FACTORS THAT INFLUENCE THE INTEGRATION OF ICTS IN THE TEACHING PROCESS IN SELECTED SECONDARY SCHOOLS IN KENYA

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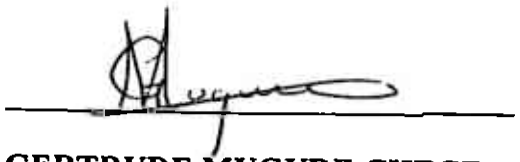
DECLARATION

I declare that this Project Report is an original own work and has not previously been submitted for an award of degree in any other university.



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DEDICATION

To my parents, for instilling a life long love for knowledge;

My family and friends, for putting up with me even when I could not be there for you

and

To my friends, Anne and Njenga, for making this journey worth every step

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LIST OF ACROYNMS & ABBREVIATIONS

ADB	Asian Development Bank
ADEA	Association pour le developpment de l'education en Afrique
BECTA	British Educational Communications & Technology Agency
BoG	Board of Governors
CAL	Computer Assisted Learning
CAT	Computer Assisted Teaching
CEPAK	Computer in Education Project in Kenya
CFSK	Computers for Schools Kenya
CPD	Continuous Professional Development
CPT	Computer Programmed Teaching
HND	Higher National Diploma
ICT	Information and Communication Technologies
InfoDEV	Information for Development Program
IDRC	International Development Research Centre
KPLC	Kenya Power & Lighting Company
KSCE	Kenya Certificate of Secondary Education
LAN	Local Area Network
LCD	Liquid Crystal Display
MIT	Massachusetts Institute of Technology
MOEST	Ministry of Education, Science and Technology
OECD	Organisation for Economic Co-operation and Development
PTA	Parents Teachers Association
ROCARE	Reseau ouest et Centre africain de recherche en education
SMASSE	Strengthening of Teaching Mathematics and Science in Secondary Education
TSC	Teacher Service Commission
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UPS	Uninterruptible Power Supply
VSAT	Very Small Aperture Technology
WAN	Wide Area Network

ABSTRACT

This research project aims at investigating the factors that influence the use of ICT in the teaching process in four secondary schools in Kenya. Three of the schools chosen are situated in Central Province and the other in Nairobi province. The research was carried out under the umbrella of a continent wide research known as the Panafrican Research Agenda on the pedagogical Integration of ICT. Kenya is one of the eleven partner countries with the specific involvement of the School of Continuing and Distance Studies. The broad objective of the Panafrican Research Agenda is to better understand how the pedagogical integration of ICT can improve the quality of teaching and learning in Africa. The study specifically establishes how the four key factors act as drivers and act as barriers to the integration of ICTs in the teaching process in the four schools under study. The focus of this study is the teacher. The literature review delves into various factors as categorised from past research studies carried out in this area from around the world. Two broad categories are discussed: external factors, which are outside the influence of the teacher and internal factors which have to do with the teacher. The research design used is exploratory in nature and methodology employed is qualitative in nature. Four schools are conveniently selected for the study. The main findings are that teachers feel the main barriers to integration of ICT in education are resource related with institutional policies and strategy also playing a contributory role. The main drivers of ICT integration in teaching process identified are mainly to do with support systems and positive response from students. In conclusion, varying success in using ICT in the teaching process has been realised in three schools where external factors are quoted as main drivers in the integration of ICT in the teaching process while one school is still grappling with the integration of ICT in the teaching process due to challenges which are mainly from external factors. Recommendations from the study include providing resources modelled at school level, developing effective policies at school level that encourage teachers to use computers in the classroom, facilitating and reward teachers who participate in continuous professional development programs which encourage teaching with ICT and ensuring integration of ICT in the teaching process transforms the way students acquire knowledge.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

This section will look at the main ideas that inform this research delving into context the study was carried out the history of the use information and communications technologies in education.

1.1.1 Panafrican Research Agenda

The Panafrica Research Agenda is an International Development Research Centre (IDRC) funded project that involves African training and educational research institutions from eleven (11) countries. The purpose of the proposed Panafrican Research Agenda on the Pedagogical Integration of ICT is to contribute and to participate in the access, construction, and production of knowledge in the information era.

Information and Communications Technologies (ICT) are increasingly present in African societies and have been introduced to varying degrees at all education levels from preschool to university and in both the formal and informal sectors. They are also used to offer distance education to teachers and other adult learners. However, depending on the various education systems across Africa, ICT are increasingly being taught as a completely separate discipline, while ICT integration into pedagogical practices to improve the quality of teaching and learning remains in the exploratory stage. Apart from South Africa, little African research is being conducted on the efficient use of ICT in education, even though an IDRC-funded study in 2004-2005 in Central and Western Africa has demonstrated the potential of ICT to transform pedagogical practices.

The objective of the Panafrica Research Agenda is to better understand how the pedagogical integration of ICT can improve the quality of teaching and learning in Africa. The development of an Observatory on ICT in African education would be the main activity in the initial two-year phase, modelled on observatories in other sectors; such as oceanography, which have successfully gathered, organized and updated data for researchers and

practitioners in specific fields. The following is a brief outline of the development of ICT use in the field of education.

1.1.2 Brief History of Computer Use in Schools

Computers made their first appearance in certain schools in Northern Africa at the end of the 1960s, mainly for management applications. They started being used in educational institutions in North America and Europe in the 1970s. The LOGO project was set up in Senegal in partnership with the Massachusetts Institute of Technology (MIT). Governments at the time were motivated by a dual goal: to initiate students to the computer and to introduce certain software programs.

LOGO, the first computer language for children, which was developed by Seymour Papert, a professor at MIT and pioneer in artificial intelligence, was especially popular in North America. Papert's overriding aim was to develop educational tools and software with socio constructivist potential. More precisely, he wanted a language that would allow students to construct their own knowledge.

For more than a decade, introductory computer courses in Africa were offered in only a few Lycees and some universities. Information and communication technologies were largely ignored. Instead computer processing took precedence. While computer processing is still taught in many schools in Africa, the behaviourist educational approach has helped in the development of Computer Programmed Teaching (CPT). The shift has thus been made from teaching computer programming per se and computer programmed teaching to Computer-Assisted Teaching (CAT), which is widely adopted in North America and Europe. Tutorials and educational software were designed to help learners acquire knowledge and develop skills. By the early 1980s, computer-assisted learning of (CAL) emerged on the scene.

In the early 1990s computers were widely seen as being important to education. Pelgrum and Plomp (1991) identified seven reasons why computers might be important to schools. These included rationales relating to social and economic interests, such as reducing the costs of education, supporting the computer industry, preparing students for work and for living in a society permeated with technology, and making the school more attractive to its potential clients. They also included educational drivers, such as acting as a catalyst to speed up the process of educational change, and improving learning processes and outcomes. There was

widespread support in the literature for the view that computers could enhance learning (e.g. Niemiec and Walburg 1992; Heppell 1993b; NCET 1993), particularly if used as a cross-curricular tool (e.g. DES 1989; ILECAS 1989; NCC 1990; Hadley and Sheingold 1993; Watson 1993).

Since the late 1990s the pedagogical integration of ICT appears to be on the ascendant in educational circles. The hope now is that teachers can better teach all manner of subjects with the help of information and communication technologies and that students will learn more, and more easily. In today's academic community, information and communication technologies are recognised as a cross-curricular competency for students and teachers alike.

1.1.3 Outline of ICT Use in Diverse Contexts in Africa

ICT has wide use in Africa; right from preschool to university level. ICT use in education is especially prevalent in secondary and technical institutions. In the technical and professional schools, ICT is used more specifically to teach and learn specialized disciplines. Thus, we observe that certain disciplines have developed ICT-related practices. Accordingly, ICT integration into learning activities in secondary schools would seem to be all the more important, since it goes beyond interpersonal communication and integrates several dimensions such as interactive learning, collaborative learning, and research for information for analysis and problem-solving.

In the higher African educational institutions, ICT integration also appears to be considered a necessity both for university students and teachers. Indeed, as we highlight below in the section on issues, numerous disciplines are either not taught or poorly taught in Africa owing to lack of teachers. ICT utilization for online learning (e-learning) is one way to address this lack, as it would provide broader access to higher learning. Moreover, the higher education sector includes graduate teaching and continuing education, where ICT holds enormous potential for adult self-training and lifelong learning. Distance education has become increasingly common, particularly in adult learner communities in various university programs. In many African universities and training schools, ICT utilization in this context fosters self-training and successful cyberspace initiatives that are independent of time or location. Thus, ICT enables coaching and tutoring outside regular class hours. This opens the way to a new approach to the concept of time units, learning locations and learning activities.

Aside from all this, online learning allows international cooperative teacher training. It also promotes national and international exchanges between teachers and contributes to the fine-tuning of pedagogical practices.

1.1.4 Brief History of Computer Use in Education in Kenya

Computer education in Kenya was introduced in 1998, although different government ministries have yet to coordinate their approach to ICT education (Adhola, 2004). Currently, the country has close to 270,000 fixed lines with a ratio of one telephone line for every 100 people. Only a small minority of Kenyans are able to make use of personal computers. The Computer Society of Kenya (CSK) puts the estimate at one computer for every 2,000 Kenyans — while the national power grid serves less than 15 percent of the population.

However, this was not the first attempt at introducing computer use in schools in Kenya. According to Wims and Lawler (2007), one of the earliest computer deployment projects, Computers in Education Project in Kenya (CEPAK), was done in 1983. The pilot phase involved introducing computer use in one secondary school in Kenya. In the second phase, five more schools, both public and private were included in the program. An evaluation was carried out in 1986 (baseline year) and in 1988. The research found that both practically and symbolically, computer science was receiving more emphasis than integration of technology into the rest of the curriculum.

A second research project (SchoolNet 2003) conducted in November 2002 covering 69 schools showed that only 46.3% of the schools had computers, and that internet and fax were rare in schools. It went on to assert that in those schools, access to the internet was severely limited and when available was mainly for administrative purposes. It also indicated that more than 20% of the schools had less than five computers, indicating that the computers were largely for administrative purposes.

1.1.5 Challenges of Pedagogical Integration of ICTs

Pedagogical integration of ICTs is not an automatic process; it is fraught with many challenges. Indeed, according to Tinio (2003), the experience of introducing different ICTs in the classroom and other educational settings all over the world over the past several decades suggests that the full realization of the potential educational benefits of ICTs is not automatic. The effective integration of ICTs into the educational system is a complex, multifaceted

process that involves not just technology—indeed, given enough initial capital, getting the technology is the easiest part!—but also curriculum and pedagogy, institutional readiness, teacher competencies, and long-term financing, among others. Of interest is the assertion of teacher competencies as one of the factors that determines effective pedagogical integration of ICT. The role of the teacher was identified, by a number of authors, as the most important factor to successful integration (Bitner & Bitner, 2002; Loveless, 1996; Zhao, Pugh, Sheldon & Byers, 2002; Conlon & Simpson; 2003; Guha, 2003; Vannatta, 2002).

The Panafrica Research Agenda has classified the barriers to ICT integration as external (concerning the school, society, etc set-up) and internal factors (concerning the teacher or the teaching process). Twining has further emphasized the importance of recognising teacher variables by categorising these barriers into three; personal factors, institutional factors and pedagogical factors. Personal factors relate to attitudes, lack of interest or knowledge about computers, lack of motivation or confidence/competence and ownership. Institutional factors relate to the school as the basic unit of change. It has wider implications for the education systems as well. Pedagogical factors relate to issues of integrating use of ICTs into the classroom and curriculum. It also goes beyond to looking at how ICTs materially affect the learning process. These factors will be delved into in the literature review in chapter two.

Factors that encourage or discourage are an area of interest in different countries the world over. There is continuous research to find best practice in integrating ICTs into the learning process. One area of interest to research is factors that encourage ICT integration, barriers to this integration and the inherent skills that support integration of ICTs in education. This is the focus of interest in this research.

1.1.6 Challenges of Pedagogical Integration Experienced in Africa

While ICT have infiltrated schools in the Northern countries in great numbers, Africa lags far behind. For several years now, African education systems have been coping with a multitude of problems, and her countries have initiated reforms that generally do not attach much importance to ICT. The ADEA (2002), for its part, has stressed that ICT represent a learning channel with the potential to enormously improve the quality of basic education teaching. And yet, as noted by the World Bank (2002) and in the latest report by the Massachusetts Research Association (2005), there is a serious lack of ICT research in Africa in the areas of effective educational uses and potential impacts on the quality of African education.

Moreover, an exhaustive review conducted in 2003 by the IDRC (Karsenti, 2003) clearly showed that only a very few studies on the integration of ICT into African education have been carried out, apart from a few works by South African scholars.

From the background of the study, it is evident that pedagogical integration of ICT has enormous benefit for Africa. Furthermore, there is diverse use of ICT in African educational institutions. Yet, there is little data concerning the levels of use. This is because little or no research has been carried out to determine various aspects of this use. This would include looking at different aspects such as the policies in place, equipment in use and level of access, the impacts and the factors that influence effective integration.

Past research in this area of the factors that come into play when integrating ICTs in education focuses on different aspect with different research coming up with broad categories to classify them. As stated earlier, the Panafrica agenda has classified them into internal factors and external factors. Internal barriers relate to teacher or teaching process while external barriers are connected to the school, society etc. In a compilation of key research barriers to use of ICTs, BECTA came up with two broad categories based on the individual and the institution; teacher-level barriers including lack of time and confidence, perceptions of computers as complicated etc, and school-level barriers such as lack of equipment, lack of access to equipment, lack of technical and administrative support among others. They further delve into these barriers and categorise them into external (first-order) and internal (second-order) barriers. First order barriers are than categorised as resource related issues such as equipment access, unreliability, lack of support etc. Second order barriers encompass both school-level factors such as organisational culture as well teacher-level factors such as beliefs about teaching and technology and openness to change (Snoeyink & Etmer 2001). A lack of equipment is the highest rated barrier internationally (Pelgrum 2001), often cited even in well-resourced countries.

This is an interesting observation supported by the Panafrica agenda which states that in the so-called industrialized countries, barriers to ICT integration are limited to three main components: hardware, software, and technical support. However, as demonstrated by Cuban (1997, 1999), technological access is an essential yet insufficient condition to foster the pedagogical integration of ICT by teachers. Investment in hardware and technical training is simply not enough. Depover and Strebelle (1996) who researched ICT use in Belgian schools

are entirely of the same opinion, noting that: *"Many studies have shown that the pedagogical effectiveness of ICT depends more on the capacities of teachers to integrate and operate new technologies in a relevant pedagogical context than on the available information technology infrastructure"*. (Free translation)

When it comes to the case of Africa, the reasons vary. There are several explanations for the failure of ICT utilization for pedagogical purposes in certain African educational contexts (see Karsenti, 2003). According to Howell and Lundall (2000), the key factors blocking educational institutions from using microcomputers as teaching and learning tools are insufficient funds, insufficient number of computers, lack of teachers with IT skills, teachers' inability to integrate the computer into the different subject areas, and lack of appropriate microcomputer teaching programs.

There is use of computers in Kenyan secondary schools. The increasing use is due to initiatives like Computers for Schools Kenya (CFSK). This non-governmental organisation partners with business organisations in sourcing and deploying computers to schools. However, there has been little research done to establish to what extent ICT has been put to use in the teaching and learning process. According to CFSK website, one of the fundamental problems of ICT in Kenya is the lack of capacity for the optimum utilization of ICT in teaching and learning, as well as in institutional management and administration. CFSK strongly advocates for ICT literacy amongst educators so that they can transform and enrich pedagogy for the benefit of all students.

1.2 Purpose of the Study

Factors that encourage or discourage are an area of interest in different countries the world over. There is continuous research to find best practice in integrating ICTs into the learning process. One area of interest to research is factors that encourage ICT integration, barriers to this integration and the inherent skills that support integration of ICTs in education. This is the focus of interest in this research.

1.3 Statement of the Problem

In Kenya, computers are now being used in schools. A national curriculum on computer studies has also been developed and is currently in use with computer studies being an examinable subject in Kenya Certificate of Secondary Education. Yet pedagogical integration goes beyond learning about the technology but using that technology to transform the teaching and learning process itself. There is need to investigate what has prevented the optimal use of ICT in the teaching and learning process. This research project seeks to explore this question by seeking to establish how system, institutional, teacher and pedagogical factors act as enablers of integrating ICT in the teaching process and how they act as barriers to pedagogical integration of ICT in four secondary schools selected for this study. The focus will be on teachers as numerous research shows that the teacher is the key determiner of pedagogical integration of ICT.

1.4 Objectives of the Research

The main objectives of this study were:-

1. To establish how system factors facilitate and how they hinder the integration of ICT in the teaching process in the four schools under study.
2. To establish how institutional factors facilitate and how they hinder the integration of ICT in the teaching process in the four schools under study.
3. To establish how teacher factors facilitate and how they hinder the integration of ICT in the teaching process in the four schools under study.
4. To establish how pedagogical factors facilitate and how they hinder the integration of ICT in the teaching process in the four schools under study.

1.5. Research Questions

The study was guided by the following research questions:-

1. How do system factors encourage and how do they hinder teachers to integrate ICT in the teaching process in the four schools under study?
2. How do system factors encourage and how do they hinder teachers to integrate ICT in the teaching process in the four schools under study?
3. How do system factors encourage and how do they hinder teachers to integrate ICT in the teaching process in the four schools under study?

4. How do system factors encourage and how do they hinder teachers to integrate ICT in the teaching process in the four schools under study?

1.6 Significance of the Study

With the introduction of ICT in Africa, a lot of advances have been made in integrating computer studies mainly in the school curriculum right from primary to university level. However, the use of ICT technologies to improve the teaching and learning experience remains largely untapped. Experience the world over shows that ICT holds enormous potential for adult self-training and life long learning.

Generating knowledge in this area is therefore crucial for the following reasons:-

i. It will help identify the challenges policy makers in Kenya must reckon with when making decision about the use of ICT in education.
ii. The finds of this research will be posted to the observatory which has been set up under Panafrica Agenda hence advancing the documentation of knowledge in Kenya and Africa as a whole.
iii. The research is an opportunity to build the research capabilities of this researcher.
iv. The research findings will help schools involved in the research in developing appropriate strategies in combating the challenges they experience.

1.7 Delimitations of the Study

The research was confined to secondary schools only in Kenya. The study focused on teachers and school managers only. While there are a wide range of technologies that can be termed as ICTs, this study will confine itself to the integration of computers in the teaching process. The study will involve four schools namely, Aga Khan High School, St. Joseph High School, Musa Gitau Secondary school and Uthiru Girls High School.

1.8 Basic Assumptions of the Study

This study assumes that the school under study already have computers for instruction in the classroom. It also assumes that the research participants were truthful and knowledgeable. The instruments used in the study are also assumed to have validity.

1.9 Definition of Significant Terms

This section gives a definition of the significant terms as they have been used in this study.

ICT (Information and Communication Technologies): In this study the term ICT is used to refer to computers and associated accessories such as printers, projectors, storage devices which include Compact Disks (CDs) and flash disks and facilities necessary to access the internet.

Computer: In this study the computer is an electronic machine, operated under the control of instructions stored in its own memory that can accept data (input), manipulate data according to specified rules (process), produce results (output) and store the results for future use.

Computer Literacy: Concerning the knowledge, skills and attitudes which enable a person to use computer technology to benefit themselves and others related to tasks they wish to accomplish.

Constructivism: The view of learning that requires the learner to actively construct conceptual meaning from experiences. This view is predominant among educational theorist in the world.

E-mail (Electronic mail): Text messages and computer files exchanged through computer communication, via Internet or intranet networks.

Internet: The international network of networks of computers. It allows one to access information stored in electronic form in various parts of the world by accessing locations known as websites.

Pedagogical: Describing the process through which teaching and learning takes place.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

One of the many challenges facing developing countries today is preparing their societies and governments for globalization and the information and communication revolution. Policy-makers, business executives, NGO activists, academics and ordinary citizens are increasingly concerned with the need to make their societies competitive in the emergent information economy "The illiterate of the 21st century," according to futurist Alvin Toffler, "will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn" (Tinio 2003).

The above statement explains why there is a global interest in the use of ICT in education. There is a growing realisation that effective use of ICT can help societies meet the challenges of the future. This literature review looks at the experience of pedagogical integration of education in developed countries and developing countries in both Asia and Africa. It also looks at various research findings on specific areas such as the drivers of effective pedagogical integration of ICT, barriers that limit integration and the skills that are required in order for pedagogical integration to effectively take place.

2.2 Overview of Literature Review

The literature review draws from some major research done on ICT and education. The aim is to link the main findings as relates to the research questions formulated for this study. It is important at this juncture to state that the drivers (or factors) encouraging effective pedagogical integration of ICT and the barriers limiting effective integration are essentially two sides of the same coin. A driver is seen as the presence of a certain factor while its absence becomes a barrier. The literature review will thus intertwine the drivers and barriers interchangeably.

The major area of interest will be research findings in similar studies carried out in different countries and the mainstream thoughts that have emerged from these studies. These thoughts translate into general categories in which factors have been classified. Central to all these research findings is the crucial role that teachers play in effective pedagogical integration of

ICT. The conceptual framework is informed by these broad categories. The two broad categories that will be looked at are internal factors and external factors. The factors will then be examined in detail.

2.3 Information and Communication Technologies

The following section looks as the various uses of ICTs in education and the various ways in which they are used in education.

2.3.1 What Types of ICTs Are Commonly Used In Education?

Accordingly, ICTs stand for information and communication technologies and are defined "diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information" (Tinio, 2003). However, this definition is not complete; according to various authors (UNESCO, 2004; Grégoire, Bracewell & Laferrière, 1996; Karsenti & Larose, 2002; Tardif, 1998), ICT in an educational context refers to a set of combined technologies that enables not only information processing but also its transmission for purposes of learning and educational development. These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony.

While computers and the internet are the most main technologies referred to as comprising ICTs, they are more than just these technologies; older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools. For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries. The use of computers and the Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access.

Moreover, different technologies are typically used in combination rather than as the sole delivery mechanism. For instance, the Kothmale Community Radio Internet uses both radio broadcasts and computer and Internet technologies to facilitate the sharing of information and provide educational opportunities in a rural community in Sri Lanka. The Open University of the United Kingdom (UKOU), established in 1969 as the first educational institution in the world wholly dedicated to open and distance learning, still relies heavily on print-based

materials supplemented by radio, television and, in recent years, online programming. Similarly, the Indira Gandhi National Open University in India combines the use of print, recorded audio and video, broadcast radio and television, and audio conferencing technologies (Tinio, 2003).

2.3.2 Pedagogical Integration of ICT

Pedagogical integration of ICT into schools means the appropriate, habitual and sufficiently regular use of ICT that produces a beneficial change in educational practices and improves student learning (Depover & Strebelle, 1996; Isabelle, 2002). This type of integration implies the routine use of ICT in the learning process. The pedagogical integration of ICT must therefore be understood as integration such that the student learns and socializes through a multitude of interactive and communication channels.

1.2.3 Why Introduce ICT Into Education?

Before examining the importance of ICT in education, the definition of pedagogical integration of ICT will be discussed. According to many authors (UNESCO, 2004; Grégoire, Bracewell & Laferrière, 1996; Karsenti & Larose, 2002; Tardif, 1998), ICT in an educational context refers to a set of combined technologies that enables not only information processing but also its transmission for purposes of learning and educational development.

The scientific literature describes different approaches to the integration of ICT into education. Raby (2004), building on the works of Lauzon Michaud and Forgette-Giroux (1991), made a clear distinction between two different types of ICT integration: physical and pedagogical. Physical integration consists of making technological equipment available to teachers and students and promoting its use for occasional pedagogical needs. Physical integration is therefore understood as a process that leads to the introduction and/or deployment of technologies in the educational institution.

In contrast, the pedagogical integration of ICT into schools means the appropriate, habitual and sufficiently regular use of ICT that produces a beneficial change in educational practices and improves student learning (Depover & Strebelle, 1996; Isabelle, 2002). This type of integration implies the routine use of ICT in the learning process. The pedagogical integration of ICT must therefore be understood as integration such that the student learns and socializes

through a multitude of interactive and communication channels. It cannot be reduced to mere physical integration, which is nonetheless imperative.

ICT wields a fundamental impact on political, economic and social conditions in changing societies. For this reason, the key stakeholders in African education—teachers, principals, specialists, parents, and governments—must be actively involved in ICT use and content; and above all the pedagogical integration of ICT into education. Furthermore, we must be concerned about ICT in education because it is clear that ICT will continue to significantly impact all societies worldwide, in all economic, social, and cultural aspects.

Pedagogical ICT integration in teaching and learning holds great promise for developing countries such as Kenya. For many years, University entry in Kenya was pegged to the number of students that the university could physically accommodate in its residential halls. Thousands of qualified students were locked out of opportunities to pursue higher education due to this criterion. Similarly, the transition ratio from primary school to secondary school is low partly due to lack of adequate form one vacancies in secondary schools. According to Tinio (2003), one defining feature of ICTs is their ability to transcend time and space. ICT make possible asynchronous learning, or learning characterized by a time lag between the delivery of instruction and its reception by learners. ICT-based delivery learning also dispenses with the need for all learners and the instructor to be in one physical location.

This is one case in point where ICT can be used creatively to extend educational opportunities to those excluded due to social, cultural or economic reasons. It provides a wider reach to even those who may have resources to further their education but are unable to attend a normal class setting due to time constraints. This has opened a whole new range of opportunities in E-learning as well as distant education. This example is highlighted in order to underpin some of the possibilities that ICTs present in providing innovative solutions in education.

Many researchers (see BECTA, 2005), have demonstrated that technologies are likely to have greater impact when integrated pedagogically, providing several benefits such as better mastery of basic competencies, the technologies themselves, skills preparation for the knowledge society and higher motivation for school learning and advancement to higher learning. In short, introducing information and communication technologies (ICT) into

African education has several benefits which include helping students preserve their past, preparing students for today's reality and ensuring a future for African students.

2.4. Categorising Factors Affecting Pedagogical Integration of ICT

The purpose of this section is to examine various ways in which these factors have been grouped together after the findings of various studies. The Panafrica Research Agenda broadly categorises barriers into two: external barriers (connected to the school, society, etc.) and internal factors (connected to the teacher or the teaching process). As stated earlier, drivers and barriers will be treated as two sides of the same coin. The categories can thus be stated to be external factors and internal factors.

In BECTA(2006) study of the barriers to the use of ICT in learning, the same broad categories were identified; external (first-order factors) and internal (second-order factors). First-order factors are resource-related including lack of equipment and lack of support while second-order barriers include school-level factors such as organisational culture and teacher-level factors such as beliefs about teaching and technology.

Further literature review that investigated the barriers to successful computer implementation into schools uncovered other common themes. These themes can be categorized within three realms; the teacher realm, the physical realm and the social realm. Within the context of the teacher's role a number of factors contributed to the level of successful integration; the individual's willingness to adapt to change, his or her comfort and skill level, as well as the ability to deal with issues of time management were the most common indicators. Within the realm of the physical environment issues of accessibility and organizational constraints arose (Loveless, 1996). Existing literature revealed that support systems were a critical piece of the puzzle as well (Bitner & Bitner, 2002; Guha, 2003; Hruskocy, Cennamo, Ertmer, & Johnson, 2000; Schmid, Fesmire, & Lisner, 2001; Walsh & Vannatta, 2001; Mouza, 2002). Within this social realm, teachers who had support systems including technicians, administrators and peers who could assist when needed were more likely to successfully integrate technology.

In his PhD thesis on Enhancing the Impact of Investment in 'Educational' ICT, Dr. Peter Twining also examined the issue of categories. He has categorised the factors under the headings: personal factors, institutional factors and pedagogical factors. Personal factors

capture the issues related to ICT use by teachers. Institutional factors touch on issues at school level as well as institutions that impact on school as an organisation. These include the education system. Pedagogical factors relate to how use of ICT is integrated into the classroom and curriculum.

2.4.1 Categories of Factors – Further Perspectives

From the various perspectives, a pattern is seen to emerge. One of this is the physical presence of the ICT equipment itself as well as physical infrastructure to accommodate this equipment. In ICT study this is known as hardware. This includes the computers, printers, radios, televisions and telephone connections. Hardware, however, is not enough itself. It has to be supplemented by software. Software includes operating system e.g. Microsoft Windows, or Mac, and application software e.g. Microsoft Office. By extension, there is need for networking facilities to ensure information is shared. This has to with Local Area Network and Wide Area Networks.

Lastly, according to Tinio (2003), a country's educational technology infrastructure sits on top of the national telecommunications and information infrastructure. This includes internet connectivity, for example Very Small Aperture Technology (VSAT), Fibre Optic and availability of broadband technologies. This can be classified as an external factor. They can be referred to as system factors.

The second aspect is the social and school realm. This includes support systems which are availed at school level to enable uptake of ICT use. This relates to technical, institutional and administrative support. Dwyer, Ringstaff and Sandholtz (1990) found that support was needed from both colleagues and administrators. They argued that support needed to take different forms for teachers who were at different stages in the process of implementing computer use in their classrooms. Hadley and Sheingold (1993) noted that administrative support, technical support and encouragement were all important. This highlighted the importance of having adequate support structures (Rhodes 1989) and computer co-ordination (Pelgrum and Plomp 1991). This view is supported by more recent research; (Bitner & Bitner, 2002; Guha, 2003; Hruskocy, Cennamo, Ertmer, & Johnson, 2000; Schmid, Fesmire, & Lisner, 2001) all identify support systems were a critical issue. Within this social realm, teachers who had support systems including technicians, administrators and peers who could assist when needed; were more likely to successfully integrate the technology. An additionally needed support system was effective professional development models and those

models that were designed to incorporate an internal support system, also aided in successful integration. These factors can be referred to as institutional factors and classified as external factors.

The third aspect is category related to teacher factors. Existing literature identifies these factors as central to pedagogical integration. The role of the teacher was identified, by a number of authors, as the most important factor to successful integration (Bitner & Bitner, 2002; Loveless, 1996; Zhao, Pugh, Sheldon & Byers, 2002; Conlon & Simpson; 2003; Guha, 2003; Vannatta, 2002). It is the skill and attitude of the teacher that determines the effectiveness of technology integration into the curriculum (Bitner & Bitner, 2002). Once teachers develop skills, they can begin to find ways to integrate technology into their curriculum and demonstrate its use to others. This is supported by other research findings. One study (Fabry & Higgs) divided attitudes into three groups: self-confidence with ICT, perceived relevance of ICT and innovativeness. The importance of teachers' confidence as a variable impacting on computer use is commonly reported in literature (e.g. Ellis 1986; Somekh 1989a; Rhodes and Cox 1990; Seaborne 1993). Somekh (1989a; 1989b) identified a problem with teachers' self-images as being non-technical, which impacted on their confidence in using the technology per se. A number of sources noted a lack of technical competence as being an important barrier to computer use in schools (e.g. Heywood and Norman 1988; Somekh 1989a; Seaborne 1993). Hadley and Sheingold (1993) identified this as one of the seven most highly rated. This is factors can also be referred to as personal factors and classified under internal factors.

The fourth aspect is pedagogical factors. These refer to the process of how learning occurs. It goes beyond the mere use of computers in schools. Seaborne (1993) argued that this needed to go beyond bolting IT onto the existing curriculum and there was a need to "look at how IT materially affects the learning process, rather than to focus solely on how you integrate it in the curriculum or learn about it." Many sources agreed with this position and identified that "there must be a willingness to change traditional approaches to learning and teaching." (Bell 1993a p.6). However, there was also widespread recognition that this was not straightforward. For example, Olson and Eaton (1986) found that routine procedures which fitted with existing teaching routines were easier to implement than novel ones which did not fit with familiar routines.

There is widespread agreement in the literature that conceptions of teaching are a fundamental obstacle to the integration of computers into schools. These were what Cuban (1993) described as *'cultural beliefs about what teaching is'* that are held by society at large as well as teachers' own conceptions of teaching. Such beliefs include views of: how learning occurs (e.g. Cuban 1993); what constitute valid sources of expertise (e.g. Somekh 1989a) and 'proper knowledge' in schools (e.g. Cuban 1993); risk-taking (e.g. Somekh 1989b); roles (e.g. Sheingold et al. 1983) and who is responsible for learning in schools. Indeed according to Tinio (2003), research on the use of ICTs in different educational settings over the years invariably identify as a barrier to success the inability of teachers to understand why and how exactly they should use ICTs to help them teach better. Unfortunately, most teacher professional development in ICTs is heavy on *"teaching the tools"* and light on *"using the tools"* to teach. At the core of this is the anxiety and worry teachers have that ICT use in the class will replace them and that they will lose their authority in the classroom.

This anxiety is not misplaced. Some examples of successful integration centred on ICT ingrained in a constructivist view of education. Constructivist theory is based on the premise that learning is provoked by the learner's desire to minimize a mismatch between what is already known and what needs to be learned or has been provoked by circumstances. The intrinsic need of the learner to make sense of the environment drives the learning, and instruction must be tailored to the developmental needs of participants (Marshall, 1993). ICT learning shifts the attention from the teacher to the learner. Will ICT replace the teacher? According to Tinio (2003) the answer is a resounding NO! In fact, with the introduction of ICTs in the classroom, the teacher's role in the learning process becomes even more critical. What can and should change is the kind of role that the teacher plays. The role of students, in turn, also expands. She further proposes that as learning shifts from the "teacher-centered model" to a "learner-centered model", the teacher becomes less the sole voice of authority and more the facilitator, mentor and coach—from *"sage on stage"* to *"guide on the side"*. The teacher's primary task becomes to teach the students how to ask questions and pose problems, formulate hypotheses, locate information and then critically assess the information found in relation to the problems posed. These factors can thus be classified as internal.

2.5. Drivers and Barriers of Effective Pedagogical Integration of ICT

This section aims to examine how the factors discussed encourage effective integration of ICT in education. The presence of most of these factors will support integration.

2.5.1 External Factors

As discussed earlier, external factors will be examined from both system and institutional factors. They lay a foundation upon which use of ICT in education can rest.

2.5.1.1 System Factors

These mainly encompass hardware, software and technical support. According to Howell and Lundall (2000), the key factors hindering educational institutions from using microcomputers as teaching and learning tools are insufficient funds, insufficient number of computers, lack of teachers with IT skills, teachers' inability to integrate the computer into the different subject areas, and lack of appropriate microcomputer teaching programs. What are more interesting are the reasons that inform these constraints. Studies show that the problems hindering African educational institutions from equipping themselves with computers are, in descending order: lack of electricity, lack of funds, insufficient accommodation capacity, lack of qualified staff and insecurity. On top of that, very little of the equipment available nationally is allocated for ICT use in education. Furthermore, in sub-Saharan Africa, the low density of telephone lines and the high costs of installing and maintaining them constitute a major barrier. Numerous authors (Oladele, 2001; Intsiful, Okyere & Osae, 2003; Selinger, 2001; Tunca, 2002; Bakhoum, 2002) have also cited lack of tools, i.e. inoperative software; insufficient or absence of technological infrastructure such as telephone lines; marginal, disparate, inadequate and obsolete communications networks; fluctuating electric power supplies; recurrent power brownouts and blackouts; ailing road systems, etc. In fact, it would seem that most African countries have neither the infrastructure to ensure nation-wide internet connection nor the wherewithal to install it.

For effective use of ICTs, the following drivers are needed:- Appropriate buildings to host equipment; this includes provisions for wiring the electrical system as well as ventilation and general security of the equipment; the presence of reliable and quality electricity supply during school hours (ICT equipments are sensitive to power supply quality and therefore stable supply is crucial); the presence of telephony network (for the internet connections); the availability of computers in schools and appropriate support technical systems for effective use of these computers. These include networking as well as printing capabilities; Physical placement of computers is also a contentious issue as noted below.

For example, placing computers in centralized labs may provide students with equitable and efficient exposure to technology but severely limit the technology's accessibility for classroom instruction (Loveless, 1996). In a research study by Wims and Lawler (2007), targeting schools in Rift Valley province, teachers pointed out that when there were no computers set aside for teachers' use, sharing computers facilities with students raised some concerns; one was the confidential nature of some of the work teachers needed to prepare using the computers and secondly was the sometimes embarrassing experience of learning to master new technology in the presence of students.

2.5.1.2 Institutional Factors

These have a lot to do with the policies and organisational structures which have been put in place both at the school level and in institutions that affect the school as an organisation. A study funded by the Asian Development Bank (ADB) for the October 2007 International conference for ICT in Education identified the following key areas as critical conditions for effective integration of ICT into schools: Aligning ICT initiatives with national and school level educational development objectives; Generate stakeholder buy in and local ownership; Model total cost of ICT ownership (short- and longer term financial needs, including funds for training, equipment upgrading/replacement, servicing and maintenance and related labour) at school level; design policies and strategies that nurture effective integration of ICT at school and national levels and promote system support of innovative schools and teachers.

Other drivers of effective integration of ICT into classroom teaching specifically related to the school level include: Availability of locally appropriate content, suitable and easy to integrate with curriculum and instructional practice; Policies on teacher ICT competencies and strategies and planning for professional development and follow up; School management with ability for strategic and financial planning; Access to functioning equipment appropriate for educational objectives; A critical mass of champion teachers who promote ICT integration and lead exploration of innovative practices; Participatory planning and decision making for ICT and Pedagogical leadership and follow up by school management.

School management is an important ingredient in integration of ICT in the teaching and learning process. In a journal article by Gakuu and Kidombo (2008), which gives the findings of ICT integration in Secondary schools in Kenya using an evaluation approach Bennett's Hierarchy of Evidence Model, teachers and learners at Uthiru Girls secondary school were

found to be at the action level or stage six of Bennett's Model. Teachers, including the Principal and Deputy Principal use computers to prepare lesson plans, source teaching information and share information between teachers and students. They further noted that the Principal, Deputy Principal and Heads of Departments have some ICT training. The principal holds a Higher National Diploma (HND) in information technology. It can be inferred that the success of integration of ICT in the teaching and learning is supported by the involvement and leadership offered by the school managers in implementing use of ICT in the classroom.
These factors offer partial solutions to the barriers as stated by different research finding and literature available. Some of barriers include: Lack of ICT equipment (Pelgrum 2001; Guha 2000), and the cost of acquiring, using and maintaining ICT resources (Cox et al. 1999); lack of access to ICT equipment due to organisational factors such as the deployment of computers in ICT suites rather than classrooms (Fabry & Higgs 1997; Cuban et al. 2001); obsolescence of software and hardware (Preston et al. 2000); unreliability of equipment (Butler & Sellbom 2002; Cuban et al. 2001); lack of technical support (Preston et al. 2000; Cox et al. 1999); lack of administrative support (Albaugh 1997; Butler & Sellbom 2002); lack of institutional support through leadership, planning and the involvement of teachers as well as managers in implementing change (Larner & Timberlake 1995; Cox et al. 1999); lack of training differentiated according to teachers' existing ICT skill levels (Veen 1993) and lack of training focusing on integrating technology in the classroom rather than simply teaching basic skills (Van Fossen 1999).

2.5.2 Internal Factors

Internal factors are also referred to as second-order factors and relate to school-level factors such as organisational culture; and teacher-level factors such as teachers' attitudes and beliefs about teaching and technology.

2.5.2.1Teacher Factors

The central role of the teacher in pedagogical integration is a running theme in this research. Below is a summary of the major personal factors that are teacher related according to a BECTA study:-
Lack of time - for both formal training and self-directed exploration (Fabry & Higgs 1997), and for preparing ICT resources for lessons (Preston et al. 2000); lack of self-confidence in using ICT (Pelgrum 2001); negative experiences with ICT in the past (Snoeyink & Ertmer

2001); fear of embarrassment in front of pupils and colleagues, loss of status and an effective degrading of professional skills (Russell & Bradley 1997); classroom management difficulties when using ICT, especially where pupil-to-computer ratios are poor (Drenoyianni & Selwood 1998; Cox et al. 1999); lack of the knowledge necessary to enable teachers to resolve technical problems when they occur (Van Fossen 1999); lack of personal change management skills (Cox et al. 1999); perception that technology does not enhance learning (Yuen & Ma 2002; Preston et al. 2000); lack of motivation to change long-standing pedagogical practices (Snoeyink & Ertmer 2001) and perception of computers as complicated and difficult to use (Cox et al. 1999).

Again according to the ADB study, drivers of effective integration include the following:- Motivation to change and learn; Advanced methodological skills; Confidence to use technology in didactically appropriate ways; Ongoing access to resources, guidance, and models for instructional ICT integration; Capacity to develop local appropriate content; Flexibility in allocation of some curriculum hours and topics; Ongoing pedagogical support from colleagues and school management; Alignment between student assessment, instructional practice and teacher evaluation; Incentives for professional development and innovation; Integrated, ongoing professional development and basic computer skills and positive attitude towards ICT use.

2.5.5.2 Pedagogical Factors

These factors closely relate with the teacher factors. The main barriers are in the area of change management by the teachers. According to the Panafrica Agenda, ICT integration into education also raises new challenges for teachers as students begin handing in assignments lifted straight from the Internet. Aside from the low pedagogical value of such effortless work, teachers must now add exposure and confrontation of plagiarizers to their many other duties. And although teachers bear the burden of proof in such cases, when they are not ICT-savvy, the task becomes practically impossible. ICT also threaten the teacher's classroom authority. ICT appeal to the students and leave the teacher with a feeling of powerlessness. This can be very unsettling, especially for teachers who follow traditional, encyclopaedic approaches.

However, as demonstrated by Cuban (1997, 1999), mere technological access is not a sufficient condition to foster the pedagogical integration of ICT by teachers. Cuban's

argument is based on a series of surveys conducted on professors at Stanford University—a relatively well endowed institution where professors have enjoyed over twenty years' access to the latest technologies and good technical support. Cuban's findings reveal that these professors use little or no ICT in their teaching practice, never mind all the resources at their disposal. Teachers' perceptions are crucial in pedagogical integration as the teacher remains at the core of integrating ICT into the learning process.

Indeed some studies, for example by Depover (2005) and Leclerc (2003), show that teachers' beliefs and resistance to change are basic factors in the use or non-use of ICT. The Québec Conseil supérieur de l'éducation (CSE) (2002) and Fullan (2001) also stress the importance of raising training and awareness for all stakeholders on the relevance of integrating ICT into schools. Without the commitment of teachers, it would be hard to imagine successful ICT integration (Isabelle & Lapointe, 2003; CSE, 2000).

The key driver in this area will therefore be to focus on effective teacher training. Teacher professional development should have five foci (ICT in Education/Key Challenges in integrating ICTs in Education, n.d):

a) Skills with particular applications
b) Integration into existing curricula
c) Curricular changes related to the use of IT (including changes in instructional design)
d) Changes in teacher role
e) Underpinning educational theories.

Ideally, these should be addressed in pre-service teacher training and built on and enhanced in-service. In some countries like Singapore, Malaysia, and the United Kingdom; teaching accreditation requirements include training in ICT use (Tinio 2003).
Of all the human resource deficiencies, the most important is surely that of teachers. Generally, initial teacher training in Africa does not prioritize the use and pedagogical integration of ICT (Karsenti, 2006; ROCARE-Cameroun et al., 2006).

2.6 Inherent Skills to the Effective Integration of ICTs

From the in depth look of barriers and drivers ineffective pedagogical integration of ICT, some common skills can be identified as inherent to this process (Adapted from SchoolNet, 2003)

a) Professional competence with ICT
b) Ability to integrate ICTs with curriculum
c) Management and leadership with ICT.
d) Time management skills
e) Change management skills

2.7 Conceptual Framework

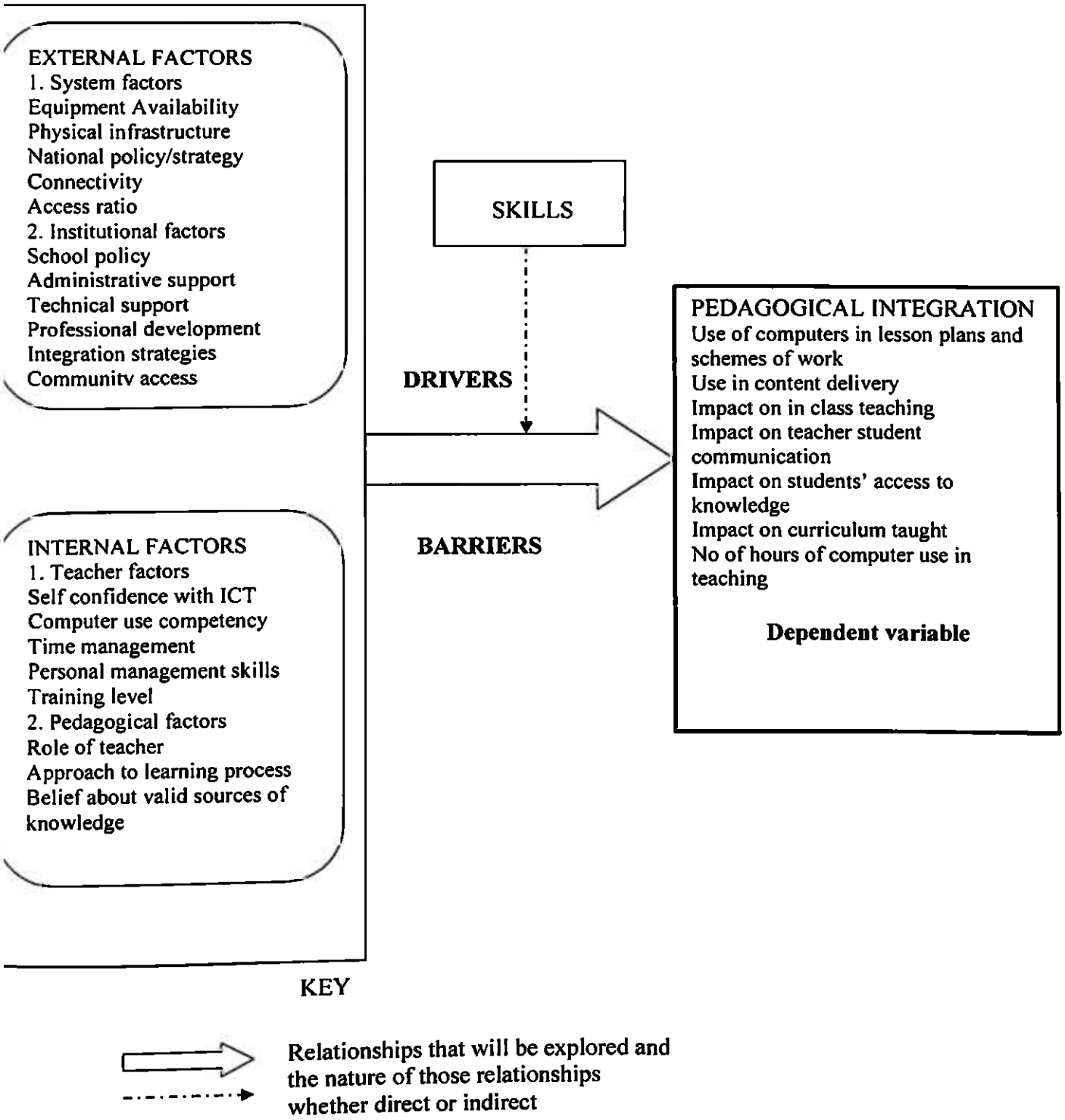

Fig 2.7.1: Conceptual Framework of Factors Affecting Integration of ICT in the Teaching Process

2.8 Operational Definitions

Table 2.8: Operational Definitions of Indicators for the Study

variables	Indicators	Measure	Measurement scale
Dependent			
ICT integration in teaching	Computers use in lesson planning	What impact have computers had on Lesson planning	Ordinal
	Computers use in-class learning	What impact have computers had on in-class teaching?	Ordinal
	Computer use in evaluation methods	What impact have computers had on evaluation methods?	Ordinal
	Reflection on teaching	What impact do computers have on reflection of teaching?	Ordinal
	Communication with students	What changes have computers introduced in the way teachers and students communicate?	Ordinal
	Learner perceptions	What impact have computers had on learner perception?	Ordinal
	Learners' access to knowledge	What impact have computers had on learner's access to knowledge?	Ordinal
	Curriculum taught	What impact have computers had on the curriculum taught?	Ordinal
	Hours taught with computers	Frequency of computer use in teaching	Ratio
	Courses taught using ICT	% of courses taught with ICT	Ratio
Independent			
External factors			
System factors	National ICT policy	Presence of policy framework for ICT use in Kenya	Nominal
	Education ICT policy	Presence of specific education policy	Nominal
	Curriculum on ICT Education	Presence of curriculum in ICT education	Nominal
	Regulations/incentives for IT use	Motivation for ICT integration in education for schools	Ordinal
	Equipment availability	❖ How many computers does the school have? ❖ How many computers are available for teachers? ❖ How many computers are available for learners?	Ratio Ratio Ratio
	Physical infrastructure	❖ Is electricity supply stable with back-up?	Nominal
	Internet connectivity	❖ Does the school have an internet connection? ❖ What type of internet connection?	Nominal Ordinal
	Access to computers	Ratio of computers to teachers and learners	Ratio
Institutional Factors	School policies/ objectives	Presence of an ICT integration policy	Nominal
	Integration strategies	Presence of maintenance and renewal strategies	Nominal
	School management support	School management support in integration of ICT in teaching	Ordinal
	Professional development	No of teachers who have attended CPD?	Ratio
	Community access	provision of access of ICT infrastructure to the community	Nominal
	Technical support	Does the school have an ICT Support?	Nominal
Internal Factors			
Teacher Factors	Computer use competency	Level of skills with computer use	Ordinal
	Time management	Time constraints with ICT use	Ordinal
	Training in ICT use	How many hours of CPD has the teacher attended?	Ratio
	Skills		
Pedagogical Factors	Role of teacher	Role of the teacher in the classroom	Ordinal
	Approach to learning process	How has learning when teaching with computers is used?	Ordinal
	Valid sources for knowledge	What impact has teaching using computers had on what is considered valid source of knowledge?	Ordinal

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology which was employed in the study. It details the research design, target population, sample selection method, data collection instruments and data analysis. A justification of the methods used will be also be given.

3.2 Research Design

Robson (1993) described three different purposes underpinning research in the social sciences: exploratory research, which aims to seek new insights, ask questions and find out what is happening; descriptive research, which aims to provide an accurate profile of the situation or phenomenon being studied; and explanatory research, which aims to explain the phenomenon being studied, often in the form of causal relationships. The purpose of this study is gaining some insight into an area where little research has previously been carried and identify some casual relationships which affect the integration of ICT into the teaching and learning process in educational institutions in Kenya. It is therefore an explanatory study which seeks to identify the various factors that drive or hinder integration of ICT in the learning and teaching process in selected Kenyan secondary schools.

For purposes of this research, multi-case study approach will be adopted. Yin (1994) defines the multi-case study as distinct from the single-case study; it aims to reveal the convergences between several cases while examining the particularities of each case. However, note that this method requires a certain rigor as well as similar investigative procedures applied to different situations in order to compare the different case studies.

This method would appear to be particularly suited for the present study; specific cases liable to demonstrate the interactions studied (ICT and education) could be selected. The multi-case comparison (Yin, 2000) would also be suitable for the proposed study because it would facilitate an understanding of the dynamic relations between ICT, learning, teaching, educational administration, etc.

3.3 Sample Size

The target population for the study was secondary schools in Central and Nairobi province which were part of the study under the Pan Africa Research Agenda. Schools targeted were those which already had computers.

3.4 Sampling Procedure

Purposeful sampling is the dominant strategy in qualitative research. Purposeful sampling seeks information-rich cases which can be studied in depth (Patton, 1990). The particular design of a qualitative study depends on the purpose of the inquiry, what information will be most useful, and what information will have the most credibility. There are no strict criteria for sample size (Patton, 1990). While there are various ways of carrying out purposeful sampling, convenience sampling will be used in this case.

Four secondary schools with computer facilities were conveniently selected for the study. These schools were conveniently chosen because computers are being used in the teaching and learning process. They were also part of the wider study of Panafrica Research Agenda. The case focused on secondary schools because wide usage is noted in this category of institutions in Africa. The schools chosen for the study were *Musa Gitau Secondary School, Uthiru Girls High school, Aga Khan High School and St Joseph High School.*

The respondents were also conveniently selected to ensure the research questions were well tackled. For each school, the school principal was a respondent for two reasons: the essential role played by school management in integration of ICT in teaching and learning and the obvious reason of giving consent and authority for the research to be carried out. The computer studies teacher, at least one science teacher and one social science teacher was chosen as a respondent in the study.

3.5 Data Collection Instruments

In addition, as suggested by Yin (2000), the investigative methods used in a multi-case study must be standardized to a certain extent. It is therefore important to use similar data collection

instruments in both the cases. This research will employ the following data collection instruments:-

- Survey questionnaires
- Guided interviews

As explained by Krathwohl (1998) and Van der Maren, the survey questionnaire has the advantage of achieving rapid contact with a large number of people. It would be very useful for obtaining responses from learners and students. Goyette (1994) describes the interview procedure as highlighting the research process through an informal conversation. He further explains that the interview procedure facilitates the planning, conduct, and even the analysis of the interview. According to Mishler (1986), it is essential to keep the subject directly on topic. Finally, the conclusion is the last step of the interview (Mishler, 1986). At this point, the interviewer should ensure that he/she has truly understood what the respondent wanted to say by summing up the responses for the interviewee's corroboration. This constitutes a form of triangulation (Stake, 1995), since the subject is "confronted" (Huberman & Miles, 1994) with the collected data.

For purposes of this research project, the interviews would be semi-structured. For instance, the interviews will be structured to enable the researcher to better understand the difficulties that teachers encounter in the pedagogical integration of ICT.

3.6 Ethical Considerations

This been a research in education some ethical considerations were taken into account. The participants were informed were taken through the research process, detailing that the research was for an academic study and how results would be used and how and to whom they would be reported. This was to ensure informed voluntary consent of the participants.

Care as also taken to treat any personal data given by participants in a confidential manner while ensuring anonymity. Participants were not required to write their names in the questionnaires used.

3.7 Data Analysis

It is important to note that this research was carried out under the Panafrican Research Agenda. To make the results useful, the data analysis strategy used was similar to that

adopted in the overall research. A qualitative data analysis was carried out using coding strategy. Codes were assigned according to the categorises defined in the conceptual framework to better explain the variables.The qualitative data analysis strategy was derived from the approaches proposed by L'Écuyer (1990), and Huberman and Miles (1991, 1994). The Panafrican Research Agenda adopted the content analysis approach (see Table 3.4.1). According to Sedlack and Stanley (1992), and L'Écuyer (1990), content analysis is a classification method whereby the diverse elements of the material analyzed are coded to allow a better understanding of the characteristics and meanings (L'Écuyer, 1990).

Table 3.7.1 General model for the Content Analysis Procedure (adapted from L'Écuyer, 1990)

Step	Characteristics
I	Reading of the collected data
II	Definition of the classification categories for the collected data
III	Categorization of the collected data
V	Scientific description of the studied cases
VI	Interpretation of results from step V

L'Écuyer's model was suited for analyzing interviews and the open ended question in the questionnaires. Thus, data obtained from the different sites would be coded according to the predetermined indicators.

3.8 Triangulation as a Validity Method

Validity is the accuracy and meaningfulness of inferences, which are based on the research results. In other words, validity is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. Validity, therefore, has to do with how accurately the data obtained in the study represent the variables of the study (Mugenda & Mugenda (2003). Validity is either external or internal. External validity is important where generalisations are made outside the studied case while internal validity is concerned with casual effects and relationships. This study does not wish to make generalisations hence external validity was not a consideration nor were relationships casual relationship being established.

An important element in all education research is triangulation which means viewing results from diverse perspectives. To ensure the data results represent the phenomena under study, triangulation strategy was used by the research. This involved using data triangulation and method triangulation. Data triangulation was ensured by collecting data from both teachers and the principal. Data provided by the principal could be collaborated by what the teachers said. Method triangulation was employed by using two instruments to collect data from the teachers. A questionnaire was used to collect data that would require more time and reflection on the part of the teacher when answering questions. This was to minimise the time required in conducting interviews so as to allow teachers attend to their lessons. During data analysis, theory triangulation was used heavily where responses were studied against different theories and perspectives to help interpret and explain the data.

3.9 Summary

This chapter gave a summary of the research design as well as justification for this design. The target population, sample selection and data collection instruments were also discussed and analysed. The use of triangulation as a means of ensuring validity was also discussed and the various methods of triangulation employed were discussed.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTEPRETATION

4.1 Introduction

In this chapter, the data collected will be analysed for each school under the main factors as explained in the conceptual framework. An analysis will be carried out for each factor from the collected data.

4.2 External Factors

These are factors that are connected to issues of infrastructure right from the national level to the school. They are resource related. Before presenting the data on the each school, a brief analysis of the national ICT environment in Kenya is discussed below.

4.2.1 National Policy and Strategies

An analysis of the existing policy documents which have been developed to address issues surrounding ICT and its use in education was carried out. This was to critically analyse if the factors developed in the study have been identified as important and what policy framework and strategies have been put in place to address these issues.

4.2.1.1 National Policies and Strategies

Though computers are being used in schools, one of the barriers to integration of ICT in education was lack of national a policy framework to harness their full potential in the teaching and learning process. The educational technology infrastructure of the schools under study rests on the national telecommunications and infrastructure. It is also governed by the policy framework concerning ICT in general and integration into education in particular. To address this challenge, government ministries have developed various documents to give policy guideline as well as strategic direction. The documents are:-

a. ICTs in Education Option Paper, June 2005 by the Ministry of Education, Science and Technology (MOEST).
b. National Information & Communications Technology (ICT) Policy, January 2006 by the Ministry of Information and Communications.
c. National Information and Communication Technology (ICT) Strategy for Education and Training, June 2006 by the Ministry of Education.

4.2.1.2 National Indictors on ICT

According to the National ICT Strategy for Education and Training (2006), some major challenges that Kenya faces in utilisation of ICT is inadequate connectivity and network infrastructure, limited access to electricity and limited digital equipment at all levels of education. According to the strategy paper, these are some of the salient statistics.

a. The average access rate is approximately one computer to 45 students in colleges & universities, one computer to 120 students in secondary schools and one computer to 250 students in primary schools against an average access rate of one student to 15 computers in developed countries.
b. An EMIS survey (2003/2004) indicates that over 70% of secondary require functional telephone lines. The teledensity is 0.33 fixed telephone lines per 100 inhabitants in rural areas and 1.97 fixed telephones per 100 inhabitants in urban areas.
c. A survey by Digital International indicated that the proportion of schools without electric power range from 58% to 96%.

4.2.2 Analysis of National Policies and Strategies

In the following section, a brief analysis of the various policy documents concerning ICT integration in education is given.

1. National Information and Communications Technology (ICT) Policy

   This is a policy that was drafted in 2006 by the Ministry of information and communications. The policy addresses the issue of infrastructure as well as human resource development.

   Article 2.4 addresses promotion of ICT in education at primary secondary, tertiary and community levels by developing ICT curricula and ensuring that teachers/trainers possess the requisite skills

   Article 2.5 addresses Electronic learning with some emphasis on developing content to address the educational needs of primary, secondary and tertiary institutions as well as creating awareness of the opportunities offered by ICT as an educational tool to the education sector.

Article 3.2 gives one of the broad objectives of the ICT policy as encouraging the use of IT in schools, colleges, universities and other educational institutions in the country so as to improve the quality of teaching and learning.

2. National ICT Strategy for Education and Training

The mission embodied in this document is to integrate ICT in education and training for improved access, learning and administration. It outlines various strategies for addressing various factors affecting integration of ICT in the teaching and learning process.

4.2.2.1 National Strategies Addressing System Factors

i. Digital Equipment

This seeks to address the challenge of limited digital equipment at virtually all levels of education. The average access rate is one computer to 15 students in developed countries while in Kenya it is one computer to 150 students.

The strategic objective is to support initiatives that provide digital equipment to educational institutions, with priority to secondary and primary schools.

ii. Connectivity and network infrastructure

This seeks to address the challenge of limited penetration of telecommunication infrastructure into rural and low income areas. This is specifically dedicated phone lines and high speed systems or connectivity to access e-mail and internet resources

4.2.3.2 National Strategies Addressing Institutional Factors

i. Technical support and maintenance

The strategy paper recognises that there is limited capability for effective use and maintenance of ICT infrastructure at educational institutions. Furthermore, very few schools are using ICT as an alternative method for the delivery of the education curriculum.

The strategic objective is to facilitate and support establishment of national ICT support centre where technical support will be provided to educational institutions.

ii. Access and equity

The overall objective will be to give to give priority to disadvantaged areas, communities, educational institutions teachers and learners.

One strategic objective is to improve access to ICT facilities for educational purposes of pupils, parents, and local community, in partnership with libraries and other services, and through the use of school ICT facilities after school hours.

4.2.2.3 National Strategies Addressing Teacher Factors

i. Training Capacity building and professional development

The teaching staff force of 197, 000 primary school teachers and 38,000 secondary school teachers will be trained in ICT literacy and integration.

The strategy objective is to build the capacity for at least one teacher in each school to teach ICT, support literacy and integration and basic maintenance of ICT equipment.

4.2.2.4 National Strategies Addressing Pedagogical Factors

i. Integration of ICT in education

Integration aims at the use of ICT to support teaching and learning in delivery of the various curricula to achieve improved education outcomes.

One strategic objective is to train teachers on integration techniques and sensitize education managers on ICT integration.

ii. Digital content

The principal challenge is to customize or develop education software to meet local education requirements in teaching, learning and administration.

One strategic objective is to provide digital content in schools to schools in various forms including interactive CDs for the purpose of integration with the teaching and learning.

It is noted that even at a national level, the various categories as captured in this study are seen as important factors affecting the integration of ICT in the teaching process. From the brief analysis it is seen that they have been addressed at policy level and strategies developed to ensure they are effectively tackled.

4.2.3 System Factors

These are external factors that are related to physical infrastructures as well the presence of resources related to the use of computers in schools. The table below gives a summary of the physical infrastructure in each school.

Table 4.3.3: System Indicators for the Schools under Study

System Indicators	Aga Khan	St Joseph	Musa Gitau	Uthiru Girls
1. Does the school have computers?	Yes	Yes	Yes	Yes
2. Does the school have internet connectivity?	Yes	Yes	No	Yes
3. 3.Types of connection and bandwidth	VSAT	Dial-up	none	dial-up
4. Total number of computers in the institution	31	14	21	23
5. No. of computers connected to the Internet	26	1	0	23
6. Percentage of computers connected to the Internet	80.65	7.14	0	100
7. Number of educators in the institution	23	31	20	35
8. Number of computers in the institution available for educators	31	14	21	23
9. Ratio of educators to computers	0.74	31	1.05	1.52
10. Number of learners in the institution	350	800	405	500
11. Number of computers in the institution available for learners	26	14	20	23
12. Ratio of learners to computers	13.46	57.14	20.25	21.74

4.2.4 Institutional Factors

Institutional factors include support systems which are availed at school level to enable uptake of ICT use. This encompasses technical, institutional and administrative support. Institutional indicators for the schools are summarized below.

Table 4.2.4: Institutional Indicators for the Schools under Study

nstitutional Indicators	Aga Khan	St. Joseph	Musa Gitau	Uthiru Girls
1. Does the school have an ICT technician?	Yes	Yes	Yes	Yes
2. Does the school have an ICT integration plan?	Yes	No	No	Yes
3. Does the school have a strategy in place to maintain and renew ICT equipment?	Yes	No	Yes	Yes
4. Does the school provide access to their ICT infrastructure for the community?	Yes	No	No	No
5. How many teachers does the institution have?	23	31	20	35
6. Number of teachers who have completed 1 to 50 hours of continuing education/professional development which included ICT integration	23	1	2	19
7. Number of teachers who have completed more than 50 hours of continuing education/professional development which included ICT integration	23	3	2	14
8. The percentage of teachers who have participated in less than 50 hours of continuing education/professional development which included ICT integration	100%	3.23%	9.52%	54.29%
9. The percentage of teachers who have participated in over 50 hours of continuing education/professional development which included ICT integration	100 %	9.68%	9.52%	40%

4.2.4.1 Technical Support

All the four schools have an ICT technician in the school. A description of the duties of the ICT technician in each school is given.

In Aga Khan High School, the ICT technician repairs and maintains the computers. He also maintains the networks and software used in the school. In St. Joseph school the ICT technician also services and maintains the computers. He is also able to carry out minor repairs on both hardware and software.

In Musa Gitau School, the duties of the ICT technician include teaching computer software packages to students well as assisting them in building their hand-on skills in using

computers. He also supports teachers in learning to use computers. He also maintains the computers in the school.

In Uthiru Girls School, the ICT technician ahs been allocated slightly more responsibilities that in the other schools. He doubles up as the computer studies instructor as well as teaching basic computer skills. He also advises school management and teachers and makes recommendations on ICT related matters in the school. This is in addition to his other duties of maintaining the computers and ensuring computers are connected to the internet.

4.2.4.2 Professional Development

Each of the school has teachers who have undergone continuing profession development which included ICT integration. The training

4.2.4.3 Integration Strategies

Integration strategies will be considered from a two-fold view; integration of ICT in teaching and strategy on maintenance and renewal of ICT equipment.

Aga Khan School has produced a draft policy and an integration plan. One of the key supporting policies is that all teachers employed in the school must be computer literate. This has greatly supported integration of ICT in the teaching and learning process. However, the school does not have strategy on maintenance and renewal of ICT equipment.

St. Joseph School has neither an ICT integration strategy nor a strategy on maintenance and renewal of ICT equipment. Introduction of computers in the school was an initiative of the Old Boys Association and not the school management. As such, there is a problem of ownership of use of ICT at the institutional management level. With the introduction of Computer studies in the school, change of attitude in use of ICT will be driven by external pressure rather than internal initiative.

Musa Gitau School does not have an ICT integration strategy yet. The school, however, has a three year contract with Computers for Schools, Kenya where they pay Kshs. 3000 per annum per computer for maintenance. The contract runs for three years. Through this plan they have been able to keep the computers in working order.

Of the four schools, Uthiru Girls School has the most clear integration strategy. The school plans to buy 6 computers every year, train all teachers and students in basic computer skills, and inter-connect computers in all the departments in the school. The Board of Governors and Teacher Parent Association are responsible for computer maintenance in the school. The aim is firstly to increase the number of the computers and secondly to replace those with lower capacity. This strategy is aimed at phasing out older and less economical to run computers. The school also plans to enter into partnership with organizations such as the Computer for Schools Kenya.

4.2.4.4 Community Access

Aga Khan School is only school which allows access by the community. The school allows other students and members of the public to access their computers for use at a fee. They offer training through a partnership with CISCO Company who have premises within the school with 13 computers

St Joseph School does not provide any access to the community to computers. This is because of the security reasons. The school has suffered several burglary attempts and therefore it is hesitant to let the community use its computers. Also, the school fears the attack of viruses taking into account that the school does not have Internet connectivity to screen and clean for the viruses.

The community at Musa Gitau School has no access to the computers because they are too few and have just been acquired recently. However, the school plans to use them for training during the school holidays and generate some income.

Uthiru Girls School does not provide any ICT infrastructure to the community. This is because the number of computers in place is not adequate for the school community and there is also the fear of misuse for example introducing computer viruses that may make them to 'crash'.

4.3 Internal Factors

In this, section, an analysis of the factors surrounding the teaching process inside the classroom was carried out. Two issues emerged from this analysis; one was the way in which

teachers prepare for lessons while the other was the way students to the use of ICT in the classroom. The analysis was thus done under two categories; teachers factors which cover the way teachers ICTs in the classroom setup and pedagogical factors which look at the way students understand and assimilate knowledge.

4.3.1 Teacher Factors

These factors are identified as central to pedagogical integration (Bitner & Bitner, 2002). These include the skill and attitude of the teacher as well as self confidence with ICT and perceived relevance of ICT.

In Aga Khan School, the use of ICT has changed the teacher's teaching process in some ways. According to the teachers, they are now able to search the internet for more teaching materials. This has increased the confidence and authority of the teacher as he/she has more sources to quote from. While there is a fear that ICTs will replace the teacher, the experience of teachers has been to give them more confidence as they have more sources of information. The teachers are also able to research about the teaching techniques and improve on their own teaching methods. ICT then becomes a tool for self-evaluation and in a sense for benchmarking

The teachers in St. Joseph School do not use ICTs in the teaching process. One of the main reasons is the negative attitude towards using computers in teaching. There is also the problem of age. The older teachers are reluctant to be taught computers by the younger teachers. The teachers also feel that they do not have the necessary skills to use computers in teaching. It is noted that only three teachers have over 50 hours of training in continuous development with ICT integration.

Musa Gitau School does not internet connectivity; however, the introduction of computers in the school has proved an impetus for teachers who are computer literate to use the internet as a source of teaching material. They download information from the internet in cyber cafes for use in preparation of lesson notes.

The teachers are open to using computers in the teaching process. The older teachers say that they do not have the competencies to do so while the younger teachers who are computer literate still feel they need more training to enable them integrate ICT in the teaching process.

In Uthiru High School, the teachers still feel they need high levels of competency to effectively integrate ICT in the teaching process. Although all teachers are computer literate, some do not still possess the competency levels required to effectively teach using computers.

The teachers are also highly motivated because the learners are interested in using computers to seek for more knowledge.

4.3.2 Pedagogical Factors

In Aga Khan School teaching using computers has changed the student's attitudes towards learning especially in sciences. By using materials from the internet, scientific concepts have been demystified. This is because abstract concepts can be demonstrated with practicals especially for subjects such as biology and chemistry. While the school says it is still too early to judge the overall impact in KCSE exam performance, the impact on student's attitude is apparent.

Communication through email has also changed the interaction between teachers and students breaking down the limitations of space and time. During school holidays, students post their assignments through email. The teacher goes through the assignments and gives feedback through email as well.

In St. Joseph School, it is mainly the computer studies teacher who uses computers in the teaching process. The use is computer has changed the teaching process. Since the teacher sources materials from the internet, she has time to reflect on the content. In this way, she is able to add new information and discard what is redundant and irrelevant. ICTs thus have the power to provide current information and capture new developments without waiting for re printing of books used in the syllabus.

For students taking computer studies, there is a deeper appreciation of concepts since practical demonstrations make them easier to understand. An example was given of the project development concept. The teacher further explained that as a result, the students develop an interest in looking for knowledge in their own free time. They also have

opportunities to access expand their knowledge on what is taught in class by accessing information stored in the computers.

In Musa Gitau School, the use of ICT has changed the experience of learning. For example, the English teacher teaches pronunciation of English words to students. The biology teacher uses stand alone CDs to simulate experiments. Simulations can be repeated as many times as necessary to ensure understanding of the concept. This moves the focus from the teacher to the students since they can learn at their own pace.

Students have developed an interest in mathematics because of the use of packages like MS Excel to teach the subject. The same goes for other science subjects where CDs are available and information has been stored on the computers. Through MS Word, students are able to improve their writing skills. This is enabled by use of tools such as spell check and thesaurus.

In Uthiru Girl school the use of computers in the teaching process has changed the way that students learn. One interesting observation is students say they have more lasting memories when they learn using computers. This is made possible by good illustrations from computer resources. A good example is the case of sciences where the school does not have some instruments. The teacher has made use of the internet to download illustrations of a microscope to give students a better understanding of its functions.
Computer resources such as Encarta library serve as a virtual library. This way, the sources of knowledge increase. Students are able to source for further information on subjects taught in class.

4.4 Analyzing Pedagogical Integration in the Schools under Study

This is the dependent variable. It looks at the level of ICT use in the teaching process and the various ways teachers are making use of ICT in the teaching. This section looks at the various ICT resources in the school under study and how they are making use of them. The areas studied include use in lesson planning, evaluation methods, teacher-student communication, and reflection on teaching, students access to knowledge and impact on curriculum taught.

Table 4.4 below gives an overview of pedagogical indicators.

Table 4.4: Pedagogical Indicators in the School under Study

Pedagogical Indicators	Aga Khan	St. Joseph	Musa Gitau	Uthiru Girls
Number of courses taught	15	11	8	10
Number of courses taught using ICT	5	1	8	5
The percentage of courses taught using ICT	33.33%	9.09%	100%	50%
Average ICT use by educators for academic purposes (hours per week	18	16	10	10

Table 4.4.1 1 Application of ICT in Schools under Study

School	Main Software Used	Application of Software
Aga Khan School	MS Word	Preparing lesson plans, notes and timetables
	MS Excel	Analysing students marks
	MS Power Point	Presentations in the classroom
	Encarta encyclopaedia	Searching for assorted information
	Internet Explorer	Searching the internet for teaching materials
St Joseph School	MS Word	Entering and analysing students' marks
	MS Excel	Teaching the use of various packages
	MS Power point	Teaching how to access information on the Glossary and CDs
Musa Gitau School	MS Word	Teaching basic computer literacy
	MS Excel	Preparation of schemes of work
	MS Quick Books	Ranking of students
	Encarta encyclopaedia	Preparation of lesson plans
		Preparation of exams
Uthiru Girls School	MS Word	Store examination papers and model answers
	MS Excel	in shared folders
	MS Power point	Download educational material from the internet and print to distribute to students
		Download illustrations of instruments such as the microscope for students to appreciate
		Take online courses through the internet

4.4.1. Analysis of Integration of ICT in the Teaching Process

This section will look at how the schools are using computers in various areas of teaching as defined by the key areas mentioned earlier and whether there is any impact as well.

4.4.1.1 Aga Khan School

The teachers use Internet search for preparing the lesson plan. The teacher is able to access information faster. It is also possible for the teachers to store, retrieve the information. This has helped in improving the quality of teaching in the school.

a. Impact of ICT on in-class teaching:

Information search from the Internet has enabled the teachers to get more teaching materials. It has enabled the teacher to have confidence in lesson delivery because a teacher can get information from many authors (sources). The analysis of students' marks on the worksheets has become easy and therefore the teacher can see the performance trends and undertake the necessary remedial actions.

b. The following is the use of ICT in the evaluating students' performance

Computers are used in preparing students' exam results, analyzing, grading the students' marks and ranking them. One can easily see the trends and give recommendations of the decisions to be taken. The teacher is able to present the student's exam results graphically using charts. Teachers are able to type exams, print and store them for future reference. All this has improved the evaluation processes

c. Use of ICT on educator-learner communication

The teachers indicated that ICT has helped improve communication between them and the students. This is more effective during school holidays when the students can do their assignments and send them to the teachers by e-mails. Likewise, the teacher can send back answers to the students using e-mail.

d. Use of ICT on reflection on teaching

The teachers affirmed that the use of ICT helps them to reflect on their teaching. This happens if a teacher has to prepare the teaching materials in advance. This enables the teacher to think in advance and improve on the teaching

e. ICT and learner perceptions

Use of computers enhances learning of subjects such as English because of spell check for example, the teacher tells the students to get background information from the internet for texts. Science teachers make use the cyber-school to teach science subjects. This makes demonstrations interesting as cyber-school brings the reality in the classroom using 4-dimensional models.

The use of computers has also opened the students up. For example when they were assisted to have e-mail addresses they started communicating with others even out of the country. The encyclopaedia Encarta is a great source of information acting as a digital library where students have access to learning materials.

f. Impact of ICT on learners access to knowledge

The teacher is able to access more information from academic journals like the "emerald". The information is updated and later the teacher can download and distribute it to the students in soft copy because all students have access to computers. All this has improved in knowledge access to both teachers and students. This is translated in students improved performance

g. Stated of ICT on which curriculum is taught

The use of ICT simplifies and makes the lessons very interesting. Students are able to grasp a lot of information. However, it is time consuming and sometimes difficult to cover the school syllabus. Although ICT has had positive impact in demonstration of abstract concepts in science practicals like in Chemistry and Biology, it is too early to measure its overall impact on performance in KCSE (0' Level) examinations because ICT use is too recent.

4.4.1.2 St. Joseph School

a. Stated impact of ICT on lesson-planning

ICT enables the teachers to make lesson plans and this makes it easy for the learners to follow the content taught, for example, the project development concept.

b. Stated impact of ICT on in-class teaching

This applies only to the computer classes where the ICT teacher is able make demonstrations of how the computer works. This is interesting because it is actual and real.

c. Stated impact of ICT on evaluation methods

Testing is easy and convenient as learners can be given assessments, which they do on their own and the teacher marks and analyzes using ICT. This applies only to learners taking computer studies as the tests are practical. The other teachers still use the manual way of processing marks. The school does not insist on the use of ICT in processing marks and therefore the teacher are not keen to use computers in processing examinations. However, the teachers draft their exams by hand and take to the school's secretary to typeset and photocopy for them.

d. Stated impact of ICT on reflection on teaching

The ICT teacher responded that he is able to select and decide on problems before the lesson and reflect on them, thus the lesson is more effective. The Computer teacher is basically a computer literate and can therefore prepare teaching material. The teacher can also retrieve teaching material from the Internet. This is done long before the lesson and therefore gives the teacher ample time to reflect on the teaching material. By so doing, the teacher is able add new information or to remove redundant or irrelevant information. The eventual impact is that the teaching material is improved which leads to effective teaching and improved performance.

e. Stated impact of ICT on learning

Teachers noted that the use of computers has a positive impact on learning. It makes learning interesting so that learners can spend more time on their search for information. This enables them to learn better. They are also able to obtain a lot of information that is stored in the computer to expand their knowledge on topics that have been taught in class. Apart from the teaching of computer studies as a subject, there is no real impact on the other school subjects as ICT is not integrated in teaching.

4.4.1.3 Musa Gitau School

a. Stated impact of ICT on lesson-planning

Not all teachers use the computer to prepare the lesson plans in the school. However, those who have used it indicated that use of computer in lesson planning make the process easier because they can save and retrieve the lesson plan for review and updating. They also stated that they use the same templates to prepare the lesson plans in following planning period hence saving precious time that can be used for other academic purposes.

b. Stated impact of ICT on in-class teaching

For the teachers who use the computer for in-class teaching, for example the language teacher, ICT has helped the learners to learn how to pronounce English words properly. The biology teacher has been able to use stand- alone CDs to simulate some experiments. This has helped the learners to understand the abstract concepts better because the simulations can be repeated as many times as the teacher deems necessary. In the process, the learners have been able to prepare science congress demonstrations in a better way and have improved the school's ranking in the competitions.

c. Stated impact of ICT on evaluation methods

The computers were introduced in the school a year ago. Therefore, use of ICT in evaluation has not been institutionalized. However, the few teachers, for example the computer teacher, use the computer for analyzing the students examination results. To them, the ranking of students in exam performance has become easier and faster. This saves time. The accuracy in calculating the students' marks has improved. It becomes easier for the teacher to counsel the individual student on his or her performance. Report cards can be prepared more easily and in a more presentable manner. This has also enhanced faster communication of exam results to the parents or guardians. Remedial actions can be taken quickly and timely.

d. Stated impact of ICT on educator-learner communication

The teachers indicated that ICT can greatly improve the teacher - learner communication. The school does not yet have Internet connectivity. However, the school has been processing the information using the computers and the printing machines available in the school. The communication has been in form of letters to the parents/guardian, learners,

sponsors and the school's publics. Unlike when the school was using the type- writers and the duplicating machines, it is cheaper to process the communication using the computers and the printers. Communication costs have gone down because of the reduction on wastage of spoilt papers while using the type writer and the duplicating machines.

e. Stated impact of ICT on reflection on teaching

The teachers stated that when they prepare lesson plans and marking guides, search for information to add to their teaching notes, they are able to think through their content in greater details. This enhances the quality of the teaching materials the class teaching and student's learning process.

f. The impact of ICT on students learning

Due to use of computer to produce neat examinations, students want to learn computers to make their work as neat. They use excel in learning mathematics and this makes the subject more appealing.

In co-curricular activities, they use computers in making banners, announcement and promotes more learning to improve these adverts or banners etc. Science teachers have access to some CDs with relevant materials and this makes their subjects more interested and continued use would improve performance. Students in form 1, 2, and 3 have learnt basic computer literacy lessons hence they can type their work, save and retrieve it later.

g. The teachers indicated the following as the impact of ICT on student's access to information:

As the school has no internet connection, students can use the available CDs to access information on the particular subject. They also use Encarta Encyclopedia to access information in various areas of their study. It ads enhanced studying of the English language learning through the use of in built dictionary.

Teachers also reported that since the introduction of computers in the school last year, students had developed a lot of interest in using them to store some of their work and to use Microsoft Word facilities like spell check to improve their writing skills. The greatest impact the computers have had is to arouse interest in students to take computer studies especially in Form one.

h. Stated impact of ICT on which curriculum is taught

The school has been able to offer the computer studies as a subject to Form 1 and Form 2 classes. Some teachers have been able to purchase educational software in CDs, which they use for teaching. The school refunds the money spent by the teachers. This has improved the learners understanding of the curriculum content and made learning and teaching enjoyable. The French teacher has been able to use CDs to teach the learners pronunciation and this has enhanced their understanding and use of the French language.

4.4.1.4 Uthiru Girls School

a. Stated impact of ICT on lesson-planning

Use of ICT in lesson planning has made the process easy and friendly. All what is needed is up-dating. The main impact has been positive in the sense that it improves teaching because one does not have to keep on preparing the lesson plan every other time. The time saved can be used in other teaching activities.

b. Stated impact of ICT on in-class teaching

The teacher uses power point presentations. The presentation is easy and the students' response positive. This has led to a wider coverage of the syllabus and it is also easy to review the lessons hence improving the learning process

c. Stated impact of ICT on evaluation methods

The use of ICT has helped the teacher to evaluate student performance trends and therefore making it possible to tell whether the class performance is improving or declining. The quick evaluation enables the teacher to take the necessary remedial actions.

d. Stated impact of ICT on educator-learner communication

The school has Internet connectivity. The ICT teacher is able to post learning materials through the local network on special accounts. The students are encouraged to share the questions and post them to the teachers account for review before the classroom lesson. This has motivated the learners to participate in the learning process, and do more reading before the classroom lesson. It becomes easier for the teacher to know the weaknesses and strength of each student and therefore can easily deal with each student. This has

greatly improved the learning process and the interaction between the teacher and the learners.

e. Stated impact of ICT on reflection on teaching

The use of ICT has enabled the teacher to reflect on teaching because he is able to compare the syllabus content, the book content and materials from the Internet. The power point projection makes the presentation well understood and teaching easy. Asked how ICT may have improved his own access to knowledge, the teacher said that most of the materials used are down loads from the Internet. Therefore, the cost of teaching materials have become cheaper because the teacher only pays for the downloading and printing of the materials. The teacher also gets the most current information for the welfare of the students. Asked how ICT has helped in producing teaching materials, the teacher said that by using power point presentations, the computer has enabled him to produce friendly teaching materials. The materials gathered are either scanned or keyed on the keyboard and then edited on power point.

f. Stated impact of ICT on learners' access to knowledge

Students reported that the use of computers has had a positive impact on their learning. They felt they were more knowledgeable and better prepared to do academic work. They were able to read more detailed researched information as well as see good illustrations provided on computer resources. This gave them long lasting memories.

Teachers observed that the use of computers for teaching has had a positive impact on the quality of teaching. The use of computers made analysis of exams easy, enabled learners and teachers to apply the skills learned enhanced knowledge of students and made preparation of schemes of work very easy.

g. Stated impact of ICT on which curriculum is taught

The teachers can access Internet materials in all subjects taught in the school.

4.5 Barriers to Integration of ICT in Teaching Process

The section looks at the challenges in integrating ICT in the teaching process as stated by teachers and school managers in the four schools under study. To analyze them effectively

4.5.1 External Factors

The main barriers discussed are resource related. The availability of computers and their placement has been quoted often as a reason hindering use computers in the teaching process.

4.51.1 External Barriers as Stated by Aga Khan School

On interviewing the teachers and the school administration the following were stated as the main barriers to integration of ICT in the teaching process.

i. Lack of equipment

According to Howell and Lundall (2000), one of the key factors blocking educational institutions form using computer as teaching tools is insufficient funds and insufficient computers. Indeed the teachers still feel that the computers are not adequate to serve the needs of school.

ii. Restriction in access

There is the constraint of connectivity. While the school has an internet connection, the speed of data transfer is slow. The computers in the schools are not networked hence this make information sharing a challenge

Another major challenge is restricted access to the internet. This happens when the security software bans certain phrases and access to the web site is completely denied. This is a two sided coin as computer viruses were cited as a major threat with the use of the internet as well as multi users. Viruses can ground the computers by damaging the operating system of the computers.

This is a barrier noted in research, (Oladele, 2001; Selinger 2001), where marginal, disparate, inadequate and obsolete communication networks hinder effective integration of ICT in teaching.

iii. Unreliable power supply

Frequent power failure were also said to be a major challenge in use of computers. This is compounded by lack of Uninterruptible Power Supply (UPS). The UPS would still not be a permanent solution though it would give opportunity for everyone working on the computer to save their work and safely shut down the computer system. The school lacks a more sustainable back up supply such as a generator.

iv. Placement of computers

The physical placement of the computers also poses a challenge. The computer lab has no white board. This forces the teachers to use the Physics lab instead. The other aspect is the logistical problems caused by moving of students to the computer lab for lessons. According to Loveless (1999), while placing computers in centralized labs may provide students with equitable and efficient exposure to technology, it severely limits their accessibility for classroom instruction.

v. Institutional support

The school management is also seen as a problem as they fail to provide accessories such as storage devices like flash disks. The teachers also reported that they had received no feed back on the progress of the integration strategy in this school.

4.5.1.2 External Barriers as Stated by St. Joseph School

i. Inadequate computers

The school has 14 functional computers. They are mainly used for computer studies. However, the school has more computers but they are not operational. Of the functional computers, only one is dedicated for the use by teacher. This has proved a constraint in integration of ICT in teaching. The computers are mainly used to teach computers studies and the teachers have not made use of them to teach in their subjects.

ii. Insufficient funds

The school principal pointed out that the cost of buying and maintaining computers is too high and the school cannot afford it. According to Cox et al (1999), the cost of acquiring, using and maintaining ICT resources is one of the barriers schools face.

iii. Maintenance of computers

Closely related of this is the high cost of not just buying but also of maintaining them. This problem is aggravated by the fact that technicians charged to maintain them are hired only when needed. Maintenance of computers is therefore closely related to financing as hiring technicians is an added overhead cost.

iv. Unreliable power supply

The school is also experiencing problems of unreliable power supply. This is in form of frequent power blackouts. This leads to loss of data as work is interrupted suddenly. It also disrupts lessons and exams in computer studies which are done using computers.

v. Lack of ICT integration leadership

The teachers also see institutional challenges as a major barrier to integration of ICT in teaching. There seems to be no ownership of the use of computers in teaching and learning. The introduction of computer in the school was an initiative of the old boys and not the school management. The appreciation of the benefits of using computers pedagogically is missing.

vi. Professional development program

There are no incentives to encourage use of ICT in the school as a professional development program is missing. Due to lack of ownership on the drive to use computers in teaching, the school does not have plans or strategies to train teachers on basic computer skills as well professional competencies in integration strategies.

vii. Technical Support

The school hires a technician on a needs basis. This means that support offered is not consistent. The school has also hired a computer studies teacher on temporary basis. While this teacher has been instrumental in supporting other teachers such as the math and science teachers in the SMASSE program, the school is not sure of the sustainability her services. The extra cost is being shouldered by parents.

viii. Absence of curriculum guidelines

The teachers also felt the absence of a curriculum from the ministry of education guiding teachers on how to integrate computers in teaching is a constraint. In the absence of this curriculum, the teachers seem lost on where to start on computer use.

4.5.1.3 External Barriers as Stated by Musa Gitau School

i. Insufficient funds

The principal sees one of the major challenges as lack of funds to purchase computers and other accessories such as LCD projectors which would be used for teaching. It for this same reason that the school does not have an internet connection as it is both expensive to install and maintain.

ii. Lack of equipment

This is because they feel that the computers in the school are not adequate while resources like laptops and LCD projectors which would facilitate the teaching process are not available. The school also lacks internet connection. Output and storage devices like flash disks are also lacking.

iii. Lack of internet connectivity

Due to constraints in financing, the school does not have an internet connection. This limits the amount of information the teachers can access for teaching purposes. Currently the information available for educational purpose comes from educational CD which are purchased separately and installed into the computers.

iv. Maintenance program/ strategy

Maintenance of the computers in use is also a challenge. There is no maintenance budget in place to ensure sustainability of their use in the teaching process.

v. System security

Another barrier has been the threat viruses spreading in the computer. The school does not have internet connectivity hence cannot download the latest anti virus software online. This means that they have to limit the use of storage devices to minimize the treat of infections.

vi. Lack of clear policy

The teachers also observed that the school lacked of a clear policy on integration of ICT in teaching and use of computers. They felt that a policy would give clear direction on how to effectively use the computers in teaching.

vii. Unreliable power supply

Power black outs lead to loss of data as the school does not have a UPS neither does it have a stand by generator. The loss of data and interruption is frustrating as the computers are a shared resource so contact time is limited.

4.5.1.4 External Barriers as Stated by Uthiru Girls School

i. Unreliable power supply

The teachers pointed out that frequent power blackouts disrupt lessons. The school does not have back up supply so they cannot mitigate against the adverse effects of power failures. They interfere with computer practical lessons as well as exams.

ii. Placement of computers

The teachers see one of the main barriers as the placement of computers in the computer laboratory. The lab is not always available when the teachers are ready to use computers for teaching purposes. Teachers felt that the computers would be effective if they were placed in the classrooms. This observation has been made in previous research, where organizational factors such as the deployment of computers in ICT suites rather classrooms leads to lack of access to ICT equipment (Fabry & Higgs 1997; Cuban et al. 2000).

iii. Physical infrastructure

Closely related to this challenge is lack of appropriate buildings to host the ICT equipment. For example, the problem of usage in class could be overcome by the use of laptops. While the school does not have laptops, there even if they were available there would be the added problem of lack of power sockets in the classrooms. According to the ADB paper, one of the drivers of use of computers is appropriate buildings to host equipment which includes the needs of wiring the electrical systems as well as ventilation and general security of the equipment.

iv. Maintenance strategy

The principal cited the high cost of maintaining computers as well as replacing the obsolete ones.

v. Computer security

The teachers identified computer viruses as one of the major threats in using of computers as a shared facility. Viruses can corrupt computer programs and databases hence pose a real threat.

vi. No teacher for ICT from TSC.

The computer studies teacher was hired by the school and there is uncertainty he may leave if he gets a better offer. TSC is yet to post a teacher to the school for computer studies.

4.5.2 Internal Factors

These are related to the teacher as well as the teaching and learning process itself. One of the most quoted reasons is the lack of skill with use in computers as well as lack of confidence. The need for training is a recurring theme.

4.5.2.1 Internal Barriers as Stated by Aga Khan School

i. Competency levels

While the schools employs teachers who have basic computer skills, the teachers still feel they lack skills and need to train further in order to improve on their competency levels. The other barrier is lack of time to learn skills that would enhance the integration of ICT in teaching.

ii. Time Management

Time is a multi faceted barrier that addresses both teacher attitude as well as curriculum issues. On the one hand, teachers feel that integrating ICTs in teaching increases their work load when they already feel stretched in covering the curriculum. Integration is therefore not seen as part of the teaching process rather as an additional task to be carried out. This is due to the fact that preparing materials for teaching using ICT is time consuming.

iii. Classroom management

When teaching using computers, the teachers find that they need to supervise students more closely as some attempt to access inappropriate material on the internet. It is also diffucult to gauge individual understanding when students are sharing computers.

iv. Availability of suitable content

Relevant software for teaching is also a major challenge. The teachers would want to use ICT to teach but lack suitable content to do so. While they have some educational software, it is not sufficient and the teacher must go the extra mile of obtaining additional software.

4.5.2.2 Internal Barriers as Stated by St Joseph School

i. Lack of skills

The teachers lack basic literacy skills. Skills are vital as they build confidence in using computers as a teaching tool as well as develop a positive attitude in teachers about the use of ICT in general. This may have created negative perceptions that computers are difficult to use.

ii. Negative attitude

It was noted that very few teachers are willing to learn and use computers in teaching in the school. The computer teacher is the one currently using computers in teaching computer studies. The chemistry teacher has, however, made an effort in acquiring computer skills. The other teachers have a negative attitude towards the use of computers in teaching.

iii. Lack of motivation

There is no training program in the school to encourage teachers to change from the old ways of teaching and learn about the benefits of integrating ICT in teaching. According to an ADB (October 2007) funded study in Asia, one of the drivers that supports integration of ICT in the class room is encouragement and support from school management.

iv. Technophobia

It was noted that while the younger teachers have some computer skills, the older teachers are reluctant to be taught by them. The reason for this may stem from fear of embarrassment in front of pupils and colleagues, loss of status and an effective degrading of professional skills (Russell & Bradley 1997).

4.5.2.3 Internal Barriers as Stated by Musa Gitau School

i. Lack of computer skills

This is the most common barrier identified by teachers in use of computers in teaching. Not many teachers had participated in CDP with a component of ICT integration.

ii. Technophobia

As in St. Joseph school, it was noted that older teachers were not comfortable learning how to use computers even in cases where younger teachers with basic skills were wiling to teach them.

iii. Resistance to change

The principal noted that older teacher were resistant of the idea of using ICT in teaching. They are still not comfortable with computer as a tool of content delivery. Perhaps they lack the motivation to change long-standing pedagogical practices (Snoeyink & Etmer 2001) where chalk and board has served them for a larger part of their career.

iv. Educational software lacking

Teachers in the school said they lack appropriate educational software to deliver content using ICT. This is true as the school is mainly using Microsoft office programs in teaching. The other software available is the Encyclopedia Encarta which can be used to search for information. This software is not customized hence it does not address the specific curriculum and syllabus needs of the school.

v. Fear of embarrassment

One of the barriers is the resistance of teachers to the shift in teaching using computers. Lack of computer literacy skills is yet another barrier. The benefits of integrating computers are not still clear hence the reluctance to embrace them. The teachers also lack good and relevant educational software to teach various subjects.

4.5.2.4 Internal Barriers as Stated by Uthiru Girls School

i. Negativity from students

The teachers reported that some students developed negative attitudes based on what their fellow students told them. They are thus disinterested in learning using computers. The discouraged could be as a result of varying competency levels of the students. Those who have lower competency levels are left behind and therefore they become discouraged. This is compounded by the fact that computers are a shared resource.

ii. Varied learning pace

The teachers mentioned learner pace of learning as a challenge in integrating ICT in teaching. Some students learn faster than others making it difficult to teacher to carry all students along. This is especially so when the resources are quite limited.

iii. Competency in computer use

The teachers in the school were of the opinion that while they have skills in computer use and have used computers in teaching, they still need to improve on their skills so that they can achieve higher levels of competency.

iv. Lack of locally available content in some subject areas

Local content address the social and culture setting of the students. It relates to the interests and needs of the students since it addresses experiences which are important in their daily life. The educational software being used is designed in America and may not be always be relevant to Kenyan students. While English is the common language of instruction in schools, the Kenyan student has developed a language that captures the subtle aspects of their unique experience.

4.6 Drivers of ICT Integration in the Teaching Process

In this section, analyses of the factors that encourage teachers to use computers in the teaching process are discussed. While lack of computers is quoted as a barrier to ICT integration in teaching, the very presence of computers in schools is quoted as one of the most common reason why teacher are encouraged to use computer in teaching.

4.6.1 External Factors

The factors discussed in this section are those that relate to the presence of physical resources a swell as support from school administrators as well as the parent ministry.

4.6.1.1External Factors Stated as Drivers by Aga Khan School

i. Presence of computers

The school has 31 computers. This translates into a ratio of 13 students to one computer which is quite good comparable with even developed countries.

ii. Internet connectivity

The school has a VSAT internet connection. This has enabled them to set up a website as well as an E-mail address for communication. School management, teachers and students have access to information on the World Wide Web. Some computers are positioned in the library meaning the school has gone a step further and established the computer as a research tool.

iii. Institutional support

The school draws support from the international network of the Aga Khan Foundation to access teaching and learning material. The school has gone further and established a policy of computer literacy for all teacher employed to teach in the school, it is easier the to encourage use of ICT in teaching as teachers are already familiar with computers.

iv. Presence of employment policy

Connectivity to the internet has encouraged the search for information on the as well as the establishment of a Cyber school.

4.6.1.2 External Factors Stated as Drivers St. Joseph School

i. Presence of resources

The school has 14 computers in place mainly for the use in teaching computers studies. The presence of computers has motivated the transfer of skills to other teachers who are taking an interest in computers as a means of content delivery.

ii. Placement of computers

Teachers in the school felt that one of the things that would encourage use of computer would be the placement of computers. The ideal location they feel is placement of these computers on their desks.

iii. Syllabus to guide integration

They also felt that a syllabus from the Ministry of education would go a long way in supporting the use of computers in the teaching process.

4.6.1.3 External Factors Stated as Drivers Musa Gitau School

i. Presence of computers

The school has 20 computers already. They have already started using them for instructional purposes in some subjects. They are also being used in teaching computer studies. The teachers feel that one of the main drivers would be availability of adequate resources such as computers, laptops and LCD projectors.

ii. School management support

The teachers said that deliberate emphasis of school management towards the integration of ICT in teaching has played a big role in encouraging the use of computers in the teaching process. The Board of Governors (BoG) was responsible for the acquisition of the computer as well as a high speed printer.

4.6.1.4 External Factors Stated as Drivers by Uthiru Girls School

i. Presence of computers

The school has 23 computers which are available for teachers use. This has encouraged their use in the teaching process. Five subjects in the school are taught with the use of computers where applicable. The teachers also stated the availability of software that supports the teaching process acts as an impetus to use computers in teaching.

ii. Internet connectivity

The school has internet connection which teachers say has enabled them to search for teaching materials. They are able to get resources for expounding concepts form the internet. The commuters are also networked hence information can be accessed from various computers without the need for physical movement.

4.6.2 Internal Factors

This section looks at factors related to the teachers and their attitude towards the use of computers in the classroom. This is with a view of analysing what encourages teachers to use computers when teaching.

4.6.2.1 Internal Factors Stated as Drivers by Aga Khan School

i. Motivation from improved performance

The teachers stated that an improvement in the performance of the sciences has motivated them to integrate computers in the teaching process.

ii. Access to information

The internet has allowed teachers to get more sources of information on various topics. The use of computer packages to analyze students' performance has made feedback timely hence remedial action can be taken immediately. The teachers also expressed more self confidence in lesson delivery as they have more sources of information.

iii. Attitude change

Learner attitude towards sciences has positively changed. This resonates well with the fact that teachers are more confident in their teaching due to the more sources of information. This has resulted in improved quality of teaching in the school.

iv. Traditional learning barriers broken down

The school of having work typed has forced teachers to learn computer skills and to become more familiar with the benefits of computer use. The school has established email communication which facilitates communication between teachers and students even during school holidays. This gives an opportunity for virtual learning. It supports decision making as teachers reported they are able to study the trends of performance and make recommendations on decisions to be made.

v. Empowering learners

Computers have empowered students to search for their own knowledge and question their own understanding. It has also opened up their horizons and some use their E mail accounts to connect and communicate with friends outside the country.

4.6.2.2 Internal Factors Stated as Drivers by St. Joseph School

i. Peer Support

The computer teacher has served champion encouraging teachers to use ICT. The science and mathematics teacher have been trained by the computer teacher under SMASSE program on how to use computers for teaching purposes.

ii. Personal initiative

The chemistry has taken an interest in use of computers and now obtains materials for teaching from the Internet.

iii. Positive Outcomes

The students taking computers studies appreciate the use of computers studies.

4.6.2.3 Internal Factors Stated as Drivers by Musa Gitau School

i. Improved performance

One of the drivers of integration has been the impact on learning and learners. Computer simulations have made it easier for learners to understand abstract concepts better as simulations can be repeated as many times as possible. There is thus a shift to learner focused teaching once ICT starts being integrated in teaching. Using educational software in CD form, for example, has been reported to have made the teaching and learning more enjoyable. The use of the educational software has also enhanced the quality of teaching materials.

ii. Information system

It has also improved decision making mechanisms as teachers can quickly analyze individual student's performance and take remedial action on time. It is the benefits and possibilities that ICT presents that motivate teachers to use it more in the teaching process. Computer literate teachers have gone a step further by going to cyber cafes to download more information in order to enhance the quality of their teaching materials.

iii. Policy or program that would encourage integration of ICT in teaching

Teachers noted that an established policy or program would guide on what measures would need to put in place to enable uptake of ICT in teaching process. This would include administrative support, technical support and colleague support.

iv. Access to computers

The school has encouraged access to computers during free time for students.

v. Leadership with ICT

The principal personally encourages the use of computers providing leadership in integration matters. This inspires teachers to go the extra mile in creativity and innovation. The principal has committed to refund teachers who go out of their way to purchase educational software. She is also planning for a training program to develop the skills of the teachers as soon as a budget is availed.

4.6.2.4 Internal Factors Stated as Drivers by Uthiru Girls School

i. Motivation to stay ahead of the students

Some of the reasons supporting ICT use in teaching is the personal motivation of teachers to stay one step of the students who are also fairly literate in computer use. The aching teachers are further motivated by the fact tat there is a chance for personal advancement and growth through correspondence courses on the internet.

ii. Positive Outcomes

Teachers are also encouraged by the benefits that accrue from using ICT in the teaching process. One of the changes in the teaching process is that the various sources of information enable them to reflect more on the content taught to students. The syllabus book content can be compared with content from books and the internet to giving the teacher more authority on content delivery. The presentation is positively received by learners hence encouraging the use of computers in teaching.

iii. Time Management

It has also assisted in optimization of time and the same can be used in academic purposes. Time is better managed where ICT is used in lesson planning and preparation of schemes of work.

iv. ICTs as Information Systems

The teachers in the school use the local area network to post learning material on special accounts for students to access before the lesson. They then posts questions to the teacher for review before the class lesson. The learners have taken more responsibility for their own learning and encouraged them to do more study and research on their own.

The use of computers in teaching has also broken barriers between the teachers and students. The interaction between students and teachers has improved as teachers get to know the strength and weakness of individuals and deal with each student differently according to their needs.

4.7 Skills Required as Stated by the Teachers

From the analysis of the four schools the, the following skills were stated as crucial in integrating ICT in the teaching process.

i. Computer literacy skills
ii. ICT integration skills
iii. Typing skills
iv. Technical skills to handle equipment like LCD projectors
v. Competency improvement skills on ICT integration.
vi. Development of educational content for delivery with ICT.

4.8 Summary

The chapter presented the data as collected. For easy of analysis, the data was presented for each school. The data was further categorized into the various categories as outlined in the conceptual framework. This was for easy of interpretation and further understanding of the data.

CHAPTER FIVE

SUMMARY FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter, a summary of the major findings for each school will be carried out. The barriers and drivers will be examined and how they contributed to the integration of computers in the teaching process. A summary of the major barriers and drivers as identified from the data collected will be analyzed in response to the research questions.

5.2 Aga Khan High School: Discussions on Pedagogical Integration

A brief look at the main finding for the school is discussed in this section. The school is using computers in all subjects.

5.2.1 Drivers of ICT Integration in the Teaching Process

The school has 31 computers and 23 teachers. The teachers all have access to the computers. The ratio of teachers to computers is 0.74. This is an impressive ratio. The school has 350 students who also have access to the computers. The student to computer ratio is 13.46. This is also an impressive ratio. According to the National ICT Strategy for Education and Training (2006), the average access rate in developed countries is 15 students to one computer. The average access rate for secondary schools in Kenya is 120 students to one computer.

The school also has internet connectivity through a VSAT connection. 80% of the computers are connected to the internet. The school uses educational software known as Cyber School for teaching in sciences. 5 out of 15 subjects are taught using computers. This is 33% of all subjects. The school has skilled teachers in ICT use. The school policy makes computer literacy a mandatory requirement for teachers to be employed in the school. All 23 teachers have also undergone more than 50 hours of Continuing Professional Development which included ICT integration.

The school is very supportive of initiatives concerning integration of ICT in teaching. For example, the school when the school invested in Cyber School, an educational software for teaching sciences, the school ensured the teachers who would use it were trained intensively.

The teachers have also been trained under the SMASSE project. The school is in the process of developing a maintenance and renewal strategy for its ICT equipment.

5.2.2 Barriers to ICT Integration in the Teaching Process

While the school has a positive approach to the integration of ICT in teaching, the teachers are experiencing challenges in the use of computers in teaching. Even with the impressive students to computer ratio, the teachers still feel that the computers are not adequate for effective instruction. The internet connection is a useful tool however it also presents certain dynamics in the classroom. Classroom management becomes an issue as the teacher must closely supervise students to ensure they do not access inappropriate web content. The internet connection is also slow making downloading of materials a task in futility in some instances.

The integration of computers in teaching is also disrupted by unreliable power supply. Teachers reported losing their unsaved work when power blackouts occur. Equally disruptive is computer viruses which on one occasion led to the total failure (crashing) of a computer. A lot of data was lost in the process. This is compounded by the fact that the computers are not networked hence the information in one computer is not likely to be backed up in another one.

Much as the teachers have more than 50 hours of training in CPD and are computer literate, they still feel that they need to improve their skills in computer use. This is consistent with research findings such as Veen (1993) that one barrier is lack of training differentiated according to teachers' existing ICT skills. Time management is also a hindrance as teachers teach even during school holidays hence lack time to increase their skills.

With several students sharing a computer, copying from each other is more likely. This automatically increases the amount of supervision by the teacher

5.2.3 Integration of ICT in the Teaching Process

The school is currently using an educational software known as Cyber school to teach sciences and encyclopedia Encarta. Encarta is a digital multimedia encyclopedia published by Microsoft Inc. It consisted of more than 62,000 articles, numerous photos and illustrations, music clips, videos, interactivities, timelines, maps and atlas, and homework tools. This is a

vast source of reference information for both students and teachers. Cyber School on the other hand is specific to sciences. The science teachers have also be trained under SMASSE on the use of ICT to support laboratory experiments and simulations for mathematics.

5.3 St. Joseph School: Discussions on Pedagogical Integration

The school is yet to embrace computers in the teaching process. A brief discussion in this section highlights key barriers to using computers in the teaching process.

5.3.1 Drivers of ICT integration in the Teaching Process

This school has a total of 14 operational computers. The rest have broken down and are not in use. The computers were acquired under an initiative of the Old School Boys Association. Through the donation, the school now offers computer studies, a subject examinable under KCSE. The ideal ratio of teachers to a computer is 2.21. The reality is that currently only one computer is available for use by teachers. The ratio of students to a computer is 57.14. This is below the average national average of 120 students to a computer. Only 1 subject out of the 11 taught in the school is taught using computers.

The school has not of achieved much in integration of the operational computers in the teaching process. Currently, only two subjects are taught using computers. The data on how computers are being used in the teaching process was given by the computer studies teacher who has successfully used computers as both to teach the tool as well as a teaching tool. The English teacher also uses computers to some extent in teaching her subject.

The school has a dial up connection which was not functional at the time of the study. Only one computer, that is 7.14%, was connected to the internet.

5.3.2 Barriers to ICT integration in the Teaching Process

One of the main challenges facing the school is the lack of adequate physical facilities. The school has many computers but only 14 are functional.

5.4 Musa Gitau High School: Discussions on Pedagogical Integration

The school has a total number of 21 computers. It has no internet connection though. With a total of 20 teachers and 405 students, the ratio of teachers to a computer is 1.05 while that of students to a computer is 20.25. The school management is very keen on integration of ICT

into the teaching process with the principal taking a keen interest in championing the use of computers. This support goes beyond the principal. The Board of Governors has also been instrumental in supporting use of computers in teaching. The BoG was responsible for the purchase of the 20 computers, a printer and a photocopier.

Two teachers in the school have under continuous professional development which involved integration of ICT in teaching. The main course taught with computers is computers studies. However, there is limited use of computers in teaching French and biology. While some teachers are keen on the uptake of ICT in teaching, some are still hesitant to use the computers for teaching.

5.4.2 Barriers to ICT Integration in the Teaching Process

The teachers at the school feel that resources are still not adequate for use in the school. The school lacks an internet connection due to the expense of acquiring and maintaining one. Lack of funds has also hindered the maintenance of the computers already in use. While the school management is keen on computer use, a policy is lacking on how ICT can be integrated into the teaching process.

5.4.3 Drivers of ICT Integration in the Teaching Process

The school has a good school management support in integrating computers in the teaching process. The principal has taken up the role of championing the use of computers in teaching and learning.

5.5 Uthiru Girls High School: Discussions on Pedagogical Integration

The school has teacher to computer ratio of 1.52 and student to computer ratio of 21.74. The school also has a dial up wireless connection. All the 23 computers in the school are connected to the internet are networked with each other. The school has around 50% of teachers who have participated in under 50 hours of CPD while 40% have participated in over 50 hours of CPD. The school is currently teaching 50% of the subjects using computers. One of main motivating factor in using computers to teach in the school is the need to stay ahead of the learners who are very eager to learn using computers.

5.5.1 Barriers to ICT Integration in the Teaching Process

The school is very keen in using ICT in teaching. They are however challenges in using computers in teaching. The school faces power black outs which are frequent and disruptive. This leads to loss of data. Computer viruses are also a major threat as they have the potential to destroy the operating system of the computer hence rendering it in operational.

The placement of computers is also a barrier. The teachers feel that integration of computers would be more effective if the computers were placed in the classroom as opposed to the computer laboratory. There is a constraint though as there are no power sources in the classrooms. The computer lab is too small and not conducive for classroom instruction. In addition there is the logistical problem in allocation of time for use of the computer lab. A teacher may be ready with the lesson but the computer lab is not available for use.

Most teachers also feel they still need higher competency levels in the use of computers in teaching. Computer skills are two fold; technical skills in using the computer itself as well skills in using the computer as a tool for content delivery. Classroom management is yet another challenge when using computers as the student's pace of learning is different. Some students have a negative attitude towards computers which makes carrying the whole class along difficult. Lastly, there is lack of locally available content in some subjects.

5.5.3 Drivers to Integration of ICT in the Teaching Process

Teachers state that the availability of computers has enabled them to use them for teaching purposes. Internet resources have also enabled accessibility of curriculum content. The information is varied and current. Availability of educational software has also supported the integration of computers in the teaching process. With the networking of all computers in the school, one can access information from any point which breaks down physical barriers. The internet connection was a project of the BoG in collaboration with the Parents Teachers Association (PTA). There is very strong support from the school management in the use of computers in the teaching process.

Another source of support is with the learners themselves. They have a lot of interest in using computers to enhance their learning process. The impact of computers has made teaching a learner-driven process. The students are aware of the benefits of the computers and are willing to develop skills for posterity.

5.6 Barriers to ICT Integration in the Teaching Process

Barriers were categorized under external and internal factors. In the following section a brief conclusion of the barriers that hinder teachers from integrating ICT in the teaching process.

5.6.1 External Factors

An overview of all factors related to physical resources and school administration support are listed in this section.

5.6.1.1 System Factors

i. Physical infrastructure

According to Howell and Lundall (2000), among the key factors blocking educational institutions from using microcomputers as teaching and learning tools are insufficient fund and insufficient number of computers. From the data gathered, St Josephs has the lowest number of computers at 14, followed by Musa Gitau with 21, Uthiru Girls with 23 and Aga Khan with the highest number at 31. This translates into students to a computer ratio of approximately 58, 21, 22 and 14 respectively. While teachers in all four schools cited lack of computers as one of the main barriers, the schools are close ranging within the ratio of developed countries of 15 students to a computer and below the national average of 120 students to one computer. Aga Khan High school has an impressive ratio of 13.46, better than some developed countries.

While the ratios look impressive at numeric value, the situation on the ground is very different. The number of computers is not a single determining factor. Another factor as cited is research is lack of access to equipment (BECTA 2007). This has a lot to do with the placement of computers. Placement of computers will be discussed as a factor on its own.

ii. Placement of computers

The placement of computers is a factor in integration of ICT in teaching. Teachers in all four schools mentioned the placement of computers as a factor. The computers are placed in a central computer laboratory which presents some challenges. In Musa Gitau, the teachers feel that placing the computers in on a floor above the staff room constraints their use in preparation of teaching material and other activities such as evaluation which they carry out in the staff room. Scheduling of classes which require computers as a means of instruction is disrupted if the lab is not available. In Aga Khan School, teachers mentioned

logistical challenges when students have to move from the class room to the computer laboratory.

This finding is consistent with earlier research such as Wims & Lawler (2007), who noted that when there were no computers set aside for teachers' use, questions of confidentiality of the teachers' work as well as embarrassing experience of trying to master new technology in the presence of students.

iii. Lack of funds

Lack of funds is at the core of lack of appropriate, updated and relevant ICT equipment at the school level. The manager in St. Joseph school talked of the high cost of buying and maintaining computers as a barrier. This was a concern of the principal at Uthiru Girls who mentioned the high cost of maintaining as well as replacing obsolete computers. Another additional cost is the overheads in cost hiring trained ICT personnel to carry out maintenance. The case was the same in Musa Gitau where the principal noted that lack of funds had hindering the purchase of additional computers as well as the other accessories like LCD projectors which would improved the process of teaching with computers. It is only in Aga Khan School where the principal felt the computers were sufficient for their purposes.

iv. Computer viruses

Computers viruses have the potential to destroy or corrupt the software in a computer and cause irreversible damage to the information stored in a computer. Teachers in all the four schools mentioned viruses as one of the most serious threat to computer use. Viruses are a treat where computers are a shared resource. Viruses can infect a computer either through the internet or through external storage devices such as flash disks and diskettes. Computers viruses can be effectively controlled by use of an anti virus. This is a program detects and neutralizes the threat posed by viruses. For it to be effective, it must be up to date. Updates are carried out through the internet.

For schools like Musa Gitau and St. Joseph who do not have internet connection, it is a challenge to have updated anti virus to guard against this threat. For Aga Khan and Uthiru Girls schools, which have internet connection, viruses are still a threat as because of networking it allows viruses to infect many computers through the network.

v. Unreliable power supply

While the research states lack of electricity as one of the most common reasons why schools are unable to equip themselves with ICT equipment, all the schools have electricity from the national power utility, Kenya Power and Lighting Company (KPLC). However, teacher and managers in all four schools cited frequent power failures as a major hindrance to integrating computers in the teaching process. Power blackouts are a threat as none of the schools has a UPS or back up supply such as generators. The main consequence of this is loss of data, disruption of lessons and disruption of computer studies exams.

vi. Internet Connectivity

Of the four schools studied, Aga Khan and Uthiru High school have functional internet connection. Musa Gitau has no internet connection while St Joseph had a dial up connection which was not functional at the time of the study. The schools with internet connection have stated that access to the World Wide Web has made the search information, knowledge and teaching materials easier. Secondly, it has opened up new horizons in communication; in the way teachers can communicate with students and the way teachers and students can communicate the world. However, even with the presence of internet, teachers Aga Khan School complained of the slow speeds of the internet.

In Musa Gitau, lack of internet connection has limited the scope of computers as a teaching tool. This is because extra material for teaching is currently through purchase of educational CDs which are installed in the computer to be used for instruction in class.

5.6.1.2 Institutional Factors

i. School management support

School management support is crucial to integration of ICT in the teaching process. Dwyer, Ringstaff and Sandholtz (1990) found that support was needed from both colleagues and administrators. Of the four school studied, teachers felt that some form of school management support was lacking. In Aga Khan School, the school management was seen as a problem as they did not sometimes provide resources when requested by teachers. The teachers complained that output devices had not been provided.

Lack of school management support was identified as a major barrier in St. Joseph School. The introduction of computers and computer studies was done as an initiative of the Old

Boys Association. The school management lacks ownership and leadership of ICT issues. This is an impediment on the use of computers in teaching as shown by the fact that little integration is taking place in the school.

ii. Professional Development Programs

Of the four schools studied, 100% of teachers at Aga Khan School had undergone more than 50 hours of CPD which involved integration of ICT in learning. St. Joseph had the lowest percentage of teachers who have undergone training. Only two teachers had been trained. Teachers identified this as a barrier as they did not know how to integrate computers in the classroom. In Musa Gitau, the teachers also stated the need for training in order to develop their skills in teaching using computers.

iii. Policies and Strategies

Some teachers touched on the need to have policies in place to guide the integration of computers in teaching. In Musa Gitau, teachers stated that lack of a school policy on ICT integration in teaching and use of computers as a barrier. Further to this, the school principal stated the lack of a clear policy on training of teachers on ICT integration right from teacher training level.

iv. Technical Support

The four schools all have a technical assistant who carries out maintenance work on computers and the associated network. However, in St. Joseph the hiring of a technical assistant is done on an ad hoc basis. This school has a number of computers which are not functioning.

v. Maintenance Strategy

Maintenance of existing equipment was cited as a barrier in using computers. In St. Joseph school, optimal use of the computers in the school cannot be made as only 14 of them are functional. In Musa Gitau School, the teachers were concerned about the lack of a maintenance strategy to ensure computers were in good working computers. In Aga Khan School, the management was concerned about the cost of maintaining computers. In Uthiru Girls School the concern was on the cost of maintaining as well as replacing obsolete computers.

5.6.2 Internal Factors

A list of all factor related to teachers attitude and the teaching process are summarised in this section and discussed for all the schools under study to see points of divergence and points for convergence.

5.6.2.1 Teacher Factors

i. Lack of skills

Lack of computers was the most mentioned hindrance by teachers. Surprising, this cut across all teachers despite their level of training and literacy skills. Older teachers were less comfortable with the use of computers than their younger colleagues.

ii. Lack of differentiated trained

The teachers used two terms, computer literacy and competency levels while using computers. According to Marshall (1993), professional development models are largely based on a behaviourist perspective where participants are taken through a sequential mapping of the software's features; little or no time is spent modelling the ways the innovation might be implemented in the classroom, and little or no thought is given to the changes that must occur in classroom routines. It would appear that teachers recognise that they need skills beyond using computers; they need to know how computers can be pedagogically integrated in order to transform the learning experience.

iii. Personal perceptions

According to the school managers, most teachers in St. Joseph school have shown very little interest in acquiring ICT skills. Perhaps they do not see these skills as important or relevant to the teaching process.

Conversely, in the other three schools, the perception that computers are useful in the teaching process and further awareness of having experienced the benefits of using computers in the classroom has played a key role in encouraging their use in the teaching process.

iv. Negative attitude

In St. Joseph school the teachers have a negative attitude towards the use of computers in teaching. Most have never used computers for teaching.

v. Resistance to change.

The principal of Musa Gitau observed that teachers are still resistant to use of computers in teaching. She noted that this more in the older teachers who seem to suffer from technophobia.

5.6.2.2 Pedagogical Factors

i. Lack Educational Software

The schools do not have much variety in education software. The most evident success in using educational software seems to be in the sciences. Cyber School is science and mathematics based. In St. Joseph the chemistry teacher has reported some success in getting CDs for her subject. In Musa Gitau, some topics in Biology are being taught using educational software. Languages are also taught using computers, for example, French lessons in Musa Gitau.

ii. Lack of local content

As pointed out earlier, the software being used currently for teaching in the school is not custom made hence does not serve the specific needs of the Kenyan syllabus and may not in some cases be relevant to the daily experiences of the Kenyan student. For that reason, teachers find it difficult to come with suitable content to teacher some topics.

iii. Classroom management

Class management is an issue when teaching using computers. Students are at different levels of competency while the pace of learning is different. Since the computers are shared by more than one student, it becomes difficult for teacher to balance individual needs against the collective needs of the class. Some students become observers and not active participants and this discourages them in learning using computers. Teachers

also need to do more supervision to ensure students access relevant information on the internet.

iv. Competing interests

The teachers cited the conflict in finishing the set course versus the extra time required to integrate computers in the teaching. According to teachers, preparing materials for teaching required more time while movement from the class room to the computer lab took up time for academic instruction. Teachers are constrained by the need to cover the syllabus for national examinations hence the ICT integration is not seen as a priority.

v. Time as a resource

According to a research by Vanatta (2000), teachers identified lack of time to learn new technologies as a leading barrier impeding their technology integration. This concern was also identified by teachers interviewed who said they lacked the time to attend courses to improve their skills.

5.7 Drivers to ICT Integration in the Teaching Process

Drivers are factors that enable uptake of technology in schools. From the data collected, some factors were identified as drivers of ICT uptake in teaching.

5.7.1 External Factors

All factors related to physical resources and school management support are summarized and discussed against the literature review.

5.7.1.2 System Factors

i. Physical infrastructure

The presence of physical infrastructure as well as computers and associated accessories supports the integration of ICT in teaching. Aga High School teachers acknowledged that the availability of computers had made the teaching process easier. This was echoed by teachers in both Uthiru Girls and Musa Gitau School as well. Teachers pointed out that the ratio of students to a computer was good during individual lessons.

ii. Placement of computers

Teachers in St. Joseph were specific not just about the availability of computers but that computers be located at their desks. Teachers in Uthiru Girls pointed out that teaching with computers would be more effective if they were placed in the classroom. In Aga Khan High school, the computer lab is on a different floor. Teachers feel that placement in more accessible place would make their use in teaching easier.

iii. Internet Connectivity

Teachers in the two schools with internet connection affirmed that the ability to browse for information through the internet had tremendous benefits for both teachers and students. The internet gives a wider scope of information from varied sources. Tied to this is networking of computers which make communication by electronic mail possible.

iv. Availability of educational software

Teachers in Aga Khan stated that the presence of software such as Cyber School and the Encyclopedia Encarta has provided great opportunities in teaching sciences in particular. Lessons have become more interesting and students are very positive to the way content is delivered.

5.7.1.2 Institutional Support

i. School management support

Institutional barriers were dependent on the school. Lack of school management support and leadership in ICT was a major barrier in St. Josephs School. The school is had very low degree of ICT integration in teaching. The computer teacher is teaching the tool as well as well as using the tool for teaching. The English and chemistry teacher were also making efforts to integrate the computers in their lessons.

ii. Training programs

Teachers expressed the need for training to equip them with skills in order for them to effectively integrate computers in the teaching process. Teacher training and on-going, relevant professional development are essential if benefits from investments in ICTs are to be maximized (InfoDev, 2009). Most teachers were not trained on ICT integration when they were in college or university.

iii. School policies

Teacher also expressed the need for policies guiding training and integration of ICT in teaching. This is a valid observation. According to ADB report (2007), policies on teacher ICT competencies and strategies and planning for professional development and follow up are effective drivers in integration of ICT into classroom teaching.

iv. Maintenance strategies

One of the effective drivers for ICT use is teachers' access to functional computers. For that to be realized, a maintenance strategy should be put in place to ensure functionality of the computers. Uthiru Girls School has a very clear maintenance strategy where the BoG and PTA are responsible for maintenance. There is also a plan to purchase 6 computers every year and well as entering partnerships with organizations such as CFSK.

v. Long term financing

Financing is a key driver in integrating ICT in teaching. The cost of investing in infrastructure to support teaching using computers is high. This is due to the cost of acquiring computers and related accessories such as LCD projectors. The cost of installing and maintaining an internet connection is also high. In addition to tis, there is a cost component related to maintenance of computers and other equipment such as projectors.

5.7.2 Internal Factors

The factors discussed in this section relate to teachers attitudes as well as the teaching process itself. Of interest is the impact on students and how positive outcomes have changed teachers' attitude in embracing computers in the classroom.

5.7.2.1 Teacher Factors

i. Positive outcomes

One of the key drivers in the use of computers in teaching is the positive reception students have given learning using computers. In Aga Kahn School, teachers reported that there has been an improvement in the performance of sciences. All schools reported that their students are performing better in science congress competitions since they started using computers to prepare for the congress.

ii. Personal motivation

Teachers in Uthiru Girls said that one of the motivations for improving their skills came from personal motivation to stay ahead of the students who were driving the learning process by demanding more from the teachers. Some students were very proficient in computer use and this challenged the teachers to be one step ahead.

iii. Authority of information

Teachers who are using computers to teach to search for information on the internet reported that they were more confident of content delivery as they had consulted multiple sources and different authors when preparing lessons.

iv. Peer support

Peer support was a unique observation in St. Joseph School. The computer teacher has taken up the role of champion and encouraged some teachers to start integrating ICT in their teaching. The chemistry teacher reported success in getting material to teach while the science and mathematics teachers are being trained under the SMASSE program by the computer teacher. This example underscores the importance of peer support systems for teachers.

v. Confidence and competency with ICT use

Teachers expressed the need to increase their competency level in use of ICT. Since ICT is a tool for teaching, confidence and competency in its use motivates teachers to use it more. Personal comfort skill levels of teachers are important as they know enough to select, operate and apply the technology appropriately in their class room.

vi. Opportunity for personal development

Some teachers are using the access to the internet to advance their professional skills. This is through distance and on line learning. Distance learning is viable option for teacher training as it would enable teachers to acquire skills while still teaching in cases where the school cannot afford to release them for full time training.

5.7.2.2 Pedagogical Factors

i. Learner Paced learning

The introduction of computers in teaching has created a lot of interest in students. They are more control of their learning. For example, where simulations are used in science subjects, students can have the simulation repeated until they understand the concepts. The students were also said to have a higher retention capacity of information when they learn using computers.

ii. Improved performance

Teachers are encouraged by the improved performance in students' performance. In Aga Khan School, the teachers have noted an improvement in the performance of science subjects. However, they were reluctant to commit themselves on the extent as they wanted this to be backed by KCSE exam results.

iii. Interactive teaching and learning experience

By introducing teaching using media such as videos, teachers in Aga Khan reported that lessons are more interactive and real. The use of 3-dimensional models also brings the reality of theoretical concepts into the classroom. The biology teacher in Musa Gitau also affirmed that experiments can be simulated as many times as necessary making it easier for students to grasp abstract concepts.

iv. Exposure to current varied sources of information

Teachers stated that the internet serves as source of materials for lesson planning. Through the use of Encarta encyclopedia, a victual library is available for both teachers and students to browse and reference at the click of a button.

5.8 Skills Required by Teachers to Integrate ICT in the Teaching Process

The skills required by the teachers in the four schools were similar. However, there were slight differences depending on the level of skills the teachers already had.

Teachers in all four schools said that they required computer skills. This was surprising considering that in Aga Khan and Uthiru schools, the teachers are using computers in

teaching in almost all subjects. In Uthiru Girls, the teachers confessed that despite having a good appreciation of ICT, they still felt constrained by lack of basic computers skills.

A specific skill related to basic computer skills was typing skills. These skills are not specific to computer use but they play a big role in the effective and confident use of computers. Basic computer training does not cover the typing aspect and it is more or less a self taught skill. For beginners in computer use, lack of typing skills is a real challenge.

The other skill required was integration of ICT in teaching process. In St. Joseph school, where use of computers for instructional purposes is still very low, they wanted basic skills which they did not possess. However, in Uthiru Girls they talked of training to increase their level of competency.

Teachers also expressed the need for technical skills in handling accessories used in conjunction with computers for content delivery. The most common is the LCD projector. For effective delivery, the teacher must also be competent in the tools used for content delivery.

In particular, teachers in Uthiru Girls talked of skills in developing content for some subjects and topics for delivery using computers.

5.9 Conclusion

The sought to establish the factors that hinder the integration of ICT in the four schools selected. The most common barriers are resource oriented. The institutional factors are also commonly cited as barriers to the process of integration. Aga Khan and Uthiru Girls have achieved a good level of success with use of computers. Some the common parameters are strong management support, availability of computers and an operational internet connection, positive attitude towards the use of ICT in teaching and teachers with skills in computer use. In Aga Khan School, 100% of the teachers have at least 50 hours of CPD that integrated integration of ICT in teaching while in Uthiru Girls, 54% of the teachers have undergone the same training. Policy makers in Kenya should concentrate on empowering schools.

Musa Gitau School is steadily integrating ICT in teaching. The school has very strong school management with the principal providing strong leadership in ICT issues. However, they are hampered by lack of an internet connection. The BoG is also very supportive and was

responsible for the purchase of computers, printer and copier. The school is also constrained by lack of funds to acquire additional equipment to support on going integration. The teachers also seem to lack insufficient training. Only 9% have undergone at least 50 hours of CPD with ICT integration.

St. Joseph has very little integration of ICT in teaching. The school has the lowest number of operational computers. The school lacks strong school management support hence little ownership and leadership in ICT integration in teaching. There is very little interest an awareness of the benefits of computer use in teaching. There is a degree of integration in computer studies. The computer teacher has gone a step further and is offering support systems for teachers in the sciences under the SMASSE program by training them on computer integration in teaching.

5.10 Recommendations

From the study of the four schools, it emerged that the schools are still grappling with external barriers. In order to encourage integration of ICT in teaching, policy makers need to look at the resource related factors as well as institutional factors. The policy document in place reviewed show that attention is being given to issues of resources at a school level. A study of drivers which facilitate ICT integration in Asian schools (ADB 2007) showed that the total cost of ICT ownership (short- and longer term financial needs, including funds for training, equipment upgrading, servicing and maintenance, and related labor) should be modeled at school level. Strategies for equipping schools with ICT equipment should not just stop at providing the equipment, it need to look at wider issues. Maintaining the equipment, upgrading equipment and placement of equipment is also a factor. Providing physical infrastructure such as buildings appropriate to host equipment is also important. Electrical wiring, ventilation and security are key considerations.

At institutional level, support systems encompassing administrative, technical and peer support are crucial to integration of technology in teaching. Teachers who had support systems including technicians, administrators and peers who could assist when needed were more likely to successfully integrate technology (Walsh & Vannatta, 2001; Mouza, 2002). Effective professional development is an important component. According to Trucano (2005), in an InfoDev report on OEDC on-going teacher training and support is critical to the

successful utilization of ICTs in education. Teacher training and professional development is seen as the key driver for the successful usage of ICTs in teaching when treated as a process and not a one-off event. Effective teacher professional development should approximate the classroom environment as much as possible. Educational institutional also need to put in place policies to guide integration ICT in teaching. Strategies should then be developed in line with these policies to cover areas such as training of teachers and maintenance of computers in the schools. Teachers must have adequate access to functioning computers, and be provided with sufficient technical support, if they are to use ICTs effectively.

At the teacher level, research has consistently shown that the teacher plays a key role in successful integration of ICTs in teaching. According to the InfoDev report, teachers remain central to the learning process. The teacher's willingness to adapt to change, his or her comfort and skill level, as well as the ability to deal with issues of time management were the most common indicators of successful integration according to Vanatta (2002). Teachers stated that they still required basic literacy skills to effectively use computers. It would appear that few teachers are confident in using computers as a resource and this affects the integration process. Teachers still fear using ICTs, and thus are reluctant to use them in their teaching. This was noted more with older teachers who more reluctant to be taught basic computer skills by younger teachers. Time and classroom management was also an issue for teachers in the study. Incentives need to be developed at both at national level and school level to encourage use of ICT in teaching. Teachers could be certified after participating in CPD programs and realize professional advancement. Teachers could also be given time paid off to participate in professional training. Schools could also introduction means of recognizing teachers who integrate ICTs in teaching formally and informally among their peers and the school community.

At pedagogical level, most teachers in the study use ICT for routine tasks in education such as lesson planning, evaluation of students, information presentation, internet searches and record keeping. Teachers are mainly using standard software to teach using computers. The most readily available software other than MS office packages seems to be in sciences and mathematics. Teachers reported positive feed back in student learning in the sciences. Local content is a challenge for teachers and in some instances teacher said they did not have appropriate content to teach some topics. According to Trucano (2005), the way ICTs are used in lessons is influenced by teachers' mastery of their subjects, and how ICT resources

can be utilized and related to them. Teacher training needs to go beyond simple teaching of basic skills but need to as address how subject knowledge can be transform the way students understand this knowledge.

5.11 Further Research

There is still a lot of research to be carried out in the area of integration of ICT in the teaching and learning process in Kenya. Some of the areas for further research and investigation include:-

1. What are the pedagogical practices adopted in schools and how is ICT used in them?
2. What and how is ICT used in specific situations where ICT has been used relatively extensively within the pedagogical practice?
3. To investigate teachers' needs for knowledge and skills in relation to the effective use of ICT
4. How can we measure outcomes of ICT use by teachers resulting from participation in professional development activities?
5. What incentives can be introduced at school level to encourage uptake of ICT in teaching by teachers? How can the education sector and specifically policy makers support such initiatives?
6. Why is there wider usage of computers in teaching sciences? Is it a question of software availability or is it a pedagogical issue?
7. What financing models should be adopted at school level to ensure sustainability of acquiring, maintaining and upgrading equipment which support use of ICT in teaching and learning?
8. What is the Total Cost of Ownership (TCO) for computers in a variety of educational settings, at both the school and system level? How should we calculate such figures?
9. What regulatory issues exist related to connectivity and information access issues as they relate to the education sector, and what guidelines and best practices have emerged?

5.12 Summary

This chapter examined the major findings of the study in response to the research questions. The conclusion was done for each school and a compilation for all the schools. Recommendations were outlined in areas where policies need to be developed and the concerns that should be addressed for each factor. Areas for further research were identified as little research has been carried out in Kenya on integration of ICT in the teaching process.

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APPENDIX I: SCHOOLS IN THE STUDY

Aga Khan High School

Established in 1961, The Aga Khan High School situated in Nairobi is a private co-educational, multicultural day secondary school. The school is located in Westlands, along Waiyaki Way, just seven kilometres from Nairobi's city centre. The Aga Khan High School, Nairobi is a not-for-profit independent school registered with the Ministry of Education, Kenya. It has 350 students (100 female and 250 male). The school has 23 teachers (12 female and 11 male). The school has a total of 31 computers. The school has internet connection which is a VSAT connection with a speed of 32kbps. 25 of these computer are connected to the internet. The school email address is "akhsn@akhsn.ac.ke, and the website is www.akhsn.ac.ke.

St. Joseph High School

This is a Government assisted public boys' secondary school and located in Kiambu North District of Central province. It was established in 1958. It is located in a rural area about 80 Km from the capital city, Nairobi. The school has 800 students (all boys). The school has 32 teachers (25 females and 5 males). The school has 14 functional computers but with many others that are not functional. The 14 are used to teach computer studies, which is an examinable subject in Kenya Certificate of Secondary Education (KCSE). At the moment, the school has no Internet connectivity. It does not also have an email address or a website.

Musa Gitau Secondary School

This is a Government assisted mixed public school. It is a day school located in the Kiambu-West District of Central Province, Kenya. It is located in the outskirts of Kikuyu Township, 25 kilometres from Nairobi City. The school's population is 405 students (140 male, 265 female). It has 21 teachers (10 male, 11 female). The school has 20 computers, which were acquired in November 2007; therefore the school has just started the process of ICT integration. The institution does not have Internet connectivity.

Uthiru Girls High School

This is a Government assisted girls' only public school. This is an urban school located in the outskirts of the capital city Nairobi. It is located in Kiambu West District of central province. The school is located along the Nairobi-Nakuru Highway, about 15Kms from the city center. It has 500 female students who are all boarders. The school has 35 teachers; 10 males and 25 females. There are 23 computers; 20 for students and 2 for administrative purposes. The school, using its own resources from school fees, bought the computers. Both the teachers and students have access to the computers. The students use the computers to learn computer literacy skills. The school has Internet connectivity and uses the dial-up wireless connection. The school's email address is "uthirugirls @yahoo.com".

APPENDIX II: SCHOOL MANAGER QUESTIONNAIRE

SCHOOL HEAD/ DIRECTOR QUESTIONNAIRE

1) Name/location/general description of the institution

_____

_____

_____

_____

_____

2) Is the school Public _____ Private _____ ?

3) Where is the school located? Urban _____ Rural

Semi-urban _____

4) Is the institution Girls only _____ Boys only _____

Mixed _____ ?

5) How many functional computers does the school have? _____

6) What is the website of the school (or websites where the school is listed)

_____

7) Please indicate the E-mail address for the school

_____

8) Does the school have internet connectivity? yes _____ No _____

9) Please describe the type of connection (dial-up, VSAT etc.) and bandwidth (Speed 128kbps etc)

_____

_____

_____

9) How many computers in the school are connected to the internet? _____

10) How many teachers does the school have? _____

11) How many computers are available to the teachers? _____

12) How many students does the school have? _____

13) How many computers are available to students?

14) Is an ICT advisor and /or technician employed by the school? Yes _____

No _____

15) Please give a brief description of the principal professional duties of the ICT advisor/technician?

16) How many teachers have completed 1-50 hours of professional development which included ICT training? _____

17) How many teachers have had more than 50 hours of professional development which included ICT training?

_____

18) Does the school have a plan for the integration of ICT? Yes _____

No _____

19) Who is responsible for ICT equipment maintenance in your school?

20) Does your school have an ICT equipment maintenance and renewal plan?

Yes _____ No _____

21) Does the community outside the school have access to your ICT facilities/infrastructure?

Yes _____ No _____

22) If yes, describe the kind of access the outside community has

_____

_____

_____

_____

_____

_____

23) In your opinion, from a school management view, what are the major barriers hindering the the achievement of your schools ICT-related goals?

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APPENDIX III: TEACHER QUESTIONNAIRE

TEACHER QUESTIONNAIRE

1. Name of Institution : _____

2. Are you Female: _____ Male: _____ ?

3. Do you have access to a computer in your institution? Yes: ____ No: ____

4: Do you have a personal email address? Yes: _____ No: _____

5. Have you had any training in the pedagogical integration of ICT? Yes: ____ No: ____

6. If yes, indicate the total number of hours of training. _____ Hrs

7. How many hours per week do you use ICT for academic purposes? _____ Hrs

8) Do you use computers to in lesson preparation Yes _____ No _____

9) Describe any change in your in-class teaching due to computer use. (what you teach, how you
teach
etc)

_____

_____

_____

_____

_____

10) Describe any impact that ICT has had on your evaluation methods (how you evaluate your students)

_____

_____

_____

11) Describe any impact that ICT has had on communication between yourself as an teacher and your students (do you encourage questions via email, submission of assignments via email etc)

12) Do you think that ICT helps you reflect on your teaching (what you teach, how you teach) if so, explain briefly with examples

13) Explain briefly how ICT may have improved your own access to knowledge (information) as an teacher?

APPENDIX IV: TEACHER INTERVIEW

TEACHER INTERVIEW

1. Name/Location of the institution

2. Describe the various ways that you use ICT for academic purposes.
   (Which software do you use for planning, teaching, marking, etc)

3. What factors do/would favour the integration of ICT in your courses?

4. What are the challenges you experience (to) using ICT in your courses?

5. What is your experience (to) using ICT in your courses?

6. What skills /competencies do you have and/or require to effectively integrate ICT in your teaching?