



UNIVERSITY OF NAIROBI
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SCHOOL OF COMPUTING AND INFORMATICS

A FRAMEWORK FOR HARNESSING ICT RESOURCES USE TO IMPROVE THE
ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN KIAMBU
SUB- COUNTY

BY:
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Declaration

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

Signed

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This project report has been submitted in partial fulfillment of the award of Master of Science in Information Systems with my approval as the university supervisor.

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DEDICATION

This work is dedicated to my son Lance Mbogo Njeru and my daughter Antonia Kathomi Njeru for their kind love and moral support.

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LIST OF ACRONYMS

IT: Information technology

ICT: Information communication technology

CD: compact disk

C.E.O: County Education Officer

TOEFL: Test of English as a Foreign Language

ITS: Intelligent tutoring system

SPSS: Statistical Package for Social Scientists

NCST: National Council for Science and Technology

MP3: Compressed file format using MPEG1 layer 3 compression

QCA: Qualification and curriculum Authority

CAI: Computer Assisted Instructions

BECTA: British Educational Technology Association

TSC: Teachers Service Commission

UNESCO: United Nations Educational Scientific and Cultural Organization

Abstract

Life today is dominated by technology. In order to achieve vision 2030 and get to the era of globalization, our schools needs to effectively and efficiently utilize ICT resources and enhance flow of information. This study developed a framework for harnessing ICT resources use in Kiambu Sub-County. In order to develop a framework, the study examined whether availability of ICT resources has an outcome on students academic performances, examined extend of availability of ICT resources in schools and identified the challenges for harnessing ICT resource use. The study was guided by three educational theories namely: Behaviorist theory by B.F. Skinner, social learning theory by Albert Bandura, and constructivist theory by Seymour. Four frameworks reviewed include analytical framework by Roger Blamire used for the integrated analysis; Kang's model on impacts of ICT use on school learning outcome dealing with factors influencing ICT use and educational performance of learners; Bilbao-Osorio's model which is used to define appropriate method for measuring the impact of ICT on teaching and learning process and Marcelo Cabrol and Eugino Severin's framework which is used to support the design, implementation, monitoring and evaluation of ICT projects in schools. The study adopted an ex-post facto approach using descriptive survey design. Eight public secondary schools in Kiambu Sub-County were targeted. Stratified sampling design was used to select the schools. Questionnaires were administered to teachers, students and school principals. Data collected was analyzed using descriptive and inferential statistics. The tools used to analyze are frequency tables with percentages, mean, standard deviation, correlation, t-test and CHI-square test. The findings show that harnessing ICT resource use in Kiambu Sub-County was still very low due to a number of huddles. The huddles are: limited availability of different ICT resources, limited ICT infrastructures, teacher's and student's lack ICT skills, lack of interest by teachers and absences of technical support.

CHAPTER ONE: INTRODUCTION

1.1 The background

Many sectors have applied ICT and in particular the education sector making it a topic of discussion in the technological arena. In order to increase pupil's academic performance, educators have accepted information communication technology (ICT) as a tool to change the teaching methods. This is because ICT offers a wide range of tools that lead to the change of the teaching process from a closed, rigid and teacher centered to an exciting interactive educational process centered on learners (H.K. Senapaty, 2010).

ICT's have been integrated by many educational institutions in the world and are using it as a method of teaching and learning. In Kenya in particular, many educational institutions have adopted ICT as method of teaching.

Schools today face many challenges when planning and deploying ICTs (Jo Tondeur 2007). These challenges include:

- a) Decision makers including the principals do not consider the objectives of education at all when acquiring ICT. They acquire ICTs without considering the purpose they will serve.
- b) Decision makers focus on the purchase of ICT hardware and software without considering the acquisition of the appropriate content, training of teachers, support and maintenance of ICT resources. They only budget for acquiring ICT resources without factoring in the cost of replacement, personnel, maintenance and technical support.
- c) Schools with computers for students have no incentives to use the same computers in class rooms. Computers are rarely used outside computer classes. The cause could be that teachers have no adequate training or they lack time to prepare the class and incorporate the use of the technology in teaching and learning.
- d) There is limited or no monitoring and evaluation done on the benefits obtained and mistakes made when introducing ICTs in schools.

Some schools in Kiambu sub-County have incorporated ICT into their teaching and learning with the hope of improving their academic performance yet struggling with poor performance. The researcher examined extent of the availability of ICT resources in Kiambu sub-county; identified the challenges for harnessing ICT resources to improve performance of

students' in Kiambu sub-County, established that there is no existing framework for harnessing the use of ICT resources for improvement of students performance in Kiambu sub-county and suggested a need to develop a framework for harnessing the use of ICT resources. The delivered conceptual framework is for developing indicators that trace the development, use and outcomes of ICTs in schools where ICT has been introduced to improve academic performances. This framework would map factors affecting the development and use of ICT resources and their outcomes on student's academic performances.

Focusing on ICT outcome can help schools concentrate on their aims and bring about the changes that will help achieve those aims. It can also help make services more students focused and needs led by identifying what works well and what could be improved. It also improves a sense of purpose and clarity about what the school is trying to achieve in terms of ICT.

According to Eugenio Severin (2009), the main challenge in use of ICT in schools is lack of indicators offering clear criteria to policy makers so as to make informed decisions. He (Eugenio) further says that most ICT projects in schools have not gone through any evaluation process and if they have, ICT use outcomes on performance have not been the focus. The main aim of the framework is that the goal of all ICT projects in schools is to improve academic performance (Kington et al 2001). The goal expected and measured in these projects should be the performance outcome brought out by development and use of ICT resources.

1.2 Statement of the problem

Students' learning remains central in any academic achievement debate. ICTs provide an opportunity for educational institutions to harness the use of technology to improve academic performance. According to Gaku et al, (2008), a lot has been directed towards the acquisition of ICT equipment in Kenya. Teaching and learning are two processes that go together. Kurmar (2008) in his paper "Convergence of ICT and Education" indicated that there are four Stages of teaching and learning using ICT. The four stages are discovering ICT tools, learning how to use ICT tools, understanding how and when to use ICT tools and specializing in the use of ICT tools. The four stages of integrating ICT tools in education are not the only challenges that hinder the

exploration and exploitation of ICT tools in education. Since Kenya is a developing country, infrastructure is a major challenge. Internet facilities have not reached most parts of the country.

Therefore despite the enormous advocacy of ICT aided teaching and learning and the heavy investment on ICT equipment, schools still faces the challenge of how to transform students' learning process (Opira, 2010). This possibly has impacted negatively on student's performance in both internal and national examination. This study therefore, ventured in answering the question: "What challenges are experienced by teachers and learners in harnessing the use of ICT resources in teaching and learning in secondary schools of Kiambu sub-county?"

1.3 Purpose of the study

This study examined extent of the availability of ICT resources in schools in Kiambu sub-county.; identified the challenges for harnessing ICT resources to improve performance of students in Kiambu sub-County, established whether there existed a framework for harnessing of ICT resources for improvement of students performance in Kiambu sub-county schools and suggested development of a framework for harnessing ICT resources. The researcher has developed a tentative framework which can possibly be adopted by Kiambu sub-county.

1.4 Objectives of the study

In undertaking this study, the researcher was guided by the following objectives:

- (i) To examine whether the availability of ICT resources has an outcome on students' academic performance in schools of Kiambu sub-county.
- (ii) To identify the challenges for harnessing ICT resources to improve performance of students in Kiambu sub-County.
- (iii) To develop a framework for harnessing ICT resources to improve performance of students in Kiambu sub-County.
- (iv) Validate the proposed framework for harnessing ICT resources to improve performance of students in Kiambu sub-County.

1.5 Research questions

This study ventured to seek answers to the following questions in regard to the challenges facing harnessing the use of ICT resources in secondary schools in Kiambu Sub County.

- (a) To what extent is ICT resources available in Kiambu sub- County for teaching and learning?
- (b) How do ICT resources affect academic performances in Kiambu sub- County?
- (c) What are the challenges for harnessing ICT resources to improve students' performance in Kiambu sub-County?
- (d) How to develop an ICT framework for the purposes of improving performance in Kiambu sub-county.

1.6 The Hypotheses

The study will be guided by the following Null hypotheses:

H₁: Availability of ICT has no positive outcome on students' performance in Kiambu sub-county.

H₂: Availability of ICT resources has no effect on students' academic performance in Kiambu sub-county.

H₃: Availability of infrastructure has no effect on students' academic performance in Kiambu sub-county.

H₄: Accessibility of ICT resources affects students' academic performance in Kiambu sub-county.

H₅: Availability of digital learning resources affects students' academic performance in Kiambu sub-county.

H₆: User-ability of ICT resources affects student academic performance in Kiambu sub-county.

H₇: Leadership awareness of the importance of ICT does not affect academic performance in Kiambu sub-county.

1.7 Limitations of the Study

- (i) Due to lack of funds the researcher was not able to visit many schools to collect data therefore few respondents were be sampled.
- (ii) There was limitation in terms of time.
- (iii) Unwilling respondents. Many teachers and principals were unwilling to divulge required information.

1.8 Significance of the study

The study sought to examine the extent of availability ICT resources for teaching and learning in Kiambu sub-county and identify the challenges for harnessing ICT resources in order to improve academic performance in public secondary schools in Kiambu sub-county. The findings from this research will assist in the Formulation of a policy for developing such a framework.

1.9 Definitions of terms

- (i) ICT integration: This is introduction of information and communication technology to teaching and learning environment
- (ii) Academic Performance: It is a term used for examining students based on how they are doing in their studies and examinations.
- (iii) ICT Impact: Are broader changes that occur within a school as a result of ICT outcomes. The effects are on the entire school
- (iv) ICT Outcome: Are short-term and immediate changes that occur in learners as a direct result of ICT experiences. The effects are on either an individual or group level.
- (v) Interoperability : It is a common rail gauge for sharing data between ICT systems, allowing information to be exchanged accurately, efficiently and economically

CHAPTER TWO: LITERATURE REVIEW

2.1. THEORETICAL FRAMEWORK

Three theories were used which informed the study and these are discussed below.

2.1.1 Behaviorist theory

B.F. Skinner an American psychologist believed that people can learn more effectively if their environment is carefully controlled. He developed the principle of operant (behavior) conditioning which states that “If the occurrence or an operant is followed by the presentation of reinforcement stimulus, the strength is increased” Skinner, (1938). This is a simple tactic of reinforcing the right behavior through reward and no reward for wrong behavior. This has led to the use of computers as a mode of teaching and learning, Skinner (1938). Many educational computer programs supply stimuli that measure a response and correct the wrong response.

With an effectively developed ICT program, high school students exploit the technology to read and assess their performance instantly as it happens in computer based tests such as language tests for example Toefl where the results are released instantaneously. This will act as an immediate reinforcement to the learners. That is why the researcher decided to propose how this program can be developed for Kiambu students to enhance performance.

2.1.2. Social learning theory

Albert Bandura,(1986) and Neal Miller(1941) recognizes that human learning is vicarious (Based on observation of models). Bandura’s model consists of four elements including attention processes, retention processes, motor reproduction processes and motivational processes.

Attention is directed at media content of potential relevance to our lives, personal needs and interests. What is learnt is retained and added to the existing stock of knowledge. Production is the actual application of what is learnt, where it may be rewarded or punished leading to greater or less motivation.

Social learning theory postulates that learners are impacted on what they observe in media such as internet, television and other ICT related media. For example many youth after

observing football players like Ronaldo making millions of dollars through soccer; they are tempted to polish soccer skills to the disadvantage of education.

In Sunday Nation 14th July 2014, it was reported that only 32% high school students in Kiambu join colleges and universities. This possibly can be attributed to the fact that many Students equate success to business and other income generating activities than pursue the academic live. The researcher sought to establish whether the programs or messages students in Kiambu County are exposed to have impact on their academic performance.

2.1.3. Constructivist theory

According to Seymour papert (1980), learner's motivation has an influence but it is not necessary for instruction which is a sharp contrast to Skinner's theory. Seymour view the learner as an active participant involved in structuring their own learning experiences.

Papert just like Piagets(1970) emphasizes the way in which knowledge is structured and organized and how the learner's prior perception to their experiences form the knowledge structure. Existing knowledge plays an important role on how learners relates to new experiences. Papert used the logo "programming language" with its screen turtle as a way of enabling learners to make the transition from concrete experiences to more abstract thinking.

ICT in schools can exploit this by allowing pupils construct their own understanding and knowledge of the world through experiencing things on computer programs and reflecting on those experiences. There is a great focus and emphasis on social and communication skills and collaboration and exchange of ideas through the internet. This is contrary to the traditional classroom where pupils work alone.

There are computer programs developed to allow pupils learn through experiments for example physical action (hands on activity through browsing) and facilitate classroom discussions.

2.2 ICT in general

According to William and Sawyer (2005) Information Technology (IT) is the term used to cover a whole range of hardware and software. They further say that Information Technology (IT) systems processes, stores and or transfers information and that IT merges computing with

high speed communications links carrying data and video. Examples of these technologies include but not limited to computers, Television, Telephone and various hand held devices.

According to Longman Dictionary of Contemporary English (New Edition, 2000) IT is the study or use of an electronic process for storing information and making it available. Information Technology (IT) systems use computers, Telecommunication Networks and other electronic devices to transfer information, hence the use of the word “communication” is very important in this case(Egbowon 2010). Hence we have the Information and Communication Technology (ICT).

Basically ICT could be seen as the combination of networks, hardware and software including the means of communication collaboration and engagement that enable the processing, management and exchange of data, information and knowledge, Ezekoka (2008)

In the context of school curriculum, the term Information and Communication Technology (ICT) is used to refer to a range of tools and techniques relating to computer-based hardware to communications including both directed and broadcast to information sources such as CD, DVDs and the internet and to associated technologies such as robots, video conferencing and digital TV. (Qualification and Curriculum Authority (QCA) 1999).

Through ICT, the whole world is reduced to a unit and any part of the world could be reached in a split of a second. That is why integration of ICT in learning is quite relevant especially in public schools hence the relevance of this project.

Information and Communication Technology (ICT) is vital to human development. This offers a wide range of tools that leads to the change of the teaching process from one closed and rigid, teacher centered or oriented to an exciting and interactive educational process centered on learners (Egbowon 2010).

ICTs use has been slow, partly contributing to the slow growth in the economies of developing world. The major impediment to the success of adopting these information and Communication technologies is user acceptance. (Gould, Boies & Lewis, 1991; Nickerson, 1981). Kenya like many African nations is still lagging behind in adoption of ICT in many areas, including the education sector and especially at primary and secondary schools. Shibanda and Musisi-Edebe (2000), pointed out that there is need for countries in Africa to accept ICT as a

priority area for development and hence invest adequately in it to promote economic development.

2.3 ICT in schools in Kenya

Information Communication and Technologies have opened a new door to change human life.”Internet is the first thing children in the twenty-first century choose whenever they encounter a question” (Myunghee et al 2011).

In Kenya, policy makers in the education field have started to pay attention to ICT use with the view of improving performance in schools and preparing pupils for the future.

ICT in schools can be used in three ways in order to improve school performance. (Heo and Kang 2009; Smaldino et al 2008). First ICT is used to improve teaching and learning. Teachers can use ICT to present, assess and monitor students in the process of acquiring knowledge and skills. Secondly, administrators can use ICT to enhance record keeping and students grading in schools. Thirdly, ICT can be used during learning to pass content and improve student’s information literacy or learning needs.

In January 2006, Kenya made a remarkable progress in putting in place a National ICT policy, framework and implementation strategy whose “aims to improve Kenyan livelihoods by availing of access, efficient, reliable and affordable ICT services”. Schools, colleges, universities and other educational institutions in the country are being encouraged by the government to use ICT in order to improve learning. The Ministry of Education has taken a step to support the strategy either directly or through various institutions and agencies with which it works with.

The importance of access to digital/video cameras, printers, scanners, fax machines, copiers and projectors in contributing to performance in education cannot be ignored. (Makhmud and Ismael 2008; Makhanu 2012). According to Hawkins (2002) more often than not computers are installed in schools around the world without sufficient thought being given on how these computers will be used. A number of secondary schools in Kenya introduced ICT to enhance teaching and learning. This justified the need to carry out a study on ICT in secondary schools in

Kiambu Sub County to establish the extent of ICT implementation and its outcome on academic performance.

2.4 ICT in learning

For a long time, teachers have been the dispensers of information in the classroom. This style of teaching known as “progressive teaching” has been there for over 50 years now.

According to Laurillard (1993), in higher education the traditional styles are not successful as it places too much emphasis on the teacher yet failure is blamed on the response of the learner. This is a fair description of how results are interpreted by teachers in secondary schools in Kenya and many other countries though these results are often interpreted as a measure of the success of individual schools and not the learner.

Laurillard (1993) argues that the instructional design as recommended by Gagne (1977) and the intelligent tutoring system (ITS) are a bit too restrictive.

Another researcher Naville Bennet (1976) reported that formal methods of instruction were more successful. However on the other hand Dick and Carey (1978) are one of the views that teacher dependant group-paced instruction is no longer the most profitable main style for the teacher but that they should be designers of instruction. All in all instructional design style is not easily manageable. Basically there seems to be a conflict as to which style of teaching is best. This underscored the necessity of this research where the researcher sought to establish how and whether the incorporation of ICT in learning had an effect on learner’s academic performance in Kiambu Sub County.

According to Bennet N. (1976), a new progressive style of teaching in high schools with a new computerized school curriculum is more relevant. To emphasize this point Cole and Criffin (1987) put forward arguments for teachers being orchestrators of computer-based activities. The researcher went to find out whether if this was applicable to high schools in Kiambu Sub County of Kenya. Cole and Criffin quoted researcher by Shavelson et al (1984) which evaluated most successful staff as those who integrated their use of computers into the curriculum in a variety of ways being prepared to change direction dependent on the learners.

According to Kumar (2008), the following benefits could be derived from the utilization and integration of ICT into teaching and learning:

(i) **Fast, accurate and direct exchange of information**

(ii) Information or messages goes electronically to the receiver. A large number of people are linked up through internet and websites. This is advantageous especially to learners.

(iii) **Rapid information processing**

Computer can sort or search through huge amount of information. Both small data and huge data can be transmitted within a specified time. This is very relevant to both teachers and learners.

(iv) **Easy handling of large amount of information**

Currently many tertiary institutions in Kenya are taking advantage of the benefits that ICT offers. Most of these institutions have computerized their systems for use at examinations, student's registrations, payment of fees etc. These can also be replicated in both primary and secondary schools. The researcher sought to find out whether this was practically applicable. Examination bodies such as Kenya National Examination Council (KNEC) are now able to register students online. Therefore there was need to find out if all the efforts being put in place has any influence on performance.

(v) **Increase availability of information**

Learners and teachers can now surf the internet for information relating to their field of study and other related matters as a result of development in Information science and technology.

(vi) **Improved quality of instruction**

The use of ICT in education has paved the way for more student-centered learning setting. ICT improves the quality of instruction by increasing the desire of the learner to explore, discover and create unique solutions to learning problems.

Today the teacher is no longer seen as the primary source of information but with the use of ICT, he is now viewed as a support, collaborator and a coach for students as they learn together and evaluate information for themselves.

Vii) ICT applies the principle of systems approach to teaching and learning.

This conserves the teachers' time and broadens the teacher's- students' access to information.

viii) ICT extends human experience

Human experience could be extended when dealing with materials that are not in the immediate environment of the learner. For example an animal like a lion can't be brought into class live rather a film or video can present it live in the class, or a zoo could be networked to the classroom through internet. Thus there is the need for ICT integration in learning.

ix) ICT helps to overcome physical limitations:

Through ICT, a lot of practices and procedures in all forms of endeavors have changed. Devices such as mobile phones, digital cameras PDAs, games consuls and MP3 players are gaining grounds among youth. Learners in developed countries no longer have the barrier of distance to contact their teachers whenever they encounter academic problem. This underscores the importance of this study.

With utilization of ICT, learners and their teachers can interact any time any day regardless of the location once they are connected to the net.

2.5 Students' performance in general

In Kenya the minimum entry requirement to university is a grade of C+. Few students attains this grade because of the many challenges they are exposed to one being the style of teaching which is conservative or where there is use of modern teaching style, it not being used to the advantage of the learners. In order to improve on this performance, teachers and the stakeholders need to integrate teaching and learning with ICT and monitor and evaluate its use.

2.6 ICT and students performances

For many people especially educators, ICT is the solution to the practical problems facing the progressive teacher. But are ICT and particularly the internet a tool for the traditionalist approach or a more progressive approach? This is a controversial debate but O'shea and Seif (1983) argues that IT allows learners to "Become liberated from the tyranny of mass educational

system with its national syllabuses and examinations and its non-adaptive teachers demanding that groups of thirty or forty children together in a classroom exhibit the form of learning.

On the other hand, Papert (1980) concurs by postulating that children need to “absorb the computer culture” and become familiar with those tools. The question is whether this computer culture can lead to improved performance, hence the need for this research.

Computer is an excellent tool for repetitive, didactic and individualized learning. This is because individualized learning pathways can be quickly constructed and monitored. Hoogeveen (1995) discusses the effectiveness of the multimedia paradigm in teaching and learning. The use of multi-media is believed to lead to the following psychological responses (Hoogeveen,1997):

- (i) A high level of stimulation of the senses, particularly the auditory and visual perception systems.
- (ii) A high level of involvement, attention and concentration.
- (iii) Emotional arousal making the activity fun.
- (iv) Strong recognition affects using mental reference modules.

The above point emphasizes that learners should experience information rather than simply acquire it. This emphasizes the need to integrate ICT in schools.

The findings of the studies conducted on ICT and education shows that there are mixed results between the use of ICT and pupils academic performance. These researches have failed to provide a clear consensus about the impact of ICT use on pupils’ performance.

The studies by Kulik (1999) and Coates et al (2004) reported that pupils who use computer-based instruction had higher performance than those without. Kulik further added that those students using computer-based instruction learn a lot in less time.

While comparing three methods, online, hybrid and campus method of teaching, Leuven et al (2004) concluded that the use of ICT by students has no impact on performance. Study by Fletcher-Flyn and Gravatt (1995) on the effectiveness of computer-assisted instruction (CAI) suggest that the positive impact of computers is relatively small. British Educational Technology Association (BECTA), (2000) found no link between level of ICT and students performances.

Other studies advocate for the traditional (progressive) methods of teaching and learning since they believe is more effective than ICT. This is in contrast to Coates et al (2005) report

which shows that students exposed to ICT performs better than those exposed to progressive methods.

Weaver (2000), Moseley et al (1999) in their study found a very small link between computer use in the curriculum and students' improvement in performance and that having more computers does not make much difference.

Moseley et al (1999) suggested that substantial gains in students' performances are achievable where the use of ICT is planned, structured and integrated effectively. The way equipment and ICT resources are used by students and teachers makes the difference. Providing ICT resources to schools will not necessarily make a difference but how it is used.

2.7 A Review of models and frameworks

Are there frameworks that have been put in place to assess the successful implementation and use of ICT resources in schools? If there are frameworks do they provide a holistic approach for assessing the successful implementation and use of ICT resources in schools? The following are five frameworks reviewed for implementing and use of ICT in schools.

2.7.1 An analytical framework, Roger Blamire (2006)

The analytical framework is used for the integrated analysis. It is built around a core of teachers, learners, and the schools as a whole. The framework helps to describe the context in which ICT is introduced and implemented. It identifies the main drivers and enablers for effective and efficient use of ICT, leading to recommendations for policy makers and stakeholders. The framework has of five levels: society, education system, school, teachers and learners which represent where strategies, enablers and barriers may be found. It reads from left to right, representing a hierarchical flow and the flow from strategy to impact.

The framework measures the impact of ICT in education without considering the learning outcomes.

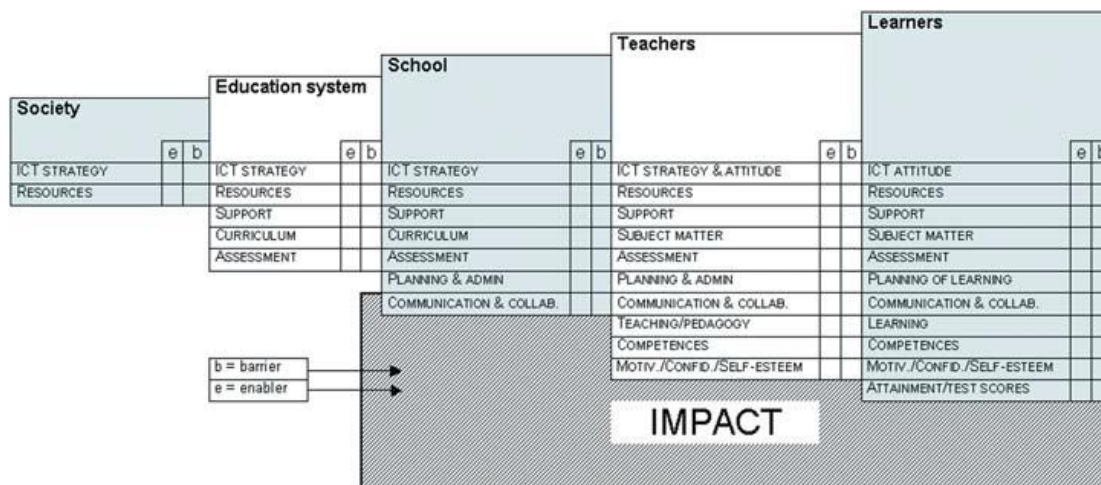


Figure 2. 1: An Analytical framework on context of ICT introduction and implementation, Roger Blamire (2006)

2.7.2. Model on Impacts of ICT use on school learning outcome, Myunghee Kang, Heeok Heo, Ilhyun Jo, Jongho Shin (2008)

The framework shows the factors that influence ICT use and the educational performance of learners. The factors are classified into three levels surrounding ICT use and educational performance: the classroom setting (micro level), the school and local community (meso level) and regional and national entities (macro level).

At the micro level ICT use and its impact on educational performance can be influenced by various factors such as the personal attributes of teachers and students, and curriculum and teaching practices.

At the meso level, the school environment and its surrounding factors may affect the use of ICT in educational practice.

At the macro level, ICT use and educational performance can be influenced by socio cultural norms, economic forces and technological advances.

2.7.2.1 ICT use

ICT is characterized as a networked computer that can process and communicate information. The following three dimensions are employed to clarify the patterns and frequency of ICT use.

(i) Places in ICT use

Place in ICT use is divided into two categories, in-school and out-of-school, based on the location where learners use ICT.

(ii) Purposes of ICT use

The category of purposes of ICT use indicates a set of classifications for the reason of ICT use and the intentionality of learning, which include learning and entertainment. Learners may use ICT for learning needs, such as obtaining knowledge, solving complex problems and acquiring new skills. Experiences that learners have without any specific intention of learning may be categorized as entertainment. ICT also creates new entertainment environments in which learners can socialize with friends and play games.

(iii) Contexts in ICT use

Learners may work individually or socially with peers while using ICT. In an individual context, learners use ICT alone without collaborating with others. A social context refers to a setting in which two or more learners use one computer together, or in which a learner works with friends to perform collaborative tasks online.

2.7.2.2 Educational performance

Based upon previous studies, educational performance may be conceptualized as a futuristic concept that encompasses not only the traditional concept of education but also the extended version of human learning. The educational performance of learners is defined as the processes and results of performance, which are revealed internally and externally through the integration of essential knowledge, skills and attitudes, and the continuing construction of experiences with ICT.

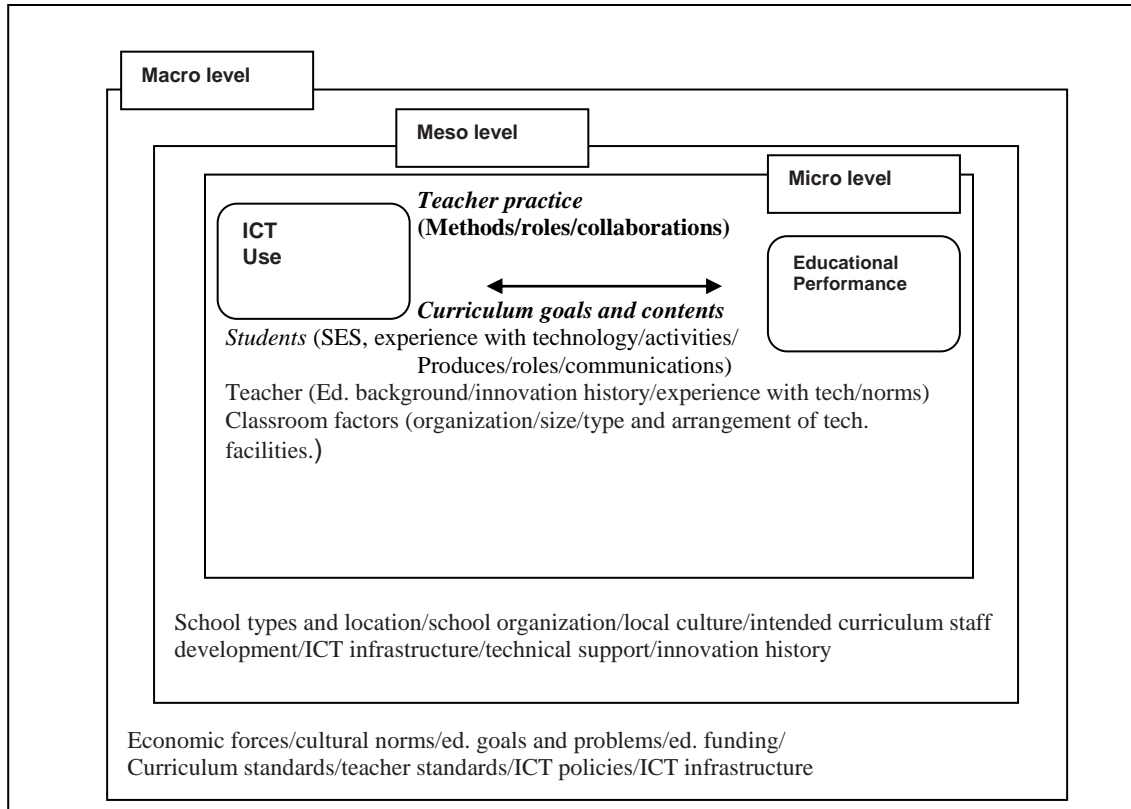


Figure2. 2: Myunghye Kang, Heeok Heo, Ilhyun Jo, Jongho Shin(2008)

2.7.3 Bilbao-Osorio's model (2003)

The objective of this model was to define an appropriate method for measuring the impact of ICT on teaching-learning Processes in higher education (IMPACTIC). The construction of IMPACTIC was related to the analysis of teaching models, Processes for Incorporating ICT into educational contexts, and the impact of technology on the educational environment. This model maps the different factors affecting the development and use of digital learning resources, and their impacts on the educational system.

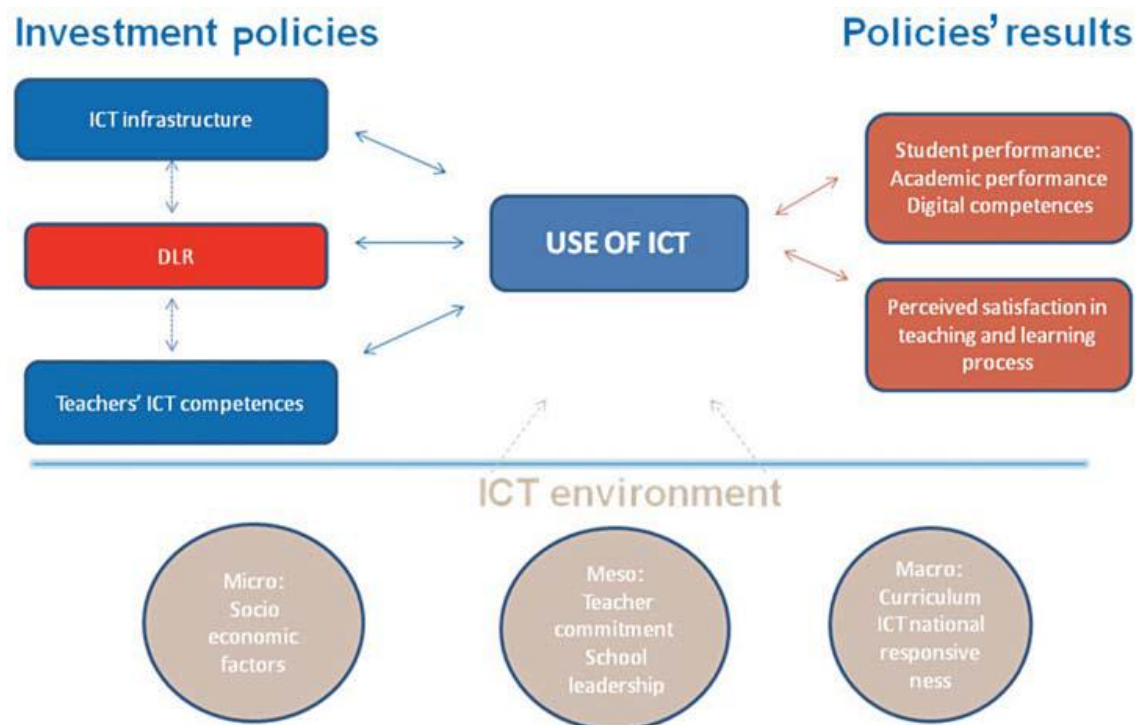


Figure2. 3: Bilbao-Osorio and Pedro (2009)

The above model evaluates the impact of ICT in the educational context, especially with the following variables grouped into three areas, namely: investment policies, policy outcomes and the means of ICT.

a. **Investment policies**

- *ICT Infrastructure:* deals with investment in equipment (computers, whiteboards, laptops, projects) and network connections. The number of computers per student or internet (broadband) is just some examples of this type of variable.
- *Digital learning resource (DLR):* This project has indicated that DLR refers to any resource used by teachers and students, or only those specially designed for use in the configuration of learning.

- *The ICT skills of teachers:* This variable refers to investments in more competent teachers, and occasionally has a positive attitude towards ICT and its use at school. The investment would input resources for teachers and ICT. On the one hand, an easy and direct measure might be the number of trained teachers in the system. For another, more complex measure can refer to changes in the attitudes of teachers trained in the use of ICT / DLR.

b. Policy results

- (i) **Student Performance:** the use of ICT and DLR could have an impact on the performance of students who go in two directions:
 - **Skills development:** the definition of ICT skills may be limited to the efficient use of the infrastructure of these, i.e. the use of a computer or internet, or have a broader scope, where students could use, find, understand and even produce different content in digital format for or show a better understanding of particular issues.
 - **Academic achievement in core subjects:** the use of ICT in learning different subjects could have an impact on actual academic achievement of students.
- (ii) **Satisfaction in the processes of teaching and learning:** using DLR and ICT could also improve or bring new teaching and learning processes, making it more interesting for students and teachers, and improve communication between different stakeholders.

ICT Environmental

The macro refers to domestic issues, the meso institutional environment and learning processes. The micro focuses on teacher practices and student, and the (collective and individual) results as defined by Erstad (2009)

The limitations of this model are that it approached benefits solely from a learning standpoint, it left out important individual ICT-related conditions such as digital literacy and internet access and it did not address the influence of ICT infrastructure.

2.7.4 Marcelo Cabrol and Eugenio Severin,s framework(2010)

The conceptual framework is used to support the design, implementation, monitoring and evaluation of the projects where ICT have been incorporated in schools. It emphasizes the monitoring and evaluation process as an integral part of the project. It allows measurement of the project's efficiency and monitoring of its development by those carrying out the project and other stakeholders, making it easier to determine best practices and promote the development of new initiatives for use of ICT in education areas. This involves the review of information before (baseline), during the process (monitoring) and at the end of the project (final evaluation).

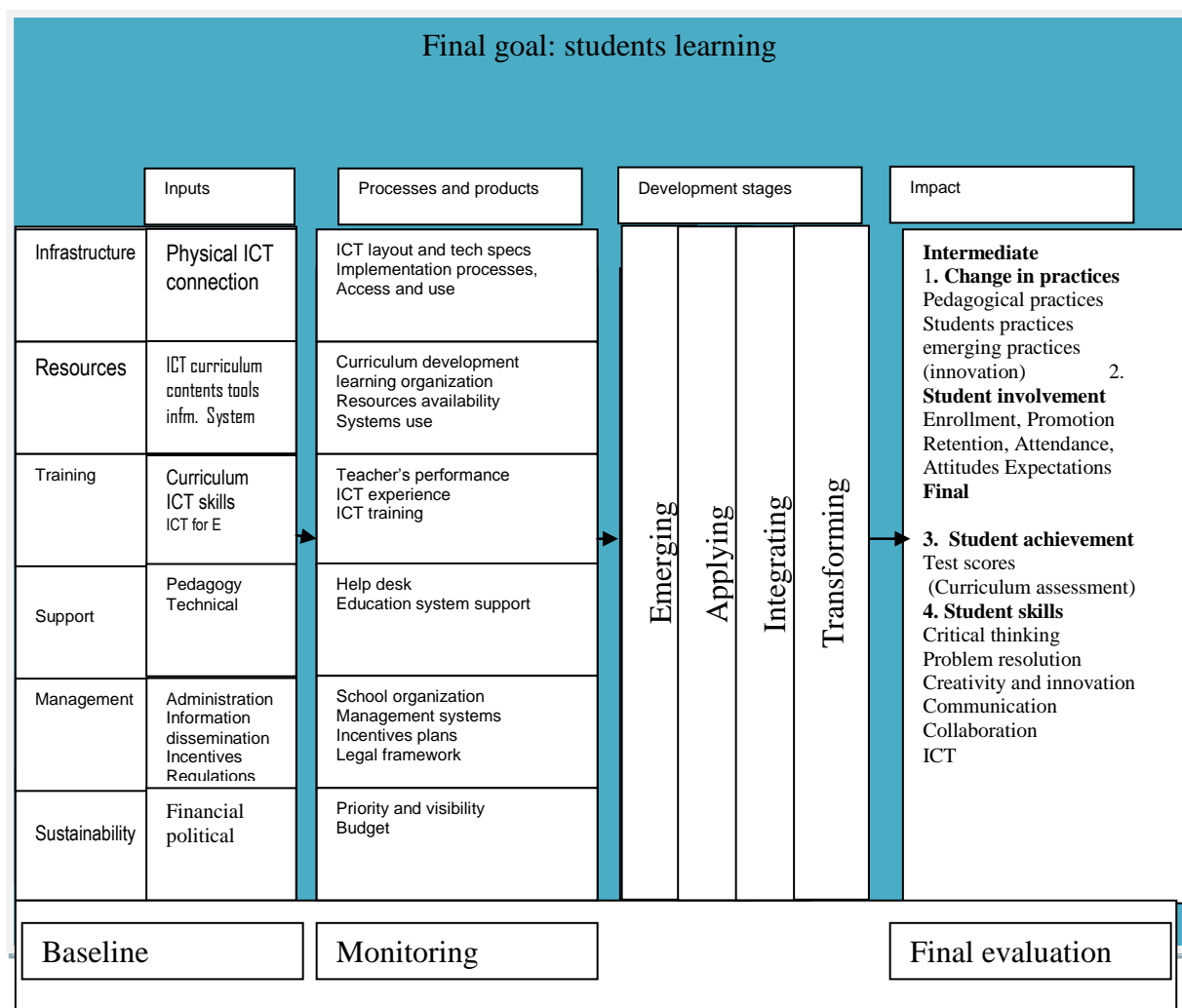


Figure 2. 4: Marcelo Cabrol and Eugenio Severin,s framework(2010)

The framework includes the following elements.

- (a) **Student learning**, as the main goal of all project implementation.
- (b) The **Inputs** refer to project lines of action and factors that could be affected by its implementation. There are five main inputs considered in any project. These are:
 - (i) **Infrastructure:** these include the following:
 - **Physical:** Initiatives associated with provision of infrastructure necessary for the use of and access to ICT. Examples are laboratories, libraries and furniture.
 - **Equipment:** Equipment planned for the project or considered part of the project (even if not conceived as a direct part of the project) includes computers, printers, projectors and the conditions included in the purchase and use of those items, e.g. guarantee and service support.
 - **Connectivity:** Access to Internet and networks that allow their use for education purposes.
 - **Support:** Activities aimed at administration, maintenance and repair of equipment as well as problem-solving related to project activities and technical support for users.
 - (ii) **Resources**
 - **ICT curriculum:** Initiatives linked to the implementation and/or adaptation of curriculum content in ICT or other subjects (in the use of ICT).
 - **Content:** Digital or analog material aimed at teaching and learning with technology tools, e.g. encyclopedias, manuals, textbooks, books, guides, videos and hypertext.
 - **Tools:** Software development or support initiatives for development of teaching and learning processes; e.g. productivity applications, virtual simulators and modeling.
 - **. Information systems:** Aimed at supporting implementation and distribution of management and education information systems at the school.
 - (iii) **Training**
 - **Teacher training:** Initial and in-service training associated with the adoption, adaptation and updating of curriculum and practices for the integration of ICT into education.
 - **ICT competences:** Training activities for the acquisition and/or certification of specific ICT skills, general education, and productivity and communication tools.

- **Use of ICT for education:** Training initiatives for the specific use of ICT in education.
- **Pedagogical support:** Efforts to provide educational support and follow up for participants, guidance or tutoring service developed for implementation of proposed activities.

(iv) Management

- **Administration:** Structures and strategies for system and project management and administration for all levels considered (school, province, country and region) as well as the relationship with other institutional stakeholders associated with the project e.g. strategic allies and donors.
- **Information dissemination:** Activities aimed at providing information about project results, strategies and actions and involving all potential interested stakeholders and beneficiaries of the project.
- **Community involvement:** How scope, strategies and actions are communicated. How all actors concerned and potentially affected by the project's development are involved.

(v) Sustainability

- **Planning:** The project's priority (short or long term) in the context of other initiatives, plans, projects or actions, including visibility (understood as the ownership level with the success and objectives of those leading the project).
- **Budget:** Long-term budget needed for operational continuity and development of complementary initiatives required for the project's success.
- **Legal framework:** Actions to adjust and adapt the rules and regulations to enhance and improve the impact of the initiative and minimize the risks.
- **Incentives:** Plans and programmes designed to (positively or negatively) underscore beneficiary commitment and the results of the project expected by its participants.

(c) The **Processes and products** are those elements that will be modified by the project and should demonstrate the results of the implementation.

- (d) The projects' **Impact** and the conditions that allow such outcomes are measured broadly with different variables.
- (e) **Development stages:** The four stages are that will impact the design, implementation and evaluation of the projects. These are emerging, applying, integrating and transforming.
- (f) The process of **Monitoring and evaluation** includes different sources of data and information.

The limitation of this framework is that it allows measurement of the project's efficiency and monitoring of its development by those carrying out the project and other stakeholders but does not measure the outcome on the students' academic performances. It emphasizes the monitoring and evaluation of the development of the project but not the use of ICTs.

2.8 The proposed Conceptual framework

The presences and use of ICT resources by the students and teachers provides an avenue to improve academic performance. The application of games, drills, animation and other graphical applications provides practices taking the form of questions (stimulus) and answers (response) which helps students develop interest in learning and in the end improves academic performance.

ICT requires new instruments to measure the progress and achievement made on its use. According to Kikis (2004) there is no clear position on the adequate indicators, instruments and scales for measurements. The proposed conceptual framework would provide an orientation for the kind of measurement required in decision making process. The conceptual framework would act as a reference. The framework would help identify the indicators or elements to look at when one wants to know if ICT has positive outcome on educational performances. This ensures that all relevant aspects are considered and a systematic approach is followed.

The proposed conceptual framework which was derived from the above reviewed framework and based on Bilboa model (2003) has the following independent variables which determine the dependent variable (student's improved academic performances):

Availability of ICT resources

This deals with the level of access to ICT resources. These are resources which include but not limited to internet, computers, TVs, projectors, and computer laboratory.

Availability of ICT infrastructure:

It's access to ICT resources and tools for processing information, building knowledge and for communication and collaboration. These are: access to devices, internet connectivity, technical support, interoperability. It gives specific reference to availability of ICT equipment. It also deals with the relationship between the product characteristics and reasons why they were selected. There are considerations on connections of existing equipment and the conditions of internet connectivity. The output measures are: how many students have access to digital resources and tools, do Schools have affordable

high speed broadband connections with associated low download costs, do Learners, teachers and parents have access to resources, digital tools and agreed performance data anywhere, anytime and are there agreed coordinated platform for managing and sharing digital content between schools(interoperability framework)?

Place of access of ICT resources:

These are: library, computer lab, resource centers.

Digital Learning resources:

These are resources particularly designed to be used in learning setting. They are access to digital resources, software for student's learning and teaching. The output measures are: Are there Collaborative content creation Supported by the county education, is content developed and procured by schools and is there access to national pool of high quality digital resources from school sectors?

Student ICT skills:

These are Ms Word, spread sheet, internet access and use of projectors. The output measure is how many students are competent in use of ICT resources and tools.

Teacher capability and skills:

This refers to teacher's competence in the use of ICT in school. It takes into account the resources devoted to towards teacher's training. They are pre-service ICT training, in-service ICT development. The output measure is how many teachers achieved competence in the use of ICT before they graduated and how many teachers have progressively been trained to upgrade or develop competence in the educational use of ICT.

Leadership awareness of ICT:

Leadership that ensures schools has a coordinated plan for the provision of infrastructure, learning resources and teacher capability to address the educational challenges. The output measure is do school have principals an e-learning plan covering Infrastructure, Learning resources and teacher capability and how many School principals are equipped to plan and lead change that delivers digital learning to all students in all areas of learning.

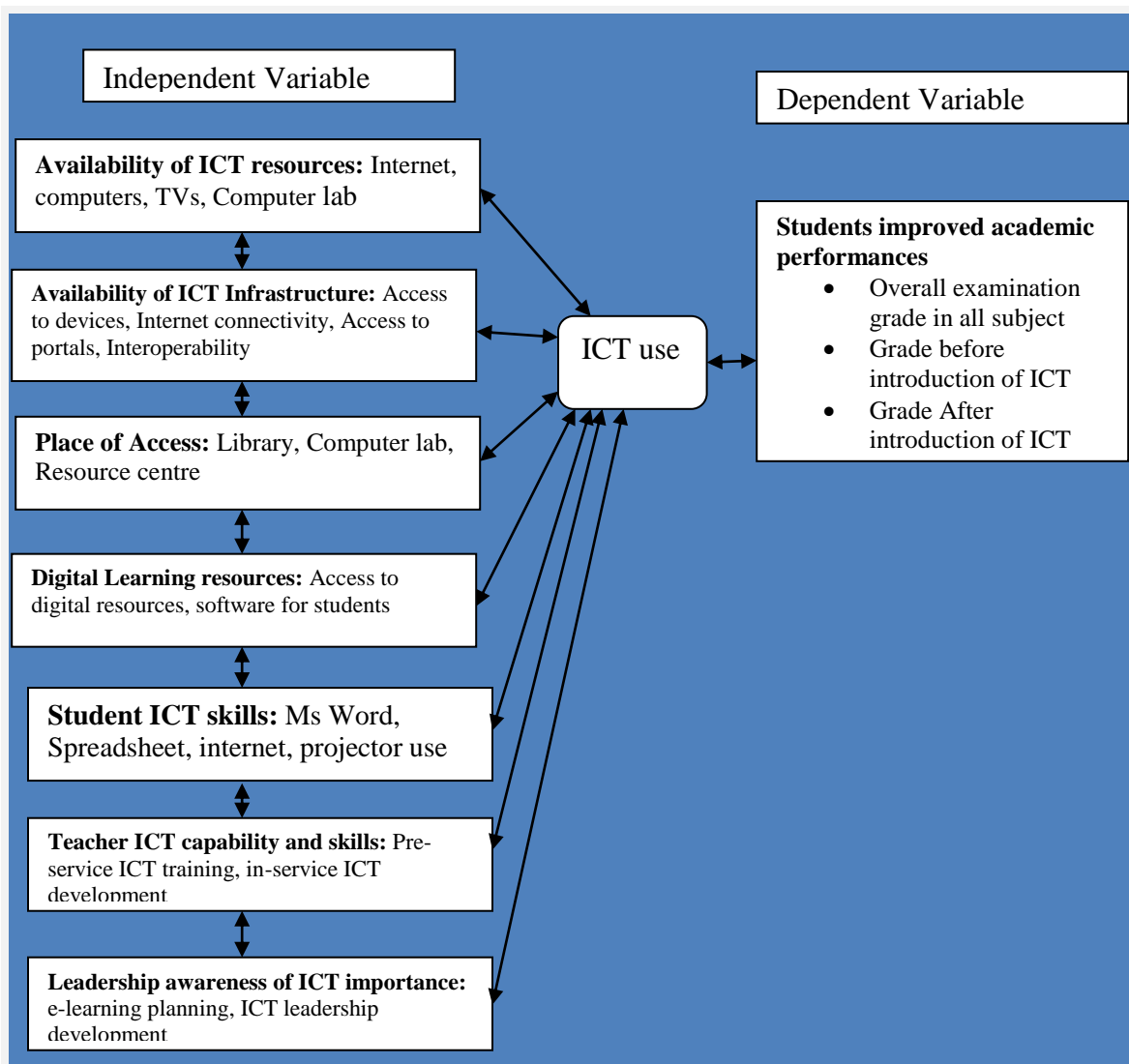


Figure 2. 5: Proposed Conceptual framework for harnessing ICT resources adopted from Bilboa model (2003)

CHAPTER THREE: METHODOLOGY

3.1 Introduction

In this chapter, the research design and location is outlined, the target population and the sampling procedure is given. The research instruments, piloting of the instruments to test the reliability and validity of the instruments in the study is also given. The data collection technique which was used in this study is also given. The method for data analysis is also explained in this section.

3.2 Research Design and locale

The design selected for this study was ex-post-facto research. In this design, the causes of behavior patterns in subjects under investigations are studied after they have exerted their effect on other variables.

According to Kerlinger, (1973) the ex-post factor research is defined as a systematic, empirical inquiry in which the scientist does not have direct control of the independent variables because their manifestations have already occurred or because they are not inherently manipulated. The variables occur in the setting, usually a natural setting, and the researcher attempts to determine the relationship and effects that are occurring between the variables (Orodho, 2009; 51). The design is appropriate because the status of ICT in schools is not manipulated and the academic result too. The location of the study is Kiambu Sub County.

3.3 Target Population and Sampling

The target population for this study consisted of all the public Secondary schools Kiambu Sub County. The targeted population involves 8 public secondary schools in the County. Students, teachers and the Principals of these schools will form the respondents of the study. In Kenya, school principals are the managers of Schools and therefore, are suited to explain the influence of ICT on performance.

Accordingly, purposive sampling is used to select the schools from which the respondents are drawn. In this form of sampling, the investigator relies on her expertise or expert judgment to select units that are representative or typical of the population (Orodho, 2009; 147). This is because it is based on either ICT integrated or not

3.4 Sampling procedure:

The researcher used stratified sampling method. Those with ICT and those without separated.

The sample selected from each category will be divided as follows:

- i) 4 County Schools.
- ii) 4 Day sub-county schools.

This sample will be stratified according to the schools identified above which are summarized in the table below:

Table3. 1: Sampling procedure

Type of schools	Status	Number of schools	Number of respondents randomly sampled per school
County schools	With ICT	3	24
	Without ICT	1	24
sub-county schools	With ICT	2	24
	Without ICT	2	24

3.5 Research Instruments

The purpose of a tool or instruments in research is to measure the variables of the study (Mugenda, 2008; 284). The researcher used the questionnaires and observation for data collection. The questionnaire was both open ended and closed ended items.

3.5.1. Piloting of the instruments

After obtaining an introductory letter from the university and another permit to do research obtained from the county education office Kiambu, the researcher conducted a pilot testing of the questionnaire in two schools in Kiambu Sub County. These schools were not included in the main study. The reason for piloting was to ensure that measurements are of acceptable reliability and validity.

Reliability-of measurements concerns the degree to which a particular measuring procedure gives equivalent results over a number of repeated trials. (Orodho, 2009; 182).A pilot test was conducted after establishing the validity. Twenty respondents from Karura high school were used in the pilot testing to answer the questionnaires. Their responses were subjected to a Cronbach's Alpha Coefficient reliability test using the following formula:

$$\alpha = \frac{K}{K - 1} \left(1 - \frac{\sum SDt^2(1)}{SDt^2}\right)$$

Where α = Reliability

$\sum SDt^2$ = Sum of the variance of individual item in the questionnaire

SDt^2 = Variance of the entire questionnaire

K = Number of the items in the questionnaire

The value of reliability α was equal to 0.78 which indicated that the questionnaire was reliable.

Validity- The degree to which test measures what it purports to be measuring (Orodho, 2009; 187).

The procedure used to measure reliability by the researcher was the revision of the questionnaires. To establish the validity, the instruments (Appendix A, B and C) were subjected to the scrutiny of two people who evaluated the relevance of each item in the instruments to the objectives. The experts rated each item on a scale. Their recommendations were used to finally modify questions. Once the questionnaires were designed and rated, the content validity index (CVI) was then computed as follows

$$CVI = \frac{\text{Agreed items by both judge as suitable}}{\text{Total number of items being judged}}$$

Table 3. 2: Questionnaire rating

	Relevant items	Not relevant items	Total
First rater	47	6	53
Second rater	45	8	53
	92	14	106

$$CVI = \frac{92}{106} = 0.868$$

The CVI value obtained of 0.868 showed that the questionnaires were valid.

3.6 Data collection Techniques

An introductory letter was given by the University. Consent to carry out the research in Kiambu was obtained from the County Education Officer (C.E.O.). The researcher visited the sampled schools and administered the questionnaires to the students, the teachers and principals. Short notes of observations were made during the visitations. The respondents were assured of confidentiality of the information they provided. The completed questionnaires were then collected from the respondents.

3.7 Data Analysis

The data which was collected were edited by the researcher. She went through the questionnaires from the respondents and the field notes to check their completeness, accuracy and uniformity in the interpretation of the questions. The data was analyzed by finding their frequencies, percentages associated with the obtained response, means, standard deviation correlation, t-scores and CHI square test to compare performances of schools with and without ICTs.

3.8 Data analysis methods used:

3.8.1 Pearson's correlation coefficient

It is also known as product moment coefficient of correlation. It is a kind of ratio which expresses the extent to which changes in one variable are accompanied by changes in the other variable. It involves number units and varies from -1 (indicating perfect negative correlation) to +1(indicating perfect positive correlation). If the coefficient of correlation is zero, it indicates zero correlation between two sets of measures.

The standard formula used in its computation is as follows:

$$r_{xy} = \frac{\sum xy}{N\delta_x\delta_y}$$

Where r_{xy} =correlation between X and Y (two sets of scores)

x = deviation of any x-scores from the mean in test X

y = deviation of any y-scores from the mean in test Y

$\sum xy$ =sum of all the product of deviation.

δ_x =standard deviation of the distribution of scores in test X

δ_y = standard deviation of the distribution of scores in test Y

N = Total number of scores of frequencies

3.8.2 Paired t Test (Correlated Groups t Test)

The paired t test (also called the “correlated groups” t test) is used when you have two samples and a within-groups design. This design is also called a dependent or repeated-groups design. A paired samples t -test is used to compare two related means. It tests the null hypothesis that the difference between two related means is 0.

A sample of 48 students had their test grade recorded before ICT was introduced in their schools and then again after ICT was introduced. The aim was to find out in general, if incorporating ICT to teaching leads to improvements in students' academic grade (i.e. test scores). The results from the sampled students were used to draw conclusions about the outcome of ICT use in general.

Let x = test score before ICT was introduced, y = test score after the introduction of ICT.

To test the null hypothesis that the true mean difference is zero, the procedure is as follows:

1. Calculate the difference ($d_i = y_i - x_i$) between the two observations on each pair, making sure you distinguish between positive and negative differences.
2. Calculate the mean difference, \bar{d}
3. Calculate the standard deviation of the differences, s_d , and use this to calculate the standard error of the mean difference, $SE(\bar{d}) = \frac{s_d}{\sqrt{n}}$.
4. Calculate the t-statistic, which is given by $T = \frac{\bar{d}}{SE(\bar{d})}$. Under the null hypothesis, this statistic follows a t-distribution with $n - 1$ degrees of freedom.
5. Use tables of the t-distribution to compare your value for T to the t_{n-1} distribution. This will give the p-value for the paired t-test.
6. To reject the null hypothesis for a t test, the t-obtained must be equal to, *or more extreme than*, the t-critical value.

3.8.3 CHI square as test

It is a test of “goodness of fit” by Karl Pearson making use of the χ^2 distribution. The test determines how well the experimental results fit in the results expected theoretically on some hypothesis.

The procedure for CHI square testing is as follows:

1. Establish the Null hypothesis.
2. Compute the value of χ^2

The value of χ^2 is calculated through the following formula:

$$\chi^2 = \left[\frac{(f_o - f_e)^2}{f_e} \right] \text{ Where: } f_o = \text{Observed frequency on some expression.}$$

f_e = Expected frequency on some hypothesis.

3. Determine the number of degrees of freedom. The formula for the computation of the degrees of freedom is as follows:

$$d_f = (r - 1)(c - 1) \text{ Where } r = \text{Number of rows in the contingency table.}$$

C = Number of columns in the contingency table.

4. Determine the critical value of χ^2 . The critical value of χ^2 is obtained from the F table for the required significance at the determined significance level (5% or 1%) for the degrees of freedom.
5. Compare critical value of χ^2 with the computed value. If the computed value of χ^2 is greater than or equal to the critical value of χ^2 then take it as significant and reject the null hypothesis. But if the computed χ^2 value is less than the critical value of χ^2 then it is non-significant and the null hypothesis is not rejected.

3.8.4 Cronbach's Alpha

It is generally used as a measure of internal consistency or reliability of a psychometric instrument. In other words it measures how well a set of variables or items measure a single, one dimensional latent aspect of individuals. Generally many quantities of interest in medicine such as anxiety or degree of handicap are impossible to measure explicitly. In such case we ask a series questions and combine the answers into a single numerical value.

Cronbach's Alpha generally increases when the correlations between the items increase. For this reason it is also called the internal consistency or the internal consistency reliability of the test. A value of Cronbach's alpha of more than 0.6 is considered as acceptable and a value of more than 0.8 as excellent.

CHAPTER FOUR: PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

4.1 Introduction

This research aimed at examining the impact of ICT on student's academic performances in Kiambu sub-county and hence developing a framework for harnessing ICT resources in order to improve academic performance.

The focus was on the following independent variables: availability of ICT resources, adequacy of ICT resources, places of access of learning resources, students/teacher ICT skills, teacher capability and skills, leadership awareness of ICT importance.

There are 21 schools in the sub-county consisting of 5 county schools and 16 sub-county schools. 6 schools have integrated ICT into their teaching and learning. 8 schools were chosen out of the 21 schools; 4 with ICT and 4 without ICT. A total of 28 students, 48 teachers and 8 principals were sampled giving a total of 184 questionnaires that were distributed. A total of 130 fully completed questionnaires were returned which formed 70.7% of the total issued questionnaires. 88(68.8%) were filled by students, 37(77.1%) were filled by teachers and 5(62.5%) were filled by the principals.

Table 4. 1: Rate of return of questionnaires

Category of respondents	Number of questionnaires issued out	Number of questionnaires returned	Percentage
Students	128	88	68.8%
Teachers	48	37	77.1%
Principals	8	5	62.5%
Total	184	130	70.7%

4.2 Background information of the respondents

4.2.1 Demographic information

This is the distribution of respondents according to their age, sex, class school, duration of teaching and subject taught.

Table 4. 2: student’s distribution according to age, sex, class and school

Attributes	Category	number	Percentage
Age	13 and below	5	5.7%
	14-16	38	43.2%
	17 and above	45	51.1%
Total		88	100.0%
Sex	Male	38	43.2%
	Female	50	56.8%
Total		88	100.0%
Class	Form 1	14	15.9%
	Form 2	34	38.6%
	Form 3	21	23.9%
	Form 4	19	21.6%
Total		88	100.0%
Schools	Karuri High	10	11.4%
	Snr Chief Koinange	10	11.4%
	Kiambu High	8	9.1%
	Kihara High	11	12.5%
	Loreto Kiambu	11	12.5%
	Gachie High	16	18.2%
	St. Ann Lioki	9	10.2%
	Kiambu Township	13	14.8%
Total		88	100.0%

The findings shows that most students' respondents were age 17 and above (51.1%), those between 14 and 16 years were 43.2% while those with 13 years and below were 5.7%. It can also be noted that most respondents were female with 56.8% a fact that most boarding schools in Kiambu sub-county are girl's schools.

The respondents per class were as follows: Form ones 15.6%, Form twos 38.6%, Form threes 23.9% and Form fours 21.6%.

Table 4. 3: distribution of teachers according the school they teach, length of service and teaching subject.

Attributes	Category	number	Percentage
Schools	Karuri High	8	21.6%
	Snr Chief koinange	2	5.4%
	Kiambu High	7	18.9%
	Kihara High	5	13.5%
	Loreto Kiambu	2	5.4%
	Gachie High	8	21.6%
	St. Ann Lioki	2	5.4%
	Kiambu Township	3	8.1%
Total		37	100.0%
Length of service	Less than 2 years		8.1%
	Between 2-5 years		16.2%
	Above 5 years		75.7%
Total		37	100.0%
Teaching subjects	Computer	2	5.4%
	Sciences and mathematics	21	56.8%
	Languages	9	24.3%
	Humanities	3	8.1%
	Technical	2	5.4%
Total		37	100.0%

The findings from the table shows that the majority of the teachers respondents have taught for more than 5 years(75.7%), 8.1% have taught for less than two years while 16.2% have taught for between two and five years.

Most respondents came from Karuri and Gachie high schools who returned all the questionnaires given.

The table also shows that most of the teacher respondents were teachers of sciences and mathematics(56.8%) followed by Languages(24.3%), humanities (8.1%) and computer and technical were the least respondents(5.4%) each.

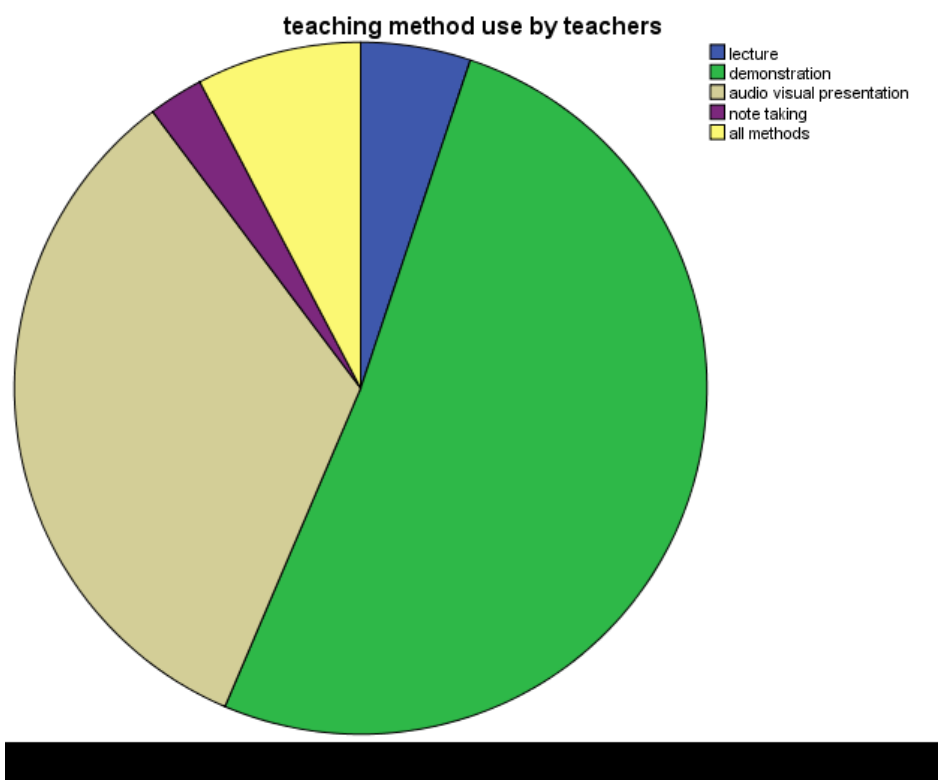


Figure4. 1: Teaching methods used by the teachers

Most teachers use demonstration method to teach followed by audio visual presentation then use of all methods of teaching. From the chart note taking is used by few teachers.

4.3 Responses on the independent variables

Table 4. 4: Students response on availability of ICT resources

ICT resources	Status	Number	Percentage
Computer/pc in class room	Not available	79	89.8%
	Fairly available	7	8.0%
	Available	2	2.3%
TOTAL		88	100.0%
Projector	Not available	16	18.2%
	Fairly available	51	58.0%
	Available	3	23.9%
TOTAL		88	100.0%
Internet connectivity	Not available	72	81.8%
	Fairly available	13	14.8%
	Available	3	3.4%
TOTAL		88	100.0%
Computer laboratory	Not available	18	2.8 %
	Fairly available	43	66.5%
	Available	27	30.7%
TOTAL		88	100.0%
Digital learning content	Not available	65	76.1%
	Fairly available	18	20.5%
	Available	3	3.4%
TOTAL		88	100.0%
Software	Not available	61	69.3%
	Fairly available	14	15.9%
	Available	13	14.8%
TOTAL		88	100.0%

Television set	Not available	33	37.5%
	Fairly available	39	44.3%
	Available	16	18.2%
TOTAL		88	100.0%

The results obtained showed that most schools have no computers in school with 89.8% supporting it while 2.3% say they have computers in classrooms.

Projectors are fairly available by 58.0% while internet connectivity is not available by 81.8%. Computer laboratory is fairly available by 66.5% and digital learning is not available by 76.1%.

Software and television are fairly available by 15.5% and 44.3% respectively.

Table 4. 5: Student’s Responses on the availability of ICT infrastructure

ICT infrastructure	Status	Number	Percentages
Internet connectivity	No	80	90.9%
	I don’t know	7	8.0%
	Yes	1	1.1%
		88	100.0%
School portal	No	27	30.7%
	I don’t know	45	51.1%
	Yes	16	18.2%
		88	100.0%
ICT devices	No	79	89.8%
	I don’t know	5	5.7%
	Yes	4	4.5%
		88	100.0%

The results from table 4.5 shows that 90.9% have no internet connectivity, 30.7% have no school portal while 51.1% doesn't know if there are school portal and 18.2% consented to have school portal.

The findings from the table shows that 89.8% have no access to ICT devices all the times, 5.7% doesn't know while 4.5% agreed to have access to ICT devices all the time. This suggests that access to ICT devices were limited..

Table 4. 6: Teacher's responses on availability of ICT infrastructure

ICT infrastructure	Status	Number	Percentages
Internet connectivity	No	14	37.8%
	I don't know	3	8.1%
	Yes	20	54.1%
		37	100.0%
School portal	No	32	86.5%
	I don't know	5	13.5%
	Yes	0	0.0%
		37	100.0%
Interoperability	No	32	86.5%
	I don't know	5	13.5%
	Yes	0	0.0%
		37	100.0%
Access to devices	No	20	54.1%
	I don't know	2	5.4%
	Yes	15	40.5%
		37	100.0%

From table 4.6, 37.8% of the teachers said they had no internet connectivity in their schools while 54.1% agreed they had internet in their schools. This suggests that there is internet in school but could be limited to specific places.

The results again from the table shows that 86.5% attest to not having a school portal, while 86.5% agreed to not having a framework for sharing data and information between teachers in different schools. The findings also shows that there was limited access to devices in schools as shown by 54.1% of the respondents who claimed that they do not access ICT devices while 40.5% attest to having access to ICT devices

Table 4. 7: Responses on location the respondent’s accesses ICT resources

Location of ICT resources	Status of time Spent	Count	Percentages
Library	Never	72	81.8%
	Sometimes	15	17.0%
	Always	1	1.1%
Total		88	100.0%
Computer laboratory	Never	41	46.6%
	Sometimes	38	43.2%
	Always	9	10.2%
Total		88	100.0%
Class rooms	Never	66	75.0%
	Sometimes	10	11.4%
	Always	12	13.6%
Total		88	100.0%
Resource centre	Never	85	96.6%
	Sometimes	3	3.4%
	Always	0	0.0%
Total		88	100.0%

The results showed that 81.8% of the students never use the library to access ICT resources, 17.0% do sometimes use the library and 1.1% uses the library. This suggests that few people use the library to access ICT resources.

The response from the students also indicates that 46.6% never use the computer laboratory, 43.2% sometimes use while 10.2% use it. This suggest that majority of the students never use the computer laboratory.

The findings from table 4.6 shows that 75.0% never use the ICT resources in the class rooms, 11.4% sometimes use it while 13.6% always use the computer laboratory. This suggests that there is limited usage of ICT resources in the class rooms.

The findings further showed that 96.6% never use resource centre to access ICT resources, 3.4% sometimes use while non always use. This suggests that resource centre could be ill equipped or it could not be there at all.

Table 4. 8: student’s responses on knowledge and skills on use of ICT tools

Type of ICT tool	Status of skills and knowledge	count	percentages
Word processing	Very poor	6	6.8%
	Poor	12	13.6%
	Fair	35	39.8%
	Good	24	27.3%
	Very Good	11	12.5%
Total		88	100.0%
Spread sheet	Very poor	12	13.6%
	Poor	17	19.3%
	Fair	34	38.6%
	Good	17	19.3%
	Very Good	8	9.1%
		88	100.0%
	Very poor	15	17.0%

Internet access of digital content	Poor	16	18.2%
	Fair	26	29.5%
	Good	23	26.1%
	Very Good	8	9.1%
Total		88	100.0%
Projectors	Very poor	20	22.7%
	Poor	28	31.8%
	Fair	21	23.9%
	Good	10	11.4%
	Very Good	9	10.2%
Total		88	100.0%
Power point	Very poor	10	11.4%
	Poor	10	11.4%
	Fair	20	22.7%
	Good	28	31.8%
	Very Good	20	22.7%
Total		88	100.0%

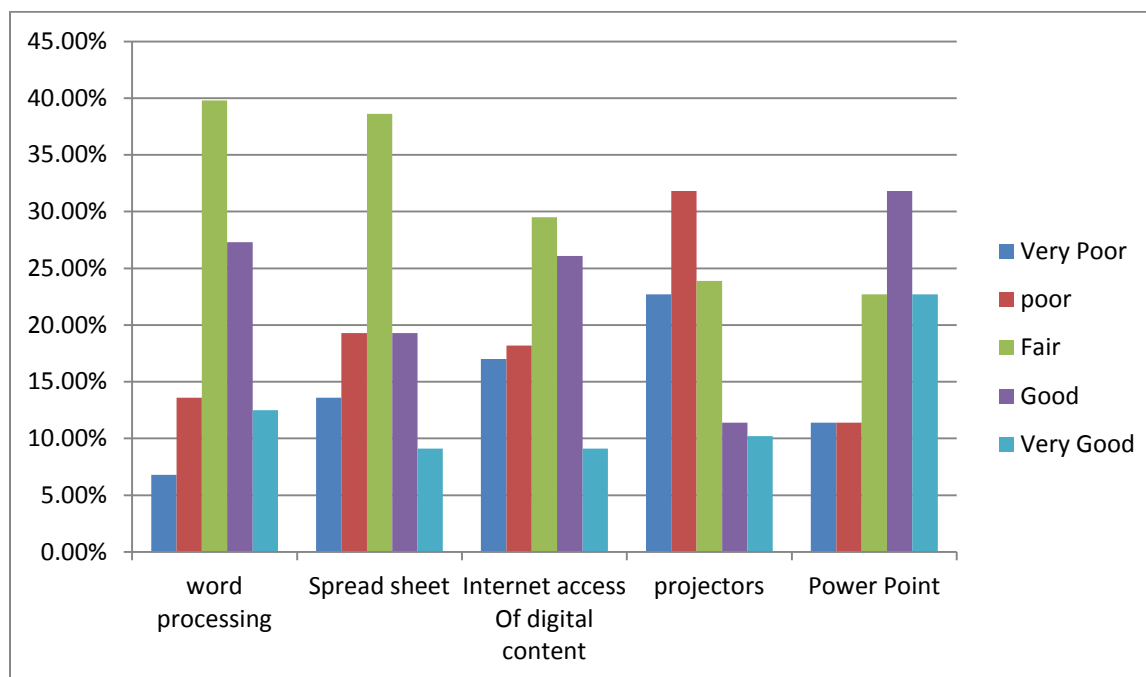


Figure 4. 2: student’s responses on knowledge and skills on use of ICT tools

From Table 4.7, 12.5% of the students are very good in word processing, 27.3% just good and 39.8% having a fair knowledge. The rest are 13.6% and 6.8% are poor and very poor respectively.

Most students have no mastery of spread sheet with 38.6% being fair, 19.3% good and 9.1% very good.

Again from the table 4.7, majority of the students have little knowledge on how to access digital content through the internet with 9.1% being very good, 26.1% good and 29.5% having a fair knowledge.

Many students according to the results from Table 4.7 have poor grasp on use of projectors with 22.7% being very poor, 31.8% poor, 23.9% fair, 11.4% good and 10.2% being very good.

Majority of the students are good in the use of power point with 31.8% being good and 22.7% very good.

Table 4. 9: teacher’s responses on knowledge and skills on use of ICT tools

Type of ICT tool	Status of skills and knowledge	count	percentage
Word processing	Very poor	2	5.4%
	Poor	5	13.5%
	Fair	11	29.7%
	Good	11	29.7%
	Very Good	8	21.6%
Total		37	100.0%
Spread sheet	Very poor	2	5.4%
	Poor	6	16.2%
	Fair	16	43.2%
	Good	10	27.0%
	Very Good	3	8.1%
		37	100.0%
Internet access of digital content	Very poor	3	8.1%
	Poor	9	24.3%
	Fair	6	16.2%
	Good	11	29.7%
	Very Good	8	21.6%
Total		37	100.0%
Projectors	Very poor	3	8.1%
	Poor	5	13.5%
	Fair	11	29.7%
	Good	12	32.4%
	Very Good	6	16.2%
Total		37	100.0%
	Very poor	4	10.8%

Power point	Poor	7	18.9%
	Fair	11	29.7%
	Good	9	24.3%
	Very Good	6	16.3%
Total		37	100.0%

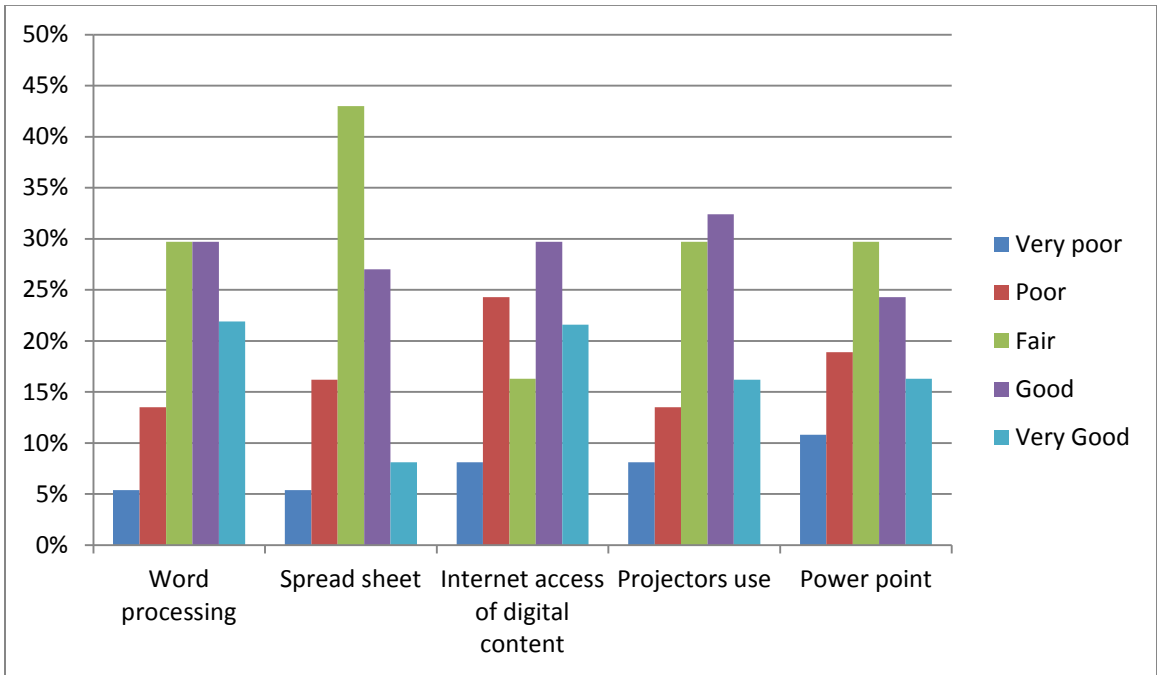


Figure 4. 3: Teacher’s responses on knowledge and skills on use of ICT tools

From table 4.8 are average in word processing with 29.7% fair, 29.7% good and 21.6% very good. Most teachers are good in spread sheet. 43.2% are fair, 27.0% good and 8.1% are very good. Majority of the teachers can access digital content through the internet 21.6% are very good, 29.7% good and 16.2% fair.

From the table 4.8, most teachers are good in the use of projectors. 16.2% are very good, 32.4% good and 29.7% fair. Most teachers can hardly use power point with 16.3% and 24.3% very good and good respectively.

4.4 Factors affecting the use of ICT tools

Table 4. 10: Students responses on the factors affecting use of ICT tools

	Frequency	Percent	Valid Percent	Cumulative Percent
my lack of ICT skills	18	37.5	37.5	37.5
Lack of ICT resources	28	58.3	58.3	95.8
Restriction by staff	2	4.2	4.2	100.0
Total	48	100.0	100.0	

Table 4. 11: Teachers responses on factors affecting use of ICT tools

	Frequency	Percent	Valid Percent	Cumulative Percent
lack of ICT skills	13	35.1	35.1	35.1
lack of enough ICT resources	4	10.8	10.8	45.9
restrictions by staff	5	13.5	13.5	59.5
Inadequate ICT proficiency	8	21.6	21.6	81.1
limited time	4	10.8	10.8	91.9
lack of internet	3	8.1	8.1	100.0
Total	37	100.0	100.0	

- Lack of ICT resources. 10.8% of the teachers showed that there is lack of ICT resources in their schools and 58.3% of the students indicated the same. At the same time, the results indicated that though some schools have ICT resources, these resources are not enough for use by both teachers and students.
- Lack of ICT knowledge and skills. The results showed that 37.5% of the students and 35.1% of the teachers lack ICT skills.
- Inadequate internet access. 8.1% of the teachers attested that though their schools have internet the same can only be accessed at the computer labs only.
- Limited time. It was reported that use of ICT required more time and effort in terms of planning, setting up of classes and ICT equipment. Most teacher respondents argued the lessons are 40 minutes long and there is no or limited time allocated for planning and co-ordination.
- In adequate ICT proficiency.
- Poor availability of sufficient ICT resources. Most schools had no computers in classrooms. The respondents reported to accessing technology at timetabled periods in computer lab.
- Absences of technical support. Respondents claimed that technical support was lacking and if for example a data projector broke down, no one would be able to fix it.
- Lack of professional development. Most teachers attest to requiring professional development in order to improve their ICT skills.

4.5 Students response on the various tasks

The following are the students response's on the various tasks

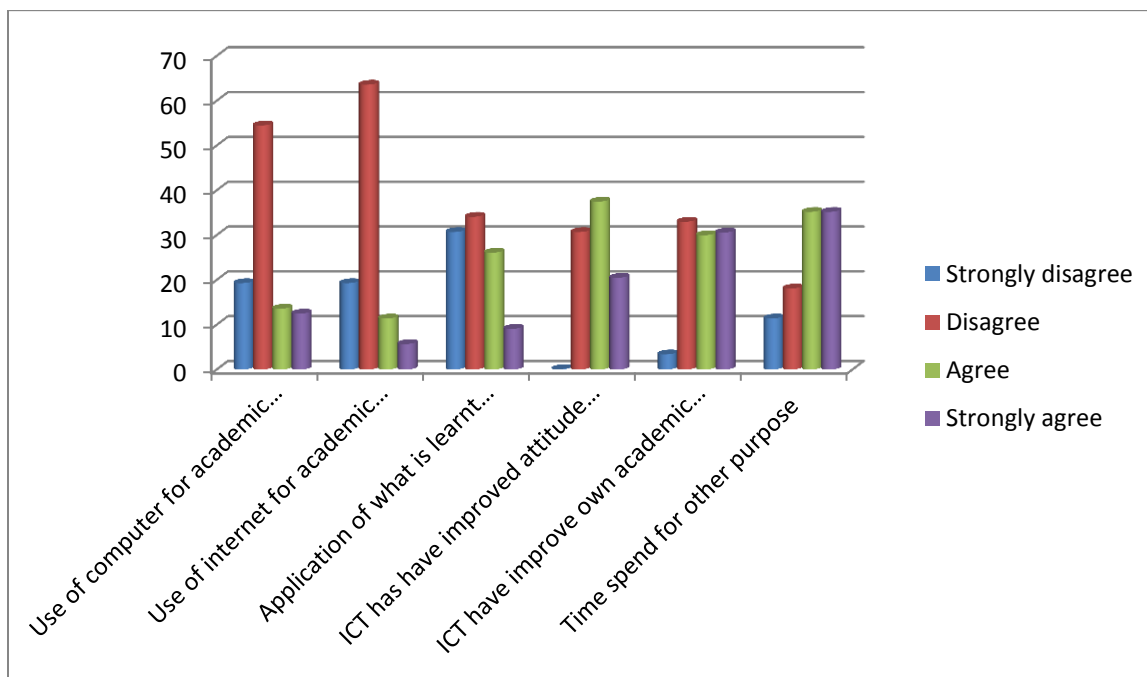


Figure4. 4: Students responses on various tasks

From figure 10, most students do not use computers for academic purposes. The findings shows that 19.3% strongly disagree, 54.5% disagree, 13.6% agree and 12.5% strongly agree to using computers for academic purposes most of the time.

The findings from table 4.9 shows that majority of the students do not use internet for academic purpose. It shows that t 19.3% strongly disagrees, 63.6% disagree, 11.4% agree and 5.7% strongly agree to use internet for academic purposes most of the time.

Table 4.9 indicates that few students apply what they have learnt during exams. 9.1% strongly agree, 26.1% agree, 34.1% disagree and 30.7% strongly agree to applying the knowledge acquired in exams.

The responses from table 4.9 shows that the student's attitude towards learning had improved since they were introduced to ICT. 20.5% strongly agree, 37.5% agree, 30.7% disagree and 11.4% strongly disagree to have had an improvement in learning through exposure to ICT.

Most students felt that ICT has helped them improve their academic performance. 3.4% strongly disagree, 33.0% disagree, 33.0% agree and 30.7% strongly agree that ICT has helped their academic performances improve.

The findings from table 4.9 show that most students spend their time for other purposes while using the computer and the internet. 35.2% agree and strongly agree to spend their time for other purpose when using the computer and internet and 11.4% and 18.1% strongly disagree and disagree respectively.

In relation to technical support, 34.1% strongly disagree, 53.4% disagree, 10.2% agree and 2.3% strongly agree that they have enough technical support. These results indicate that technical support is lacking in most schools.

The response from table 4.9 shows that most schools have no digital learning content. 39.8% strongly disagree 56.8% disagree, 1.1% agree and 2.2% strongly agree to have enough developed digital learning content in their schools.

4.6 Verification of the hypotheses

To validate the framework the hypotheses were tested. The indices for the independent and dependent variables were calculated by adding up all valid responses from the respondents' opinions per each of the eight variables (i.e. Availability of ICT resources, Availability of ICT Infrastructure, Place of Access, Learning resources, Student ICT skills, Teacher ICT capability and skills, Leadership awareness of ICT importance and Students improved academic performances). The reason for aggregating these responses was that the Pearson's correlation required continuous data.

The researcher used a Pearson correlation analysis method to verify the hypotheses to find out whether students' academic performances were linearly correlated with each of the seven independent variables. Thus, the categorical data was transformed into quantitative forms. Extreme positive responses (i.e. strongly Agree, very good) were assigned the value of 4 and 5 respectively and the extreme negative responses (i.e. Strongly Disagree, very poor) were assigned the value of 1. The analysis entailed the verification of the hypotheses at level of significance of 0.05. To test the other hypotheses, the researcher calculated the means, expected

frequency, observed frequency, standard deviation and the variance of schools with and without ICT. A t-test and CHI square analysis was done to determine if the mean differences obtained between two the sets of respondents and were real or were simply the result of sampling error.

4.6.1 Test of the first hypothesis

The first null hypothesis was stated as: “Availability of ICT has no positive outcome on students’ performance in Kiambu sub-county.” The null hypothesis was tested using a t test and CHI square methods to find out whether there is a relationship between the two variables.

4.6.1.1 T test analysis

The mean, standard deviations and the variances of the finding are presented in table 14 below and the calculations follows.

Table 4. 12: Mean, standard Deviation and variance of school without ICT

	Current academic grade
Mean	5.60
Standard deviation	2.658
Variance	7.067
Total number of Number	40

Table 4. 13: Mean standard Deviation and variance of school with ICT after ICT incorporation to learning.

	Current Grade after ICT
Mean	7.33
Standard deviation	2.478
Variance	6.142
Total number of Number	48

$$\mathbf{H_0} = \mu_1 - \mu_2 = \mathbf{0}; \mu_1 - \mu_2 \neq \mathbf{0}$$

$$\begin{aligned}d_f &= (n_1 - 1) + (n_2 - 1) = n_1 + n_2 - 2 \\ &= 40 + 48 - 2 = 86\end{aligned}$$

If $t \geq t_{\text{critical}}$ or $t \leq -t_{\text{critical}}$ then reject $\mathbf{H_0}$ otherwise $\mathbf{H_0}$ is not rejected.

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\bar{\mu}_1 - \bar{\mu}_2)}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}}$$

$$s_p^2 = \frac{d_{f1}s_1^2 + d_{f2}s_2^2}{d_{f1} + d_{f2}}$$

$$= \frac{39(3.7) + 47(7.1)}{39 + 47}$$

$$= 5.56$$

$$t = \frac{(7.33 - 5.60) - (0)}{\sqrt{\frac{5.56}{40} + \frac{5.56}{4}}}$$

$$= \frac{1.73}{0.50}$$

$$= 3.46$$

The confidence level is 95% and $t_{0,1}$ and the degree of freedom is 86.

$$t_{0.1,86,2 \text{ tailed}} = t_{\text{critical}} = 1.664$$

The obtained value t (3.46) is much greater than the critical t (1.664) so the null hypothesis was rejected and it was concluded that the grades for students with ICT are significantly higher than those without ICT.

4.6.1.2 CHI Square test

The following is a comparison of the students' academic grades before and after ICT was incorporated to the students' learning. CHI square test has been used to also test the Null hypothesis "Availability of ICT has no positive outcome on students' performance in Kiambu sub-county."

Table4. 14: Computation of χ^2

	Observed frequency (f_o)	Expected frequency (f_e)	($f_o - f_e$)	($f_o - f_e$) ²	$\frac{(f_o - f_e)^2}{f_e}$
	4	4	0	0	0.000
	1	3	-2	4	1.333
	5	8	-3	9	1.125
	9	9	0	0	0.000
	5	11	-6	36	3.273
	4	7	-3	9	1.286
	8	3	5	25	8.333
	10	1	9	81	81.000
	1	1	1	0	0.000
	1	1	0	0	0.000
TOTAL	48	48			$\chi^2 = 96.350$

Degrees of freedom (d_f) = (r-1) (c-1) = (10-1) (2-1) = 9

The critical value of χ^2 is 16.919 at level of significance of 0.05 and the critical value of χ^2 is 21.666 at level of significance of 0.01.

The computed value of χ^2 is much greater than the critical values of χ^2 at both 0.05 and 0.01 levels hence it is taken quite significant. The null hypothesis was rejected with greater confidence. Hence it was suggested that ICT has positive outcome on students' academic performances.

4.6.2 Test of the second hypothesis

The second null hypothesis was stated as: "Availability of ICT resources has no effect on students' academic performance in Kiambu sub-county". A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 17 below.

Table4. 15: Correlation between availability of ICT resources and current student's grade

		Availability of ICT resources	Grade after introduction of ICT
Availability of ICT resources	Pearson correlation	1	0.054
	Sign.(2-tailed)		0.013
	N	48	48

The results of this analysis showed a weak positive linear correlation of 0.054 between availability of ICT resources and students academic performance. Since the computed p-value is less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was rejected. This suggests that availability of ICT resources is significantly important towards academic performances in Kiambu sub-county.

4.6.3 Test of the third hypothesis

The third null hypothesis was stated as: "Availability of infrastructure has no effect on students' academic performance in Kiambu sub-county". A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 18 below.

Table 4. 16: Correlation between availability of ICT infrastructure and current student’s grade

		Availability of ICT infrastructure	Grade after introduction of ICT
Availability of ICT infrastructure	Pearson correlation	1	0.130
	Sign.(2-tailed)		0.009
	N	48	48
	Sign.(2-tailed)		0.001
	N	48	48

The results of this analysis showed a weak positive linear relationship of 0.130 between availability of ICT infrastructure and students academic performance. Since the computed p-value is less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was also rejected. This suggests that availability of ICT infrastructure is significantly important towards academic performances in Kiambu sub-county.

4.6.4 Test of the fourth hypothesis

The fourth null hypothesis was stated as: “Accessibility of ICT resources does not affect students’ academic performance in Kiambu sub-county”. A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 19 below.

Table 4. 17: Correlation between Place of ICT access and current student’s grade

		Place of access of ICT resources.	Grade after introduction of ICT
Place of access of ICT resources.	Pearson correlation	1	-0.061
	Sign.(2-tailed)		0.021
	N	48	48

The results of this analysis showed that there was very weak inverse relationship of -0.061 between Place of access of ICT resources and students academic performance. Since the computed p-value was less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was not rejected. This suggests that as Place of access of ICT resources was increased; the academic performances of students in Kiambu sub-county went down. This can be explained by the fact that when students have more access to ICT resources they tend to misuse it by visiting social media at the expense of learning sites.

4.6.5 Test of the fifth hypothesis

The fifth null hypothesis was stated as: “Availability of digital learning resources does not affect students’ academic performance in Kiambu sub-county”. A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 20 below.

Table 4. 18: Correlation between Learning resources and current student’s grade

		ICT learning resources	Grade after introduction of ICT
ICT Learning resources	Pearson correlation	1	0.211
	Sign.(2-tailed)		0.049
	N	48	48

The results of this analysis showed a positive linear relationship of 0.211 between ICT learning resources and students academic performance. Since the computed p-value was less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was rejected. This suggests that availability of ICT learning resources were significantly important towards academic performances in Kiambu sub-county.

4.6.6 Test of the sixth hypothesis

The sixth null hypothesis was stated as: “User-ability of ICT resources does not affect student academic performance in Kiambu sub-county”. A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 20 below.

Table 4. 19: Correlation between Students ICT skills and current student’s grade

		Students ICT skills	Grade after introduction of ICT
Students ICT skills	Pearson correlation	1	0.137
	Sign.(2-tailed)		0.025
	N	48	48

The results of this analysis showed a positive linear relationship of 0.137 between students ICT skills and student’s academic performance. Since the computed p-value is less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was rejected. This suggests that student’s ICT skills were significantly important towards academic performances in Kiambu sub-county.

Table 4. 20: Correlation between teacher capability and skills and current student’s grade

		Teacher capability and skills	Grade after introduction of ICT
Teacher capability and skills	Pearson correlation	1	0.284
	Sign.(2-tailed)		0.050
	N	37	37

The results of this analysis showed a very positive linear relationship of 0.284 between teacher capability and skills and students academic performance. Since the computed p-value

was less than the significant value 0.05 it implies that the results were statistically significant and further rejecting the null hypothesis. This suggests that teacher capability and skills were significantly important towards academic performances in Kiambu sub-county.

4.6.7 Test of the seventh hypothesis

The seventh null hypothesis was stated as: “Leadership awareness of the importance of ICT does not affect academic performance in Kiambu sub-county”. A Pearson product correlation coefficient was used to test this hypothesis and the results are summarized in the Table 23 below.

Table4. 21: Correlation between Leadership awareness of ICT importance and current student’s grade

		Leadership awareness of ICT	Grade after introduction of ICT
Leadership awareness of ICT	Pearson correlation	1	0.667
	Sign.(2-tailed)		0.019
	N	5	5

The results of this analysis showed a very positive linear relationship of 0.667 between leadership awareness of ICT and students academic performance. Since the computed p-value was less than the significant value 0.05 it implies that the results were statistically significant. The null hypothesis was rejected. This suggests that leadership awareness of ICT were significantly important towards academic performances in Kiambu sub-county.

4.7 Refined framework

The findings tested the framework. All independents variable were tested against the current student’s grade in the schools with ICT. The correlation between availability of ICT resources and current students grade was found to give a positive linear relationship between the two hence availability of ICT resources was retained in the framework.

The correlation between availability of ICT infrastructure and current student's grade showed a positive linear relationship between the two hence availability of ICT infrastructure was also retained in the framework.

The correlation between ICT learning resources and current students grade showed a positive linear relationship between the two hence ICT learning resources was also retained in the framework.

The correlation between student's ICT skills and current student's grade was found to be a positive linear relationship between the two hence student's ICT skills were retained in the framework.

The correlation between teacher's capability and ICT skills and current student's grade was found to have a positive linear relationship between the two hence teachers' ICT capability and skills was retained in the framework.

The correlation between leadership awareness of ICT importance and current student's grade showed a very positive linear relationship between the two hence it was also retained in the framework. The correlation between places of access of ICT resources was also a small negative value and it implied that when there is too much access to ICT resources without control students tend to abuse it. Most students will most likely use the same ICT resources for other purposes not related to learning. From this view Place of access to ICT resources needs to be monitored very closely.

In addition new elements emerged which emerged from the research were incorporated and these are time for ICT access and constrains as other independent variables affecting the dependent variable. Both listed as other major factors to consider when integrating ICT in school as seen from the challenges stated.

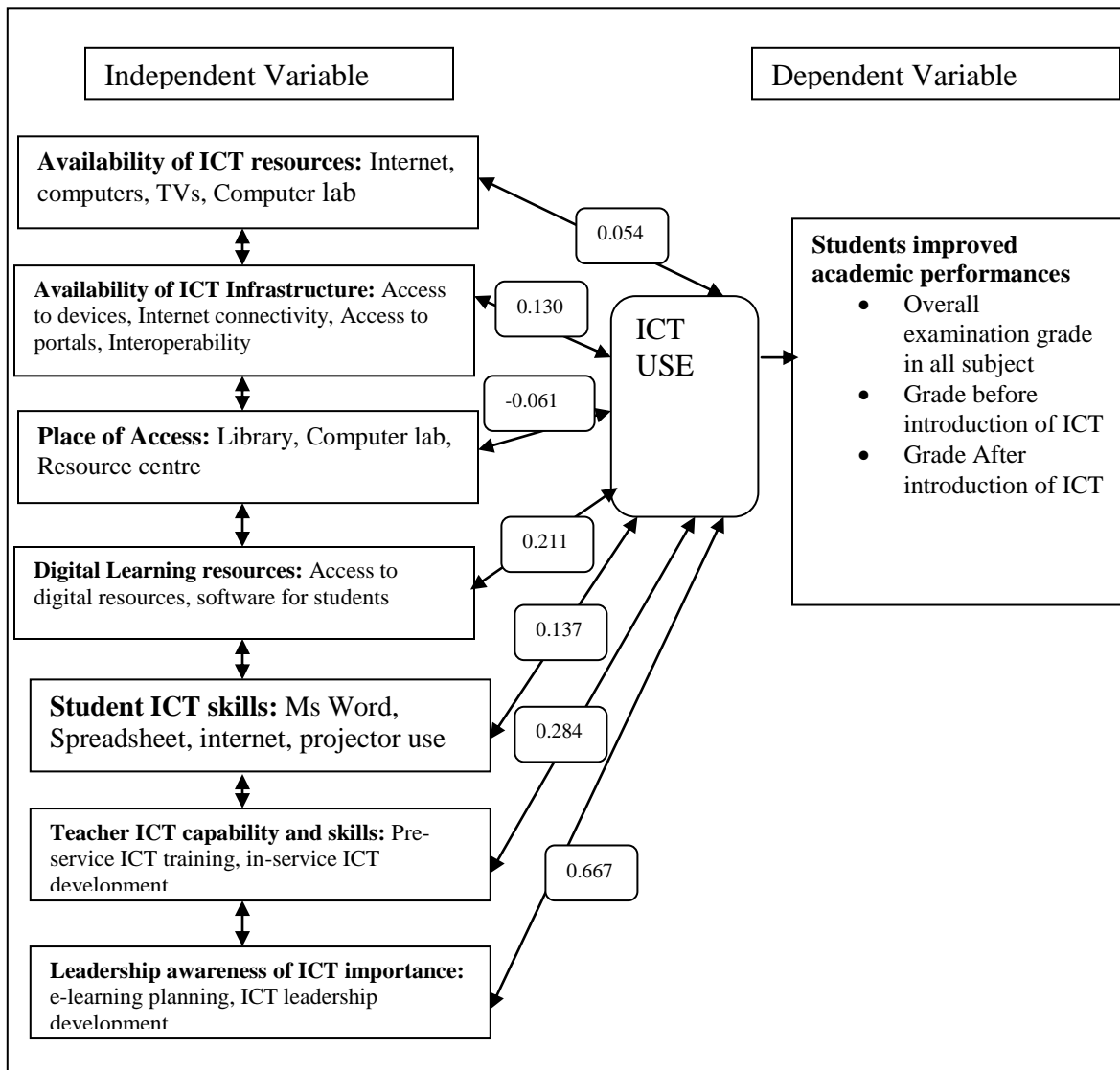


Figure 4. 5: Refined conceptual framework

ICT access time:

Time per session for computer classes is increased to allow planning and co-ordination and frequency of ICT resources use

Constrains on use of ICT resources

These are:

- (i) Content wares- what technology can offer in terms of content and relevance of materials.
- (ii) Experts- Absences of qualified staff (technicians, support personnel, content experts, trained educators) who can manage and assist in ICT.
- (iii) Capacity building- The interest in building expert workforce in ICT.

Availability of ICT resources

These are resources which include but not limited to internet, computers, TVs, projectors, and computer laboratory.

Availability of ICT infrastructure:

These are: access to devices, internet connectivity, technical support, interoperability.

Place of access of ICT resources:

These are: library, computer lab, resource centers.

Learning resources:

They are access to digital resources, software for student's learning and teaching

Student/teacher ICT skills:

These are Ms Word, spread sheet, internet access and use of projectors.

Teacher capability and skills:

They are pre-service ICT training, in-service ICT development.

Leadership awareness of ICT:

They are e-learning planning and ICT leadership development

4.8 How to apply the framework

Once the individual school has decided to invest in ICTs, it must choose how to go about it in order to achieve the required objectives. The following are the guidelines on how to apply the framework:

First step is for the schools to provide basic infrastructure. These include the provision of wireless. LAN and WAN connectivity, computer laboratories, resource centers and libraries with internet and computers.

Secondly the schools should provide ICT resources. These resources should be made adequate for use by both teachers and the students. Resources like projectors should not be shared if they are shared there should be a time table plan. Every classroom should have pc or computer to be used when required. Computer labs should be easily accessible to all. The lab should have the latest technology to promote learning. Resources should be scaled up and those old ICT equipment and network be replaced. Thirdly Schools should have powerful software in order to improve access to resources, materials and information.

Fourthly, teachers should be equipped with basic level of ICT skills. There should also be teacher development. Teachers should attend pre and in service training. Schools should give collaborative active and sustainable learning opportunities to teachers.

Fifth, leaders should attend leadership awareness training on importance of ICT use in schools. Leaders should be able to create environment for teachers to reflect and review effective teaching practices and incorporate ICT use. They should have a learning roadmap to help teachers in effective use of ICT in their classes.

Students should be supplied with the necessary ICT skills. They should be allowed to use ICT resources in most occasions in order to sharpen their learning skills.

Access time to ICT resources should be increased to both teachers and students. Computer lessons should have double period equivalent to 80 minutes to give the teacher's time to plan and organize the students.

Constrains on use of ICT resources should be considered. Content wares for the students should be limited to learning only. Trained personnel should be hired in schools.

CHAPTER FIVE: CONCLUSION, DISCUSSIONS AND RECOMMENDATIONS

5.1 Introduction

The research objectives that were earlier given in chapter two are discussed in relation to the findings.

5.2 Summary of findings

The following are the discussion of the research objectives:

5.2.1 Availability of ICT resources on students academic performances

According to Mbwesa (2002), the availability of ICT resources can enhance learning by making education less dependent on differing teacher quality and by making education available at home throughout the day. Furthermore, availability and use of ICT resources in schools improve student's learning through communication and also improve mode of acquiring information Riel (1998). Jackson, D., B. Edwards and C. Berger (2003) stresses that computers raise the potential to equip students with higher-order skills such as inquiry, reasoning, problem solving and decision making abilities, critical and creative thinking and learning how to learn.

The results from the research showed that availability of different ICT resources in Kiambu sub-county was still very low. The response from the students showed that 89.8% had no computer in the class rooms, 81.8% of the students respondents stated that they had no internet connectivity in their schools, 58.0% reported to fairly have projectors, 66.5% reported to fairly have computer laboratory and about 69.3% consented to not having software for students. The availability of ICT resources in schools improves cognitive development Jonassen (1996). Despite the limited resources, ICT improves academic performances in Kiambu Sub County.

The study further reveals that ICT infrastructures in schools are very low. 90.9% of the students indicated that internet connectivity was not available while 15.2% consented to availability of school portal. 37.8% of the teachers indicated that internet connectivity was not available while 0.0% consented to availability of school portal, 86.5% indicated that they had no platform for data and information sharing.

The study revealed that, because of the limitation in the numbers of computers and laboratories, the computer laboratories are timetabled and time for accessibility was limited. Teachers and students are supposed to adhere to time schedules which do not promote accessibility. However, timetabling enables better organization and management of the few resources and most respondents agreed that there is access though insufficient in schools in Kiambu Sub County.

According to the findings majority of the students hardly accessed ICT facilities from resource centers and in libraries where there were no ICT facilities for students use. No time was allocated for students practice in the computer lab. The study also showed that computer lab was the most popular places to access ICT resources. Learning on the internet conforms to constructivist approach to instruction (Jonassen, 2002) so the limit to places is not an ideal practice.

According to UNESCO (2002), the safest way to bring computers to institutions is teaching students skills of how to use word processors, spread sheets, data bases and graphic tools. These tools are required later on in life. The study has shown that 39.8% of students rated their skill as good in Ms Word, about 28.4% rated as good in Spreadsheets and that 51.3% of teachers rated their skill as good in Ms Word, about 35.1% rated as good in Spreadsheets.

5.2.2 Challenges affecting harnessing of ICT resources use to improve academic performances

The findings showed that 67.6% of the teachers showed that there is lack of ICT resources in their schools and 80.7% of the students indicated the same. At the same time, the results indicated that though some schools have ICT resources, these resources are not enough. The results showed that 48.6% of the students and 45.5% of the teachers lack ICT skills. The findings also indicated that there was inadequate internet access.

It was reported that use of ICT required more time and effort in terms of planning, setting up of classes and ICT equipment. Most teacher respondents argued the lessons are 40 minutes long and there is no or limited time allocated for planning and co-ordination. There were also lack of interest by teachers and they have inadequate ICT proficiency skills.

The findings also showed that there was poor availability of sufficient ICT resources. Most schools had no computers in classrooms. The respondents reported to accessing technology at time tabled periods in computer lab.

There were absences of technical support. Respondents claimed that technical support was lacking and if for example a data projector broke down, no one would be able to fix it.

There was lack of professional development. Most teachers attest to requiring professional development in order to improve their ICT skills.

5.2.3 Development of a framework for harnessing ICT resources use to improve performance of students in Kiambu sub-County.

Four frameworks were reviewed and a framework was developed that gives a criteria for harnessing ICT resources. The elements of the framework were availability of ICT resources, availability of ICT infrastructure, Availability of digital learning resources, teacher ICT capability and skills, students ICT skills and leadership awareness of ICT importance.

5.2.4 Validation of the proposed framework.

The conceptual framework was validated using three methods: Pearson's correlation coefficient Correlation, t test and CHI square test. The analysis showed that there was positive linear correlation of 0.130 between availability of ICT infrastructure and current student's grade, a small positive correlation of 0.054 between ICT learning resources and current students grade, a positive correlation between student's ICT skills and current student's grade, a positive linear correlation between teacher's capability and ICT skills and current student's grade, the correlation of 0.667 between leadership awareness of ICT importance and current student's grade showed a very positive linear relationship. The student's grade and places of access to ICT resources showed a negative correlation of -0.061 meaning that the places to access ICT should be increased but the sites the students visits should be controlled. A t test and CHI square analysis showed that incorporation of ICT into teaching and learning improves students' academic performances.

5.3 Conclusion

The aim of this study was to investigate the influence of: availability of ICT resources, availability of ICT infrastructure, Places of ICT resource access, student ICT skills, teacher ICT capability and leadership awareness of importance of ICT in schools on the students' academic performances. The study also determined the challenges and constraints that influence the use of ICTs in teaching and learning process. The study showed that availability of ICT resources, availability of ICT infrastructure, Places of ICT resource access, student ICT skills, teacher ICT capability and leadership awareness of importance of ICT were major determinants of ICT use in teaching and learning process.

Based on the study findings teacher's ICT capability, availability of ICT resources and availability of ICT infrastructure are significant determinants of ICT use in teaching and learning and hence the change in academic behavior.

The leading challenges of ICTs use in the teaching are lack of teachers training on; lack developed digital content and lack of trained personnel.

5.4 Recommendations

Information Communication Technology (ICT) has become a commonplace entity in all aspects of life. The use of ICT has changed the way business and institutions are governed. Therefore ICT application in secondary school education cannot be overemphasized. The study recommends the following:

1. Provision of ICT resources and infrastructure to schools.

The National government in collaboration with the Kiambu county government should endeavor to make provision for ICT resources such as computers and necessary software to enable schools to adopt ICT in teaching and learning.

Computer labs need to be established in all schools and be adequately equipped. Internet connectivity should also be enhanced.

2. Development of digital learning content

The Government should establish a policy on digital content. In the same light all school in the country including Kiambu county schools should be facilitated to adopt the digital

content. This will also facilitate development of school ICT portals and interoperability framework which the research found lacking in Kiambu-sub county schools.

3. Adequate provision of ICT skills

Curriculum developers and the ministry of Education need to create more time in the time table where ICT skills are taught to learners especially at the high school level who are about to graduate to face job market or further training.

4. Recruiting and training of personnel

Most high school teachers lack adequate ICT skills. Therefore there is need for in-service training of both the teachers and support (technical) staff to ensure proper adoption of ICT skills in Kiambu sub-county schools.

5. 5 Suggestions for further study

Based on the findings of the study the researcher suggests the following:

- I. The framework is tested again in other parts of the country.
- II. Further research needs to be done regarding framework formulation for ICT development not only in Kiambu County but in other counties too to act as a basis for policy formulation to guide the government and other stake holders in Kenya.

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APPENDIX A: TEACHERS QUESTIONNAIRES

Dear Sir/madam,

You have been randomly chosen as a respondent in a survey on “**A FRAMEWORK FOR HARNESSING ICT RESOURCES TO IMPROVE THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN KIAMBU SUB-COUNTY**” which is being undertaken as part of an educational research. Your cooperation in filling this questionnaire will ensure that the study is a success. Please feel free to give your views on the items given by answering all questions and indicate your choice by putting a tick in the checkbox before the answer you feel most appropriate or fill the gaps by giving reasons or information in relation to a particular question. The responses will be treated with utmost confidentiality.

Please provide information about yourself by ticking the appropriate boxes.

1. Name of school

2. How long have you been teaching?

Less than 2 years between 2- 5 years More than 5 years

3. What subject do you teach?

.....

4. How is the availability of the following ICT resources in your school?

		Not available	Fairly available	Available
A	Computer/Pc in class room			
B	Projector			

C	Internet Connectivity			
D	Computer laboratory			
E	Digital content			
F	Television set			
H	Others (specify)			

5. Answer the following questions in relation to your school?

		No	I don't know	Yes
	ICT Infrastructure			
a	Does your school have internet connectivity like LAN, WAN or optical fiber?			
b	Does your school have a portal for teachers, parents and students to access ICT resources, digital content and information any time?			
c	Do you have a framework or a platform used to exchange data and information in your school?			
d	Do all students and teachers have access to ICT resources and tools (devices) like computers?			

	ICT learning resources			
e	Do you have a collaborative digital content creation supported by the County education office?			
f	Is the digital content used in your school procured by the school?			
g	Does your school develop digital content for its use?			
h	Do teachers routinely share digital learning content?			
i	Do you have access to national pool of quality digital content?			
	Teacher ICT capability and skills			
j	Did you undergo training on the use of ICT before you graduated?			
k	Have you attended any training to upgrade or develop competence in the educational use of ICT since you were employed?			

6. How often do students access ICT resources in the following locations?

		Never	Not sure	Sometimes	Always
A	Library				
B	Computer lab				
C	Class rooms				
D	Resource centre				

7. What are the challenges affecting teachers access and use of ICT resources in your school?

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8. What is the rating of your expertise in the use of the following?

		Very poor	Poor	Fair	Good	Very good
A	Word processing					
B	Spread sheet					
C	Internet					
D	Projectors					
E	Accessing digital learning content					
F	Others(Specify)					

9. What factors do affect your use of the above ICT tools?

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10. Tick the most appropriate response to the following.

		Strongly disagree	Disagree	Don't agree	Agree	Strongly agree
A	Students' use computer for academic purpose most times					
B	Students' use internet for academic purpose most times					
C	ICT has helped my students apply what they have learnt during exams					
D	ICT has made my students' attitude towards learning improve					
E	Since ICT was introduced in our school students' academic performance has improved					
F	Students' spend most of the time for other purposes (hearing music, movies, face book) while using the computer and the internet.					
G	We have sufficient technical support to assist when using ICT resources.					
H	There is enough developed digital learning content in our school					

11. Which of the following teaching method do you use mostly to teach?

Lecture method Demonstration Narration Text-reading
Audio-visual presentation Note writing

12. What was your KCSE subject grade before the introduction of ICT? If applicable

A A- B+ B B- C+ C C- D+ D and below

13. What is your subject grade after the introduction of ICT in your school? if applicable

A A- B+ B B- C+ C C- D+ D and Below

14. Which of the following policies and practices would be most effective in ensuring widespread use of ICT resources throughout your school?

Technical support which is always av

Support from senior management

Initiating of staff ICT training in my school

Timetabling of rooms and equipment/access to ICT resources

Availability of developed digital learning content

Development of ICT infrastructure

Availability of staff ICT capacity building through on –service ICT training and in-service ICT professional development

E-learning planning

Leadership development on ICT

Platform for sharing and accessing digital content

THANK YOU FOR YOUR TIME

APPENDIX B: STUDENTS QUESTIONNAIRES

Dear student,

You have been randomly chosen as a respondent in a survey on” **A FRAMEWORK FOR HARNESSING ICT RESOURCES TO IMPROVE THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN KIAMBU SUB-COUNTY**” which is being undertaken as part of an educational research. Your cooperation in filling this questionnaire will ensure that the study is a success. Please feel free to give your views on the items given by answering all questions and indicate your choice by putting a tick in the checkbox before the answer you feel most appropriate or fill the gaps by giving reasons or information in relation to a particular question. The responses will be treated with utmost confidentiality.

Please provide information about yourself by ticking the appropriate boxes.

1. Your age

2. Your sex:

Male

Female

3. Your class:

(a) Form 1

(b) Form 2

(c) Form 3

(d) Form 4

4. Name of your school

5. How is the availability of the following ICT resources in your school?

		Not available	Fairly available	Available
a	Computer/Pc in class room			
b	Projector			
c	Internet connectivity			
d	Computer laboratory			
e	Digital content			
f	Software			
g	Television set			
h	Others (specify)			
i				

6. Answer the following questions in relation to your school?

		No	I don't know	Yes
	ICT Infrastructure			
A	Does your school have internet connectivity like LAN, WAN or optical fiber?			
B	Does your school have a portal for parents and students to access ICT resources, digital content and information any time?			
D	Do all students have access to ICT resources and tools (devices) like computers?			
	ICT learning resources			
E	Do you always have access to school digital learning content at school and at home?			
F	Do you have access to national pool of quality digital content?			

7. How often do you spend time accessing ICT resources in the following locations in your school?

		Never	Not sure	Sometimes	Always
a	Library				
b	Computer lab				

c	Class rooms				
d	Resource centre				
e	Others(Specify)				
f					

8. What are the challenges affecting your access and use of ICT resources in your school?

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9. How can you equate your knowledge and skills in using the following ICT tools?

		Very poor	Poor	Fair	Good	Very good
a	Word processing					
b	Spread sheet					
c	Internet					
d	Projectors					
e	Accessing digital learning content					
f	Others(Specify)					
g						

10. What factors do affect the use of these ICT tools?

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11. Tick the most appropriate response to the following.

		Strongly disagree	Disagree	Agree	Strongly agree
a	I use computer for academic purpose most times				
b	I use internet for academic purpose most times				
c	ICT has helped me apply what I have learnt during exams				
d	ICT has made my attitude towards learning improve				
e	Since ICT was introduced in our school my academic performance has improved				
f	I spend most of the time for other purposes (hearing music, movies, face book) while using the computer and the internet.				
g	We have sufficient technical support to assist when using ICT resources.				
h	There is enough developed digital learning content in our school				

12. What was your examination grade before ICT was introduced in your school? If applicable

A A- B+ B B- C+ C C- D+ D and Below

13. What is your examination grade after introduction of ICT in your school? If applicable

A A- B+ B B- C+ C C- D+ D and Below

14. Suggest how your school can help you improve use of ICT for learning.

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END

THANK YOU FOR YOUR TIME

APPENDIX C: PRINCIPALS QUESTIONNAIRE

Dear Sir/madam,

Your school has been randomly chosen as a respondent in a survey on “**A FRAMEWORK FOR HARNESSING ICT RESOURCES TO IMPROVE THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN KIAMBU SUB- COUNTY**” which is being undertaken as part of an educational research. Your cooperation in filling this questionnaire will ensure that the study is a success. Please feel free to give your views on the items given by answering all questions and indicate your choice by putting a tick in the checkbox before the answer you feel most appropriate or fill the gaps by giving reasons or information in relation to a particular question. The responses will be treated with utmost confidentiality.

Please provide information about yourself by ticking the appropriate boxes.

1. Has ICT been introduced in your school? If yes state when

Yes No

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.....

2. Do you think the improvement of ICT infrastructure and services would influence student's performance?

Yes No I don't know

3. Do you have a plan on e-learning? If yes please explain

Yes No

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.....

4. Have you attended any leadership development course on use of ICT? If yes indicate the level

Yes No

5. What are your recommendations on the use of ICT?

.....
.....

END

THANK YOU FOR YOUR TIME