you use computers in your work? Yes () No ()
6. If yes to the above question, what work do you do with the computers? Please explain.

7. Are you trained to use computers?
Yes () No ()
8. What training have you received in using computers? Please explain.

SECTION B: USE OF COMPUTERS AND MAINTENANCE

9. How many hours do you spend in computer and maintenance work for the school during the week?

1-5 () 21-25 ()

6-10 () 26 -30 ()

11-15 () 31 -35 ()

16-20 () 36 -40 ()

Over 40 hours, how many? -----

10. How many computer lessons are you allocated to teach in a week? -----

11. How many computers are in the school?

12. How many computers are in the computer room? -----

13. How many students use computers in a computer lesson? -----

14. Are the computers adequate per computer lesson? Yes () No ()

15. What programs are used in the school?

i) Word Processing----- Yes () No ()

ii) Spread Sheets ----- Yes () No ()

iii) Databases ----- Yes () No ()

iv) Publishing/composing Newsletters-----Yes () No ()

v) Presentations (PowerPoint etc.) -----Yes () No ()

vi) Internet Access ----- Yes () No ()

ii) E-mail -----Yes () No ()

viii) Others, please specify -----.

16. Are you trained on how to use the programs used in the school? Yes () No ()

Does the **use** and **knowledge** of the following areas of computer technology enable you to perform better as a Computer teacher/technician? (Please (√) the appropriate response.)

17. Internet access -----Yes () No ()

18. E-Mail -----Yes () No ()

19. Databases -----Yes () No ()

20. Word Processing -----Yes () No ()

21. Spreadsheets -----Yes () No ()

22. Presentation software (PowerPoint) -----Yes () No ()

23. Publishing software (for creating newsletters etc. --- ---Yes () No ()

24. How can use of ICTs be improved in your school as regard to?

i) Access to computers-----

- ii) Skills and training-----
- iii) ICT Management in the school -----
- iv) Transmission of skills and competencies -----
- v) Acquisition of knowledge -----

TECHNOLOGICAL DEVICES

25. How often do you use the following? Please explain

- Computers with peripherals-----
- i) Networked computers -----
 - ii) Server -----
 - iii) Scanners -----
 - iv) Printers -----
 - v) Uninterrupted power supply (UPS) -----
 - vi) Radio card -----
 - vii) TV card -----
 - viii) External Modem/Internet-----
 - ix) Various software types-----
 - x) Other, please explain-----

USE OF OTHER ICTS

26. Radio: Is the radio used for educational purposes in your school? Yes () No ()
27. If (Yes) to the above question, please explain how you use the radio for education purposes in the school-----

28. TV : Is television used for educational purposes in your school? Yes () No ()
29. If (Yes) to the above, please explain how you use the TV is used for education purposes in the school

30. Explain how you use the following items for educational purposes
- i) Telephone extensions -----
 - ii) Mobile phones -----
31. Is the following equipment available or used in your school? If it is available, please explain how it is used for educational purposes.
- a) Video equipment-----
 - b) Digital microscopes-----
 - c) Audiotapes and cassettes -----

32. PHILOSOPHY OF LEARNING AND PEDAGOGY

Please indicate at what setting your school is in relation to use of computers in teaching and learning

Setting A – Setting that is dominated by the teacher as the main provider of subject content is adopting a teacher centred approach

Setting B – A learner centred philosophy describes setting where content comes from a variety of resources, and where the projects are chosen and designed by students. ICT Tools and resources are selected by students in ways that match the aims of the projects

Setting C – Where both approaches are used

33. UNDERSTANDING THE CURRICULUM

At what stage do you think your school is? Please indicate with a (√) the correct response.

Stage 1: Awareness stage when students become ICT literate to technology available and how it can be used -----

Stage 2: Students learn basic skills and begin to apply various ICT tools to their regular learning assignments and projects -----

Stage 3: Students become more capable and confident with ICT. They begin to integrate and overlap both subject areas and tools. -----

Stage 4: Applied use of ICT in which students are now enabled to address larger more complex, real-world professional issues. -----

34. STRUCTURAL IMPACT OF ICTS

Describe briefly how use of ICT has affected new role for the following

- a. Staff -----
- b. School work flow -----
- c. Authority -----
- d. Information flow -----
- e. Rules and procedures -----
- f. General evolution of the system i.e. equipment and other facilities including personnel -----

35. PSYCHOSOCIAL IMPACT OF ICTS

Comment briefly on the impact of ICT on the following:

- a. human resources -----
- b. attitudes -----
- c. motivation -----
- d. group dynamics-----
- e. communication -----

f. interpersonal relations -----

g. computer literacy-----

36. GOALS AND VALUES

Comment briefly on the following.

a. Ethical and legal issues-----

b. Security and data confidentiality. -----

37. Vision statement

What is the vision of the school as far as ICT is concerned?

38. Mission statement -----

39. How does the mission statement help the individual members visualise the schools aspirations for the future of the school?

40. Comment briefly on the procedures in the following

a. procedure of acquisition-----

b. replacement of equipment, parts -----

c. maintenance of hardware and software -----

41. What is the make/model/type of the computers? Please indicate below

42. How often is the computer software updated?

43. How often are the computers replaced with new computers/parts?

44. Are you trained to maintain the school computers? Yes () No ()

45. If Yes to the Q 44, where did you receive your training?

46. Do you find your training in computer care and maintenance satisfactory? Yes () No ()

47. What improvements can be made? -----

48. Comment briefly on the following:

a) Security of the equipment-----

b) Security of the working environment-----

49. What other challenges do you face as computer teacher/technician?

50. How can those challenges be solved? -----

THANK YOU FOR TAKING TIME TO ANSWER THE QUESTIONNAIRE

APPENDIX VII

QUESTIONNAIRE FOR THE NON-TEACHING STAFF (BURSAR, ACCOUNTANT, SECRETARIES)

Diffusion of Information Communication Technologies (ICTs) in the Education Sector in Kenya: A Case Study of Secondary Schools in Nairobi Province.

The interview/questionnaire is designed to gather information on the diffusion of Information Communication Technologies in the Secondary Schools in Nairobi. Do not write your name on the questionnaire. *All the information given in this questionnaire will be treated with confidentiality.*

Please mark the correct information/choice with a (√)

SECTION A: PERSONAL INFORMATION

1. Please indicate your gender
Male () Female ()
2. What is your age bracket?
Under 25 years ()
25-30 years ()
31-35 years ()
36-40 years ()
41-45 years ()
46-50 years ()
51-55 years ()
56-60 years ()
Over 60 years ()
3. Designation -----
4. What is your highest academic qualification?

5. Do you use computers in your work? Yes () No ()
6. If yes to the above question, what work do you do with the computer?

7. Are you trained to use computers? Yes () No ()
8. What training have you received in using computers?

SECTION B: USE OF COMPUTERS

9. By use of a (√), rate the statements given below.

Scale:	a) Proficient	b) Above average	c) Average	d) Fair	e) Poor
i) Your overall computer literacy skills					
ii) Your typing/keyboarding skills					

10. What program do you use?

- i) Word Processing----- Yes () No ()
- ii) Spread Sheets ----- Yes () No ()
- iii) Databases -----Yes () No ()
- iv) Publishing/composing Newsletters----- Yes () No ()
- v) Presentations (PowerPoint etc) -----Yes () No ()
- vi) Internet Access ----- Yes () No ()
- vii) E-mail ----- Yes () No ()
- viii) Other, please specify -----

11. Are you trained on how to use the programs that you use? Yes () No ()

12. Are there other programs that you use in your work? Please indicate below.

13. TECHNOLOGICAL DEVICES

How often do you use the following?

- a) Computers with peripherals-----
- b) Video equipment-----
- c) Digital microscopes-----
- d) Various software types-----
- e) Telephone extensions and mobile phones -----
- f) Audiotapes and cassettes -----

13. Do you find the work that you do with the computer satisfactory? Yes () No ()

14. What improvements can be made? -----

15. How many hours do you use the computer for school work in the week?

16. What are the challenges you face as a member of staff as far as use of computers are concerned? -----

17. How can those challenges be solved? -----

THANK YOU FOR TAKING TIME TO ANSWER THE QUESTIONS

APPENDIX VIII

OBSERVATION SCHEDULE FOR COMPUTER COORDINATOR/COMPUTER TECHNICIAN AND THE LIBRARIAN

Where possible with permission from respondents and school authorities, the researcher will request to access certain documents. The researcher will use the observation schedule below.

The researcher will observe/inspect and record the following:

1. Computer rooms bookings -----
2. Records of software and reading materials -----
3. Records of meetings of computer clubs -----
4. Records of how computers are shared and distributed in the school -----
5. Teacher/student computer files and printed products -----
6. School management documents such as notices, correspondence and accounts records

7. To inspect the following facilities and resources
 - a) Electrical wiring-----
 - b) Internet access-----
 - c) Lighting-----
 - d) Air- conditioning-----
 - e) Space-----
 - f) Furniture design-----
 - g) Safety work environment -----
8. Technological devices
 - a) Computers with peripherals-----
 - b) Video equipment-----
 - c) Digital microscopes-----
 - d) Various software types-----
 - e) Telephone extensions and mobile phones -----
 - f) Audiotapes and cassettes -----
 - g) Telephone lines -----

APPENDIX IX

2006 KCSE RESULT ANALYSIS

 KCSE Results Analysis Booklet
PUBLIC SECONDARY SCHOOLS – NAIROBI NORTH DISTRICT

S.NO	NAME	ZONE	DIVISION	GENDER
1.	EASTLEIGH HIGH SCHOOL	EASTLEIGH	STAREHE	BOYS
2.	JAMHURI HIGH	CENTRAL	STAREHE	BOYS
3.	KAMUKUNJI SEC	BAHATI	KAMUKUNJI	MIXED
4.	KAMITI SEC	KAHAWA	KASARANI	MIXED
5.	KAHAWA GARISSON	KAHAWA	KASARANI	
6.	MUSLIM GIRLS	JUJA ROAD	STAREHE	GIRLS
7.	MOI FORCES ACADEMY	EASTLEIGH	KAMUKUNJI	BOYS
8.	NGARA GIRLS	CENTRAL	STAREHE	GIRLS
9.	OUR LADY OF MERCY	BAHATI	KAMUKUNJI	GIRLS
10.	PARKLANDS BOYS	CENTRAL	STAREHE	BOYS
11.	PUMWANI SEC	CENTRAL	STAREHE	BOYS
12.	PANGANI GIRLS	JUJA ROAD	STAREHE	GIRLS
13.	PARKLANDS ARYA GIRLS	CENTRAL	STAREHE	GIRLS
14.	RUARAKA HIGH SCHOOL	RUARAKA	KASARANI	MIXED
15.	ST. TERESA'S BOYS	EASTLEIGH	KAMUKUNJI	BOYS
16.	ST. TERESA'S GIRLS	EASTLEIGH	KAMUKUNJI	GIRLS
17.	STAREHE BOYS	CENTRAL	STAREHE	BOYS
18.	UHURU SEC	BAHATI	KAMUKUNJI	MIXED
19.	NDURURUNO SEC	JUJA ROAD	STAREHE	MIXED
20.	STAREHE GIRLS	CENTRAL	STAREHE	GIRLS

PRIVATE SECONDARY SCHOOLS – NAIROBI NORTH DISTRICT

S.NO.NAME	ZONE	DIVISION	GENDER	
1.	ARYA BOYS	CENTRAL	STAREHE	BOYS
2.	ARYA GIRLS	CENTRAL	STAREHE	GIRLS
3.	BALKAN HIGH	KAHAWA	KASARANI	MIXED
4.	BROOKSHINE	KAHAWA		GIRLS
5.	EXETER ACADEMY	CENTRAL	KASARANI	MIXED
6.	FOREST VIEW ACADEMY	RUARAKA	KASARANI	MIXED
7.	FRAMES OF MIND	RUARAKA	KASARANI	GIRLS
8.	GURU NANAK	CENTRAL	STAREHE	BOYS
9.	KHALSA GIRLS	CENTRAL	STAREHE	GIRLS
10.	KARURA SDA	RUARAKA	KASARANI	MIXED
11.	KASARANI ACADEMY	KAHAWA	KASARANI	GIRLS
12.	KENYAN COLLEGE	CENTRAL	STAREHE	BOYS
13.	LA VERSE	KAHAWA	KASARANI	GIRLS
14.	NGARA QUEENS	CENTRAL	STAREHE	MIXED
15.	OSHWAL GIRLS	CENTRAL	STAREHE	GIRLS
16.	QUEEN OF APOSTLES	RUARAKA	KASARANI	BOYS
17.	RIDEWAYS SCHOOL	KAHAWA	KASARANI	MIXED
18.	S.G.G.S. STARLIT ACADEMY	CENTRAL	STAREHE	MIXED
19.	SSD SEC.	CENTRAL	STAREHE	GIRLS
20.	SHARDA HIGH	CENTRAL	STAREHE	GIRLS
21.	ST. DOMINIC SAVIO'S		STAREHE	MIXED
22.	ST. JOHN'S HIGH	CENTRAL	STAREHE	MIXED
23.	TEMPLE ROAD	CENTRAL	STAREHE	MIXED
24.	WAKULIMA SEC	CENTRAL	STAREHE	MIXED
25.	GLOBAL VISION	RUARAKA	KASARANI	MIXED
26.	KENYA MUSLIM	RUARAKA	KASARANI	BOYS
27.	MOGRA STAR ACADEMY	RUARAKA	KASARANI	MIXED
28.	ST. CATHERINE MOUNTAIN VIEW	KAHAWA	KASARANI	GIRLS
29.	DON BOSCO SECONDARY	CENTRAL	STAREHE	BOYS
30.	IMPERIAL ACADEMY	CENTRAL	STAREHE	MIXED
31.	PAN AFRICAN HIGH SCH.	CENTRAL	STAREHE	MIXED
32.	MARION ACADEMY	KAHAWA	KASARANI	GIRLS
33.	ST. EDWARDS	KAHAWA	KASARANI	MIXED
34.	ST. FLORENCE	KAHAWA	KASARANI	GIRLS
35.	SUN FLOWER ACADEMY	RUARAKA	KASARANI	MIXED
36.	ST. NICHOLAS SENIOR	RUARAKA	KASARANI	MIXED
37.	GLADYS SEC.	RUARAKA	KASARANI	MIXED

APPENDIX X

KCSE RESULTS ANALYSIS BOOKLET

 **KCSE Results Analysis Booklet**
PUBLIC SECONDARY SCHOOL - NAIROBI WEST DISTRICT**DAGORETTI DIVISION**

S/NO.	SCHOOL	TYPE
1.	DAGORETTI HIGH SCHOOL	BOYS BOARDING
2.	DAGORETTI MIXED	MIXED DAY
3.	LENANA SCHOOL	BOYS BOARDING
4.	MOI GIRLS NAIROBI	GIRLS BOARDING
5.	MUTUINI SEC. SCHOOL	BOYS DAY
6.	NEMBU GIRLS HIGH SCHOOL	GIRLS BOARDING
7.	PRECIOUS BLOOD RIRUTA	GIRLS BOARDING
8.	RUTHIMITU GIRLS SEC. SCHOOL	GIRLS BOARDING
9.	RITHIMITU MIXED SEC. SCHOOL	MIXED DAY
10.	UPPER HILL SCHOOL	BOYS BOARDING

WESTLANDS DIVISION

S/NO.	SCHOOL	TYPE
1.	HOSPITAL HILL HIGH SCHOOL	MIXED BOARDING
2.	KENYA HIGH SCHOOL	GIRLS BOARDING
3.	KANGEMI HIGH SCHOOL	MIXED DAY
4.	NAIROBI SCHOOL	BOYS BOARDING
5.	NAIROBI MILIMANI SEC. SCHOOL	BOYS DAY
6.	PARKLANDS ARYA GIRLS SEC. SCH.	GIRLS DAY
7.	ST. GEORGES GIRLS SEC. SCHOOL	GIRLS BOARDING
8.	STATE HOUSE GIRLS	GIRLS BOARDING

LANGATA DIVISION

S/NO.	SCHOOL	TYPE
1.	LANGATA HIGH SCHOOL	BOYS DAY
2.	OLYMPIC SEC. SCHOOL	MIXED DAY
3.	KAREN C SECONDARY SCHOOL	MIXED DAY

PRIVATE SECONDARY SCHOOLS - NAIROBI WEST DISTRICT**WESTLANDS DIVISION**

S/NO.	SCHOOL	TYPE
1.	STRATHMORE SCHOOL	BOYS DAY
2.	KIANDA SCHOOL	GIRLS DAY
3.	LORETO CONVENT, VALLEY ROAD	GIRLS DAY
4.	CONSOLATA SCHOOL	MIXED DAY
5.	ST. MARTINS GIRLS KIBARAGE	GIRLS BOARDING
6.	AGA KHAN HIGH SCHOOL	MIXED DAY
7.	ST. MARY'S SCHOOL	BOYS DAY
8.	KARURA SDA	BOYS BOARDING
9.	COMPUERA GIRLS	GIRLS BOARDING
10.	KITSURU BOYS	MIXED BOARDING
11.	ST. DEBORAH SCHOOL	GIRLS/DAY/BOARDING
12.	AKIBA SECONDARY	MIXED DAY
13.	ANANDA MARGA	MIXED DAY
14.	KYUNA ACADEMY	MIXED DAY
15.	LORETO CONVENT MSONGARI	GIRLS DAY
16.	STEPH JOY SCHOOL	GIRLS DAY

DAGORETTI DIVISION

S/NO.	SCHOOL	TYPE
1.	LIGHT ACADEMY	BOYS BOARDING
2.	ST. HANNAHS BOYS	BOYS BOARDING
3.	ST. HANNAHS PREPARATORY	GIRLS DAY/BOARDING
4.	FOREST VIEW ACADEMY	GIRLS BOARDING
5.	GOOD SAMARITAN	MIXED DAY
6.	GITU ACADEMY	MIXED DAY
7.	ENNA SCHOOL	MIXED DAY
8.	SATELLITE STAR	BOYS BOARDING

APPENDIX XI

COMPUTERS FOR SECONDARY SCHOOLS, NAIROBI PROVINCE (2008)

	RECEPIENT INSTITUTION	DISTRICT	POSTAL ADDRESS
1	Aquinas High School	Nairobi	P.O. Box 72000, Nairobi
2	Arya Boys Secondary School	Nairobi	P.O. Box 10706 – 00400, Nairobi
3	Brother Beusang Catholic Secondary School	Nairobi	P.O. Box 24023 – 00502, Karen
4	Dagoretti High School	Nairobi	P.O. Box 21070 – 00505, Nairobi
5	Kahawa Garrison Secondary School	Nairobi	P.O. Box 514 – 00618, Nairobi
6	KinyagoDandora Secondary School	Nairobi	P.O. Box 25915 – 00504, Nairobi
7	Lenana School	Nairobi	P.O. Box 30256 – 00100, Nairobi
8	Muslim Academy- Girls Secondary	Nairobi	P.O. Box 41013, Nairobi
9	Nairobi School	Nairobi	P.O. Box 30047, Nairobi
10	Ngara Girls' High School	Nairobi	P.O. Box 31624 – 00600, Nairobi
11	Our Lady of Fatima Secondary School	Nairobi	P.O. Box 20511 – 00200, Nairobi
12	Pangani Girls' Secondary School	Nairobi	P.O. Box 30152 – 00100, Nairobi
13	Parklands Boys High School	Nairobi	P.O. Box 40420, Nairobi
14	Pumwani Secondary School	Nairobi	P.O. Box 16364 – 00100, Nairobi
15	Ruaraka High School	Nairobi	P.O. Box 57378, Nairobi
16	St. Georges Secondary School	Nairobi	P.O. Box 43050 – 00100, Nairobi
17	St.Teresa's Boys' Secondary School	Nairobi	P.O. Box 71324 – 00622, Nairobi
18	Starehe Boys' Centre	Nairobi	P.O. Box 30178 – 00100, Nairobi
19	Uthiru Secondary School	Nairobi	P.O. Box 29034, Nairobi

APPENDIX XII

SUSTAINABLE IMPLEMENTATION OF ICTS IN NAIROBI COUNTY,

SAMPLLED SCHOOLS

Public schools	Students	Sample response	
1. Uhuru Secondary	20	19	
2. Dagoretii High	20	20	
3. Kamiti Secondary(M)	20	20	
4. Dandora Sec (M)	20	18	
5. Nairobi School (B)	20	20	
6. Starehe Boys	20	13	
7. Moi Forces(B)	20	20	
8. Uthiru Girls	20	18	
9. Lenana School	20	15	
10. Aquinas Boys	20	15	
11. Buru Girls	20	11	
12. Moi Girls	20	19	
13. St Georges Girls	20	17	
14. St Theresa Boys	20	20	
15. Embakasi Girls	20	18	
16. Karen C(M)	20	20	
17. Pumwani Boys	20	20	
18. St Theresa Girls	20	19	
19. Langata High(B)	10	10	
20. Pangani Girls	20	16	
21. Muhuri Muchiri	10	10	
22. Kahawa Garrison	10=410	10=358	
Non Response	410-358	62+42= 104	
Private schools	Sample respondents		
1. Forest View(G)	20	20	
2. Marion(M)	20	17	
3. Arya Boys	20	15	
4. Arya Girls	20	11	
5. NPC Buru Buru(Mixed)	20	17	
6. St Marys (B)	20	20	
7. Aga Khan (B)	20	20	
8. Muslim Girls	20	12	
9. Welkim (G)	20	20	
10. Loreto Convent VR(G)	20	20	
11. Brookshine(B)	10	10	
12. Apostolic Camel(G)	10	10	
13. St Hannahs Girls	10	3	
14. St Hannahs Boys	10	9	
15. St Peters (B)	10	4	
Total	250	208	= 208+358=566
Non-response	42		