

**DETERMINANTS OF INFORMATION AND COMMUNICATION  
TECHNOLOGY INTEGRATION IN THE TEACHING OF SCIENCES  
IN PUBLIC SECONDARY SCHOOLS IN KISUMU EAST DISTRICT –  
KENYA**

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Requirements for the Degree of Master of Education in Curriculum  
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## **DECLARATION**

This research project is my original work and has not been presented for a degree in any other university.

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## **DEDICATION**

This research project is dedicated to my dear mother Jenipher Aketch Ondhoro and father Archealeus Ondhoro Omwami.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

<b>CD</b>	Compact Disc
<b>DEO</b>	District Education Officer
<b>DQASO</b>	District Quality Assurance and Standards Officer
<b>EFA</b>	Education for All
<b>ICT</b>	Information and Communication Technology
<b>MOE</b>	Ministry of Education
<b>MOEST</b>	Ministry of Education Science and Technology
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization

## ABSTRACT

Information and Communication Technology play a very vital role in dissemination of knowledge and presenting content in a sequenced manner. However, concerns about the ICT integration in the teaching of sciences have been reported widely as a global phenomenon. In Kenya, conventional methodologies of teaching which are teacher centered and less interactive continue to dominate classroom lesson delivery. The integration of ICT in teaching is very critical to the development of quality education delivery, especially in the light of changes in the system generally and demands placed on education to steer realization of Vision 2030. The study sought to establish the determinants of ICT integration in the teaching of sciences in Public Secondary Schools in Kisumu East district, with a view to suggest strategies to be employed to enhance integration of ICT in teaching of Sciences. The study was guided by four objectives: to determine availability of ICT infrastructure in public secondary schools in the teaching of sciences, to determine ICT skill level of Science teachers, to establish the frequency of ICT use in the teaching of Science and to identify strategies used by Secondary Schools to promote ICT use in the teaching of Science in Kisumu East District. The determinants were related through a conceptual framework. The study used social constructivism theory which state that the instructor assumes the role of a facilitator and a co-learner and guides, plans, organizes and provides direction to the learner who is accountable for his or her own learning. The study adopted descriptive survey design where qualitative and quantitative data were collected. Using simple random sampling method, the researcher sampled 16 schools, 16 principals, 16 science teachers and 100 science teachers. Primary data were collected using principals, science HoDs and science teachers questionnaires that were pretested to ensure reliability and validity. Data collected were analyzed using a combination of statistical computations. These included frequencies, tables and percentages. The analyzed data were interpreted and presented using tables and texts for clarity. The study found that availability of ICT infrastructure influenced ICT integration and schools that offer Computer Studies in their curriculum had well established infrastructure and the study found out that majority of their lessons were ICT integrated. The findings established that majority of science teachers were not well equipped with ICT skills and knowledge and this limited their ability to integrated ICT in their lessons. On frequency of use to deliver lessons, it was established that Science teachers rarely use ICT to deliver their lessons. The study also found out that schools have strategies to improve on ICT integration especially by in servicing of Science teachers, building and equipping science laboratory and purchasing of more ICT equipments. The recommendation from this study were that the Board of management should include in their strategic plan ICT infrastructure, Ministry of Education should prioritize in-servicing of science teachers to improve on their ICT skills in order to embrace ICT in delivery of their lessons. The study concluded that ICT infrastructure influenced ICT integration as schools that had well established infrastructure had majority of their lessons delivered with ICT.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background to the study**

Education is an investment in human capital and empirical evidence, based on endogenous growth models shows that human capital is a key determinant of economic growth, (MoE, 2005). Information Communication Technology (ICT) can play an important role in re-shaping education to respond to contemporary information society needs and reduce gaps that exist between socio-economic realities (United Nations Educational, Scientific and Cultural Organization, 2009). Many of the productivity gains in the developed world economies over the past two decades can, to a great extent, be attributed to the impact of ICT (MOE, 2005).

According to Ministry of Education (2011) information and communication technologies are commonly defined in education as diverse set of technological tools and resources used to communicate and to create, disseminate, store and manage information. Technologies of information and communication include computers, internet and broadcasting technologies, that is, radio, television and mobile phones. In educational context ICT refers to various resources and tools presented on the computer that help link various learning communities together in new and different ways (MOE, 2011).

Integrating ICT in teaching and learning is not a new concept in education. It is as old as other technologies such as radio. Ministry of Education (2011) defines ICT integration as the seamless incorporation of technology to support and enhance student engagement in meaningful learning and for attainment of curriculum objectives. Integration of ICT in education is important in learning and teaching process as it increases learner's motivation, makes students to understand better abstract concepts, allows collaborative learning and provides the opportunity for learning through simulation (MoE, 2011).

The origins of computer-assisted instructions where students learn from programmed computer package can be traced to the works of Skinner (1954) on his work on experiments with ICT teaching machines which came as a result of dissatisfaction with traditional methods of learning which were teacher based and did not exploit the individual student potentials. Skinner (1954) suggested that, the experimental analysis of behavior could be applied in the construction of a teaching machine. The ICT teaching machine would present a carefully sequenced set of ideas to a student and reinforce his or her responses to direct behavioral capabilities. Skinner's ideas led to the development of programmed learning materials (Skinner, 1954).

According to Grabe and Grabe, (2007) some factors influence the likelihood that ICT will be integrated in schools which include access to ICT facilities, teachers' expertise, ICT resourcing or cost, ICT leadership and general teaching. On teachers' ICT expertise, there is growing and widespread

awareness that the pedagogical and technical expertise of the teacher is absolutely critical in the teaching and learning (Grabe and Grabe, (2007). This has made governments in sub-Saharan Africa, as elsewhere to emphasize on teacher development as the key to effectively implementing policy and curricular, to using ICT to enhance teaching and teaching to raising educational standards. Information and communication technology integration is primarily an individualized approach to teaching which allows students to work independently developing self independence which encourages mastery of content thus aiding mastery of learning sciences, (Bell, 1986).

Effective introduction of ICT technology into schools is also largely dependent upon the availability and accessibility of ICT resources that is, hardware, software, and communication infrastructure (Liverpool, 2002). Therefore, if technology cannot be accessed as in many educational institutions in sub-Saharan Africa, Kenya included, then, its integration is likely to face challenges or progresses slowly, (Liverpool, (2002). However, Bransford & Brown, (2000) in their study noted that, the situation has been improving in the last few years. Schools are increasingly being equipped with computers for teaching, learning and administrative purposes; connectivity is improving and the students are enthusiastic about using computers for learning despite inadequate computers in the institutions (Bransford & Brown, 2000).

United Nations Educational, Scientific Cultural Organization, (2009) further believe that under right conditions, ICT can have a monumental impact on the expansion of learning opportunities beyond cultural barriers and outside confines of teaching institutions of geographical barriers. Information and communication technology thus is perceived to be critical for reaching education for all (EFA) goals by boosting the current rate of progress in developing countries, so as to meet the demands of a rapidly evolving information society. The report further notes that, ICT policy programmes exist in developing countries that stimulate its use which vary in scope, focus, budget and complexity, with slow progress where the benefits cannot be measured and demonstrated in a sound way (UNESCO 2009).

Focusing on Kenya in particular, education is taken to be the cornerstone of economic and socio-political development. As Ayot and Patel, (1992) observed, the fundamental goal of education is to prepare and equip the youth to be happy and useful members of the society. This goal can only be achieved through provision of quality education. They further assert that, quality education will entail the development of the school subjects through professionally trained teachers who are using appropriate audio-visual media and following communication techniques that help impart maximum knowledge and skills to students. They note further that, teachers are required to improve and use instructional methods that lead the students to realize their full potential.



Formulation and implementation of national policies on ICT use as outlined by Ministry of Education, (2006) are additional essential prerequisites along with supportive local policies, teachers' expertise and cost of ICT. The Ministry of Education (2006) through recommendation of Sessional Paper No.1 of 2005 came up with the national ICT policy in 2006 as a vehicle through which the policy objectives can be realized. KEMI, (2011) note that ICT is about using new tools to help students' master key concepts and skills embedded in science, social studies and other curriculum activities. KEMI (2011) further notes that ICT integration in education does not mean that ICT is added as an additional subject in our curriculum but involves guiding students by all subjects' teachers with acquisition of certain ICT skills (KEMI, 2011).

Omufwoko (2009) studied factors influencing the use of ICT for learning among students at technical colleges in Nairobi focusing on time, ICT infrastructure, expertise and cost of using ICT and student to computer ratio in general. Akunja, (2011) in her study of factors determining ICT integration in the teaching and learning in secondary schools in Kisumu City also studied factors of ICT integration using the same approach, but with emphasis on proficiency of secondary school principals, availability of ICT infrastructure and policy framework.

The government of Kenya through the Ministry of Education under the economic stimulus programme funded five (5) schools per constituency in order to integrate ICT in teaching. It is evident that, the government

underscores the use of ICT in facilitating teaching and learning, (Government of Kenya, 2009). Few schools in Kisumu East district have been embracing ICT in teaching and learning in general. The study seeks to establish determinants of ICT integration in teaching of sciences in public secondary schools in Kisumu East that is taking off slowly. From the District Education Office, Kisumu East, Kenya Certificate of Secondary Education examination analysis from 2007 – 2010, only three secondary schools have been taking computer studies as an examinable subject.

### **1.2 Statement of the problem**

The ICT national policy of Ministry of Education seems to remain at the national level without true reflection of its implementation on the ground (Ministry of Education, Science and Technology, 2005). Despite the Ministry of Education effort to develop digital content for schools, funding schools to purchase ICT infrastructure and developing comprehensive ICT National Policy to be implemented in teaching, science teachers still continue to use conventional teaching methods (MOE, 2005).

Computer for Schools in Western Kenya has continued to supply schools with computers, which are rarely used by teachers in teaching with majority of lessons characterized with lectures. It is against this background that this study seeks to establish the determinants of ICT integration in the teaching of sciences in public secondary schools in Kisumu East District. District Quality Assurance and Standards Officer's Standards Assessment Executive summary

report of 2009 and 2010 revealed that only 10 schools out of 48 schools, had computers and only five (5) had relevant instructional compact discs (CDs) for science subjects compared to 15 schools in Kisumu North District which had 15 schools out of 22 schools.

This trend evidently indicate that, the schools in Kisumu East district have been slow at integrating ICT in learning and teaching and more specifically, in the teaching of sciences. Moreover, the schools that have ICT equipment rarely use them to teach science subjects. The study, therefore, sets out to establish the determinants of ICT integration in teaching of sciences in public schools with focus on levels of ICT infrastructure, procurement procedures of ICT infrastructure, the extent of ICT use in teaching of sciences and strategies used by schools to promote ICT use in teaching of sciences in Kisumu East District.

### **1.3 Purpose of the study**

The purpose of this study was to establish the determinants of ICT integration in the teaching of sciences in public secondary schools in Kisumu East District, Kenya.

### **1.4 Objectives of the study**

This study was guided by the following four specific objectives

- i) To determine availability of ICT infrastructure in public secondary schools used in teaching of sciences in Kisumu East District.

- ii) To determine ICT skill level of science teachers in integrating ICT in teaching of sciences in public secondary schools in Kisumu East District.
- iii) To establish the frequency of ICT integration in teaching of sciences in Kisumu East District.
- iv) To identify strategies used by secondary schools to promote ICT integration in teaching of sciences in Kisumu East District.

### **1.5 Research questions**

This study was guided by the following research questions

- i) How does availability of ICT infrastructure in public secondary schools influence ICT integration in teaching of sciences in Kisumu East District?
- ii) To what extent does ICT skill level of science teachers affect the integration of ICT in teaching of sciences public secondary schools in Kisumu East District?
- iii) How frequent do science teachers integrate ICT in teaching if sciences in public secondary schools in Kisumu East District?
- iv) What are the strategies used by the schools to promote ICT use in teaching of sciences in Kisumu East District?

### **1.6 Significance of study**

The findings of the study may be useful to principals in making decisions on appropriate ICT infrastructure for their institutions. It is also expected that the findings of this study could provide valuable information to science teachers

to simplify difficult concepts. The findings could also be used by the District Education Officer (DEO) to identify areas that still require capacity building in the teaching of sciences in the District. Lastly the study could provide the principals with appropriate strategies to promote teaching of sciences.

### **1.7 Limitations of the study**

The researcher encountered some limitations which affected his effectiveness in carrying out the study. One of such limitations is the suspicion which some of the respondents viewed the study. On competency level in ICT, some respondents were insincere and unwilling to avail information on their ICT competencies. The researcher tried to mitigate these limitations by assuring the respondents on the confidentiality of their identity. On competence level of the respondents, cross tabulation was done that ensured accuracy of responses.

### **1.8. Delimitation of the study**

This study took place within Kisumu East District, Kisumu County. The study targeted only 31 public secondary schools in Kisumu East District, which had computers. The study dealt with science teachers, science HODs and principals because they play a great role in the implementation of ministry of education national ICT policy. The respondents were suitable to the study as they were involved in day to day interaction in the school hence could provide first hand information/data.

### **1.9 Basic assumptions of the study**

The study was based on the following assumptions:-

- i) Public schools in Kisumu East district were implementing Ministry of Education's National ICT policy.
- ii) Data gathered was accurate and correct
- iii) That there are certain challenges facing science teachers in their integration of ICT
- iv) That there are certain factors that influence science teachers in their endeavour to integrate ICT.

### **1.10 Definition of significant terms**

This section does with significant terms that were used in the study.

**Computer assisted instruction** refers to techniques whereby students study individually from a programmed computer package.

**Conventional method** refers to a method of instruction characterized by lectures discussion, demonstrations and homework dominated by the teacher.

**ICT integration** refers to introduction, consolidation and full use of electronic means of capturing, processing, storing and disseminating information.

**Information and Communication Technology** refers to technologies including computers, telecommunication and audio-visual systems that enable the collection, processing, transmission and delivery of information and communication services to users.

**Information Communication Technology Literacy** refers to the ability to accept, learn and adapt the new technology and make use of its opportunities.

**Information Society** refers to social, business and educational environment where individuals and organizations communicate and access the world's commercial, education and entertainment resources over a universal network linking them together.

**Infrastructure** refers to an integrated system of facilities used to provide one or more ICT services such as computers or internet.

**Integration** refers to incorporation of technology in teaching that involves learners.

**Integrated computer assisted instructions** refers to a technique whereby teacher instructions supplement the computer programme.

**Strategy** refers to measures used by schools to improve on ICT integration.

### **1.11 Organization of the study**

This study has five chapters where chapter one covered the background of the study, the objectives, research questions, statement of the problem, limitations and delimitations of the study, significance, basic assumptions of the study and definition of significant terms. Chapter two looked at Literature review

Which focused on background to ICT, availability to ICT infrastructure, ICT skill of science teachers, frequency of ICT use, strategies used to promote ICT use, theoretical framework as well as conceptual framework. Chapter three covered research methodology, design, research instruments and their reliability and validity; data collection procedures and data analysis techniques. Chapter four involved data analysis and description of findings which was based on questionnaire return rate, demographic characteristic, ICT

infrastructure, challenges facing ICT integration and strategies use to promote ICT use. Chapter five provided a summary of findings, conclusion and recommendations.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter discussed the background to ICT, levels of ICT infrastructure and equipment in public secondary schools, ICT procurement procedures, competency levels of science teachers, extent of ICT use, strategies used to promote use of ICT as well as the theoretical and conceptual framework.

#### **2.2 Background to information and communication technology**

Pelgrum, (2003) notes that, “computer education” started to become popular in educational policy making in the early 1980s’ when relatively cheap microcomputers became available to the consumer market. Pelgrum, (2003) further observed that towards the end of 1980’s, the term computer was replaced by information technology (IT) signifying a shift of focus from computing technology to the capacity to store and retrieve information. This was followed by the introduction of the term information and communication technology (ICT) around 1992, when email started to become available to the general public.

The world education forum in 2000 listed harnessing of new information and communication technologies as one of the most important strategies to help achieve education for all goal, (MOE 2005). However, the Dakar framework for action also cautioned that, to be effective, the new technologies should serve rather than drive the implementation of education strategies.

### **2.3 Availability of ICT infrastructure in public secondary schools**

Omufwoko, (2009) points out that, schools need to be equipped with modern ICT gadgets to enable them access internet fast. The computers should have latest version and computer packages to enable students perform a variety of tasks. She notes that such hardware must be the latest multimedia with adequate storage capacity and memory. Akunja (2011) observes that lack of adequate ICT infrastructure has hampered provision of efficient and affordable ICT services in the country. She suggested that emphasis should be placed on provision of software development. Other consideration should be Promotion of local manufacture and assembly and implementation of ICT policy of framework of 2006.

Kenya Education Management Institute (2011) argues that, for effective integration of ICT in teaching and learning, schools must acquire appropriate hardware and software which is well maintained. Such infrastructure includes computers, connectivity, projectors and laptops which are requisite for integration of ICT. Kenya Education Management Institute, (2011) further observes that, schools in Kenya are slowly integrating ICT in teaching and learning. Acquisition of ICT equipment depends on the vision and mission of the school where learning institutions are required to formulate the relevant policies that will help make ICT integration a reality in the teaching and learning process.

Hawkings, (2004) in Ten lessons for ICT and Education in the developing world noted that while many Ministries of Education around the world have made the commitment to computerize the schools, few have well established infrastructure to fully integrate the use of computers as Pedagogical tools in the classroom. Educational Institutions are required to develop an ICT strategy that incorporate the ICT infrastructure and goals of the institution and how this will be met using ICT and provide a supporting framework for implementation. Sheingold and Hadley, (1990) study observed that, teacher worked in schools where hardware and access to resources were twice the average on ICT use, were comfortable with technology and used computers for many purposes.

#### **2.4 Information and communication technology skills of science teachers**

United Nation Educational, Scientific and Cultural al Organization (2009) observed that the proportion of teaching staff adapting their skills to an ICT-enabled instruction model was small in developing countries and the nature and intensity of ICT use in schools was very low. This evidently shows that teacher competency level need to be addressed by training and deployment of teachers to use ICT in education. The study also revealed that quantity and quality of ICT facilities or related resources in schools for educational purposes was low.

Kenya Education Management Institute (2011) notes that, before a school can successfully integrate ICT, it needs to ensure that teachers acquire appropriate ICT and pedagogical skills that are necessary for ICT. Such skills enable the teachers to have the self drive and enthusiasm to integrate ICT in learning and teaching. Omufwoko, (2009) emphasized that motivation to use computers is reduced where teachers have inadequate technical skills.

Akunja (2011) in her study of ICT in Kisumu East found out that, a number of teachers who used internet daily at school level were more than those who accessed it at home basically to send or receive email. Majority of principals mainly used computers in administrative functions. This leaves a gap in science departments where level of teacher competency in ICT integration is being studied. Her study revealed low ICT level among principals who are the curriculum custodian in our educational institutions.

According to Ayoub (2011) in his study on ICT use in Science and Mathematics Teachers at Dar-es-salam University college of Education observed that teaching and learning in science and Mathematics places a lot of challenges to teachers and students and is setting an a alarm to education stakeholders. To address learning challenges the government adopted ICT in schools and competency based learning as alternative approaches. To this and the college and other teacher training colleges are required to develop teachers' competencies in technology and constructive learning approaches. The study by Ayoub revealed that pre-service teachers had the knowledge of

content but limited knowledge of technology, pedagogy as well as knowledge about the interaction between technology, pedagogy and contents. The finding of the study proposed that in the teachers training programme to develop teachers' understanding of the relationship between content, pedagogy and technology thus enhance student learning through the use of technology.

According to Mugenda, (2006), research on the use of ICT in different educational setting over the years, invariably identify as a barrier of success the inability of teachers and other staff on how they cause ICT to help them work better. Various ICT competencies must be developed through education system for ICT integration to be successful. He further noted that the relations between teacher's skills in using computers, their Pedagogical thinking and their self reported practices are not matching. Thus only a small percentage of teachers had adequate technical computer skills. MOE (2011) also identified these challenges and noted that most newly qualified teachers coming out of teacher training institutions today have only limited exposure to ICT and almost no actual training on how to incorporate ICT in their teaching practice. Therefore there is need to develop ICT curriculum for teachers undergoing training so as to equip them with the desired ICT knowledge and skills thus promoting the ICT use in teaching.

## **2.5 Frequency of ICT use in teaching**

Acquisition of digital materials in learning institutions is vital as it helps to determine the likelihood that ICT will be embraced by the institutions.

Pelgrum (2002) indicates that, even though teachers show great interest and motivation to learn about the potential of ICT, in practice, the use of ICT is relatively low and it was focused on a narrow range of applications, with word processing being the predominant use. Pelgrum further reveals that lack of ICT infrastructure was one of the factors for non-usage of ICT in teaching and learning.

United Nation Educational, Scientific and Cultural Organization (2009) revealed that there was limited use of ICT in pedagogical support with very minimal technical support to the teachers. The study also indicated that there was inadequate ICT software both for general teaching and specific subject, hence low level of ICT integration in teaching. Learning institutions therefore need to embrace ICT use to make integration reality in the teaching of sciences.

## **2.6 Strategies used by secondary schools to promote ICT use in teaching**

Kenya Education Management Institute (2011) points out that, school administrators were expected to facilitate the development and acquisition of learning digital materials and ensure that they were used in teaching and learning. It involves constructing computer laboratory, equipping it with relevant digital content for the entire curriculum subjects and internet connectivity for internet surfing. KEMI (2011) further notes that ICT expertise is a vital strategy where schools administrators should ensure that teachers acquire appropriate ICT skills that are necessary for ICT integration.

United Nation Educational, Scientific and Cultural Organization (2009) observes that, vision of school management with regard to pedagogy and ICT concerning the new dimensions of traditional lifelong learning and connectedness should be embraced to make ICT integration a reality in the teaching and learning process. It also underscores staff development in ICT where all teachers should acquire knowledge and skills for using ICT in teaching and learning. There is also need to inbuilt the skills in teacher training colleges to equip them with necessary ICT skills. Ministry Of Education (2005) outlines a number of strategies to address key policy issues by Ministry of Education. The Ministry of Education is supporting the development of digital content to be provided to educational institutions.

Ministry of Education, (2011) in its manual for teachers and school administrators outlines a number of strategies to promote ICT use in teaching with capacity building given priority where schools identified in all the phases of ICT funding, Principals are taken for induction on the procurement, specification and maintenance of ICT Equipments. Such capacity building is cascaded to the school level where structured training is conducted under the supervision of ICT champions in the Districts. The Ministry of Education continues to support ICT infrastructure in Secondary Schools by funding one school per constituency to benefit for ICT funding. Another strategy adopted by the Ministry of Education to promote ICT use in teaching is infrastructure funding to construct computer laboratories where each financial year District Education Board is mandated to identify schools for infrastructure funding.

Centre for mathematics, Science and Technology Education in Africa, (MOE 11) recognizes the importance of ICT integration in the teaching of sciences and mathematics by introduction of ICT integration in the teaching of sciences in SMASE INSET from 2011 as a strategy to promote ICT use in science to explain abstract concepts and make teaching more interactive. This was blended with lesson study where science teachers plan together after identifying a study problem in a given topic or subject. This led to video shooting of lessons in all the districts for reflective thinking to improve the delivery of lessons. Under the SMASE programme District, planning committees have purchased ICT equipments for INSET centers for SMASSE INSETS which is changing the science teachers teaching methodology from convectional methods to ICT enabled interactive methods.

Akunja, (2011) in the study of ICT in Kisumu East Suggested that schools need to develop partnership with corporate institutions such as Communication Commission of Kenya (CCK), Safaricom and Microsoft to influence funding to improve on ICT infrastructure in educational institutions. Such partnership in the last five years enabled one school from the District to benefit from CCK funding for purchase of computers. When such partnerships are strengthened the ICT infrastructure of schools will improve and integration of ICT will be enhanced. She also suggested that Board of Governors to develop school based policies to customize 2006 ICT policy of the Ministry of Education to come up with school based policies.



## **2.7 Summary of literature review**

In conclusion, the integration of ICT in teaching of sciences in public secondary schools increases participation of students and makes learning more interactive. KEMI (2011) observes, schools in Kenya were slowly integrating ICT in teaching and its use was yet to become a reality in educational institutions. Pelgrum (2003) similarly notes that, ICT was not well embedded in teachers' practices in the classroom and its use was ineffective and has proven difficult to integrate with traditional curriculum settings. Centre for Mathematics, Science and Technology Education in Africa (MOE 2005) also notes that, since introduction of SMASE in secondary schools in mathematics and sciences, ICT component has been very minimal. It was therefore important that ICT Integration determinants be studied for effective integration in the teaching of sciences.

## **2.8. Theoretical framework**

This study was guided by Vygotsky's (1978) social constructivism theory. It postulates that in the process of knowledge construction and cognitive development of principal importance was the social context within which teaching and learning takes place. The proponent of this theory posit that the process of collaboration between learners and their peers as well as with the instructors or experts leads to socially negotiated knowledge, culminating in concrete knowledge building that would otherwise not be possible. In the process, the learning environment should be designed to support and challenge the learner's thinking processes in order for them to think critically. This is

achievable through collective efforts by the stakeholders in the integration of ICTs in education.

Another Vygotskian notion was that the instructor assumes the role of a facilitator and co-learner and guides, plans, organizes, and provides directions to the learner, who is accountable for his/her own learning. The teacher supports the learner by means of suggestions that arise out of ordinary activities, by challenges that inspire creativity, and with projects that allow for independent thinking and new ways of learning information. Students work in groups to approach problems and challenges in real world situations, this in turn leads to the creation of practical solutions and a diverse variety of student products.

The theory views the context in which the learning occurs as central to the learning itself. A social constructivist notion is that of authentic learning, where the student takes part in activities relevant to the application of learning that take place within cultural contexts similar to reality. The learning experience is envisaged as a shared process. The stakeholders in the learning process are considered as integral in learning. Approaches based on constructivism stress the importance of mechanisms for mutual planning, diagnosis of learner needs and interests, cooperative learning climate, sequential activities for achieving the objectives, formulation of learning objectives based on the diagnosed needs based on the interests of the learner. Development of student's social interaction and learning through affording

appropriate social and intellectual skills begins in school learning contexts. Collaborative learning activities encourage students to develop team building skills and to understand how individual learning is related to the success of group learning.

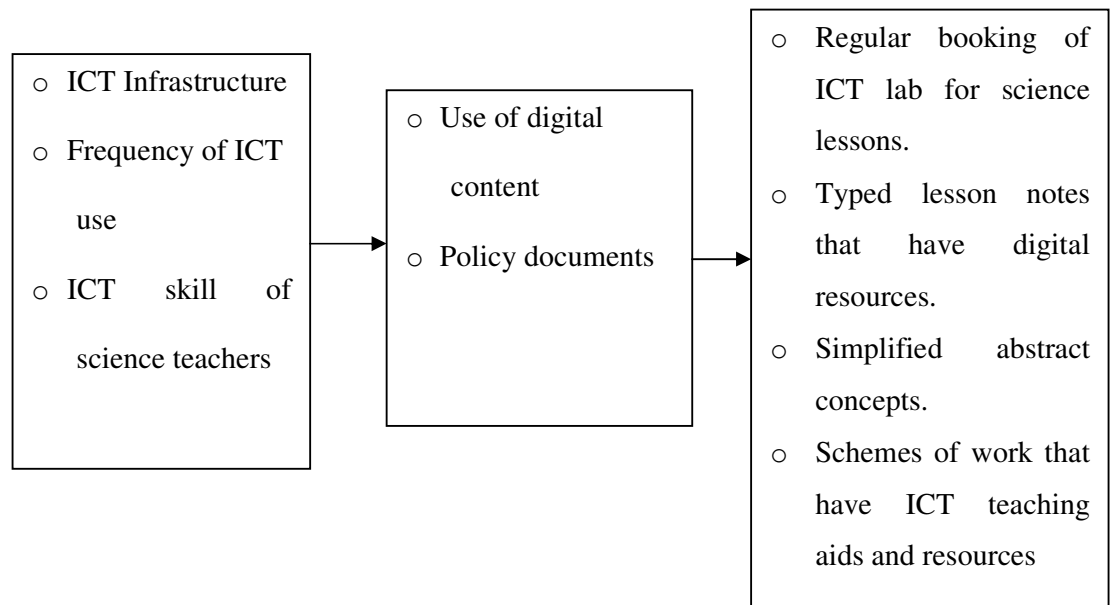
The social constructivist theory aims to make learning more interactive and participatory with students being able to do tasks on their own under guidance of their teachers. Computers provide students with tools to experiment and advance their own learning at their own pace. A Vygotskian classroom emphasizes creating one's own concepts and owning knowledge. It stresses assisted discovery through teacher-student and student-student interaction. Dynamic support and guidance are provided based on the learner's needs. Students are exposed to discussions, research collaborations, electronic information resources, and project groups that work on problem analysis.

The social constructivism theory was therefore suitable for this study since it took in to account active involvement in the teaching/learning process by learners within a richly mediated environment afforded by new ICTs. Also, there is participation by all the stakeholders such as teachers or instructors, technical staff as well as administrators who should work in collaboration for successful implementation of a system that integrates ICTs.

## 2.9 Conceptual framework

The conceptual framework for this study was based on the concept that ICT integration in the teaching of sciences can be implemented to enhance teaching of sciences in public secondary schools.

**Figure 1 Conceptual framework on the determinants of ICT Integration**



This conceptual framework shows how independent variables influence dependent variable but also shows how intervening variables influences both independent and dependent variables. On independent variables ICT infrastructure was central in the kind of digital content a school had as well as identification of teachers training needs to improve on their ICT competency. ICT infrastructure determined the number of computers and other ICT

technologies which influenced the extent of ICT use in the various science subjects which is influenced by the kind of ICT infrastructure the school has.

The intervening variables are also interlinked with policy documents being central by controlling the type of digital content used in teaching of science in public secondary schools. The same policy also controlled the use of mobile phones in secondary school as well as access to internet. The same policy also set guidelines on computer use by giving specification on school computers. This showed the influence of policy documents on the ICT infrastructure hence the influence of intervening variable.

Dependent variables were influenced by both independent and intervening variable as the ICT infrastructure influenced computer use which in turn resulted into simplified abstract concepts like how the blood is pumped by the heart in Biology. The conceptual framework brought out clearly integration in the teaching of sciences characterized with typed lesson notes, lesson plans that have digital resources with schemes of work that have ICT teaching and learning aids. ICT integration ensured programmed radio broadcast as well as constant booking of ICT machines and equipment for use in class.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter describes the methodology used in carrying out the research. It described the research design, target population, sample size and sampling procedures, research instruments, reliability and validity of research instrument, data collection procedure and data analysis techniques.

#### **3.2 Research design**

Kothari (2004) observes that research design is a blue print, which facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible hence yielding maximum information with minimum expenditure of effort, time and money. This study employed descriptive survey design which is concerned with conditions of relationships that prevail where researcher does not manipulate the variables but determines and report the way things are (Best & Kahn, 2003). The design is suitable when gathering data from a relatively large number of cases at a particular time. It involved collecting information by administering questionnaires to a sample of individuals that describes events, then organizes, tabulates, depicts and portrays the variables (Kothari, 2004).

#### **3.3 Target population**

Target population is defined as that population to which a research wants to generalize the results of the study, (Mugenda & Mugenda, 2003). The target

population of this study included 31 public secondary school with computer laboratories, 31 principals, 31 science HODs whose schools had computer laboratories and 200 science teachers in Kisumu East District.

### **3.4. Sample size and sampling techniques**

A sample is a subset of the target population to which the researcher intends to generalize the results (Wiersma, 1986). Sampling is a research procedure that is used for selecting a given number of subjects from a target population as a representative of that population, (Mugenda & Mugenda, 2003). They further suggest that for descriptive studies, fifty percent or above of the accessible population is enough for the study. They note also that where time and resources allow, a researcher should take a bigger sample. Based on the above percentage 16 schools were selected using simple random sampling. All the principals of the selected schools were automatically participated in the study (Kothari, 2004). The same applied in the selection of science HODs. Fifty percent of science teachers were selected through simple random sampling.

**Table 3.1**

#### **Sample size and percentage**

<b>Respondents</b>	<b>Target population</b>	<b>Sample size</b>	<b>Percentage</b>
Principals	31	16	51
HODs	31	16	51
Science teachers	200	100	50

### **3.5 Research instruments**

The research instrument for data collection for this study were questionnaires with both open and close ended questions for all three categories of the respondents, principals, science HODs and science teachers. The questionnaires for this research were developed by the researcher. Questionnaire was used since it helped to collect data from a wide range of respondents, very economical in terms of time and respondents were free to respond to items without fear or victimization since they were not required to write names on the questionnaires as well as giving first hand information. The questionnaire for the three categories of the respondents was designed in two sections. Section A collected background information of the respondents on gender, academic qualifications, teaching experience and the type of school. Section B of the questionnaire tackled four objectives of the study on availability of ICT infrastructure, ICT skill of science teachers' frequency of ICT use and strategies used by schools to promote ICT use in teaching of science.

#### **3.5.1 Validity of the instrument**

Wiersma (1985) refers to validity of an instrument as the degree to which a test measures what is supposed to measure. Content validity was used. Mugenda and Mugenda, (2003) note that, content validity is a measure of the degree to which the data collected using a particular instrument represents a specific domain of indicators or content of a particular concept. To determine the validity of the questionnaire, a pilot study was conducted prior to the



actual research where two schools were involved. The pilot study helped the researcher to modify and fine tune the questionnaires.

### 3.5.2 Reliability of the instrument

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials, (Mugenda & Mugenda, 2003). To establish the reliability of the instrument, test-retest method was conducted from a similar population in two secondary schools in Kisumu East District after an interval of two weeks to the same group of respondents. Scores were then be correlated using the Pearson product moment.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Reliability coefficient varies between -1.00 and +1.00 with reliability of 1.00 indicating perfect reliability (never attained in practice) and 0 indicating no reliability and -1.00 to 0 shows negative reliability. The coefficient indicates the extent to which a test is free from error of variance. The closer the reliability the extent to which a test is free from error of variance and is a measure of differences among proportions in the dimension assessed by the test (Best & Kahn, 2003). The pilot study obtained coefficient relations of 0.6, which made the instrument to be considered reliable for Kothari (2004) confirms that reliability of 0.6 is adequate.

### **3.6 Data collection procedure**

A research permit to conduct the study was obtained from National Council for Science and Technology (NCST). The researcher informed the District Education Officer and the District Commissioner about the intended study. Thereafter, schools were visited with consent of the principals. The questionnaires were delivered by the researcher to the respondents in the sampled schools for filling in and collected after they were been duly filled. This procedure was appropriate as it ensures that respondents were accessible which in turn resulted into a high response.

### **3.7 Data analysis techniques**

After collection of the data, data cleaning was done in order to determine inaccurate, incomplete or unreasonable data and then improve the quality through corrections of detected errors and omissions. After cleaning, the data collected were coded and entered in the computer for analysis. Data analysis procedures that were employed involved both quantitative and qualitative procedures. Quantitative data derived from the demographic section and other closed questions were analyzed using descriptive and referential statistics. Qualitative data generated from the open-ended questions in research instruments were organized in themes and patterns, categorized through content analysis. The data analysis required the use of computer spreadsheet and for this reason; the statistical package for social sciences (SPSS) was used.

## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

#### 4.1 Introduction

This chapter presents findings of the study, which have been discussed under the thematic areas and sub sections in line with the study objectives. The thematic areas were questionnaire return rate, demographic characteristics of the respondents. The analysis of data collected and interpretation was in relation to the objectives and research questions.

#### 4.2 Questionnaire return rate

Questionnaire with both open and closed-ended questions to collect qualitative and quantitative data were administered to three groups of respondents, the principals, HOD Science and science teachers. Table 4.1 summarizes the response rate for each category of respondents.

**Table 4.1**

#### Questionnaire return rate

Category of respondents	Administered	Returned	Return Rate
Science Teachers	100	83	83%
HOD Science	16	16	100%
Principals	16	16	100%

The study targeted 132 respondents (16 principals, 16 science HoDs and 100 science teachers) in collecting data on determinants of ICT integration in the teaching of sciences in public secondary schools in Kisumu East District from the study, 115 respondents (16 principals, 16 science HoDs and 83 science teachers) out of the sampled 132 respondents filled and reported the questionnaires making a response rate of 87.1%. This is shown in table 4.1. This has a good response rate for Mugenda and Mugenda (2003) asserts that response rate of at least 70% is adequate. This high response rate was achieved by administering the questionnaires and collecting them the following day to avoid wastage and losses.

#### **4.3 Demographic characteristics of respondents**

Since data was collected from science teachers HOD, Science and their principals, an attempt was made to present data in terms of demographics of respondents, highlighting the three different groups where possible. The respondents have, therefore, been categorized according to gender, work experience level of education, teaching experience and teaching subjects. This was followed by description of the items of the study that basically looked into the four study objectives to guide analysis and discussion.

##### **4.3.1 Distribution of respondents by gender**

The gender of the respondents was of concern to the study as it assisted the researcher to identify the dominant gender in the district and also established the gender that was integrating most ICT in the teaching of sciences. In view

of this, the respondents were asked to state their gender. Table 4:2 shows the responses on gender.

**Table 4.2**

**Gender distribution of respondents**

Gender	Teachers		Science HODs		Principals	
	Frequency	%	Frequency	%	Frequency	%
Male	57	68.7	8	50	10	62.5
Female	26	31.3	8	50	6	37.5
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>	<b>16</b>	<b>100</b>

Table 4.2 shows that out 83 science teachers who responded to the questionnaires 57(68.7%) were males and 26(31.3%) were females. This showed that there were more male science teachers than females in the schools in the district. This could be attributed to the fact that most of the males preferred science based subjects at their teacher training which could have influenced their number in the district. Out of the 16 science HODs selected there was equitable distribution of fifty percent of both gender which showed that the selected schools had attained gender parity in science HOD leadership. On principals out of 16 principals selected 10(62%) were males while 6(37.5%) were females. Most of the schools were headed by male teachers with urban and peri-urban having majority of ICT schools.

### 4.3.2 Distribution of respondents by level of education

This was of concern to the study as it would reveal education background of the respondents. In view of this, the respondents were asked to give their education level. The principals were asked to state their education levels as this would help to assess their involvement in making ICT equipments available for teaching of sciences. This was illustrated by table 4:3

**Table 4.3**

**Distribution of the respondents by level of education**

Level of education	Science Teacher		Principals	
	Frequency	%	Frequency	%
Dip Education	19	22.9	0	0.0
B. Science	16	19.3	2	12.5
B. Education	36	43.4	8	50
M. Education	12	14.5	6	37.5
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.3 less than 50% of the science teachers had Bachelor of education degree and only 12(14.5%) had masters' degrees. Half of principals had Bachelor Degree while 37.5% had masters of education Degree. This showed that most teachers and principals had high qualification. Since most of the principals had higher academic qualification they were expected to offer leadership in the availability of ICT in their respective schools.

### 4.3.3 Distribution of respondents by years of teaching experience

The work experience of the respondents was considered in the study. The respondents were asked to give their experience in years in the service as shown in Table 4.4

**Table 4.4**

**Distribution of respondents by work experience**

Work experience (years)	Science Teachers		Science HODs		Principals	
	Frequency	%	Frequency	%	Frequency	%
1-3	10	12	2	12.5	0	0
4-6	10	12	1	6.2	0	0
7-9	12	14.5	3	18.8	0	0
Over 9	51	61.4	10	62.5	16	100
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.4 majority of science teachers had over 9 years teaching experience that is 51(61.4%) had 7- 9 years of work experience 12(14.5%) had 4-6 years of work experience 10 (12%) had 1-3 years work experience. The science HODs had majority with over 9 years of experience 10(62.5%) and only 2 (12.5%) had 1-3 years experience who were HODs in newly established schools while all the principals had over 9 years teaching experience. This showed that majority of science teachers in Kisumu East District had over 9 years teaching experience.

The working experience of the principals would help illustrate their ability to steer school programmes with confidence in reference to embracing new technologies in the teaching of sciences.

#### **4.4 Availability of ICT infrastructure in public secondary schools**

Information and communication technology infrastructure is the most important component in the integration of ICT (MOE, 2005) it determines the capacity of the school to use the available digital content to support teaching. Availability of ICT infrastructure therefore influences in the integration ICT in the teaching of sciences. It was therefore of importance in this study and the first objectives of the study sought to determine availability of ICT infrastructure in Public Secondary schools used in teaching of sciences in Kisumu East District. The respondents were therefore asked to respond on items touching on computer studies in their school curriculum, number of working computers and where in the school were the computers used.

##### **4.4.1 School that offered computers studies in their curriculum**

Schools offering computerized studies in their curriculum tended to have ICT infrastructure as it formed instructional materials in the delivery of the curriculum. Computer studies had great weight in explaining the availability of ICT infrastructure in the schools. The respondents gave their responses on the schools that offered computer studies in their curriculum as shown in table 4.5.



**Table 4.5**

**Schools that offered computer studies in their curriculum**

<b>Computer studies in curriculum</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Yes	46	55.4	7	43.75
No	37	44.6	9	56.25
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

According to table 4.5, half of science teachers noted that their schools offered computer studies in their curriculum which was attributed to the ICT infrastructure available in their schools while 37 reported that computer studies was not offered in their school a factor attributed to non existence of ICT infrastructure. The science HODs also gave their response on the item where only 7 out of 16 schools offered computer studies in their curriculum. The seven schools 43.75% had well established ICT infrastructure, which gave them advantage to integrate ICT.

**4.4.2 Computer laboratory**

Computer Laboratory was of great importance for it would help to provide opportunity for ICT infrastructure for the integration ICT and use of digital content in secondary schools.

Computer laboratory was considered because its equipments could provide the teachers with opportunity to prepare digital content to deliver ICT supported

lessons and have regular booking of computer laboratory to present their lessons.

**Table 4.6**

**HoDs Responses on schools with computer laboratory**

<b>Computer laboratory available</b>	<b>Yes</b>		<b>No</b>		<b>Total</b>
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	
	7	43.7	9	56.2	16

From table 4.6 out of 16 science HoD 7 indicated that their schools had computer laboratory while 9 respondents reported that their schools lacked computer laboratory which accurately confirmed response on computer studies in the curriculum which gave the same percentages. The results of the study on this item confirmed the study by Akunja (2011) on the availability of ICT infrastructure in Kisumu East District who found out most schools lacked computer laboratory.

#### **4.4.3 Use of computers in the school**

Use of computer in the school was central to the study as the place of use determined the likelihood that the school will embrace ICT in the teaching of sciences. The respondents gave their views on this item as shown in table 4.7

**Table 4.7****Extent ICT use in the school**

<b>Place of use of computers</b>	<b>Science teachers</b>		<b>Science HODs</b>		<b>Principals</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Office Administration	37	44.6	5	31.2	8	5.0
Lesson preparation	15	18.1	5	31.5	2	12.5
Science Laboratory	63	75.9	2	12.5	2	12.5
Classrooms	0	0	7	43.7	2	12.5
Library	23	27.7	7	43.7	2	12.5

From table 4.7 majority of schools used ICT equipment in the administration office where 44.6% of science teachers reported that computers were used in the administration offices for administrative duties which was also confirmed by principals who also reported at the rate of 50% and in classroom where teaching went on teachers reported 0% with principals and science HODs had 12.5% and 43.75% respectively which could be attributed to few ICT equipments in the schools under the study. Lesson preparation which requires regular working to prepare digital content recorded low percentages among the three categories of respondents 18%, 31.25 and 12.5 science teachers, science HODs and Principals respectively. Use in science laboratory recorded high percentage among the teachers of 75.9% while the HODs and Principals recorded 12.5%. These findings confirmed the study by Omufuoko (2009) on factors influencing the use of information and communication technologies for

learning among students at the technical colleges in Nairobi Province who confirmed that computers were mainly used in computer laboratory.

#### **4.5 Information and communication technology skills level of science teachers**

Information and communication technology skill level of science teachers determine effective teaching delivery and zeal in curriculum delivery. ICT skill level of science teachers therefore result into adequate lesson preparation with ICT enabled content leading to efficient lesson delivery. The ICT skill level of the teachers was considered because the teacher is a facilitator of teaching therefore the skill capacity is very key in influencing learning among the students. Skill level in ICT enable the science teachers to have regular booking of computer laboratory. Table 4.8 shows the ICT skill level of science teachers and science HoDs in the sampled schools for the study.

**Table 4.8**  
**ICT skill level of the respondents**

<b>Level of computer training</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Packages	45	54.2	10	62.5
Certificates	23	27.7	3	18.75
Diploma	15	18.1	3	18.75
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

The respondents were required to state their level of computer training. Table 4.8 shows that majority of science teachers had computer packages training. From the table out of 83 science teachers 45 (54.2%) had computer packages, 23 (27.7%) had Certificate training while 15 (18.1%) had Diploma. The same trend was noted among science HODs where 10 (62.5%) had packages while those with Certificate and Diploma were 3 each at 18.75%. It was evident that majority of science teachers and HOD science had computer packages as their level of training in computer.

#### 4.5.1 Computer training sponsorship

The study was also interested to identify if training cost in ICT could have influence on teachers integrating ICT in their teaching. Training cost have direct influence on the number of teachers enrolling of ICT training. If there is cost effective sponsorship, many teachers would opt to take computer courses which are likely to improve on curriculum delivery. Response of teachers ICT literacy sponsorship was tabulated as illustrated in Table. 4.9.

**Table 4.9**

#### **Computer training sponsorship of science and science HoDs**

<b>Sponsor</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
School	15	18.1	2	12.5
Self	67	80.7	14	87.5
Well Wishers	1	1.2	0	0
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.9 which had responses on respondent's computer training sponsorship, majority of teachers sponsored themselves for the training were 67 (80.7%) of science teachers sponsored themselves while 18% were sponsored by the school and only 1.2% were sponsored by well wishers. The science HODs had the same trend where 14 out of 16 (87.5%) had self sponsorship while only 2 (12.5%) were sponsored by their schools. This trend shows that the teachers were interested to further their computer skills.

#### **4.6 Frequency of ICT use in the teaching of science**

This was of central importance to his study as it determined how often the science teachers integrated ICT to deliver their lessons. Frequency of ICT use was an indicator that teachers are moving away from convectional teaching methods to students' centred methodology which is very interactive.

##### **4.6.1 Embracing ICT in teaching**

The respondent's opinion was sought on the use of ICT in teaching of sciences. The respondents gave their response of this item as tabulated in table 4.10. Table 4.10 indicates that all the 83(100) science teachers embraced ICT in their teaching while 81.25% of science HODs integrated ICT.

**Table 4.10**

**Frequency of using ICT integration in teaching of sciences**

<b>Embracing ICT in teaching</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Yes	83	100	13	81.25
No	0	0	3	18.75
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

**4.6.2 Science subjects where ICT integration was embraced**

The respondents were asked to rate how ICT was embraced in the science subjects the respondents gave their responses as illustrated in the table 4.11, 4.12 and 4.13.

**Tables 4.11**

**Frequency of using ICT in teaching Physics**

<b>Embrace ICT in teaching physics</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Yes	20	24.1	4	25
No	63	75.9	12	75
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.11 majority of the Physics teachers did not embrace ICT in teaching where 63(75.9%) teachers and 12(75%) taught without embracing ICT with only between 20-25% embracing the technology in their teaching.

**Table 4.12****Frequency of using ICT in the teaching Chemistry**

<b>Embrace ICT in teaching Chemistry</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Yes	27	24.1	5	31.25
No	56	67.5	11	68.75
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.12 majority of chemistry teachers did not embrace ICT where 56(62.5%) teachers and 68.75% of science HODs gave report that they were not integrating ICT in teaching of Chemistry.

**Table 4.13****Frequency of using ICT integration in teaching of Biology**

<b>Embrace ICT in teaching Biology</b>	<b>Science teachers</b>		<b>Science HODs</b>	
	<b>Frequency</b>	<b>%</b>	<b>Frequency</b>	<b>%</b>
Yes	30	36.1	8	50
No	53	63.9	8	50
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.13 above majority of Biology teachers 53(63.9%) did not embrace ICT in their teaching while 50% of HODs embraced in ICT in their lessons.



### 4.6.3 Lessons delivered using ICT

The respondents were asked to rate the number of lessons delivered using ICT in the three science subjects. The responses are tabulated in table 4.14.

**Table 4.14**

#### Lessons delivered using ICT

Lessons delivered using ICT	Science teachers		Science HODs	
	Frequency	%	Frequency	%
All	1	1.2	1	6.25
3	6	7.2	2	12.5
2	12	14.5	5	31.25
1	33	39.8	5	31.25
N/A	31	37.3	3	18.75
<b>Total</b>	<b>83</b>	<b>100</b>	<b>16</b>	<b>100</b>

From table 4.14 majority of science lessons were delivered without embracing ICT where 31 (37.3%) admitted that all their lessons were delivered without embracing ICT while only between 1.2% and 6.25% had all their lessons delivered embracing ICT.

### 4.6.4 Challenges faced in integrating ICT in teaching sciences.

The study had interest in the challenges that teachers faced in integrating ICT which when well addressed the teachers will adopt effectively ICT use in their teaching. The respondents cited three major challenges, which affected

integration of ICT in teaching of sciences in their schools. These challenges are shown in table 4.15 below;

Table 4.15 shows challenges faced by schools integrating ICT

**Table 4.15**

**Challenges faced in integrating ICT**

<b>Challenge</b>	<b>Frequency</b>	<b>Percentage</b>
Inadequate computers	55	47.8
Lack of ICT knowledge	51	44.4
Lack of computer laboratory	9	7.8

The first challenge was on inadequate computers where most schools had a low student computer ratio, which made the teachers to mainly use conventional methods of teaching. The few available computers also had network problem which affected downloading of some contents. Many schools lack LCD projector for power point presentation and hiring of the same also proved to be expensive. Schools have also not acquired smart boards as well as relevant software to enable integration. The few computers had malfunctioning which hindered effective integration.

The second challenge was lack of ICT knowledge where majority of teachers just had basic computer training with non having degree in ICT. Possession of ICT skill provides the teacher with opportunity to manipulate ICT equipment with regard to connection and even internet surfing to get relevant content.

The ICT skills also enable teachers to prepare ICT enabled lessons and regular booking of ICT laboratory to deliver the prepared content. The levels of ICT training also provide the teacher with the confidence to organize simulations using computers to avoid dangerous experiments.

The last challenge that was noted in the study was lack of ICT laboratory in most of the schools for safe storage of ICT equipments. Computers require safe and secure storage with burglar proof windows and doors which were missing in most of the schools. Availability of computer laboratory will ensure that all the computers are networked and internet connectivity installed. This challenge could be attributed to financial constraints that majority of the schools faced. This also explains inadequacy of ICT equipments in the schools.

#### **4.7 Strategies used to promote ICT use**

Based on the challenges experienced in the integration of ICT use in the teaching of sciences, the science teachers suggested strategies that need to be put in place to address those challenges as shown in table 4.16. To address the first challenge of inadequate computers, majority of the teachers suggested that schools should buy more computers to increase the number to meet recommended computer student ratio. Some also suggested backup generator be purchased to address power blackouts. Teachers were also of the opinion that digital content be made available to all schools to facilitate effective integration.

**Table 4.16**

**Strategies promote ICT use**

The table below shows strategies to be adopted by the schools

<b>Strategy</b>	<b>Frequency</b>	<b>Percentage</b>
Purchasing more computers	32	27.8
In-servicing of science teachers	83	72.2

From the table 4.16 majority of the teachers were of the opinion that teachers be in serviced to upgrade their ICT skills in order to enhance integration of ICT in teaching of sciences. On science teacher's computer knowledge, the respondents suggested that teachers be in serviced by their schools in ICT through school based workshops. Some also suggested that SMASE funds at the District planning committee account be used to in service science teachers in ICT. Other strategies on ICT skill level upgrading included regular in fresher courses, training in ICT and employing an instructor to capacity build the teachers. It is hoped that if these strategies are employed by science teacher, then ICT integration will be effectively embraced in the teaching of sciences.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter focuses on the summary of the study conclusions, recommendations and suggestions for further research.

#### **5.2 Summary**

The study investigated determinants of ICT integration in the teaching of science in public secondary schools in Kisumu East District. The study was guided by four objectives. Reviewed literature from different sources revealed that ICT infrastructure is a very important determinant in the integration of ICT in teaching of sciences as it influenced the type of digital content to be used and where to use the content. In addition, it emerged that ICT skills level was still very low and this needs to be upgraded through in-servicing to enable them manipulate the ICT equipment. The literature also revealed that inadequate ICT equipments have reduced the frequency of ICT enabled lessons in public secondary school. The literature review also found out that there are strategies put in place to promote use.

The study was guided by Vygotsky's social constructivism theory, which postulates that in the process of knowledge construction and cognitive development, of principal importance is the social context within which teaching and learning takes place. The methodology used for the study involved descriptive survey design which involves obtaining information concerning the current status of phenomena to help draw valid conclusions

from discovered facts. The study targeted 31 public secondary schools in Kisumu East District. The researcher used simple random sampling to obtain the 16 schools. Three sets of questionnaires were used for the study, science teachers, science HoDs and principals. Data collection has done by physical administration of the questionnaires. The collected data was collated and analysis done using both qualitative and quantitative approaches. The results were presented using tables, frequencies and percentages with brief explanation of the relevant interpretation.

The study pursued four objectives and consequently made four major findings. The first objective has to determine availability of ICT infrastructure in Public Secondary Schools used in the teaching of sciences in Kisumu East District. The ICT infrastructure was conceptualized into computers studies in the curriculum, computer laboratory and use of computer in the school. The study revealed that majority of schools did not offer computer studies in their curriculum in that out of 16 schools, 9(56.25%) were not offering computer studies which could be attributed to non availability of such ICT infrastructure.

On availability of computer laboratory, the same trend was evident where 9 schools 56.25% lacked computers laboratory. The place of use of computers in school was central to integration of ICT. Of the five places of use of computers in the school administration office had between 44.6% and 50% while classroom had the lowest percentage of use of 0% among teachers and 12.5% among the school principals. It was therefore concluded that the

schools had few ICT infrastructure whose use was mainly in the administration office.

The second objective was to determine ICT skill level of science teachers in ICT use in teaching of science in Public Secondary Schools in Kisumu East District. This objective looked at the level of teachers' computer training and training sponsorship. The study established the majority of teachers had computer packages where 45(54.2%) of science teachers and 62.2% science HODS with packages. It was evident that the majority of the science teachers had basic computer training. On sponsorship for training majority of the science teachers sponsored themselves were 67(80.7) and 14(87.5%) science teachers and science HOD'S sponsored themselves respectively. It is therefore concluded that science teachers and HOD had basic level of computer training.

The third objective was to establish the frequency of ICT use in the teaching of sciences in Kisumu East District. The study established that majority of science teachers and science HoDs embraced ICT in their teaching. However, the number of lessons where ICT was integrated was low in all the three sciences subjects with 39% of the science lessons delivered without ICT integration and only 1.2% of the science teachers integrating ICT in all their lessons.

The fourth objective was to identify strategies used by Secondary School to promote ICT use in teaching of sciences in Kisumu East District. The study established that the school adopted three main strategies. First strategy was equipping ICT infrastructure of the school by purchasing more computers to increase student computer ratio. Second strategy was to in-service science teachers to improve their ICT skills. The third strategy was to mobilize funds for construction and equipping of computer laboratory. It was evident that there was need to put strategies in place to improve on ICT integration in the teaching of sciences.

### **5.3 Conclusions**

The study sought to establish the determinants of ICT integration in the teaching of sciences in Public Secondary Schools in Kisumu East District. The study found out that availability of ICT infrastructure is a determinant in ICT integration as schools that offered computer studies in their curriculum had well established infrastructure and majority of science teachers had their lessons furnished with ICT enabled content. The ICT infrastructure was then a determinant in the integration of ICT in teaching of sciences. ICT skill level of science teachers also largely influenced ICT integration. The study established that majority of the science teachers were not well equipped with ICT knowledge and this influenced their manipulation ability of ICT gadgets.



On frequency of ICT use, the study found out that the teachers rarely use ICT to deliver their lessons. The study also established that strategies have been identified to improve on ICT integration especially in-servicing of teachers, building and equipping science laboratory and purchasing of come computers.

#### **5.4 Recommendations**

Basing on the findings of the study and the conclusions made, a number of recommendations were pointed out:

- i) The principals with the Board of Management of their schools should prioritize ICT infrastructure in their five years strategic plan to enable their schools to be well equipped with ICT infrastructure to facilitate ICT integration as the school were noted by the findings to be having inadequate ICT infrastructure.
- ii) The policy makers at the Ministry of Education and Teacher Service Commission should prioritize in-servicing of science teachers to improve their ICT skills as the study found that majority of the science teachers had low skills in ICT. The District Education Officer with Quality Assurance and Standards Department should continue with SMASE INSET on ICT integration every year. Teacher training colleges and universities also need to introduce ICT component in all science subjects.
- iii) All science teachers should embrace ICT integration in the delivery of their lessons. Quality Assurance and standards Officers should ensure that in their Standards Assessment they capture ICT integration in order to give appropriate feedback.

### **5.5 Suggestions for further research**

Despite the findings observed by the study, there are still some areas which may need further research to be able to understand determinants ICT integration in the teaching of sciences better. These include:

- i) Replication of the study in another District, which is dominantly rural setting.
- ii) Conducting a study on school based factors that influence ICT integration in teaching and learning in secondary school.

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## APPENDICES

### APPENDIX I

#### QUESTIONNAIRE FOR SCIENCE TEACHERS

**Instructions:** Please enter the choice you have made by ticking (√) the answer in the space corresponding to your choice for structured questions. Write the response for the open ended question in the space provided.

Your name will be treated with strict confidentiality and will not be published in this study.

#### Section A: Back ground information

1. What is your gender?

Male ( )

Female ( )

2. What is your highest academic qualification?

PH.d ( )

M.Ed. ( )

B.Ed. ( )

B.Sc. ( )

Dip. Ed. ( )

Others (please specify) \_\_\_\_\_

3. How many years of teaching experience do you have?

1 – 3 years ( )

4 - 6 years ( )

7 – 9 years ( )

Over 9 years ( )

4. Which subjects do you teach?

Biology ( )

Chemistry ( )

Physics ( )

### **Section B**

1. ICT Infrastructure/Equipment

Does your school offer computer studies in curriculum?

Yes ( )

No ( )

2. What is the total number of working computers do you have in your school?

1 - 5 ( )

6 – 10 ( )

11 – 15 ( )

Over 15 ( )

3. Where in the school are the computers used?

Administration office ( )

Lesson preparation and teaching ( )

Library ( )

Computer Laboratory ( )

4. ICT skill level of teachers in ICT use.

(i) What is the level of your computer training?

Packages ( )

Certificate ( )

Diploma ( )

Any other (please specify) \_\_\_\_\_

(ii) Who sponsored you for computer literacy programmes?

School ( )

Self sponsored ( )

NGO ( )

Well wishers ( )

Any other (please specify) \_\_\_\_\_

a) Do you embrace ICT integration in teaching and learning of sciences?

Yes ( ) No ( )

b) If yes, in which subject(s) mostly?

Physics ( ) Chemistry ( ) Biology ( )



c) How many lessons per week in the identified subject(s) is delivered using ICT?

All lessons ( )

3 lessons ( )

2 lessons ( )

1 lesson ( )

None ( )

d) Which challenges do you face integrating ICT in your teaching of sciences?

i) \_\_\_\_\_

ii) \_\_\_\_\_

iii) \_\_\_\_\_

iv) \_\_\_\_\_

c) What are the strategies you put in place to solve the cited challenges?

i. \_\_\_\_\_

ii. \_\_\_\_\_

iii. \_\_\_\_\_

iv. \_\_\_\_\_

## APPENDIX II

### QUESTIONNAIRES FOR HODS

**Instruction:** Please enter the choice you have made by ticking (✓) answer in the space corresponding to your choice for structured question. Write the response for the open ended question in the space provided.

Your name will be treated with strict confidentiality.

#### Section A: Background information

1. What are your teaching subjects?

Maths/Physics ( )

Maths/Chemistry ( )

Biology/Chemistry ( )

Maths/Geography ( )

Maths ( )

2. What is your gender?

Male ( )

Female ( )

3. How many years teaching experience do you have?

1 - 3 years ( )

4 – 6 years ( )

7 – 9 years ( )

Over 9 years ( )

4. What type is your school?
- Day ( )
- Boarding ( )
- Day/Boarding ( )
5. Which category is your school?
- National ( )
- Provincial ( )
- District ( )
6. Where is your school located?
- Urban ( )
- Peri-Urban ( )
- Rural ( )

## **Section B**

### **I. ICT Infrastructure**

1. Does your school offer computer studies in the curriculum?
- Yes ( ) No ( )
2. Do you have a computer laboratory?
- Yes ( ) No ( )
3. What is the total number of working computers in the computer laboratory?
- Over 40 ( )
- 10 – 20 ( )

4. Where in the school are the computers used?

In administration office ( )

In lesson preparation and teaching ( )

Science laboratory ( )

Classrooms ( )

Library ( )

5. Apart from computers what other ICT equipments does your school have?

LCD Projector ( )

Flash Discs ( )

Printer ( )

CD ( )

Any other, specify\_\_\_\_\_

## II. ICT skill level of science teachers

1. How many teachers are in your department?

Over 15 ( )

10 – 15 ( )

(10 -5 ( )

Less than 5 ( )

2. How many teachers are computer literate?

Over 15 ( )                      10 -15 ( )

5- 10 ( )                      Less than 5 ( )

None ( )

3. What is the level of your teachers in computer training

Certificate ( )

Diploma ( )

Degree ( )

Any other (please specify) ( )

4. Who sponsored teachers for computer literacy programmes?

School ( )

Self sponsored ( )

NGO ( )

Well wishers ( )

Any other, specify \_\_\_\_\_

### III. Frequency of ICT use in teaching learning of sciences

1. Do teachers embrace ICT integration in teaching and learning of sciences?

Yes ( ) No ( )

2. If yes, in which subjects(s) mostly?

Physics ( )

Chemistry ( )

Biology ( )

Mathematics ( )

Computer Studies ( )

Any other, specify \_\_\_\_\_

3. How many lessons per week in the identified subject(s) is delivered using ICT?

All the lessons ( )

3 lessons ( )

2 lessons ( )

1 lesson ( )

None ( )

**IV. Strategies used to promote ICT use**

1. Does your school have plans to use/increase use of ICT in teaching of sciences?

Yes ( ) No ( )

2. Is it contained in the school's strategic plan?

Yes ( ) No ( )

3. What are the strategies in your school to increase use of ICT in teaching of sciences?

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## APPENDIX III

### PRINCIPALS' QUESTIONNAIRE

Instruction: Please enter the choice you have made by ticking answers in the space corresponding to your choice for structured questions and the space provided for open ended questions.

#### Section A: Background information

1. What is your gender?

Male ( )

Female ( )

2. What is your highest academic qualification?

M.Ed ( )

B.Ed ( )

B.Sc. ( )

Dip. Ed ( )

Others (please specify) \_\_\_\_\_

3. How many years of teaching experience do you have?

1- 3 years ( )

4- 6 years ( )

7- 9 years ( )

Over 9 years ( )

4. What type is your school?

Day ( )

Boarding ( )

Day/ Boarding ( )

5. Where is your school located

Urban ( )

Peri urban ( )

Rural ( )

### **Section B**

1. What is the total number of working computers does your school have?

Over 20 ( )

16- 20 ( )

11-15 ( )

6- 10 ( )

1-5 ( )

2. Do you have computer laboratory?

Yes ( )

No ( )



3. Where in the school are the computers used?

Administration office ( )

Lesson preparation and teaching ( )

Science Laboratory ( )

Classroom ( )

Library ( )

4. How many teachers are computer literate in your school?

Over 15 ( )

10 – 15 ( )

5- 10 ( )

Less than 5 ( )

5. Which subject has many computer literate teachers?

Biology ( )

Chemistry ( )

Physics ( )

6. Do teachers embrace ICT integration in teaching in your school

Yes ( ) No ( )

If yes which subject?

Biology ( )

Chemistry ( )

Physics ( )

7. Does your school have plans to use/ increase use of ICT in teaching?


Yes ( ) No ( )

8. What strategies do you have in ICT integration in your school?

## APPENDIX IV

### RESEARCH AUTHORIZATION

REPUBLIC OF KENYA



**NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY**

Telephone: 254-020-2213471, 2241349, 254-020-2673550  
Mobile: 0713 788 787 , 0735 404 245  
Fax: 254-020-2213215  
When replying please quote  
secretary@ncst.go.ke

P.O. Box 30623-00100  
NAIROBI-KENYA  
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/13/013/41** Date: **20<sup>th</sup> May, 2013**

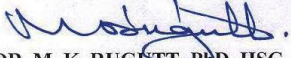
Joseph Ondhoro Ochieng  
University of Nairobi  
P.O Box 30197-00100  
Nairobi

**RE: RESEARCH AUTHORIZATION**

Following your application dated **3<sup>rd</sup> May, 2013** for authority to carry out research on *“Determinants of Information and Communication Technology integration in the teaching of sciences in public secondary schools in Kisumu East District-Kenya.”* I am pleased to inform you that you have been authorized to undertake research in **Kisumu East District** for a period ending **30<sup>th</sup> June, 2013**.

You are advised to report to the **District Commissioner and District Education Officer, Kisumu East District** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

  
**DR. M. K. RUGUTT, PhD, HSC.**  
**DEPUTY COUNCIL SECRETARY**

Copy to:

The District Commissioner  
The District Education Officer  
Kisumu East District

“The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development”.

# APPENDIX V

## RESEARCH PERMIT


PAGE 3

**Research Permit No. NCST/RCD/13/013/47**  
**Date of issue 20<sup>th</sup> May, 2013**  
**Fee received KSH. 1,000**

**THIS IS TO CERTIFY THAT:**  
**Prof./Dr./Mr./Mrs./Miss/Institution**  
**Joseph Ondhoro Ochieng**  
**of (Address) University of Nairobi**  
**P.O Box 30197-00100, Nairobi**  
**has been permitted to conduct research in:**

**Location**  
**Kisumu East District**  
**Nyanza Province**


**on the topic: Determinants of Information and Communication Technology integration in the teaching of sciences in public secondary schools in Kisumu East District-Kenya.**

**Applicant's Signature**  **Secretary National Council for Science & Technology**

**for a period ending: 30<sup>th</sup> June, 2014.**

**CONDITIONS**

- 1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit**
- 2. Government Officers will not be interviewed with-out prior appointment.**
- 3. No questionnaire will be used unless it has been approved.**
- 4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.**
- 5. You are required to submit at least two(2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.**
- 6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice.**


  
**REPUBLIC OF KENYA**  
**RESEARCH CLEARANCE PERMIT**

**GPK60551mt10/2011 (CONDITIONS—see back page)**

APPENDIX VI

RESEARCH AUTHORIZATION FROM DISTRICT COMMISSIONER  
KISUMU EAST

REPUBLIC OF KENYA



**NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY**

Telephone: 254-020-2213471, 2241349, 254-020-2673550  
Mobile: 0713 788 787 , 0735 404 245  
Fax: 254-020-2213215  
When replying please quote  
secretary@ncst.go.ke

P.O. Box 30623-00100  
NAIROBI-KENYA  
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/13/013/41** Date: **20<sup>th</sup> May, 2013**


Joseph Ondhoro Ochieng  
University of Nairobi  
P.O Box 30197-00100  
Nairobi

**RE: RESEARCH AUTHORIZATION**

Following your application dated 3<sup>rd</sup> May, 2013 for authority to carry out research on *"Determinants of Information and Communication Technology integration in the teaching of sciences in public secondary schools in Kisumu East District-Kenya."* I am pleased to inform you that you have been authorized to undertake research in **Kisumu East District** for a period ending 30<sup>th</sup> June, 2013.


You are advised to report to the **District Commissioner and District Education Officer, Kisumu East District** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

  
**DR. M. K. RUGUTT, PHD, HSC.**  
**DEPUTY COUNCIL SECRETARY**

Copy to:

The District Commissioner  
The District Education Officer  
Kisumu East District

*Authorized*  
  
11/6/2013


*"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development"*



## APPENDIX VII

### RESEARCH AUTHORIZATION FROM DISTRICT EDUCATION OFFICE

MINISTRY OF EDUCATION

Telegrams:		DISTRICT EDUCATION OFFICE
Telephone: Kisumu (057) 2022626		KISUMU EAST
When replying please quote		P.O. BOX 1914
	REF:KSM/E/MISC./29/VOL.III/(171)	KISUMU
		11 <sup>TH</sup> JUNE, 2013

**TO WHOM IT MAY CONCERN**


**RESEARCH AUTHORIZATION**  
**JOSEPH ONDHORO OCHIENG'**

---

The above named is a student pursuing Masters Degree in Education at the University of Nairobi.

This is to certify that, he has been granted authority to undertake research on *"Determinants of Information and Communication Technology Integration in the teaching of sciences in public secondary schools in Kisumu East District - Kenya"* for a period ending *30<sup>th</sup> June, 2013.*

Kindly accord him the necessary assistance he requires to accomplish the assignment.

  
FOY DISTRICT EDUCATION OFFICER  
KISUMU EAST DISTRICT

**THOMAS ODHIAMBO OKELLO**  
FOR: DISTRICT EDUCATION OFFICER  
KISUMU EAST