A STUDY OF COMPUTER INTEGRATED EDUCATION IN SECONDARY SCHOOLS IN NYANZA PROVINCE, KENYA

by

FLORENCE ODERA
BA. Ed (HULL), MA Ed (HULL), MPh (WALES)

PHILOSOPHIAE DOCTOR (PhD)
FACULTY OF EDUCATION

PROMOTERS: PROF W. J. FRASER
PROF L. R. KILLEN

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FLORENCE ODERA

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PROF L. R. KILLEN

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DECLARATION

I declare that this research report handed in herewith for the degree of Doctor of Philosophy at the University of Pretoria is the researcher's independent work. It has not been submitted for a degree or examination before in this or any other university.

FLORENCE Y. ODERA

21 day of 3 2002.

DEDICATION

This work is dedicated to my late parents, Andronico and Nerea, who inspired and motivated me to love education and believed in the education of girls as a catalyst to better family living.

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ABSTRACT

This study is about computer-integrated education focusing on public secondary schools in Nyanza Province, Kenya. It is concerned with the investigation of issues involved in the implementation of computer technology in secondary education. The purpose of the study was to investigate how computers are used in schools and to provide evidence on the obstacles that inhibits effective implementation of computers in teaching and learning. It examined government policy, curriculum guidelines, secondary school computer policies and the school departmental policies regarding the use of computers in the classroom. A review of relevant literature explored the use of computers in teaching and learning in developed and developing countries.

Data were collected from Officers in the Ministry of Education, the Director and a Curriculum specialist at the Kenya Institute of Education (KIE) using structured interviews, from Principals and Heads of Department, using questionnaires in order to obtain qualitative and quantitative data. A semi- structured interview was also used for in-depth investigation with computer teachers. The data collected were analyzed through the use of descriptive statistics and tabulation. A sample of two Senior Education officers, two Curriculum Specialists, 25 Principals, 89 Heads of Department and 20 teachers participated in the investigation representing rural, urban and suburban areas.

It was established from the data obtained that the Kenya Government formulated a policy and supports the use of computers in secondary schools but there was no written policy document or guidelines circulated to schools for the implementation of the policy. It was further revealed that the government had no funds for purchasing computers for schools. Further results indicated that KIE had developed a Secondary Computer Syllabus and distributed it to some secondary schools, but no evaluation was done to assess the effectiveness of computer education in schools.

Most of the Principals reported having a computer policy and practiced whole school integration of computers in education, and using computers to teach computer literacy, traditional subjects and in administrative work. It was also found that a few HODs had departmental policies for the use of computers and were applying computer technologies in the teaching of the traditional subjects such as Accounting, English language, Mathematics and Science Education. Further more, computer teachers saw themselves as competent with computer literacy skills and taught students word processing, spreadsheets, database and programming. They were less confident to integrate computers into traditional subjects, although some of them integrated computers into various subject topics.

Barriers to computer integration into traditional subjects that were identified by the participants as lack of teacher training in the use of computer technology in the teaching of subjects and lack of adequate computers and lack of suitable software. The study suggests that systematic teacher preparation at pre-service and in-service course would facilitate effective integration and use of computers in teaching and learning. Finally, the study identified various limitations and makes suggestions for further research direction and recommendations for improvement and immediate action. A model of re-training of teachers is proposed to assist Principals of schools in the task of staff development in CIE.

KEY WORDS

Policy
Curriculum
Evaluation
Implementation
Secondary Computer Syllabus
Computer Integrated Education
Computer literacy
Teaching and learning
Qualitative and quantitative studies
Software application

CONTENTS

CHAPTER 2 ROLES AND FUNCTIONS OF COMPUTERS IN THE LEARNING ENVIRONMENT

CHAPTER 3 FACTORS FACILITATING AND AFFECTING THE USE OF COMPUTERS IN SCHOOLS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACCE	-	Australian Council for computer Education
ACE	-	Advanced Certificate in Education
BA	-	Bachelor of Arts
BEd	-	Bachelor of Education
BSc	-	Bachelor of Science
BOG	-	Board of Governors
CAD	-	Computer Aided Design
CAL	-	Computer Assisted Learning
CBI	-	Computer-Based Instruction
CD	-	Curriculum Development
CIA	-	Computer Assisted Education
CIE	-	Computer Integrated Education
COL	-	Commonwealth of Learning
DEO	-	District Education Officer
DfEE	-	Department for Education and Employment
ERIC	-	Educational Research Information Center
HOD	-	Heads of Department
ICT	-	Information Communication Technology
IMF	-	International Monetary Fund
IT	-	Information Technology
KCSE	-	Kenya Certificate of Secondary Education
KIE	-	Kenya Institute of Education
MBL	-	Micro-computer-based Laboratory
MOE	-	Ministry of Education
NCES	-	National Center for Education statistics
NCET	-	National Council for educational Technology
NGO	-	Non Governmental Organization
OTA	-	Office of Technology Assessment

PDE	-	Provincial Director of Education
PTA	-	Parents Teachers Association
SAP	-	Structural Adjustment Programme
TLTC	-	Teachers Learning Technology Competencies
TTM	-	Teachers as Trainers Model
UK	-	United Kingdom
UNESCO	-	United Nations Educational Scientific and Cultural Organization
USA	-	United States of America

CHAPTER 1

PROBLEM STATEMENT AND DESCRIPTION OF THE RESEARCH METHODOLOGY

1.1 Introduction

This study is about computer Integrated Education in Nyanza Province, Kenya focusing on public secondary schools. Kenya is a country situated in the Eastern part of Africa. It is a multi-racial society and English is the official medium of classroom instruction from primary grade four (Ages 9-10 years) to university education and for official correspondences, but Kiswahili is the official National language. There are eight provinces in Kenya and Nyanza Province is in the Western part of Kenya. At the time of this research, there were 524 secondary schools (both public and private) in Nyanza Province. The research is concerned mainly with investigating issues involved in the implementation of computers in the classrooms. This chapter, addresses the background to the study problem, the problem identified, the objectives of the study, significance of the study and basic assumptions. In addition, it states the research questions, the conceptual framework, methods of research and definition of terms used in this study which are not familiar to those who will use this thesis, and the last part gives an overview of the thesis organisation.

1.2 Background to the study Problem

Kenya is a developing country with a fast growing school population, and there has been an increasing demand for new methods of teaching and learning to meet the needs of the teachers, students and the public at large. McAnany and Mayo (1980) report that the use of education technology is considered as promising a great deal to those who seek for radical change in educational curricular and techniques, because of its multiple effects and its apparent potential to produce and distribute quality materials in teaching and learning. McAnany and Mayo (1980) echo the recommendations put forward in 1961 when the Ministers of Education attended the UNESCO conference on the Development of Education in Africa held in Addis Ababa, Ethiopia. The report suggested that African countries in renovating their

educational systems would be well advised to study the use of the most up-to-date educational techniques and teaching aids. Thus, recent years have witnessed several major projects in developing countries to use instructional technologies such as radio, television, and films, and now the emphasis is on computers in order to keep up with developed countries.

Computers were introduced into the school systems in developed countries due to the demands by the parents for their children to be computer literate. There were many other reasons put forward by the leaders and parents for the implementation of computer education in education such as:

- To prepare students to participate fully in future society by acquiring computer literacy skills that include learning of common business tools, such as word processing, spreadsheets and database (Berson, 1996 and Yee, 2000);
- Motivational effects: the motivational function of the computer has been considered an important reason in many computer-based instructional programs. It is believed the use of computers helps to release the students from boring paper work. It motivates them to learn and students are so interested excited when they use computers (Bagui, 1998; and Ertmer, Addition, Ross and Wood, 1999);
- The use of computers makes the lesson more interesting to students, either through direct interaction or by providing the teacher with access to more interesting materials (Gibson, 2001; Liu, Macmillan and Timmons, 1998; and Myhre, 1998);
- Improve methods of teaching: the use of computers helps to bring changes in classroom practice in order to improve subject matter teaching (Rice, Wilson, and Bagley, 2001, and Dexter, Anderson and Becker, 1998);
- To widen access to experiences not easily available in the classroom (Heinich et al. 1996 and 2002; Dexter et al. 1998; and Makau, 1999);
- Teachers also enjoy using technology. It helps to improve their skills in teaching (Myhre, 1999; Simmt, 1998; and Russell, Finger and Russell, 2000).

It is potential advantages such as the above that led the industrialized nations to adopt computers in teaching and learning in the classroom. As a result of the huge claims

about the potential contributions of computers to students' learning, some of the African countries like Kenya also followed the footsteps of the developed countries and introduced computers into their education system (Hawkridge, 1991).

In Kenya, computers first appeared during the 1980's when private secondary schools and commercial institutions started computer literacy courses (Hawkridge 1983, Makau 1990). The introduction and use of computers in other institutions and work places since then has been rapid, following the technological development of simple and cheaper computers in various parts of the industrialized world. These technologies found their way into Kenyan schools and institutions of learning. There are now various types of computers in Kenya. These include mainframe computers, mini-computers, microcomputers, and laptop/notebooks (Onunga, 1997).

The private secondary schools have been teaching students various computer skills and each had its own approach to computer education. In order to provide a uniform standard of computer education in secondary schools, it became necessary to produce Secondary Computer Syllabus for schools. The Kenya Institute of Education was responsible for providing this syllabus. There is no information available to confirm that schools are using the syllabus to teach computer programs as stated in the Secondary Computer Syllabus, and whether schools are integrating computers into teaching and learning traditional subjects.

However, in 1996 the Minister for Education launched a larger and more ambitious computer education project for public secondary schools. From the point of view of the Kenya government, the main objective was to help large numbers of secondary students to be computer literate. This was in response to the perceived problem that a lack of computer skills was preventing Kenyan youths from acquiring jobs (Kyungu, 1997). However, the government project gave no indication of how computers were to be used. Whether computers were to be integrated and used to assist in the mastery of those specific curriculum areas taught in secondary schools, or whether computer education were to be an optional subject or a compulsory subject for all students in secondary school. This has led to many problems in the implementation of computer education in secondary schools (e.g. lack of uniformity in utilization, pattern of use, lack of trained teachers, lack of computer textbooks and relevant software packages).

Despite all these problems, many schools have continued to purchase computers. But it is not clear whether schools are using computers for the purposes and the objectives intended by the government.

1.3 Statement of the Problem

Several research findings on computer-integrated education from developed countries have reported the general effectiveness of computers as a method of instruction (McRobbie & Thomas, 2000: 142, Zang, 2000: 467). However, lack of information regarding utilization of computers as tools for classroom instruction in secondary schools in Nyanza province necessitated this study. No study of this kind has ever been done to determine how effectively computers can be used for instructional purposes in Kenya. It is because of lack of such knowledge that I felt encouraged to investigate the relative effectiveness of CIE in secondary schools in Nyanza Province.

By researching CIE in the case study institutions in Nyanza Province that is my home province, I was in a good position to access the schools easily. Second, a guiding principle of my research was that it should promote the use of computers in schools in Nyanza province. At the time of my research, many secondary schools in Nyanza Province (see appendices 2) had not introduced computer education. Since charity begins at home, my visit to the Provincial Director of Education (PDE) and secondary schools encouraged them to start computer education program as I observed their reactions. Third, the BEd students I train in educational technology at Maseno University in Nyanza province use some of the schools where I conducted the case study for teaching practice, so the information would be useful for future teaching practice placement of the students. However, while some of the Principals, Heads of Department and teachers were familiar to the researcher, the collection of data was undertaken objectively.

A recent study by Azita (1999:32) in the USA recommended that greater attention should be devoted to understanding why the potential of computers for instruction remains unexplored in school settings. Azita (1999) reports that up to now not many studies have attempted to examine the reasons that technology is not being used within the mathematics classrooms. Christman and Badgett (1999:136) also suggest

that further research is necessary to determine whether computers are comparatively more effective in teaching difficult subjects areas. At the same time, Jones and Paolucci (1999:17) cite the same problem in the USA and quote a more recent editorial commenting that 'with all the studies available research on why and how the use of technology is effective remains minimal.' Moreover, Norum, Scott, and Duffied (1999:192) point out the need for more qualitative studies that look at the adoption and integration of technology by teachers emphasizing especially the value of sharing information about teachers' experiences with technology. Given that these studies are suggesting difficulties with the use of computers in First World classrooms, it is to be expected that the situation might be even more severe in Kenya. Therefore, one aspect of the present study will be to determine whether the situation is similar, and whether the reasons for lack of computer use in classrooms are similar to the reasons in other countries. This study further explored differences in attitudes that teachers could have about the integration of computers into teaching and learning being a new educational technology in secondary education.

1.4 Objectives of the Study

My general research goal is to establish an informed, up-to-date view of the use of computers in secondary schools in Nyanza Province, Kenya. Therefore, the study aims to achieve the following objectives:

- To analyse existing Computer Integrated Education policies and practices in developed and developing countries.
- To identify secondary schools in Nyanza province which have computers for my research project, and to determine the roles played by the Principals and Heads of Department in the introduction and use of computers.
- To investigate the use of computers integrated education in the identified secondary schools and establish how teachers use computers in teaching and learning in Nyanza Province of Kenya.
- To analyze and describe, through a review of literature the use of computers, the factors that encourage and affect the use of computers in teaching and learning.

- To investigate classroom teachers' attitudes, towards the use of computers and determine their views and beliefs about the value of computers in teaching and learning.
- To provide evidence on the problems and obstacles inhibiting effective implementation of computer education in secondary schools in Nyanza Province.
- To develop a model for re-training teachers in the use of computers in teaching and learning.
- To provide suggestions and recommendation for the effective implementation of computer integrated education in secondary schools, and future research on CIE in Nyanza province.

1.5 Significance of the Study

The significant of this study rests on some of these assumptions: The first is that computer integrated education yields substantial benefits for individual students both young, adults and society at large. Secondly, a major benefit of computers is in their ability to improve students' knowledge of computer productivity tools to prepare them for the world of work and future higher studies in computer science. Thirdly, computers have the potential to improve and increase students' performance in academic subjects. The study of Computer Integrated Education (CIE) in secondary schools is very important. The findings of this study would be valuable for the following people in Nyanza Province, Kenya:

- Planners in the Ministry of Education in Nyanza Province. This includes Education Officers responsible for overseeing the implementation of the Ministry of Education policies and Inspectors of schools responsible for school curriculum implementation in schools.
- Schools using computers and those new schools planning to introduce computer-based learning and;
- Other researchers.

Since 1996, many public secondary schools in Kenya have acquired computers and other support materials. This has been due to two major reasons. The first is the

realisation that one of the basic human rights is the right to education (Johnson, 2000:593), and that every child has a right to be educated, and that computers could help to provide this education to all secondary students. The second is the need for trained manpower, to prepare secondary students to participate in a technical society. This involved investing heavily in the young generation and providing them with the best possible educational opportunities. In the same general ways that computers have been used in other developing and developed countries, computers were introduced into Kenyan public secondary schools to help teach computer literacy, and to help improve students' performance in traditional subjects through improved curricula and instruction.

The demand on the parents and the government to fulfil these goals is very high which now forces the government to decide on educational priority areas. Thus, the need to justify the expenditure on computers in education arises. This requires a review of the present pattern of expenditure on educational technology and consideration of alternatives. It is necessary that the benefits derived from these programs should merit the cost of equipment, preparation and utilisation process. It is difficult to identify the costs associated with technology development and use in education. Researchers in America report that justification for cost benefits of investing in technology is examined in terms of cost-effectiveness. This includes the extent to which computers motivates students think and reason, to learn, new ideas and when students are actively interacting with computers and are enjoying what they are doing, and again if students performance in academic subjects improves (Hawks and Combre, 2000:28). This also involves training teachers to be computer literate so that they can be able to assist learners. In order for schools in Nyanza Province to decide whether to continue to invest heavily in computer technology, the schools and parents must consider evidence from research findings, and then examine how the present services can be improved and used economically by all students in the school.

The value of computers as part of students' learning is widely recognised and is in their function of providing a degree of realistic practical teaching and learning in the in the classroom. This idea has been demonstrated by Crook (1994); Pedretti, Mayer-Smith, and Woodrow (1999) and Woodrow (1998) who report that the use of computers is a good way of promoting students' standard of education, and of

enabling them to proceed to higher studies in computer technology. In contrast, there has been a lack of research studies to provide evidence concerning how teachers and students use computers in secondary schools in Nyanza Province. Similar studies by Hawkridge (1991), Makau (1990), Mwanda in progress and Kiboss (2000) conducted in Kenya were not concerned with the integration and use of computers as tools in the classroom. In fact, Hawkridge's study was a survey of computers used in Kenya and was not an investigation study in secondary schools in Nyanza Province. Makau (1990) study was about computer innovation in Kenyan secondary schools and was conducted when public secondary schools in Nyanza Province had not started using computers. Mwandas' study (in progress) is concerned with Computer Assisted Learning (CAL) in teaching and learning geography in secondary schools in Nairobi. Kiboss (2000) study was concerned with the views of a group of students and their teacher regarding the impact of a computer-based instruction (CBI) programme that involved the collaborative learning of a physics course on measurement. This study aims to fill the gap created by the absence of formal research in Nyanza Province.

Furthermore, effective implementation of national curriculum innovations such as technology in education can be facilitated by efficient management of the classroom environment together with a well-trained teaching force and qualified technical personnel to carry out the maintenance and repairs of computers. In addition, the provision of equipment, software, adequate support materials, physical facilities like classrooms are important factors that need to be considered for the effective utilization of computers. The present availability and utilisation of these factors can only be ascertained by a systematic evaluation.

Moreover, in a rapidly changing society such as Kenya, the amount of knowledge and information that the learners need to gain at school increases very rapidly. It is no longer possible to rely on traditional methods of teaching alone, since it is not possible to provide students with new ideas and skills necessary to tackle some of the difficult subjects like mathematics and science. The nature of education must therefore incorporate educational technology to enhance teaching and learning in schools in order to produce skilled manpower to participate in the development of a country. Kenya National Commission for UNESCO (1993:44) recommendation indicated that the overall objective of computers in teaching and learning is to make

Kenya an electronic country by the year 2000. But this has not been realised. This calls for research studies to be undertaken into computer integrated learning, in a search for the most cost-effective approach to maximize its potential as a tool in the classroom instruction in secondary schools in Nyanza Province. In order to determine the success and usefulness of technology for teaching and learning the views of teachers must be analysed.

Two factors are particularly important and merit careful study before computers can be integrated and used in classrooms. The first factor concerns the preparation of the teachers, and the second concerns the management and planning issues such as the provision of funds for maintenance. There has been no systematic study of these issues in secondary schools in Nyanza Province. From my observation, it seems that the educators in the country believe that once the schools obtain some computers, teachers would just use them even when some of the facilities and services are not available, contrary to what happens in developed counties. For example, the issue of teachers' ability to integrate and use computers in the classroom is very significant. Providing schools with computers and putting them in the resource centre or classrooms/computer laboratories does not bring about technology integration. Teachers are key to the integration of computers, and preparing them for this role is essential.

Moreover, this study is unique because it emphases the teachers' role in the integration of technology in the classroom. A study by Dockstadder (1999:73-74) pointed out that the role of the teacher in the infusion of technology is very important. He feels that teachers need to be well equipped with the skills of integrating computers into the curriculum. Dockstader believed that the teacher must be able to understand what technology integration is all about, why technology needs to be integrated and how to integrate it. The scholar further explained that "technology integration is using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways." Dockstadder adds that computer integration is not substituting 30 minutes of reading for 30 minutes of computer skill development. It means for example, using computers to teach 30 minutes of reading or writing. It also means incorporating technology in a manner that enhances students' learning, and arranging the goals of curriculum and

technology into a co-ordinated harmonious whole. This scholar identified several reasons why teachers should integrate computers into teaching and learning. He claimed that students had an intrinsic need to learn about technology, that the use of computer technology could increase their motivation and academic engagement time, and they (computers) provided a useful way of giving students access to information. He advocated that students should develop their computer literacy by applying various computer skills as an integral part of the learning process.

In order for the teacher to be able to integrate technology into the curriculum, the skills must directly relate to the content area and to the classroom assignment and the skills need to be tied together in a logical and systematic model of teaching. In this usage, the teacher should choose a core area in a subject like mathematics or language then decide what computer skills could best be taught in this area, then choose a lesson that could be taught through computers. This requires the teacher to master the skills of lesson planning, presentation, and how to evaluate the lesson. So the integration comes when the students learn through computers and not when they are taught about them.

The greatest advantage of a computer-integrated lesson is that it enables the teacher and the students to be actively involved in learning by doing. Therefore, in view of the complexities involved in the integration and utilisation of computers, this study is very necessary for the understanding of the integration, management and organisation required for the successful implementation and use of computers in secondary schools in Nyanza province. All research seeks to answer questions. The significance of this study is that it will provide evidence on how computers are used in secondary schools, the factors influencing and determining the integration of computers from the teacher's point of views and on the problems faced by teachers and students. With this information, school administrations will be in a better position to improve the services of computer-integrated education in a more useful and worthwhile investment.

1.6 Scope and Limitation of the Study

This study aims to provide a clear picture of Computer Integrated Education (CIE), and to examine the school policy and problems facing the implementation of

technology in secondary schools in Nyanza province. However, there are various limitations that need to be mentioned. Firstly, the study focuses on the use of computers in the classroom by teachers in secondary schools, excluding primary schools and higher education institutions such as universities and teacher training colleges. Secondly the study does not involve the participation of students. Thirdly, it concentrates on case studies in a limited number of schools with computers.

This research does not claim to provide complete solutions to the problems with which teachers are currently confronted when using computers. It presents an attempt to expose, through the use of in-depth interviews, how computers are used in the classroom and the factors influencing the integration and use of computer technology in schools and the problems encountered by the teachers and students. It is hoped that the systematic study of the integration and use of computers in secondary schools in Nyanza province, and reasons for employing this technology, may provide answers to some of the questions currently being raised about the high cost of technology in education.

1.7 Basic Assumptions

This study is designed to investigate certain basic assumptions and to discover, through detailed case study whether they are valid in Nyanza Province secondary schools. These basic assumptions are designed by the researcher and are the foundation upon which this research study is based, and will guide it. The basic assumptions and the reasons for selecting them are:

- All schools with computers use them as tools for learning in the classroom. This assumption is based on the idea that teachers will be able to integrate and use computers for teaching and learning computer literacy, and integrate computers into teaching traditional subjects. It will also provide quantitative evidence of how many schools are using computers in teaching and learning. Therefore, based on this reasoning, teachers' responses are needed to give a complete picture of what is happening with computers in schools.
- Computers are effective in teaching students academic subjects and computer literacy skills. This assumption is based on empirical evidence by previous

researchers in the area of technology and is documented in a review of related literature in Chapter 2.

- Computers are used for cooperative learning in all secondary schools. This assumption is also based on empirical evidence by previous scholars (Denning and Smith (1998) and is documented in a review of the literature in Chapter 2.
- If schools are properly equipped with computer technology, teachers can integrate and use them effectively in classroom instruction. This assumption is based on empirical evidence (Mellon, 1998) and is documented in a review of literature in Chapter 3. It will reveal the number of schools working towards technology integration and using computers in teaching and learning academic subjects contained in the syllabus. Investigation of this assumption will require qualitative and quantitative data.
- The use of computers improves the quality of classroom instruction. This assumption is also based on empirical evidence and is investigated in the review of literature in Chapter 2.
- Teachers and students value computers as tools for teaching and learning. This assumption is based on empirical study indicating that teachers are keen to use computers because they offer an alternative to traditional teaching. These new methods are popular with students and it give students access to experiences that would be difficult for teachers to provide in any other way as reviewed in Chapter 2 (Myre, 1998:3-103).
- There is no difference in attitudes between the experienced and less experienced teachers towards the use of computers in teaching and learning. This supposition is based on the logic that computer attitudes refer to an individual's feeling about the personal and societal use of computers in appropriate ways. Positive attitudes include an anxiety-free willingness or desire to use the computer, confidence in one's ability to use the computer and a sense of computer responsibility (Clark, 2000).
- There is no significant difference in attitudes between the male and female students towards the use of computers. This assumption is based on empirical research findings (Young, 2000:204-211) reviewed in Chapter 3.
- Students learn effectively with computers as they do with other media. This assumption is based on the debate by researchers (Clark, 1994; Ellington,

Percival, and Race, 1993; and Kozma, 1994) discussed in Chapter 3 that it is not possible to find one media which is best for teaching and learning all subjects.

- All secondary schools with computers have specific policy for the integration and the use of computers in teaching and learning. This assumption is based on empirical research findings reviewed in Chapter 3 The role played by the school administration is important in the overall integration and use of computers by the teachers and students.
- Accessibility of computers in the school has direct relationship with classroom utilization. This assumption is based on the research findings by (Carol, 1997, Clark, 2000) and is reviewed in Chapter 3.
- Students are motivated to use computers as tools in learning academic subjects. Motivation is viewed as a critical determinant of students' classroom learning and achievement in part because students who are highly motivated tend to provide greater effort and persist longer at academic tasks than do students who are less motivated (Wolters and Rosenthal, 2000:804). The researcher assumes that computers have the capabilities to motivate students to learn by providing motivational effects as indicated in Chapter 3.
- Using computers enables students to be actively engaged in aspects of their learning. In relation to this study, it is assumed that computers provide students with opportunities to learn by doing individually or in small groups as reviewed in Chapter 2.
- If secondary school teachers are trained in the use of computers they can integrate and use them in teaching and learning in the classroom. This supposition is based on the research findings reviewed in Chapter 3 Sections 3.3.1.1 (Parr, 1999:280; Scheffler and Logan, 1998:308).

1.8 Research Questions

Research on computers as tools for teaching and learning supports its integration into the curriculum (Cornu, 1996). These studies have examined the contribution of computer-integrated education in teaching and learning computer literacy skills and various school subjects (Dockstadder, 1999). Some of the research findings have indicated lack of equipment, accessibility, lack of teacher training and lack of funds as

some of the obstacles to the effective integration and use of computers in teaching and learning. The main questions derived from these studies to be answered during this research are as follows:

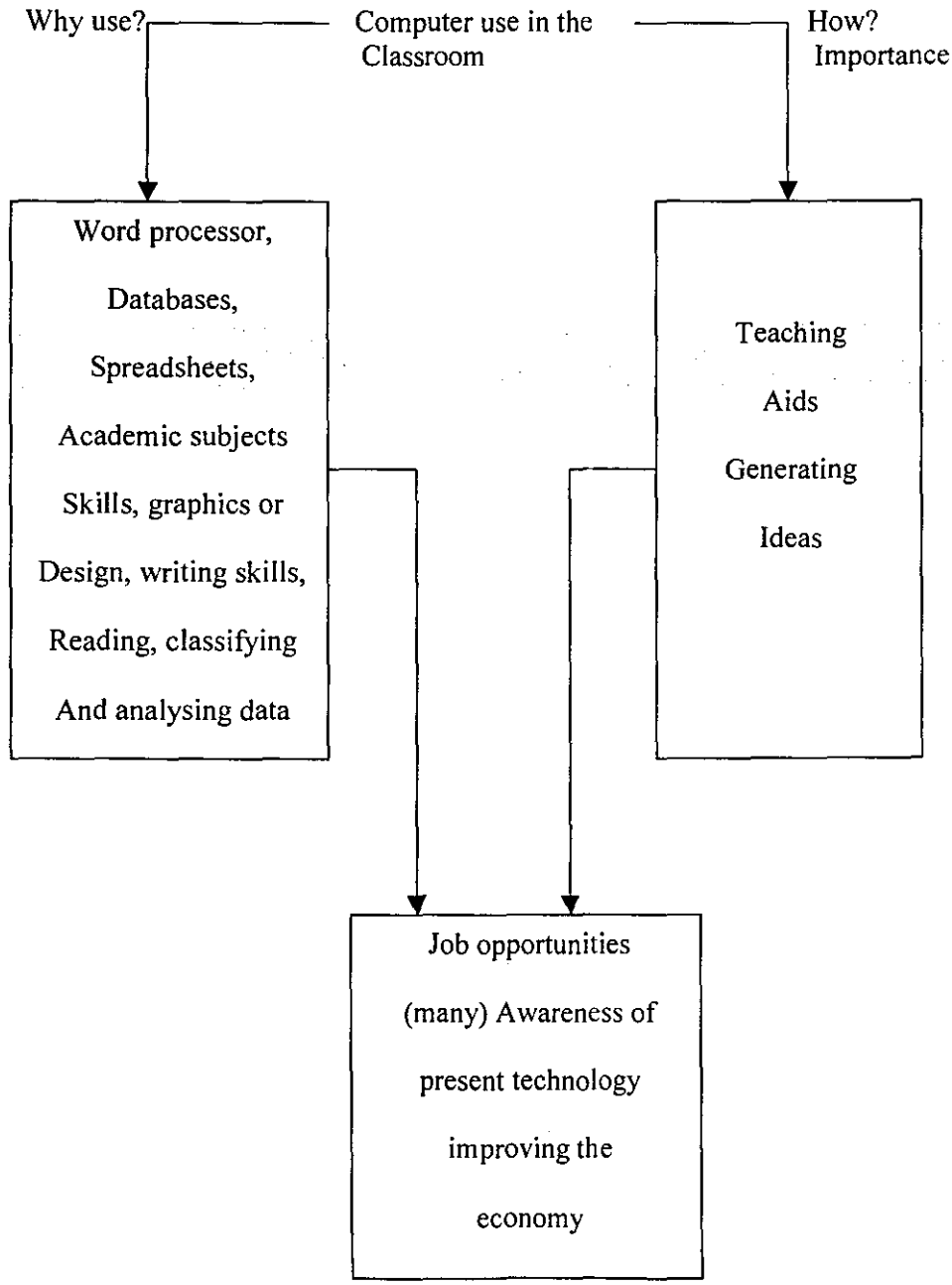
- Are computers and software available in the schools?
- How are computers being used in teaching and learning in public secondary schools in Nyanza province?
- What are the factors influencing the use of computers in teaching and learning?
- What are the needs and expectations of teachers with regards to the use of computers in teaching and learning?
- Is there a difference in teachers' attitudes, views and beliefs about the role of computer in the curriculum instruction?
- Is there a policy on the integration and use of computers in teaching and learning?
- What are the views of teachers on the motivational effects of computers on students learning?

1.9 Conceptual Framework

The conceptual framework for this study is based on a socio-learning approach because a school is a social organisation. Crook (1994:52) believes that it helps to clarify psychological issues arising within educational practice. Crook (1994) suggests that this framework could have a particular value for addressing issues relating to the educational use of new technology. The study assumes that computer use in classroom instruction has the values of increasing students' knowledge of computers as productive tools and by providing early experience with computers in the classroom either within existing school subjects or in special courses. Crook (1994:7) argues that there is a great deal of controversy over how computers could be best deployed in teaching and learning in the classroom. He felt that this could involve instruction in the use of word processors, spreadsheets, databases, and applications for graphics or design and for improving skills. This provides the reasons why there is need to encourage the use of computers within education. The tools computers create are in widespread use in everyday life so students must be helped to control and understand them within the preparatory setting of the school. Crook (1994) points out that computers are very important aid for generation of ideas. They

allow students to engage in various useful manipulative activities, for example to generate visual patterns, they can also help to develop children's' writing skills. This is reflected in new ways of presenting, composing and communicating ideas in writing. Thus, a student's spelling can be checked, the learner can also manage the overall text in a more flexible manner. It can also extend their experience of drawing, writing skills, reading skills, classifying and calculating, and experimental science. Computers can also create a greater continuity between school and work because the powerful tools that are learnt in various computer colleges are now accessible in classrooms thus equipping students with skills for jobs.

FIGURE 1.1: CONCEPTUAL FRAMEWORK



1.10 Research Strategy and Methods

1.10.1 Introduction

The research design, procedure and tools to be used for data collection and analysis are described in this section. The research methodology was designed to obtain information, opinions, and suggestions on computers as a tool for instruction in education. It includes a brief explanation of the literature review and how the field research was conducted. The collection of data was carried out using structured interviews with Officers from the Ministry of Education and Curriculum specialists at Kenya Institute of Education, questionnaires for Principals and Heads of Department and semi-structured interviews for teachers to provide empirical evidence on the use of computers in teaching and learning. Brief explanation on the administration of the instruments, the rational for selection of data and their merits are also included.

1.10.2 Review of Literature

A large section of this thesis is based on a review of related literature, both published and unpublished. References were obtained by searching relevant indexing and abstracting services such as ERIC, Internet, and from printed library materials. Many periodicals and journals were also scanned for the purpose of this thesis. The study involved personal correspondence through electronic and print media with several researchers.

1.10.3 Field Research Procedures

The field research was conducted in three phases. The first phase was a visit to the Ministry of Education and Kenya Institute of Education and to interview key officers in charge of computer education. The second was a visit to the Provincial Director of Education in Nyanza Province. The purpose was to obtain a list of schools with computers, to seek permission to visit secondary schools to distribute questionnaires to the Principals, Heads of Department, and to arrange for interviews with computer teachers. The third phase was to conduct interviews with computer teachers using

semi-structured interviews and audio tape recording, and to collect the questionnaires from the Principals and Heads of Department.

1.10.4 Data Collection Instruments

The researcher used three methods to collect data from the Officers from the Ministry of Education, Curriculum specialists at KIE, Principals, Heads of Department, and. This included structured interviews, semi-structured interviews and questionnaires.

1.10.4.1 Structured interview method

The structured interviews were conducted to collect information from the Ministry of Education Officers and Curriculum specialists from the Kenya Institute of Education. The structured interview method was conducted because it has some distinctive advantages. For example, it is possible to achieve a complete response with different categories of a sample and ensure the validity of the results. It is also possible to collect more complex information where necessary, qualifying answers and generally obtaining results in greater 'depth.' Interview methods produce better control of the survey (Borg and Gall, 1989:451). Moreover because it involves the collection of data through direct verbal interaction between individuals, it is adaptable and the responses of the interviewee can be used to alter the interview situation. The researcher can build trust and rapport with respondents and this can increase the reliability of the information that is gathered. Interviews are used in qualitative research because they permits open-ended exploration of topics and elicits responses from the words of the respondents. But the method also has some limitations. For example, the interview cannot provide anonymity for the respondents.

Nevertheless, the researcher developed a blue print to guide the qualitative study. This was a general interview guide outlining the issues that were to be explored and some general questions that were to be asked during the interview. Mayan (1996:8) stated that an interview guide ensures that all relevant topics are covered, while enabling a researcher to build a conversation by adapting the interview to each situation and the participants. Mayan (1996) explained also that having a guide keeps the interaction focused and allows the best use of the limited interview time available while

permitting individual perspective and meaning to surface. This information encouraged the researcher to use interview method.

1.10.4.2 Semi-structured interview method

The second phase of fieldwork was an investigation using semi-structured interviews to collect data from classroom teachers using computers. I used semi-structured interviews because they allow the use of a detailed topic guide and a number of pre-determined questions on special topics: while at the same time the participants are allowed to digress and the interviewer may employ unscheduled probes (Bell, 1993:33). There were some questionnaires constructed before hand, and a list of topics was also developed to act as a framework for the interview. This method allowed me to tackle each topic in a flexible manner and the interviewees were free to elaborate on their responses. They also gave their views at their own pace. The method further enabled the researcher to use careful "probes" to encourage and motivate the interviewees to feel relaxed while trying to reduce bias. In addition, the semi-structured interview method was used because it can generate insight to be investigated further. Bell (1993:8) argued that semi-structured interview method is especially suitable when one aspect of a problem needs to be studied in some depth within a limited time–scale. The semi-structured interview method is also appropriate because it allowed the researcher to use a divers range of techniques to collect data and analyse them both quantitatively and qualitatively. Techniques such as in-depth interviews, participants' observation and audio tape recording are very useful in collecting information during the semi-structured interviews.

1.10.4.3 The Questionnaire Survey method

The second phase of field research was a questionnaire survey developed to collect information and to elicit qualitative and quantitative data from Principals and Heads of Department in public secondary schools. Although the questionnaires completed by Heads of Department differed to a certain extent from that of Principals, they contained many common questions on the use and integration of computers into teaching and learning. The draft questionnaires were piloted with four Principals and four Heads of Department. There were no major errors to be corrected so the

information contained in piloting questionnaires formed part of the actual data collected from the participants. I used questionnaire surveys because they have the following advantages:

- The method can be used to gather information from a large or small number of people;
- it is cheaper to administer questionnaires;
- it reduces biasing errors that might result from the personal characteristics of an interviewer and the variability in their skills;
- and the absence of an interviewer provides greater anonymity;
- the method also permits wider geographical contact and the time required to collect the data is much less (Cohen and Manion and Morrison, 2000; Nachmias and Nachmias, 1992; Wallen and Fraenkel, 2001).

However, questionnaires cannot probe deeply into the participant's opinions and feelings. Again, once the questionnaires are distributed, it is not possible to modify the items, even though they may be unclear to the participants. Murioki (1995:321) also reports that "respondents can easily lie about essential details, particularly those pertaining to personal matters." Equally, responses can be quite unpredictable and hence frustrating to a researcher because "they may also provide insufficient information. In many cases, respondents have to be followed up, that can be an arduous and time-consuming exercise. But a response rate of between 25 and 50% is generally considered to be reasonably adequate." The format of the questionnaire I developed and distributed to participants formed part of the appendices. The questionnaires were hand delivered by the researcher.

1.10.5 Sources of Data

The investigation focused on Officers from the Ministry of Education and Kenya Institute of Education, Principals of secondary schools, Heads of Department and teachers. The schools included rural, urban and suburban settings. The criteria for the choice of institutions was based on:

- Schools with computers;
- Urban, suburban and rural areas;
- Accessibility and;
- Principals, HODS and teachers' willingness to participate in the investigations.

Four categories of secondary schools were selected for this study in order to enable the researcher to conduct comparative analysis on the pattern of the use and integration of computers, and to collect quantitative and qualitative data. The institutions included:

- Public secondary schools;
- Girls secondary schools;
- Boys secondary schools and;
- Mixed secondary schools

At present there are two main types of secondary schools in Kenya. These are public and private schools. Public schools are those built and run by parents through the Parent Teachers Association (PTA) and Board of Governors (BOG), and the community on a collective effort through fund raising. The bulk of the development including physical facilities and equipment is the responsibility of the parents and the community. Public secondary schools are further grouped into National, Provincial and District. The National schools admit students from all over Kenya. The Provincial schools draw three quarter of students from their own provinces, and fifteen percent from different provinces. The district schools cater for students within each district area. The public schools are further classified as Girls boarding, Boys boarding, Boys day, and Mixed secondary schools. Mixed secondary schools cater for boys and girls. The schools are within walking distance of the students' own homes and are mostly day schools. The schools that participated in the investigation were drawn from the list obtained from the Director of Education in Nyanza Province. The details of the fieldwork and selection of case study institutions are explained in Chapter 4.

1.10.6 The Sample of the schools that participated in the investigation

The field research institutions included twelve girls, seventeen boys and one mixed secondary schools that had computers according to the list the researcher obtained from the Provincial Director of Education in Nyanza Province (Chapter 4 for details). These figures match Bell's (1993) suggestion that thirty is a reasonable number for a research investigation in education. The participants consisted of thirty Principals and 90 Heads of Department. However, after visiting the schools to distribute questionnaires, the researchers identified only 25 schools with computers, 20 schools in which computer education was taught, and each school had only one computer teacher who took part in the investigation. There were also five schools that had computers and used them for administrative work only. Therefore, only 25 Principals and 89 Heads of Department completed and returned the questionnaires to the researcher. Table 1.1 summarises the sample institutions, location and the actual number of teachers who took part in the research.

Table 1.1: Secondary schools in which the study was conducted and respondents

Location	Schools	Principals	Heads of Department	Teachers
Urban	7	7	28	3
Suburban	3	3	12	3
Rural	15	15	49	14
Total	25	25	89	20

It should be noted that the number of Officers from the Ministry of Education and Curriculum specialists is not included because they were not part of the field investigation.

1.10.7 The Pilot Study

After designing the research tools for Principals and Heads of Department a pilot was carried out in two schools, one Boys' and a Girls school. Two Principals and eight Heads of Department took part in the exercise each representing department of

Humanities, Languages, Maths and Sciences. The aim was to evaluate the research instruments and improve them. The pilot study helped me to develop the experience to administer the research tools and the necessary procedures before conducting the actual research. The piloting data collected from Principals and Heads of Department were analysed. The responses were classified into categories according to a cording scheme and amendments made as required. Since there was no any major alteration the piloting questionnaires were included in the main research data.

1.10.8 Administration of research questionnaires

Once the research tools were ready, arrangements were made with various groups of people before investigation into the research problems was undertaken. This was important because of four reasons. Firstly, the objective of the study was to be explained to the interviewees. Secondly, I had to seek permission to visit schools to conduct the interviews and to administer questionnaires. Seeking permission before investigation into the research problem is undertaken was very essential. It was very necessary for the researcher to obtain the consent and cooperation of the participants who were to provide the information. This was an important stage in this research project due to the nature of the data required. Bell (1993:52) emphasized the importance of consent to conduct a study and stated that no researcher can demand access to an institution, an organisation or to materials. Permission to carry out the research was absolutely essential for me. It enabled me to explain to the people concerned a clear picture of what the research entailed, stating clearly the purpose of the visit, the objective and nature of the research, its practical application, the design, and methods and procedures to be used in data collection. This included explaining also the type of participants to be interviewed, time for the interview and any other data to be collected. Third, I had to apply for access to copies of relevant official publications or documents on computers in education. Fourth, I had to assure the interviewees of the confidentiality and anonymity in their contributions (Bell, 1993, Cohen and Manion, 1994).

I also wrote four different letters to the interviewees and people concerned with this study (see appendices 3-6). One letter format was addressed to the Ministry of Education and the second was addressed to the Director of Kenya Institute of

Education regarding the intended interviews on the use computers in secondary schools. The third letter was addressed to the Provincial Director of Education (PDE) Nyanza seeking permission to visit schools for the purpose of research. The fourth letter was addressed to the Principals of secondary schools. This was an informal letter concerning the visit and subsequent arrangements and distribution of questionnaires to Principals and Heads of Departments, and asking Principals to inform computer teachers about the intended interviews with them.

1.10.9 Data Collection Procedures

I started my fieldwork by visiting the Ministry of Education office and Kenya Institute of Education in Nairobi to make appointments and to deliver the letters for permission to conduct the interviews and visit the schools. Secondly the researcher visited the Provincial Director of Education in Nyanza Province to seek permission to visit schools with computers. After receiving the letter from the Provincial Director of Education (see appendix 7) the researcher visited the schools to distribute questionnaires to Heads of Department and the Principles, then made arrangements to conduct semi-structured interviews with 20 classroom teachers who were teaching computer education at the time of this research. I used audio tape recorder to collect teachers' responses. The specific answers from the interviews and questionnaires were collected and included in the analysis and discussion of the results in Chapter 6 and 7.

1.10.10 Data Analysis

Mayan (1996:9) reports that data analysis is the most time-consuming part of the research. At this stage, the researcher "probes emerging patterns comparing and contrasting data, trying to fit pieces and bits of data into different categories." This requires thorough preparation and organisation. Thus, all of the information gathered from secondary and primary sources was analysed in the following order:

The structured interview method Analysis:

Data collected from the Ministry of Education and Kenya Institute of Education was analysed through the use of simple tabulation and description of the findings that formed Chapter 5.

Questionnaire method Analysis:

For the open-ended and closed questions contained in questionnaires for the Principals and Heads of Department, analysis was done by the statistics unit of the University of Pretoria using "Statistical package: SAS version 8" that involved grouping of data into categories of different research questionnaire topics. The interpretations, description and the data analysis was carried out by the researcher using description, graphical expression and tabulation. The data analysis combined qualitative and quantitative methods, and is presented in Chapter 6.

Semi-structured interview method Analysis:

The data collected from the computer teachers using semi-structured interviews and audio tape recording was also classified into categories according to a coding scheme. The data analysis combined qualitative and quantitative methods. Qualitative analysis was used for the interpretation of documents, discussions and interviews. The quantitative data analysis was based on simple tabulation of responses to various points. A detailed analysis of all the data collected from semi-structured interviews with computer teachers are presented in Chapter 7.

1.11 Definition of Terms

In this section, definitions are given only to key terms related to CIE. Other concepts will be described in substance where they appear in the text.

Closed-ended question: Is a structured survey questionnaire where the alternative answers are listed and the participants have to select only one from among them.

Co-operative Learning: refers to learning environments that are believed to promote active learning as students talk and work together toward some goal rather than

listening passively to a lecture. It is also believed to foster respect for diversity, to enhance achievement, and to advance language skills (Denning and Smith, 1997:178). Cooperative learning is not just putting learners to work in groups to solve some common problem. Rather, for an educational environment to be called cooperative it must have the following elements:

- Positive interdependence between students seeking mutual goals collectively,
- Face-to-face interaction between students,
- Each students accountability for mastering the material to be covered; and
- Appropriate use of interpersonal and social skills by students (Denning and Smith, 1998:178).

Cooperative learning in Computer Integrated Education involves students working in groups at the computer to perform a task. Sometimes the learning activities are designed around existing software such as spreadsheets, word processors, and hypermedia/multimedia programs.

Computer Integrated Education: refers to the incorporation of computers into the whole school organisation. This means the total integration into subjects; integration in teaching; integration in learning; integration into the profession of the teacher; hardware and software integration, and integrated environment. It also means using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways (Doctsadder, 1999:73).

Facilitation of Learning: In teaching and learning the teacher acts as a facilitator of learning by creating a supportive classroom environment in which students interact and learn with computers effectively. This requires the teacher to:

- Provide learning task and presentation;
- React to students' responses and provide feedback; and
- Help the students to accomplish learning tasks by serving as a tutor until learning outcomes are realised by the learners (Alberts, 2000: 39), and
- Help students to set goals for learning with computer technology

Induction Course: This is school based orientation program for any new teacher posted to a school. Especially newly appointed teachers need to be introduced formally to the use of technology programs in their present schools to be familiar with the school regulations and general organisation patterns and policies. This includes classroom management and techniques of curriculum implementation.

In-service Course: An on-going teacher education program of activities designed to develop the knowledge, skills and experiences necessary for practising teachers to carry out their work more effectively in the integration and use of computers in teaching and learning.

Instrument: In research, an instrument is a device or procedure for systematically collecting information. Common type of instruments includes tests, questionnaires, rating, scales, checklists, and observation forms. It also refers to the conditions under which it is used, when it is to be used, and by whom it is to be used (Wallen and Fraenkel (2001:81).

Mediation of Learning: In teaching and learning the teacher as the presenter of the lessons derived from the national curriculum mediates between the aims of education and student's learning needs. This includes integration and use of computers as a vehicle through which a message could be passed to students. The medium mediates between the teacher and the learner (Ellington, Percival and Race, 1993, Stuart and Tatto, 2000).

Pre-service Course: This refers to training student teachers at the University or Diploma colleges on the use and integration of computers into teaching and learning.

Secondary Education: In Kenya secondary education is a four-year course. Students join secondary education after completing eight years of primary education and obtaining the minimum entry pass marks at a national examination held at the end of every year. At present secondary schools in Kenya are of two categories. These are public and private schools. The secondary school curriculum includes Mathematics, Sciences (Biology, Chemistry, Physics), Agriculture, Languages (Kiswahili, English, German, French and Literature), Agriculture, History/ Government, Home Economics, Business Education/Economics, Religious Education, Social Ethics, Physical Education and Technical subjects.

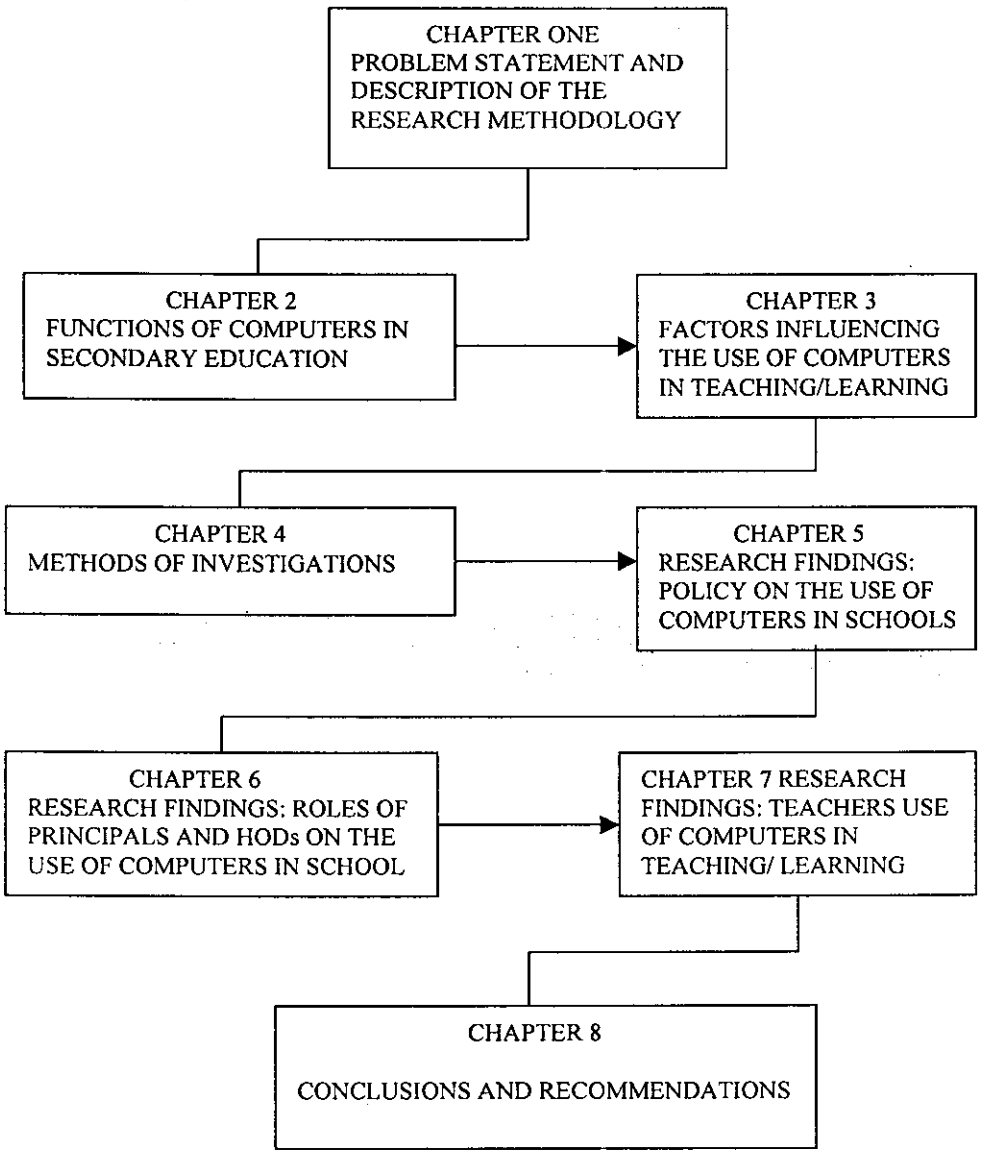
Open-ended question: Is a survey question that does not include a list of alternative answers to select and the participants have to answer in their own words.

The sample: A sample as it is used in the research literature means any group on which information is obtained regarding the research problem being investigated. Often it is selected from a large group. The large group is called population.

1.12 Plan of the research project on the use of computers in secondary schools

The research programme on the use of computers in secondary schools in Nyanza Province for this study has been discussed as displayed in the following Figure 1.2.

Figure 1.2: Research project plan for this study



1.13 Organisation of the Thesis

The main text of the thesis consists of eight chapters as shown in figure 1.2 above, each addressing a different aspect of Computer Integrated Education (CIE). Chapter 1

opens with a discussion of a broad introduction of the research study that outlines the subject, purpose and objectives of the study, the research problem and sets the scene for what is to follow by explaining and describing the general issues in this research. Chapter 2 describes the roles and function of the computers in the learning environment and provides an overview of the way in which the computer has been used as a tool in teaching and learning process in secondary education. Chapter 3 is concerned with practical problems that arise when computer-based innovations are introduced and integrated into the curriculum for instruction, discussing the major factors that facilitate and affects the use of computers in teaching and learning in the classroom. The concept of motivation, accessibility and availability, attitudes, teacher preparation, cost-effectiveness, and administrative support are reviewed. Chapter 4 shifts attention and presents a model to be used to assess Computer Integrated Education (CIE) in secondary schools in Nyanza Province. This is includes a discussion of the research methods and strategies to be used in the field research to collect data from the Officers from the Ministry of Education, Kenya Institute of Education and in secondary schools in Nyanza Province. Chapter 5 contains the research findings on the government policies regarding the use of computers in public secondary schools. Chapter 6 presents data analysis and a discussion of the findings from Heads of Department (HOD), and Principals' responses to questionnaire survey on the use of computers. Chapter 7 describes the research findings of a case study with computer teachers. The final chapter of the thesis, Chapter 8, is devoted to a summary and discussion of the main research findings and recommendations for action and further research.

1.14 Summary

This chapter has described an outline of the research project on computer-integrated education to be undertaken in Nyanza Province of Kenya. It has explained what is involved in the study and all the requirements for the field research. This has included a brief discussion of the background to the study problem, the problem identified, the main objectives of the study, the research questions and basic assumptions guiding this research. The main part of the chapter has explained the significant of the study, methods of data collection, and provided definition of various terminologies related to computer-integrated education.

The chapter has also discussed briefly the characteristics of the computer that distinguishes it from other media employed in teaching and learning, These qualities includes amongst others the capabilities of the computers in mathematical calculation and scientific experiments. It has further explained the main objectives for the introduction of computers in secondary education in both developed and developing countries as that of teaching computer literacy skills and in teaching and learning those traditional subjects such as mathematics, sciences, languages, social studies and graphics.

The value of computers as an integral part of students' learning to help promote standard of education and quality of learning has been noted (Woodrow, 1998:4-6, Pedretti et al. 1999: 131-143). The challenge is on knowledge and level of computer integration for effective utilisation by the teachers. This can only be achieved if the computer is totally integrated into the curriculum content areas and not as a substitute for example "30 minutes of reading for 30 minutes of computer skill development" (Dockstadder, 1999:73). The chapter explained also that integrating computers implies using them to teach for example "30 minutes of reading or writing." Moreover, the potential of computers in teaching disadvantaged students has also been identified.

The crucial role of the teacher in the integration and use of computer technology has also been explained (Dockstadder, 1999:73-74). Teachers must be trained and supported in order to incorporate fully the use of computers in classroom instruction (Whitefield and Templeton, 2000:70-80). This includes in addition, the support from the administration and the school community. Chapter 2 examines further the evidence from relevant literature both secondary and primary on the functions and utilisation of computer as a tool in the school classroom.

CHAPTER 2

ROLES AND FUNCTIONS OF COMPUTERS IN THE LEARNING ENVIRONMENT

2.1 Introduction.

This chapter is devoted to a review of relevant literature on the roles and functions of computers in the learning environment in developed and developing countries. In this chapter, I investigated through literature search the use and integration of computers in teaching and learning. It constituted an appropriate and reasonable framework for the discussion of relevant issues. This exercise also revealed what is currently being done and what has not yet been accomplished in this field. The purpose of the literature review was to identify the main lessons from previous research that are relevant to Kenya, and to use this for more detailed exploration of specific topics in my case studies in Nyanza Province. It also provided an insight into the methods, measures, subjects and approaches used by other researchers that I could use to design and formulate my field research tools. The review of literature also provided information on the potential benefits and limitations of computers and their effectiveness in teaching and learning. The literature review covers six major areas adopting the classification of Heinich, Molenda, Russell and Smaldino (2002:214), and Anderson (1991). They listed the main roles and uses of computer application in the classroom in America and developing countries. This included: the computer as an object of instruction; as a tool; as instructional device; as a catalyst; and as a means of teaching logical thinking (Heinich, et al. 2002). In addition, Anderson (1991:40) identified three major modes of how computers could be used in education in developing countries similar to those of Heinich, et al. (2002) and included also the use of the computers as a tutor and tutee. For example, the students for whom the computer is a tutor are able to work through tutorial type programmes at their own time or pace. The computer as a tutee facilitates communication between students and a teacher in distance learning program via the Internet or e-mail (Heinich et al. 2002).

The objectives of this review of literature were concerned mainly with describing various ways in which computers have been used in secondary education. This

included reviewing previous research findings and related literature on the functions of computers in secondary education, the use of computers in teaching and learning computer literacy skills. It also examined literature on the use of computers in teaching and learning traditional secondary school subjects such as mathematics, sciences, social studies, languages and graphics. In addition, the chapter discusses the teaching strategies, the role of the teacher in classroom instruction, relevance of CIE in schools, impact of computers on students and teachers are examined. Further discussion looked into the roles of computers in teaching and learning; benefits and limitations of computers; and relevance of CIE in teaching and learning. The review of literature also examines government policies that guide the integration and use of computers in schools.

2.2. Government policies on the use of computers in schools

The introduction of computers in the school environment in many countries came about as a result of government policy pronouncement (Clark, 2000; Crawford, 2000; Kirkman 2000; Mizukoshi, Kim and Lee 2001 and Pearson, 2001). Most of the policy statements were written documents and others were not documented for circulation to schools but were contained in the existing educational policies. Since then computer technology has flourished in almost all sectors of education. However, in teaching and learning, the computer is used to enhance educational potential, and is now widely used as a teaching and learning tool. However, the integration of computers into teaching and learning is a critical issue that requires adequate support from the government. In order to successfully integrate computers into teaching and learning, there is need for a clear government policy to guide schools in their implementation programs. Pearson (2001:279-290) reports on various government policies on the use of computers and noted that the American government formulated computer policy in 1996 titled "Getting America's students ready for the 21st century." The policy document included the provision of technology and during the last decade, the number of microcomputers in schools was in the ratio of 1 computer to each 10 students. Other reports indicated that most states in USA required teachers to be computer literate. For example, "Title 5 Regulation, in Section 441617 of the California Education Code (California State Legislature1997), requires teachers to take an educational computing course." (Zhao and Cziko, 2001:6).

Similarly in Australia Pearson (2001) reports on the government policy document on the use of computers that was entitled "Learning Technologies in Victorian schools." The government was committed to improving teaching and learning through the use of appropriate computer technology and computers are available in schools to the students' ratio of 1 computer to each 12 students. Russell et al. (2000:158) adds that the policy recognized the importance of teacher education in computer technology. For example, one of the State Education Departments (Education Queensland) developed the "Minimum Standards Project (Education Queensland, 1999) for teachers in using IT." The standard requirement included four key areas: "information technology, curriculum planning including classroom planning and management, school planning and student-centred learning." The other requirement was that "all teachers were to have a minimum level of skills in the use of computers for learning." In addition, the Australian Council for Computer Education (ACCE) 2000 developed a rationale for the specification of teacher learning technology competencies (TLTC) by teachers. The policy of ACCE suggested that teacher "professional development program should aim at improving teaching practice first and foremost with a goal of improving learning outcome for students" (Russell et al. 2000:158).

Furthermore, Pearson (2000) reports on the British government policy document titled "Connecting the Learning Society: National Grid for Learning" in 1997. In this connection, Opie and Katsu (2000:80) state that since 1980s the British government policy on the use of computers in schools was to ensure that schools were provided with computers and in each school where computers were placed teachers were trained in their use. About 230 million pounds was set aside for ICT training of teachers, and resources were also provided to ensure its successful implementation in UK schools. Opie and Katsu (2000) reported that the Statutory Curricular requirement of the National Curriculum for England and Wales consistently emphasised the incorporation of computers. Even the revised National Curricular that was to be implemented in 2000 stated that "Pupils should be given opportunities to apply and develop their ICT capability through their use of ICT tools to supplement their learning in all subjects." Similarly Crawford (2000:183) reports on a National Curriculum for England introduced in secondary schools in August that contained an order for Computer technology (ICT) that emphasised the teaching of IT as a descret subject. Crawford (2000) observed that the earlier reports in the English National

Curriculum Order for other subjects supported advisory documents. This included policy guidelines such as the School Curriculum and Assessment Authority (SCAA) 1995, National Council for Educational Technology NCET 1995a, NCET 1995b: Department of Education and Employment 1998 continue to stress the value of IT throughout the school curriculum. All these policy guidelines documents on the use of computers in schools demonstrate the commitment of the UK government to IT in schools

Moreover, Pearson (2001:280) describes a five-year Hong Kong government policy document entitled "Information Technology for Learning in a new Era. Five Year Strategy 1998/1999 to 2002/03." Pearson (2001) noted that the policy was formulated because the government was concerned with the adoption and use of computers in schools to widen opportunities for learning, to improve the motivation of learners, and to increase level of students' achievement. Pearson (2001) observed that the five-year policy strategy consisted of various initiatives to promote the use of computers. Pearson (2001) noted that through the government specific policy plan, each secondary school was to get 82 computers, and all schools were to have access to the Internet. Moreover, the policy included teacher-training programs. Schools were to be provided with funds for training teachers in computers so that by 2001 all teachers would have basic skills in computers literacy, and by 2002/3 (75%) of teachers were expected to be competent in the use of computers. The policy also included appointment of computer co-ordinators and some teachers were to be trained in creative work with computers.

In addition, Pearson (2001) reported that the other component of the policy was the provision of resources to teachers. Schools were allowed to obtain extra funds from the government for teacher education programs, and schools were to be assisted by the designated officers from computer resource centres. According to Pearson (2001) most of the policy requirements had been implemented by mid 2001.

Furthermore, to highlight the importance of policy on computers in education Rovisk and Kommune (1995: 856) report that in (1984) the Parliament of Norway approved a white paper no 39 (193/8) which introduced computer technology into schools. Rovisk and Kommune (1995) noted that a ministerial task force was established to

organise and co-ordinate the computer programs. According to their report, the purpose of the task force was to make plans for the introduction of compulsory computer education in schools. According to the scholars, the policy referred to the teacher training, vocational computer training, provision of computers, and by 1987 the government adopted compulsory computer education.

Moreover, from developing countries, Waslowick (2002) reports on Brazilian government Information Communication Technology (ICT) policies and implementation published in 1981. The Ministry of Education and the Secretary of Informatics created the first national ICT project in 1983 to introduce computers in schools. The project was implemented in several centres in different states in order to develop qualified people to deal with computers in education. From 1988 to 1989, the government created more centres for computers in education to produce more trained computer literate people and to create and distribute computers to schools. The Ministry of Education made further development and in 1997, created a new National Programme on computers in education with an aim to distribute computers to schools and to train teachers in computer education. The main objectives of the project as reported by Wazlowick (2002:69) was:

- commit the schools to use computers;
- to install appropriate computers and network facilities;
- to train teachers in computers;
- to produce high quality educational software for use in schools;
- interconnect schools; and
- to provide financial support for ICT project.

According to Wazlowick (2002:69), the project was to be implemented in two phases. The first stage aimed to introduce students and teachers to computers, and in the second stage the computer was to be incorporated in the teaching and learning process and school administration was to be improved with the use of computers.

However, Wazlowick (2002) noted that the government had difficulties in deciding on which schools (among the 7500schools) to receive computers. Consequently, schools

were chosen according to the size of the student population, suitable infrastructures, security, phone lines, and building. As a result, the scholar noted that the Brazilian policy on ICT was to use computers in selected schools only.

UNESCO (2002:30-31) reports of a Malaysian government policy document known as "Education for Smart Schools" that was formulated to develop ICT and was to be implemented in stages. According to UNESCO, the Smart Schools had five main goals that aimed at:

- The development of individual child covering the intellectual, physical, emotional and spiritual domain.
- To provide opportunities for the individual to develop their special strength or abilities;
- To produce a thinking workforce that is technologically literate;
- To democratise education to provide equal access to students to learn with computers; and
- To involve parents of the children, private sectors and the community in ICT education process.

UNESCO noted that the government had a plan to convert all schools to "Smart schools" by the year 2010, and the first phase of implementation began in 1999 as a pilot project in 90 schools. UNSECO observed that the pilot project consisted of preparing computer materials for teaching and learning of four subjects (i.e Bahasa Malaysia, English language, Science and Mathematics). The other component of the project included assessment to give more accurate and comprehensive feedback of students' progress in computer education, and in management system in which computers were to be used to improve school administration required to support the teaching and learning. Furthermore, UNESCO noted that the implementation plan comprised of integrated education with emphasis on thinking, language and values across the curriculum, students to learn at their own pace, teacher to be facilitators of learning rather than pouring all the knowledge and learning being self-directed.

In conclusion, it is important to note that all the government policies discussed above contained common features. All the policies addressed the issue of teacher training in computing skills, provision of adequate computers, teaching and learning resources and financial commitment to the implementation of computer technology in schools. Such computer education policy commitment would be useful for the introduction and use of computers in Kenyan schools. However, this study will explore these policy statements from developed countries to determine if it would be useful for the Ministry of Education in Kenya to publish such written computer policy documents for secondary schools.

The contributions of these scholars indicate that a policy on computers in education is a national responsibility. In this connection, Rudd (2001:212) states that given the current importance of computer education, and the amount of funding involved for computer programs in schools, policy makers in developed and developing countries expect returns from these initiatives in the form of improved standards' of students performance, hence the need for research into the whole school integration and use of computers.

2.3 Functions of Computers in Secondary Education

Computers can play several important functions in the teaching and learning process. Bitter (1989:25) reports that computers are used in education for three major purposes. First they are used to teach students curriculum subjects and computer application tools such as word processor and spreadsheet. Second, computers are used to keep records and to help teachers plan educational programmes. Third, they are used to perform administrative functions such as keeping school records, school budgeting, doing the payroll, scheduling programmes of activities, and keeping students records such as examination results and assessment data as reported by (Becker, 1999; Bitter, 1989; Millar, 1997). The other functions noted by Heinich et al. (1996: 230-232) include that of playing the role of 'an object of instruction'. This applies to the use of computers in teaching computer literacy skills to students in which the students learn about computers, and how to use them for processing and analysing data. This includes teaching students computer programming and other software. The next function according to Heinich et al. (1996:231) is that of the

'computer as a tool.' In its function as a tool, the computer servers as a sophisticated calculator, typewriter, multimedia composer, presentation aid, communication device and data retrieval source. This function can provide students with the opportunities to use word processing for writing and communicating with their colleagues from other parts of the world though e-mail.

Computers can also serve as a tool for classroom instruction as noted by Bitter (1989:232). In this role, students can use computers to solve complex mathematical calculations and to learn how to manage information and create their own databases. It can also help students to learn specific skills in subjects such as mathematics, science, language, social studies and help to increase students' achievement in examinations. Moreover, the computer plays the function of a catalyst for school restructuring. It provides a source of ideas for teachers and can catalyse their development of more varied, more motivating and more contemporary practice. Computers have helped to facilitate the rapid dissemination of new ideas to bring change in the way schooling is organised. This includes introducing alternative approaches to education that revolve around the technology rich environment. Such new changes include students learning in groups, co-operative learning, problem solving, simulated problems and using computer-based tools to collect information. Watson and Tinsley (1996:198) add that computers can also act as a catalyst to equalize experiences between the rich and the poor, urban and rural, and minority and non-minority students. In addition, the computer plays the function of amplification of thinking. That is, teaching logical thinking. The students use, for example, Logo programming that provides them with experiences that enhance their thinking skills.

2.4 The potential of computers as tools of instruction

Computers have several capabilities as tools for classroom instruction. Their main capabilities includes some of the following:

- Computers can store large amounts of information, such as data;
- Computers can also analyse the same data very fast;

- The computer can search information very quickly and provide the results of searches immediately;
- Computers can be made to produce requested information in different ways. This includes, first as text and graphics on television monitor screen; as moving images; as charts, graphs, tables, histograms; second as hard copy through printers and copiers; and third as magnetically-stored information on computer discs, and though cables and telephone links to other computers (Ellington et al 1993:178)
- Computers can control other electronic mechanical equipment, and can be used to access other information storage media, like videodiscs, compact discs and databanks; and
- Computers can be employed to give 'simulations of situations and conditions which would be far too dangerous to work with directly, for example, Processes in the core of nuclear reactors' (Ellington et al. 1993).

These are just a few of the ways in which computers that can be utilized in teaching and learning. However, the ultimate benefits can only be realised if the computer is programmed to perform them in relation to teaching and learning in the classroom.

2.5 Reasons for using computers in classroom instruction

Computers are used in teaching and learning for two main reasons. The first one is that computers can be effective teaching tools across the national curriculum. They can be used to increase the effectiveness of classroom instruction by introducing improved methods of teaching specific skills. The computer is regarded as a very powerful medium that helps students to learn subjects like mathematics, geometry, science, social studies, graphics and other subjects effectively. Secondly, they are used to expand and reinforce students' computer literacy skills. This usage has been viewed as being central to the introduction of computers in developed and developing countries during its inception (Abas, 1995, Boyd-Barret and Eileen 1991, Heinich et al. 1996; Watson and Tinsley, 1996). The computer is, therefore, used to help meet a great variety of educational needs both in schools and out of school education.

2.6 Patterns of using computers in Teaching and Learning

Dexter, Anderson, and Becker (1998) report that computers are used in two identified patterns. First, they are used by teachers to supplement classroom teaching, such as using them in direct relation to curriculum, but they carry only a minor part of the teaching and learning responsibility in comparison to the teacher. This applies to a situation when computers are used as teaching aids in a teacher-centred way. Dexter et al. (1998) add that in this usage, the teacher imparts facts and procedural skills to students and integrates computer technology as a complement to this style. They use computers mainly for drill and practice. Secondly, computers are used as a core part of instruction, carrying out the primary task of teaching, so that the teacher only becomes supplementary. In this way, computers can be used to extend learning opportunities beyond the confinement of the classroom or school. In such use, processes and media resources are given the front line role and they are made an integral part of the teaching and learning processes. This is student-centred learning in which "teachers use software and information technology to allow students to work in active ways. The computer supports active learning, and it becomes a tool with which the students may construct knowledge." However, Addison and Fridman (1997:56) report that such practices are aimed also at reinforcing skills, enriching current topics or extending topics beyond current levels. This includes the integration in which computer technology facilitates learning beyond what is currently possible.

However, in terms of technology integration, Addison and Fridman (1997:56) state that certain barriers and teacher beliefs may lead them to use computers in a supplementary way. Such barriers include limited equipment, lack of teacher training and time, as well as teachers' preferred instructional methods of teaching. But there is a consensus that if all human and administrative barriers are removed, and computers are used in instruction, they could assist teachers to reach their instructional objectives, and teach with increasing effectiveness. Moreover, there is evidence from the literature that computers could be used during private independent study, in a small group discussion and for a large group instruction, to achieve the following educational objectives:

- to provide or increase students motivation,

- to promote learning;
- to increase discussion among groups of learners thereby encouraging full participation;
- to teach skills;
- to improve the effectiveness of other media employed in teaching and learning situations (Addition and Fridman, 1999 and Dexter et al. 1998).

2.7 Benefits of using computers in teaching and learning

Having discussed the roles and the reasons for the introduction and use of computers in education, it is important to look into the contribution they can make as a tool for classroom instruction. This requires examining the disadvantages and advantages to using computer programs to help achieve formal instructional goals. Some of the advantages of using computers are as follows:

- Due to its versatility in handling various kinds of resources the computer is suitable for all types of learning ranging from group learning, individualized instruction, and mass instruction (Ellington and Race, 1993: 220-226).

- Computers involve the students actively in the learning process, and provide fast and systematic feedback to learners (Bitter, 1989: 240-241).

- The computer makes teaching easier for the teacher so it saves time. The teacher can attend to other classroom duties while the students work with computers (Slabbert, 1999:73-74).

- The use of computers offers a change from the teacher's voice and breaks monotony (researcher own idea).

- Computers free the teacher from the daily routine of lesson presentation.

- Computers enable the teacher to help individual students as needs arise during the lesson (Slabbert, 1999: 73-74).

- Computers can give access to rich materials not easily available to the teacher. The computer can bring real-world conditions into the classroom. For

example, with computer simulations students can observe a nuclear reaction or fly jets in the classroom (Bitter, 1989:244).

- Computers give students personalised instruction and students can work at their own pace as they interact with technology. This allows all students, slow and gifted alike to learn at their own pace (Slabbert, 1999:73).

- Computers can be useful for record keeping of students' work. The teacher can keep individual lessons prepared in advanced for all students and can also monitor their progress (researcher own idea).

- Computer programs can provide a broad diversity of learning experiences that embody a variety of instructional methods and can be at the level of remediation or enrichment that is effective for learning (Heinich et al. 1996:234-235).

- The computer is consistent and precise. It supplies reliable and consistent instruction from student to student, regardless of the instructor, time of day or location (Slabbert, 1999: 73-74).

- Computer-based instruction can improve effectiveness and efficiency in teaching and learning. Effectiveness according to Heinich et al. (1996) refers to improved learner achievement, and efficiency means achieving the objectives in less time or at lower cost (Heinich et al. 1996:235).

- Where the teacher is not prepared or does not have other adequate materials, the computer can be the source of information. It can cover a growing knowledge base associated with information explosion and can manage all kinds of information such as graphic, text, audio and video materials (Heinich et al. 1996:235).

- Teachers can use computer programs as a teaching aid to explain or reinforce concepts in many different subjects (researcher own idea).

- Computers can teach students computer literacy as well. By simulating real-life situations, computers can make learning subjects like mathematics, science languages and social sciences interesting and exciting. Because the

instruction can be flexible, it motivates students to learn and enables them to revise what has been learnt (Heinich et al. 2002).

- The computer can provide visual elements in teaching and learning. Colour and animated graphics can add realism and appeal to drill exercises. It is also useful for demonstration and teaching practical subjects topics (Heinich et al. 2002).

- Above all, computers enable students to learn from one another globally through e-mail, and other forms of communication systems.

Although computers can contribute to teaching and learning in many different ways, there are also inherent disadvantages in their use as a medium of classroom instruction. Some of these shortcomings range from administration to the technology itself.

2.8 Disadvantages of computers in teaching and learning

- Hardware and software are still too expensive for most schools to afford, especially in developing countries. Along with this is the cost of maintenance and repairs that in addition may sometimes require the presence of a full time technician to be employed.

- Design and development of software for use with computers requires trained personnel and takes a lot of time. This makes software very expensive to purchase.

- It can encourage lazy teachers not to prepare their work ahead of time. Once they depend entirely on the computer they may not care to plan adequately.

- Computers require a classroom environment free from dust and high humidity, with adequate ventilation and this might not be available in many schools.

- Compatibility is a crucial issue that must be looked into before purchasing the software, because software developed for one computer system may not be compatible with another (Heinich et al. 1996:235). Due to differences in

hardware, computer programs are rarely accessible to many schools and this limits its widespread utilisation (Slabbert, 1999:71).

- Computer programmes usually cover very small sections of the syllabus and do not teach effectively in the affective, motor, and interpersonal skills domains (Heinich et al. 1996:235).

- Commercially designed computer software may not be relevant to the needs of students and teachers. This requires additional time to view and evaluate them, making necessary adjustment before they are used in teaching and learning (Heinich et al. 2002:229).

- There is lack of social interaction among students as they work on the computers alone with little time to consult with one another or with the teacher (researcher own idea).

Despite these various limitations of computers as a teaching aid, the benefits discussed in section 2.4 led many countries to adopt them as tools for classroom instruction. Their potential to provide students with knowledge and practical skills is recognised by many authors and researchers such as (Christmann and Badgett (1999) and Clark (2000). They report that computers are excellent learning device that can be used to aid teachers in teaching various skills and at the same time assist students in learning specific subjects. According to these researchers, using computers for classroom instruction has several possible effects, most of which now require a new approach to exploit the capabilities of the computer as a learning resource in the classroom so that it can be utilised effectively in the learning processes. In this connection, Cornu (1996:5) feels that there is an urgent need for infusing technology into the curriculum and calls for a clear-cut decision with regards to integration of new technologies in schools. Not an addition, but integration in subjects, integration in teaching, integration in learning, integration in the school, and integration in the profession of the teacher.

Before discussing the value of computer integrated education, there is need to define the word to 'integrate' so that all the stakeholders can be clear about its relevance in the effective utilization of computers in teaching and learning.

2.9 Definition of Computer Integrated Education

Oxford Advanced Learner's Dictionary gives two meanings of the word to 'integrate.' The first is 'to combine two things in such a way that one becomes fully a part of the other' and the second refers to 'become or make-become fully a member of a community, rather than remaining in the separate group.' Cornu (1996:3) adds that integration means 'combining parts in a whole.' I believe that the integration of computers into teaching and learning makes both meanings applicable because when the technology is incorporated into curriculum it should be built into the whole education system. Cornu (1996:3-4) looks at the integration of technology in many aspects. First as hardware and software integration, second integration into disciplines, and third integration into teaching and learning. As such, a system of education in any country needs to design integrated resource-based learning in which the new technologies are incorporated to teach specific skills and subject topic areas at the same time. Cornu (1996) believes that only when technologies are integrated will their use become natural, easy and they will have a wide effect on teaching and learning.

Therefore, integrating computers in the school curriculum means introducing a new method of teaching and learning in the classroom which takes into account the following requirements:

- aims of general secondary education;
- meeting new demands of society in students skills;
- reforming the curriculum;
- training teachers in new skills;
- internal school organisation;
- hardware provision and maintenance;
- stabilizing of funding policies;
- support by technical staff;
- equity of access for all students;
- software development and provision;
- development and provision of complementary materials;

- Copyright policies for software (IFIP, 1993:15 in Millar, 1997:6).

Consequently, in order to implement CIE and incorporate computers into the teaching and learning process, the whole school community should be well informed about the new development. This includes teachers' awareness of the demands on their teaching responsibility, students' awareness of changes in patterns of learning, and the need for extra funds to purchase and maintain the computers. Arrangement must also be made to provide the necessary teaching and learning resources and the facilities for integrated learning to take place. This is very important because "technology integration is using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways" (Dockstadder, 1999:73).

Many researchers have also discussed and supported integrating computers into school curriculum (Cornu, 1996; Cameroon, 1999; Heinich, et al.1996; Mills and Ragan, 2000; Sakamato and Miyashita, 1996 and Van Weert, 1996). According to these scholars, an integrated approach has the potential to demonstrate various types of computer applications to teach specific subject topic areas. The teacher could employ software applications as the main classroom instruction or use them as an integral part of the whole school organization. Secondly, when the computer is integrated into the school curriculum, it will be part of the teaching and learning process. This will require curriculum developers to design new integrated curricula and to incorporate technology as a fundamental component of instructional methods. Teachers will also be required to plan their schemes of work and lessons integrating technology. The integration of computers into education should start with the teacher, through teacher education programmes. Thirdly, an integration of computers into the school curriculum will definitely lead to grassroots school involvement. All the school administration, the Parents Teachers Association (PTA), and the Board of Governors (BOG) will take part. This will motivate the teachers and students to find out other ways to utilize the computer technology effectively.

2.10 Teaching and Learning with computers in the classroom

Once the integration of technology into the curriculum is done, teaching and learning changes from the teachers' traditional approach of talk and chalk to a resource-based

approach. Heinich, et al. (1996: 8, and Smith and Ragan (1993: 2) report that teaching simply means giving a person or a student knowledge of something or skill. According to them, teaching is synonymous to instruction. That is, the arrangement of information and environment to facilitate students' attainment of intended specific learning goals (Heinich, et al. 1996:8); Smith and Ragan, 1993:2). This deseription includes the classroom situation, the method and resources required to impart knowledge, skills and to guide students' learning. The teacher as the pilot must plan his/her work thoroughly in advance, and prepare a lesson to include all the necessary motivational skills and activities to present an effective lesson. When the teacher sets to plan the lesson he /she should be guided by some of the following questions:

- What kinds of things does he/she want the students to learn: is it skills, facts, concepts, attitudes or values?
- What are the instructional objectives or desired outcomes?
- What is the most appropriate sequence of topics and tasks?
- What is the most appropriate lesson delivery method?

Since teaching involves what the teacher does as well as what the students' experience, it is essential for the teacher to focus his classroom activities on incorporating the use of computers in a properly structured lesson with clearly stated objectives.

2.10.1 Planning for teaching with computers

How should classroom instruction be organised so that students can learn with computers efficiently? The teacher as the pilot must start by planning how to teach with the technology. This is the logical starting point. Because some schools provide a separate computer education course, and others integrate computers into subject-matter teaching preparation, there is a need to consider how best computer technology could be used effectively. Since the move right now is towards total integration of computers into the school subjects, the teacher must be thoroughly prepared in advance in order to present effective lessons to students in the classroom.

However, the integration of computers into teaching various subjects places a heavy demand on the teacher to be very clear about the statement of objectives. The

objectives will help the teacher to describe the general nature of the curriculum and provide an idea of the amount of work that should be covered within a given period. It will also enable the teacher to consider which teaching methods should be employed. Furthermore, the objectives will assist the teacher to plan the content and process to be used in the assessment (Ellington and Race, 1993).

Moreover, according to Heinich et al. (1996:52) effective teaching starts with careful and thorough planning. Consequently, the incorporation of computers into teaching and learning requires the teacher to have all the relevant skills and resources in order to integrate and use compute effectively. The teacher must have the national syllabus and a course book for the teacher and the one for the students (in the case of Kenya) and other relevant textbooks from which to derive the schemes of work.

2.10.1.1 Preparing the Schemes of work

From my experience, planning the scheme of work is the starting point for effective classroom teaching. A scheme of work is a plan derived from the prescribed syllabus for a particular level of education, showing how much of the syllabus will be covered within a given period, usually one term or two terms. The teacher can exercise his individuality and originality within the limits of the syllabus, in terms of how each topic will be arranged (including the use of computer technology), how it will be taught, how much time will be spent on each topic. But the most important reason for having a teaching scheme is to ensure that the teacher is clear about what he/she wants students to learn. There are also four other reasons for teachers to make a teaching scheme. These are as follows:

- to ensure that the subject matter is covered within the estimated time and that the lessons are taught in the most suitable manner,
- to enable the teacher to cater for needs of the students;
- to ensure continuity in the learning process;
- to enable teachers of different subjects to consult with one another and coordinate their efforts in teaching.

A scheme of work is very important since the teacher extracts the daily lesson topics from it. It is at this stage that the teacher must integrate the use of computers.

Generally, the schemes of work provide a lot of information (content) that the teacher can transfer for planning the lesson and to elaborate on. Such information includes topics, subtopics, teaching aids, references, objectives, students' activities and remarks (Ellington et al. (1993); Heinich et al. 1996 and 2002).

2.10.1.2 Teachers' Preparation for teaching with computer technology

In order to make the best use of computers once the scheme of work is prepared, there are a number of important points to be considered. These include:

- the purpose for using the computer in teaching and learning;
- selecting an appropriate program to integrate into the lesson (Kay et al. 1999:224).
- pre-viewing the program so that the teacher is familiar with the content. This will enable the teacher to make note of any point that can be brought out about the content with the class. The teacher can also edit or modify some irrelevant section of the lesson and replace with better ones from her lesson plan. The teacher can also identify sections that need reinforcement with other visual media to make the lesson more effective, and to ensure that the computer program is up-to-date;
- preparing the students to be ready to benefit from learning with technology. Students could be prepared to use computers in many ways such as: making them aware of why they are using a computer and what they are expected to learn from it, the content could be discussed briefly; and concepts and other unrelated points can be explained.
- Planning for follow-up activities should be carefully organised such that the teacher reinforces what the students have learnt by giving extra assignments or group work.

Therefore, it is important to remember that teaching and learning with computers would be more effective if both the teacher and the learner prepare for it in advance and this can be achieved if the teacher plans carefully and thoroughly.

2.10.1.3 Lesson Planning

From experience, a lesson plan is an important tool that teachers must prepare before proceeding to teach any subject in the classroom. A lesson plan must include: the objective(s), time allocation, steps or stages of the lesson (content to be covered: that is, the information/knowledge to be given to students), teaching aids, in this case the computer, other resources, references, evaluation. These aspects of lesson planning are extremely important in the teaching and leaning process. It should be noted that the lesson plan is the teacher's tool and guide. The teacher is unlikely to succeed in his work in an attempt to incorporate computers in teaching without the aid of a lesson plan.

The value of the lesson plan is that it helps the teacher to focus his attention on the achievement of specific learning objectives. This, in turn, directs the students to acquire or to perform certain behaviour once learning has taken place. In addition, the lesson plan is valuable because it helps the teacher to know in advance his role in guiding the learners as they work with computers, and which activities students are supposed to do if learning is to take place effectively.

There are other important reasons why a lesson plan is necessary for effective teaching with computers. These include the fact that a lesson plan:

- helps the teacher to remember what he is going to teach and how he will teach it;
- is arranged in a systematic way and encourages logical development and presentation of learning materials;
- gives the teacher confidence and assists him in getting his information and ideas across to the students;
- helps the teacher to achieve his objective(s) for the lessons he is expected to teach with technology.

According to Schefller and Logan (1998:305) teaching no longer centres around the transfer of knowledge from the teacher to students. Learning comes from student inquiry, critical thinking, and problem solving based on information accessed from a

variety of sources provided by the teacher. This calls upon the teacher to be a good planner when integrating technology into the lesson plan. A classroom in which computers are integrated into teaching and learning is a place of interactivity. The students work and collaborate as knowledge is applied to authentic situations. The teacher's lesson planning and presentation should aim at providing activities geared towards helping the learner to solve real life problems.

2.10.1.4 Lesson Presentation

Introduction of the lesson: In the introductory part of the lesson, an effective teacher should be able to link the learning that took place previously with the new materials to be learned in the current lesson. He should be able to motivate students and sustain their interest before they start learning with the computers. The introduction to a lesson creates a need in the students to participate fully in the lesson. In addition, it should create an atmosphere that is conducive to the attainment of the objectives of the lesson. A lesson that has been properly planned indicates how the teacher will do this and links the learners effectively to working with computers. The introduction of the lesson should give way and lead into the development of the lesson. The teacher should use the introduction to set the tone for the rest of the lesson.

The main part of lesson: As the students start to work on the computer, the lesson must develop and proceed in a sequence of logical steps or stages that eventually enable the teacher to achieve the objectives and to ensure that learning takes place. During this exercise the teacher's role changes from that of a presenter of information to that of a guide, and he should be able to communicate his ideas by guiding the students on what they are learning clearly by giving clues and cues (Tema, 1998:5; and Heinich et al. 1996:353). An effective teacher should therefore be able to encourage and reward students in addition to motivational effects the students get as they work with computers.

Conclusion or Summary of the Lesson: The conclusion of the lesson offers the teacher a chance to determine whether learning has taken place, and whether the teacher has achieved his objectives. The teacher must plan for effective summary of the whole lesson incorporating students' participation to assess their understanding of

what they have learnt. He can do this by asking questions about the lesson orally or by using written assignments, individual research project or group work.

Organising the Learning Environment: According to Fraser (1996:344) "the classroom environment, climate, atmosphere, tone, ethos or ambience of a classroom is believed to exert a powerful influence on student behaviour, attitudes and achievement." The teachers' personality, manner of dress, cheerfulness and confidence, and disciplinary ability are some of the qualities required of an effective teacher in the classroom. An efficient teacher should therefore be able to organise and manage the learning environment effectively, so that the learners are able to take full advantage of the learning situation, by providing sufficient teaching and learning resources, equipment for students, organising the classroom properly, handling interruptions in a correct manner and maintaining discipline.

During the teaching process the teacher should be able to assess the progress of the lesson and adjust the objectives, if necessary, in the light of experience during instruction and make the necessary comments in the remark column. He should also make changes in other objectives in the light of the emerging knowledge of the learners, their abilities and competencies (Ellington, Percival and Race, 1993:194-7).

2.10.2 Evaluation of the teaching and learning processes

Heinich et al. (2002:74-78) report that "evaluation and revision is an essential component to help the development of quality instruction." Evaluation involves activities that are designed to measure the effectiveness of a teaching and learning system as a whole. There are many purposes for evaluation in education. The two major ones include assessing learners' achievements and evaluating teaching methods and use of media in teaching. Evaluation should be an ongoing exercise in teaching and learning. Teachers need to carry out "evaluation before, during, and after teaching" a topic using computers. Heinich et al. (2002) state that before teaching and learning with computers, the teacher needs to measure learners' characteristics to ensure that there is a fit between existing students' computer literacy skill, the methods and materials to be used. Similarly, during teaching evaluation can take the form of question-answer format or a short quiz to assess if students understand what is taught, and to detect problems or difficulties with instructional method that might

interfere with learners' achievement. But evaluation after the lesson can take the form of a written exercise in which the students work individually with the computers. It can also includes oral work when the teacher assess the general knowledge of a concept from the whole class, practical or group project work on the computer to understand how students perform in a specific subject topic. However, evaluation of teaching and learning need to be planned systematically and discussed by the staff. Evaluation is useful in the effective utilisation of teaching and learning resources.

2.10.3 Appropriate Teaching Strategies

Teachers need to have clear ideas of which methods of teaching could be most appropriate for teaching and at what level to employ such strategies. Teachers have sole responsibility to make decisions of teaching methods they feel confident to adopt with regard to the use of computers. The teacher needs to consider during lesson planning which of the two main teaching approaches in education to use teacher-centred and student-centred approach. Within the two teaching strategies, the teacher can employ any of these methods: Lecturing, use of example, demonstration, discussion, project method, experiment, fieldtrips and discovery. The teaching methods were suggested and recommended by philosophers and psychologists, like Rousseau, Froebel, Pestalozzi, Comenius, Plato, Montessori, Dewey and Piaget (Saettler, 1990:4-7) and many other pioneers in formal education. Their contribution to appropriate teaching method led to the idea of child-centred education. They argued that children must be active in learning and that the idea of pouring information in to them was undesirable. They stated that a suitable learning environment would facilitate the development of imaginative and creative ability in children. Therefore, the teaching methods and the curriculum must be based on the child, and what the child is taught must also coincide with experience through employing different teaching aids in the lesson presentation. Many of their ideas are relevant to the use of computers in teaching and learning, and are practised in schools by teachers to present the lesson. Therefore, the integration of computers into the school curriculum can be effectively realised through these approaches if the teacher is properly organised.

2.10.3.1 Teacher-centred approach

Although the philosophers, psychologists and other pioneers in formal education advocated a student centred approach, many schools and other institutions of higher learning use a teacher-centred strategy (expository). In this approach the teacher imparts to students in the class the subject matter which is laid in the syllabus after preparing the lesson plan. The classes take place according to the school timetable and last for a specified period. The teaching methods vary from teacher to teacher but normally teachers use an integrated approach that combines all the teaching skills such as lecturing, questioning, use of example, reinforcement, stimulus variation and set induction, with lecture as the main method. However, the integration of computers into a teacher-centred approach requires a whole school involvement because the school timetable must indicate the number of periods per subjects to be covered by the computer lessons. In Kenya, this will follow the pattern that was adopted by the former school radio programmes in which all the radio lessons were included in the school timetable. This would serve as a reminder to the subject teachers to infuse the use of computer technology in their own timetable whenever they plan their lesson in a teacher-centred teaching approach.

2.10.3.2 Student-centred Approach

The protest by educators against the curriculum that was teacher-centred led to the adoption of student-centred approaches to teaching and learning. The student-centred (or learner-centred) teaching and learning environment provides students with a high flexibility of choice regarding the learning program that is geared towards the individual student's life and learning styles. It involves the teacher preparing a learning situation with adequate resources for students to manipulate. It also gives power to individual students to access and handle a wide range of information. In this type of learning the students' needs and interest are given high priority, and they are accorded the necessary assistance in order to achieve their learning objectives effectively (Alberts, 2000; Barbara, 1995 and Tema 1998).

The move to student-centred approaches in education is based on the ideas of philosophers and progressive educationists like Dewey (discussed in section 2.9.3) who reported that children would not learn unless their interests are enlisted and

unless learning is self-originated from some instinctual source within them. In addition, Killen (2000:xi) explains that when the teacher uses learner-centred approaches to teaching there is need "to set the learning agenda" such that the teacher has "less direct control over what and how students learn." The teacher is no longer "a provider of all information," but has a major role as a planner, organiser, and a facilitator of learning. Consequently, the infusion of computer technology provides an opportunity for self directed learning in which the student himself plays an active role in the learning process (Alberts, 2000:48). In this learning environment the teachers' role is that of a guide who must prepare in advance what the students are to achieve when studying specific concepts or topics.

The discussion of teacher-centred and student-centred approaches refers to a concern with students learning in the classroom, since instructional and learning activities complement one another in teaching situation. In order to help students to learn effectively, the teacher is expected to create a warm and friendly atmosphere in the classroom that provides opportunities for effective learning to take place. To be able to do this, teachers can employ various educational technologies.

2.10.4 The concept of Learning and CIE

Learning focuses on the individual for whom all instructional activities are designed. Heinich, et al. (1996: 8) describes learning as the development of new knowledge, skills or attitudes when the individual interacts with information and the environment. At the same time, Kozma (1994:8) feels that learning is "an active, constructive, cognitive and social process by which the learner strategically manages available cognitive, physical and social resources to create new knowledge by interacting with information in the environment and integrating it with information already stored in memory." While there are many definitions of learning in different literature, its specification hinges on the following conditions as reported by Heinich et al. (1996), and Ellington, Percival and Race (1993):

- The state of the knowledge of the learner before instruction;
- The statement of the objectives to be achieved;
- How the objectives are to be achieved or exposure to learning experiences;

- Conditions of the learner after exposure in relation to the stated objectives;
- What media is required for the necessary learning experiences? (Heinich et al. (1996 and 2002).

According to Killen (2000:xiii a) "learning is a process of acquiring new information and abilities." Learning takes place any time and all the time. Therefore, the teacher needs to select an appropriate teaching strategy that could provide students opportunity for effective learning. Students' learning is enhanced as they interact with the environment and with the use of various technologies. From a psychological point of view, there are several theories of learning that date back to over half a century, and each has implications for classroom teaching and students' learning with computers (Heinich et al. 1996:15). Students' learning in the classroom can be explained using two major theories of learning namely: behaviourism and constructivism (Alberts, 2000:26-28; Heinich et al. 1996:16-17; Slabbert, 1999:46-48). The more we know about these theories of learning, the concepts and research that underpin them the better we can use computers in teaching and learning. The two theories of learning are important for two reasons explained in Sections 2.9.5.1 and 2.9.5.2.

2.10.4.1 Behaviourist approach to teaching and learning

According to Heinich et al. (1996:15-17), the behaviourist perspective is associated with B. F. Skinner who was the key architecture of the behaviourism movement. Skinner's research with pigeons involved investigating the control and condition affecting stimulus-response mechanisms. Skinner believed that conventional classroom situations did not supply sufficient reward for learning to take place. He also felt that subject matter could be presented to the student in small quantities, and students' understanding should be tested with a written answer before the learner moves to new material. Once the response has been made, the student should learn immediately if the answer was correct or not. In this way, the learner gains psychological reward of success and proceed at his own pace. In relation to the use of technology, Skinner stated that the machine itself does not teach, but simply brings the students into contact with the person who composed the material it presents. The application of Skinner's ideas to learning resulted in the design of linear programs.

Consequently, as result of Skinner's work, Alberts (2000: 26) reports that behaviourism explains learning as a system of behavioural responses to stimuli. He feels that teachers who accept the behaviourist theory assume that the learning behaviour of students is a response to their environment. Because learning is regarded as a form of behaviour modification, the teacher has a duty to prepare an environment in which the correct behaviour of the students is reinforced. He also points out that behaviourists are concerned with the effect of motivation, practice, feedback and reinforcement on learning.

Therefore, in teaching and learning behaviourism for example, places emphasis on writing objectives such as learning objectives, behavioural objectives and performance objectives. At present all teachers in Kenya are expected to write objectives for the lessons they are teaching and all pre-service teachers must learn to write objectives for lessons. Writing objectives is very important because in teaching, teachers need to be very clear about the goals of education to be achieved, and it is not possible for teachers to assess how much a student has learned without defining in observable terms what learning they are seeking. Therefore, from these notions, Tiene and Ingram (2001:26) suggest that teachers must specify the goals of instruction in terms of behavioural objectives that usually consist of three parts. These include: "the behaviour to be learned, the conditions under which the behaviour is to be demonstrated, and the criteria by which to judge the amount of learning."

The significant of the above description of learning is that it provides one model for deciding how to use computers in instruction. Based on the behaviourist approach to learning, computers can be used for mediation of learning, facilitation of learning, collaborative learning, group learning, individual learning and mass instruction.

2.10.4.2 Constructivist approach to teaching and learning

According to Killen (2000:xvii a), the basic premise of constructivisim is that knowledge is obtained and expanded through active construction and reconstruction of theory and practice, and that learning is not just a passive process. Constructivism is described as "an approach to learning in which students are provided the opportunity to construct their own sense of what is being learnt by building internal connections or relationships among the ideas and facts being taught." Furthermore,

this method emphasises that learners actively construct knowledge for themselves by forming their own representations of the materials to be learnt, selecting information they perceive to be relevant, and interpreting this on the basis of their present knowledge and needs. There are two main approaches to constructivism, cognitive constructivism and social constructivism. Killen (2000xiii-xiv a) explains that cognitive constructivism focuses on the cognitive process that people use to make sense of what happens in the world. In the classroom, students use previous knowledge and combine it with what they learn to construct and reconstruct knowledge in order to make it meaningful. On the other hand, social constructivism treats learning as a " social process whereby students acquire knowledge through interaction with the environment instead of merely relying on the teachers lectures."

In this connection, Tiene and Ingram (2001: 34) state that "constructivism has the potential to foster a radically different approach to teaching as well as exciting new uses for computers in the classroom." Teachers can use computers to support constructivist approaches. For example, the computer networks are being used to have students communicate about their learning experiences through e-mail from different places. Students share cultural backgrounds and school experiences in a way that helps them to develop mutual cultural perspectives. Similarly, Tiene and Ingram (2000) add that the Internet has provided a powerful new ways for students to share experiences, opinions, and information with others at vast distances. The scholars believe that computers can provide materials to explore the tools with which to create, and the means with which to communicate. They also feel that these materials can facilitate constructivist efforts in the classroom such that the students explore learning more effectively on their own and the teacher acts only as a guide.

2.10.5 Facilitation of learning via the computer

The other important role of computers in students' learning is that of facilitation of learning. According to Alberts (2000:35) facilitation of learning via technology is concerned with the creation of a supportive learning environment for students to learn effectively with the technology. Such a learning environment should enable personal relationships to be created between the students, the teacher and with other learners. Computer technology has many capable tools that enable the facilitation of learning to take place. For example, the teacher can give the students assignment to work with

word processor to learn communication skills. The students will learn the skills with the computer and at the end of the lesson the students submit their work to the teacher. The computer facilitates learning by giving students instruction on how to perform the task. Researchers have acknowledged the ability of the computer to facilitate learning (Pendretti, Smith, and Woodrow, 1998; Mills and Ragan, 2000). The capabilities of the computer to engage the students in an interactive manner changes the role of the teacher in the classroom from that of a presenter of information to that of a coordinator of learning resources (Heinich et al 1996:353). During classroom instruction, the teacher performs various roles that include being a facilitator, manager, counsellor, a guide, and a motivator. Similarly, in mediation of learning, sometimes the computer is used as a vehicle through which a message can be transmitted to learners for example the use of the Internet or self-instructional programmes.

2.10.6. The Teacher's Role in CIE Learning Environment.

2.10.6.1 How the computers help students to learn

The use of computers as an instructional tool helps students to learn in four over lapping stages. Firstly, the computer **makes students want to learn** by motivating them to become more enthusiastic, and by increasing their interest. Well-designed computer programmes are highly attractive so students can enjoy working with the computers to extract information from databases, or encyclopaedia, and entering information in a word processor. Secondly, the computer enables **students to learn by doing.** The use of computers in teaching is essentially learning by doing, and when the students learn by doing it is far more effective than watching the teacher. When the students learn by doing they become involved in the exercise. They try things out, experiment, practice and learn from mistakes. For example, students use the computer for analysing data in a spreadsheet, and as a communication tool when sending e-mail to different people. Thirdly, the computer can help students to get **immediate feedback** on what they learn. Students are able find out whether what they are doing is right or wrong, good or bad and the computer provides feedback while they still remember the problem. The fourth one is **digesting.** The students have more control over the manner they navigate the materials in the package by moving forward, backward, repeating parts until they get the correct answer or until they understand

the information. The computer allows the learners to gain a sense of ownership over what they learn (Ellington et al 1993:180-181). All of these factors have been shown to be important in helping students to learn in any instructional situation (Killen, 2002).

2.11 The Relevance of CIE to Teaching and Learning

The extent to which computers can be viewed as being relevant in teaching and learning in schools seems to vary from person to person and from country to country. During the early 1980s Clark (1983:445) challenged researchers to refrain from conducting additional studies examining the relation between media and learning. Clark argued that there were no specific learning benefits to be gained from the use of particular media. However, Clark's view that specific media offer no identifiable contribution to learning needs to be reconsidered. For example, a recent review of research literature by Kozma (1991), has suggested that "capabilities of a particular medium, in conjunction with methods that take advantage of these capabilities, interact with and influence the way learners represent and process information and may result in more or different learning when one medium is compared to another for certain learners and tasks" (Kozma, 1991:179). The need for alternative instructional media in teaching and learning has also been reported by Abas (1995). Abas (1995) reported that teachers felt that students learn from computers. Similarly Azita (1999) noted that students learn from computers and suggested a number of particular applications and benefits of computer programmes and recommended programmes that illustrate difficult mathematical calculations. Heinich, et al. (1996) also supported the use of computers in teaching and learning by stating that computers are an integral part of teachers' work and that some students will definitely learn from the use of technology.

From these studies, it would seem that the important question is not " Should computers be used in instruction? But rather "How should computers be used in instruction to maximise student learning?"

2.11.1 Using Computers as a tool in Classroom Instruction

Many claims have been made about the benefits of computers in relation to cost-reduction, and the special advantages as a medium of instruction. But some of these claims have been questioned. Whether the use of computers motivates students to learn or improves the quality of learning is still debatable. However, there is general agreement on the value of teaching students to use computers as productivity tools during teaching and learning. This includes using computers to do complex calculations, data manipulation, word processing, and presentations, either within the existing school subjects or in special courses as reported by various scholars (Azita, 1999; Clark, 2000; Crook, 1994; Heinich et al. 1996 and 2002; Ken and Anderson 1990 and Zhang, 2000). The first usage involves direct instruction in school subjects like mathematics, sciences, languages and social studies. It also includes drill and practice tutorials, games, simulations and problem solving (Crook, 1994; Hargrave and Kenton, 2001; and Heinich et al. 1996). The second one includes instruction in the use of computer tools such as spreadsheets, programming, word processing, and database management.

There is some value in preparing students for employment- oriented technical training in computer related skills. In this connection, Walker and White (2002) support the need for computer technology integrated training. They report that students who might otherwise be reluctant to enter a school of education's teaching program may consider the more respected and better paying field of education technology because "technology is where the money is in education" (Kenway, 1998:76) in Walker and White, 2002:65). Secondly there is computer literacy as informatics. Here the students should be able to understand social, economic, political and cultural dimensions of information technology. This is important for national development and should aim at closing the gap between the rich and the poor. Thirdly there is the issue of computer literacy for national development of the county (Abas, 1995; Hawkrdge, 1991; and Heinich et al. 1996). Thus, the use of computers as productivity tools led to the introduction of computers into the education system in many countries and was first aimed at teaching students basic computer literacy skills. However, the term computer literacy is vague.

2.11. 2 Defining Computer Literacy Skills

Many researchers have discussed and attempted to describe computer literacy skills (Heinich, et al.1996; Karsten and Roth, 1998; Martin, 1991; VanWeert, 1996 and Hidgon, 1994). According to Heinich, et al. (1996:228) the term computer literacy means "the ability to understand and use computers." They also explain that computer literacy instruction incorporates three types of objectives such as knowledge, skill, and attitude. The knowledge objectives include understanding of the terminology, identifying the components, describing computer applications, and analysing social and ethical issues concerning the use of the computer. Heinich et al. (1996), further state that the skill objectives include learning keyboarding and the ability of the students to use computers for different applications such as word processing, searching databases, and retrieving information. Tiene and Ingram (2001) express similar sentiments.

Moreover, Higdon (1994: 436) noted that the definition of computer literacy depends on the computer literacy course, program, or focus of the teaching process. She points out that if the focus is science based then the computer literacy skills become more specialised in nature. But she concurs with other researchers (Heinich et al. 1996, Abas, 1995; Karsten and Roth 1998) that word processing, spreadsheets, database creation and usage are the basic skills that are necessary for any student to learn in a computer literacy course.

Abas (1995:156) reported a computer literacy program that was highly participatory, known as the Malaysian computers in education project. According to Abas (1995), the Malaysian government funded this computer literacy project. The aim was to involve secondary students actively in learning with computers so as to acquire computer skills, and to understand the computer literacy content. The project team used the computer syllabus prepared by the Ministry of Education, trained teachers, and supplied hardware and software to schools. In this study, the students were expected to cover the following topics in the computer literacy syllabus: introduction to computer systems such as graphics, types of computer systems like spreadsheets; computer systems and operating for example database management system; teaching systems including introduction to programming. The students were also supposed to

learn how computers process data, the effects of computer use and computer ability, its effects on lifestyle, including computer misuse and abuse, different application packages and computer use in the future. In addition, the students were expected to learn word processing and explore computer careers (Abas, 1995:153).

Despite the government effort to provide computer literacy course to students, the project was not effective. Abas noted several problems associated with the project such as lack of trained teachers, frequent transfer of teachers, ineffective in-service course organised for teachers, security of resources and hardware. However, the research findings by Abas (1995) from a developing country provides useful information that the researcher will use during field investigation on the use of computers in Nyanza Province to examine whether computers are used in the same way. Whether the same problems identified by Abas (1995) are prevalent in schools to be investigated. Nevertheless, as a result of these computer education Abas (1995) reported that students learnt a lot of skills. They gained knowledge of computer literacy skills, and they enjoyed the computer classes. Both the teachers and students were highly motivated and significant achievement was realised.

In another development, the aim of teaching students computer literacy skills was also advocated in Kenya. In 1996, the Minister for education Joseph Kamotho announced a plan to incorporate computers into the public secondary school curriculum. The Minister noted that computer skills would enable Kenyan youths that pass through secondary schools to be computer literate. The Minister further emphasized that students would be able to learn all computer literacy skills. These skills he believed would enable the students to compete favourably for employment in the world market and prepare them to pursue advanced studies in Information Technology (Daily Nation Newspaper, 1996).

However, teaching students computer literacy skills also requires schools to integrate technology into the whole school curriculum. This would provide all students with opportunity to participate in computer literacy programs. For example, Blomeyer (1991:123-124) describes an integrated computer literacy program he found at Hilldale Community High School in America. He conducted a case study in this school to assess the use of computers. Blomeyer found that Hilldale had a course in computer literacy for all new students. Blomeyer observed that all students were

expected to be familiar with computers, their history and essential vocabulary involved. In particular, the students were also required to: learn about the impact of computers on society; vocational implications and controversial issues such as privacy and electronic crime; to interact with computers by practising keyboard skills; to observe and write simple programs, and to apply computer skills in related subjects areas. The implementation of computer literacy at Hilldale was guided by a goal which stated that: "an infused computer literacy program taught across Department by all staff reaches more students and diminishes negative impact upon curriculum." A similar study will be carried out by the researcher in secondary schools in Nyanza province to find out how teachers integrate and use computers for literacy programs.

2.11.3 Using the computer to learn how to use word processing

A word processor is a writing tool just like a pen or a pencil. It is a valuable tool used in all introductory computer literacy courses. It is also a powerful versatile tool that can save and recall typed information. Using a word processor saves time, facilitates revisions and improves students' writing. A word processor makes changes easy by erasing, moving and copying text, and all other ordinary typing tasks may be done quickly and efficiently (Nicholas, 1996; Owston and Wilderman, 1997; and Zhang, 2000). In addition, a word processor allows students to easily revise and edit their composition, thereby avoiding too much recopying of the work. This exercise enables students to demonstrate pride in producing legible, neat and attractive piece of work as they practice word processing skills. At the same time, word processing helps to eliminate the physical barriers that students experience as they struggle to make letters. When the students are working teachers are also able to view students' work on the monitors without interfering with the exercise. On the other hand, Zhang (2000) noted that students taking science subjects were not encouraged to use word processing extensively. Therefore, (Heinich et al. (1996:226) stressed the need for every student to be familiar with word processing skills because it helps to improve students writing skills, reading and composing stories. Consequently, many researchers have been concerned about the capabilities of computer word processing to improve students' writing skills.

2.11.3.1 Using Word Processor to improve writing skills

Synder (1993:58) reports on a comparative study in which the writing produced with a word processor was compared to writing with pens. The aims of the research were focused on the quality of work concerned with effects of word processing on written products. The researcher used a controlled comparative study to investigate effects on quality. Synder (1993) noted that the exercise involved drafting or composing work first with a pen, and then the text was transferred to the computer. The participants were required to write short essays. The work was collected and analysed for about four weeks. The results of the study showed that writing of weaker students improved with computers. Other results indicated that gifted students benefited the most.

In another instance, Synder (1993:58) reports on a case study research in which the participants were expected to acquire word processing skills at the same time as they produced computer text to be compared with their essays written by pen. After the analysis was done, the results showed that the writing quality of fast typists was significantly better than quality of slow typists. Synder (1993) concluded that studies in word processing should ensure that students type at least as fast as they write before using computers for writing. The researcher observed also that learning how to use the word processor and mastering keyboard skills could interfere with the quality of the text produced.

Furthermore, Ronald and Widerman (1997:202-218) conducted a three-year experimental study to provide empirical evidence of the impact of word processing on the quality of students' writing and on classroom processes as an integrated part of the elementary curriculum in Canada. The purpose of the study was to investigate whether extensive experience with and ready access to word processing could lead to improvement in students' writing. The researchers used a comparative study of two groups of students. One group consisted of 52 with experience with computer skills, and had access to computer for use at any time. The other group of 58 students had no experience of computer usage and wrote most of their work by hand. Data analysis was done qualitatively and quantitatively. The results were grouped under: assessment of writing quality, volume of writing, use of computers, length of composition, students' writing practices and teachers' practices. From the results, the researchers

concluded that the there was a great improvement in writing quality of the students who had experience with computers skills as opposed to those who had no experience. This was due to the fact that students who scored high marks had access to computers before the experiment was conducted, while those who scored less marks had no or little knowledge of the computer. They also noted that the use of a word processor contributed greatly to the increased quality of the experienced students' writing skills.

Similarly, Zhang (2000: 467) conducted a one-year case study to provide more evidence that using a word processor would produce useful results when measured over a longer period of time. The researcher aimed to determine the effect of word processing on the learning of writing skills of students with learning disabilities. The researcher used a special software computer program designed for students with learning disability in mastering writing skills. Zhang (2000) realised that these students had difficulties with constructing sentences, spelling, developing main ideas, forming paragraphs, and certain other mechanics of writing. In addition, Zhang noted that these students were not motivated to learn and were not even enthusiastic for almost all the academic work. Quite often they did not participate in writing or reading exercises. In order to help these students to be actively involved in writing, a special writing curriculum was designed to include 'ROBO-Writer'as the writing tool for these students. The students practised the exercise three times a week for twenty minutes per period, under the supervision of the teacher in the lab. The results of the study indicated that students' motivation in writing skills increased. Some of them produced well-written pieces of work. They also demonstrated positive attitudes towards writing and some of their work was neatly composed. For example, Zhang, (2000) observed a very good piece of writing produced by one student who used to be lazy and behaved badly in class. This student wrote a composition of three hundred and fifty words within twenty minutes, something he could not do before. The story had very few spelling mistakes and included some compound sentences (Zhang, 2000:473).

In conclusion, Zhang (2000) noted that the special programme ROBO-Writer designed for these students showed very encouraging results and helped to meet the special needs of students with learning difficulties. Zhang suggested that specially

designed tools should be created to help meet the educational needs of disadvantaged learners and that teachers should be involved in designing such curricula.

2.11.3.2. Using Word Processor for revision work

Computer word processing has also been used in the classroom as a tool for revision work. Synder (1993:59) observed a strong interest in the effect of word processors on revision of class work. This was revealed by a number of comparative and case studies documented by Synder (1993). These studies examined the effects of word processing on revision patterns and the quality of the writing produced when word processors are used. The results showed an increase in the frequency of revision exercises. The other findings revealed that a small number of students did not increase their revision exercise when using word processor. Other results indicated less revision with word processor alone, but the revision was more effective when a prompting program was incorporated in the word processing software, which encouraged learners to earry out revision exercises.

2.11.3.3 Using computers to learn Spreadsheets

Heinich et al. (1996: 237) defines a spreadsheet as a page of rows and columns that displays word, numeric, and formula entries. According to them, a spreadsheet can be used to record, average and manipulate data. They point out that spreadsheet programmes are easy to use tools that should be exploited by teachers and students to create graphics from numerical data. At the same time, Alessi and Trollip (1991: 249) add that spreadsheet can also help teachers to budget and to carrying out evaluation of students' examination results. In this connection, Ken and Anderson (1990:83) report that "a teacher may use a spreadsheet that enables her to enter marks for tests throughout the year and automatically calculates class averages for each test as well as maintaining an ongoing average for each student." Similarly, they say that "students may use a spreadsheet to compare the return on funds invested at various rates of interest, and work out income when different taxes are applied to the interest earned." Ken and Anderson (1990) feel that the real power of spreadsheet lies in the way students can ask "What if" questions. This question helps to stimulate students thinking skills and lead the learners to other uses of the spreadsheet. The use of spreadsheets is most applicable in school subjects such as business and economics.

Students can also use spreadsheets in "problems involving time, distance, and speed and relationships between sides, diagonals and angles in two-dimensional figures or edges, faces and verticals in three-dimensional shapes" (Ken and Anderson, 1990: 84). The use of spreadsheets helps students to plan, predict, and to explore given data. Therefore, in order for the students to learn and benefit from the capability of spreadsheets effectively, the teacher needs to play an active role. As the students work with spreadsheet, the teacher should be able to encourage them to explore, challenge their hypotheses, and help them to evaluate their prediction. From the contribution of Ken and Anderson (1990), the use of computers to teach spreadsheets would be effective in helping students in Kenyan secondary schools to learn subjects like business education taught in form one, and Economics taught in form three and form four if the computer could be integrated into the curriculum. This would help to prepare school leavers who opt to pursue advanced commercial courses and even those who join higher education studies in economics and accountancy.

2.11.3.4 Using computers to learn programming

Computers have been used in secondary schools in developed counties like America for the purpose of teaching programming. This is especially true at secondary level (Alkin, 1992). It is claimed that programming skills will lead to a better or more rapid development of higher cognitive skills to "improve thinking, comprehension of basic concepts, problem-solving abilities, planning ability and precision of expression and to lead to the discovery of powerful ideas"(Alkin, 1992:896). Moreover, Underwood (1994) adds that Logo programming provides an environment for the exploration of mathematical concepts. Secondly programming skills will be useful in helping students to find employment and to prepare some students to proceed for more advanced college courses (Alkin, 1992:896). In addition, McCoy (1996:438) reviewed several studies on computer-based mathematics learning and found that programming Logo was used to improve geometrical knowledge. McCoy (1996) noted the importance of teaching students programming skills and reported that in learning programming, students write their own programmes and create mathematical models, then the computer provides immediate feedback to assist them in exploring and refining their knowledge.

Similarly, Makau (1999:16) noted the value of learning programming skills. Makau feels that some aspect of programming should be taught in secondary schools in Kenya. He reports that programming has grown into a profession just like accountancy, law or medicine. But he regrets to point out that while professions like law and accountancy are integrated into the school curriculum, there is almost nothing in the curriculum to prepares students to go into programming. He believes that students who start programming early in their formative years are more likely to be better programmers than those who start after matriculation.

In addition, the need to teach students programming properly using quality materials has also been pointed out by researchers. For example, Cheng-Chih Wu, Lin and Lin (1999: 225) report that the quality of programming textbooks needs to be examined in order to understand how programming examples are used in the textbooks to explain to the students problem-solving concepts. Cheng-Chiu Wu et al. (1999:225) report on a study they conducted to examine 16 high school computer-programming textbooks used in Taiwan. The purpose of the study was to look into the nature and the presentation style of programming examples in the textbooks. The researchers based their examination of the presentation styles of programming into four major problem-solving steps such as: "problem analysis, solution planning, coding and testing/debugging." According to the report, the textbooks were examined by two groups of people: the authors and a high school computer teacher. Furthermore, the assessment focused on the programming examples contained in each textbook. Cheng-Chih Wu et al. (1999) designed three types of questions to guide them in assessing the programming examples objectively and systematically:

> What type of the problems is solved by each programming example?
>
> In what form is each problem-solving step presented in an example?
>
> Which of the four problem-solving steps are specifically described in each example (Cheng-Chiu Wu et al. 1999:229).

In addition, the researchers prepared a list of items that they referred to in relation to the three questions. The results of the study were then compared and indicated that the problems solved by all the examples in the programming textbooks included mathematics problems, graphics problems, syntax-oriented problems, and real-life

problems. Other findings showed lack of detailed explanation of some of the problem-solving steps, in particular problem analysis and testing/debugging. Moreover, other results revealed that most of the authors of high school computer textbooks were not trained in computer science but had attended in-service courses. Finally the researchers recommended that in order to improve the quality of computer programming textbooks for high schools in Taiwan, a list of review criteria should be set up. This recommendation is quite in order more so for developing countries like Kenya where there is lack of qualified teachers to write computer programming text books and consequently use books donated from developed countries and no one knows whether they are relevant to the needs of the students.

2.11.3.5 Using Computers to maintain Databases

A Database is a computer program intended to keep information in an ordered form like a filing system. It is simply a collection of related information organized for quick access to specific items of information. Heinich et al. (1996:408) feel students in schools need to learn how to manage information, to retrieve information, to sort out resources, to organise information and to evaluate their findings. Heinich et al. (1996) add that a database is a versatile and easy to learn computer tool. He believes that students can access databases for inquiry and research studies and at the same time, they can create their own databases. For example, he says that students can design information sheets and questionnaires to collect data, put in relevant facts, and then retrieve the data in different ways. Heinich et al. (1996:232) believe that once the students complete constructing databases as part of their learning exercise they are able to engage in higher-level thinking skills as they analyse and interpret the data. However, Ken and Anderson (1990:75) point out that if the students have never used a database programme before, it is better for the teacher to start by obtaining a database or creating one for them instead of expecting learners to create their own databases. Students need to have time to consider questions related to planning and design of databases before they can embark on any assignment. According to Ken and Anderson, the process of learning database can be broken into three stages. In the first stage the students learn using a database ereated by somebody. Secondly the students build their own database in which the record format has been designed and tested by the teacher. And third, the students investigate the database subjects and then design

the record format for themselves before building their own database for use. Ken and Anderson (1990:74) report on the role of the teacher in using database as a learning tool. They identify five important major roles that the teacher needs to play in helping students to learn database skills. Such roles include:

Teacher as a planner: must link database lesson to the subject matter related to the curriculum, to be familiar with the operations of database, experiment with various databases and lesson ideas, and consult with other teachers who use databases.

Teacher as Facilitator: should be familiar with the subject matter being studied and be conversant with operating database program in order to assist students having difficulties, and to carry out some evaluation.

Teacher as Guide: should be able to use questioning strategies to guide students to higher levels of thinking or to the application of different strategies.

Teacher as Manager: must be able to prepare the necessary disks and classroom resources and collect other relevant materials for students to use in other areas as in decision-making.

Teacher as participant: Accept assistance and ideas from students as part of the collaborative environment and provide learners with plenty of opportunities to learn. In conclusion, the teacher needs to exercise tolerance and patience to help students as they learn database management. The teacher needs to train the students to recognise and appreciate databases, and understand that the ability to use a database effectively is a skill valued in the job market (Ken & Anderson (1990: 74).

Research studies confirm that teaching and learning database is useful and beneficial to both teachers and students. Davis (1995) cited in Berson (1996: 493) describes the result of a small-scale experimental study he conducted using ninth grade students studying social studies. The students were exposed to computer-assisted instruction using a time-line database and concept-mapping program. The researcher used two groups of students. The results showed a significant improvement for students using computers compared to the control group. The students in the experimental classes demonstrated "increased academic achievement, motivation, self-directed thinking, self-initiated activity, construction of memory, analytical analysis, and collaborative

peer interaction." Other results indicated that the experimental students demonstrated positive attitude towards the content and instructional design. Moreover, teachers acknowledged the potential of computer database in teaching social studies compared to using conventional methods. They noted that computer database enabled them to plan their work carefully in order to restructure the learning environment. Thus, computers were integrated and used successfully in teaching and learning information handling skills. Students learnt by doing, acquainted themselves with information and created databases. Such usage of computers in education would be useful if implemented in Kenyan secondary schools.

2.12 Integration and use of computers in curriculum subjects

Computers have been used in developed and developing countries as an instructional medium to improve the quality of teaching and learning. As such computers have been incorporated into many school subjects and are widely used for direct instruction in science experiments, mathematical calculations, social studies, languages, graphics and many other subjects (Sakamoto and Miyashita, 1996; Heinich et al. 1996; and Johnson, 1996).

2.12.1 Learning mathematics with computers

Hunter (1994: 510) reports that, in America, there is a generation of elementary and secondary students who lost interest in mathematics and science despite the fact that educational technology like computers are available in the schools. Consequently, there have been continuous calls for creative and innovative approaches to the teaching of mathematics and science to enable students to understand these subjects better. However, McCoy (1996:438) reviewed several studies on computer-based mathematics learning and found that computers have been used to teach mathematics in three distinct ways: programming logo, computer assisted instruction (CIA) in the form of Micro worlds and as mathematics education tools.

The problem with the teaching of mathematics has been a concern to the USA government. Clark (2000:179) reports that the National Centre for Education Statistics (NCES 1998) revealed that few teachers used computer-based technologies for teaching purposes, and that computers were not integrated into most instructional

curriculum. Therefore, following mounting concern about the low performance in mathematics by students in middle and high schools in America as reported by Hunter (1994:510), Azita (1999:33) carried out an investigation to examine the extent to which computers were being used by middle and high school mathematics teachers in the state of Missouri. The aim of the study was to find out how frequently teachers used computers in their classrooms and to establish specifically the purposes for using the computer, and to identify the factors influencing teachers' decisions about the use of computers. Azita (1999) adopted a questionnaire survey method to collect data. The study involved one hundred and eighty one participants. This sample included 65 middle and 116 high school mathematic teachers representing 65 school districts from urban, rural and suburban areas. After data analysis, the results indicated that teachers did not use computers for any other purpose apart from drill and practice. Azita established that teachers did not have adequate knowledge about when and how computers could be used in teaching and learning mathematics. Further analysis showed that teachers were also not effectively trained in the use of computers to teach mathematics. Azita suggested that there is need to encourage teachers to find more time to teach with computers and thereby to interact collectively with students as they learn mathematics. Azita recommended the integration of computers into mathematics curriculum in order to provide a problem-solving environment for the learners and the teachers. Azita believed this would instil a sense of being more responsible and committed to the use of computers in teaching and learning mathematics.

In conclusion, the researcher noted that mathematics teachers were not adequately trained in the use of computers and, therefore, were not convinced about the usefulness of computers in their lesson presentation. Further results indicated that teachers did not recognize the potential of computers in enhancing the curriculum they teach. Due to lack of teachers' positive beliefs on the capabilities of computers to improve students learning mathematics, and their ineffective training, Azita suggested that teachers must be competent and have confidence about their understanding of mathematics content. Azita felt also that teachers must posses adequate knowledge about the pedagogical issues related to teaching mathematics content effectively. Azita stressed that if teachers are to improve the standard of mathematics education, they should have access to computers and they should have adequate knowledge about the software and its capabilities. They should also be conversant with the use of

computers in teaching and learning. Above all, Azita recommended that in-service training on new technologies should be provided to maths teachers. And lastly, he recommended that there is need for teachers to be supported by their communities in order to perform their work effectively.

2.12.2. Learning science with computers

Teaching and learning science, whether in developed or developing countries, requires the use of various teaching aids/apparatus. Again, in most areas of science education, the use of technology is quite acceptable and highly recommended to enhance learning. Researchers have pointed out the capabilities of computers to improve students' scientific knowledge. For example, Woodrow (1994:579) noted the value of integrating technology into science teaching and stated that "computer-based technology gives science teachers access to a rich variety of textual materials and graphic information." Woodrow (1994) explained that the use of computers provides new instructional strategies which the teacher and students can employ. This includes sophisticated laboratory and simulation tools.

Yet many science teachers shy away from incorporating technology into their teaching and learning process despite the availability of computers in the schools. (Clark, 2000:179) pointed out that few teachers used computer-based technologies for instructional purposes and that computers are not being integrated into most instructional curricula. Heinich et al. (1996:236) noted that advancements in technology have now made it possible to integrate computers into the school curriculum and hence into the teaching of science. He stressed that the emphasis in teaching and learning should now be on providing learners with the opportunities for problem solving. This, he believed should include cooperative learning methods which may not necessarily require additional special training on the part of the users. He further stated that computers are now more of a natural tool to use in teaching and learning because a wide variety of software is available. This provides students with experiences to work together to solve complex problems. He also believes that when the computer is integrated into the curriculum, students will be able to incorporate several different types of computer applications to explore a problem in a particular field. So the traditional method of teacher-centred instruction used by most teachers

will change. The students will learn by doing which is the corner stone of all science learning. The students will also learn to explore topics in science and create meaningful learning experiences for themselves (Heinich et al 1996:236).

When the computer is integrated into the classroom the role of the teacher changes from that of the information provider to that of a facilitator of learning (Clark, 2000:180). For example, to integrate technology into teaching and learning effectively, Heinich et al. (1996:136) suggests (a very simple integration approach as an example) that the teacher could give students an assignment to prepare a report on ecology. A group of students would use a computer database to search for resources to use in compiling the report. They could also send electronic messages to people in various places requesting relevant information. In addition, the students could use a data base program to store and sort out their information. At the end of their research they could use a word processor and hyper media program to prepare a written document. Lastly, the students would use a projector to display their findings to the rest of the class. In this type of computer integration into learning science, Heinch et al. (1996) emphasises that the teacher must provide opportunities for learners to complete their work and learn effectively. If this strategy is to be effective, the teacher needs to plan in advance to integrate the computer into teaching and learning, prepare good learning environment for the students, and work in collaboration with the students during the research period. After the presentation, the teacher could organize for a science quiz session for all students or give further assignments.

In another instance, Christman and Badgett (1999:135-143) carried out a comparative study to evaluate the effectiveness of CAI on the science achievement of American students following two different teaching methods. The assessment covered four subject areas: General science, Physics, Chemistry and Biology. The participants were drawn from urban, suburban and rural secondary schools. The sample included a total of 2343 students. The purpose of the study was to establish the differences that existed between the academic achievement levels of science students who used computer-assisted instruction and those who used traditional approaches to learn biology, general science, chemistry and physics. The experimental group that used systematically designed traditional instruction supplemented with CAI obtained significantly better academic achievement compared to the control group that adopted

a conventional teaching approach. Further results indicated that CAI was more effective among science students living in urban areas followed by those in suburban and those from rural areas had the lowest test score. In conclusion, Christman and Badgett (1999) appealed for more research to establish whether CAI could be more effective or ineffective among groups of students or within certain academic areas so as to support effective use of CAI in science subjects. This study is potentially relevant to the proposed study in Kenya because it will also consider differences in computer use among urban, suburban and rural schools. In fact, some of the apparent limitations of the Christman and Badgett study will be used to guide the data analysis in the Kenya study. In particular, the Kenya study will take into consideration the differences in the availability of computers between urban, suburban and rural schools, a factor that seems to have been overlooked in the Christman and Badgett (1999) study.

Researchers who support computer integrated learning in science subjects apparently generally do so because of their conviction that one kind of medium will supplement and improve the effectiveness of another media, thereby making the teaching/learning period an exciting experience to both the teacher and students. The use of a variety of media seems to improve the effectiveness of media like computers (Hargrave & Kenton, 2001). This is because there is no single medium that is adequately suitable to meet all students' needs and even the most excellent technology must be frequently supplemented with discussions, demonstrations, displays experiments and even field trips.

Similarly, McRobbie and Thomas (2001:142) conducted an experimental study to investigate the factors that influenced teachers and students to use Microcomputer-Based Laboratory technology in chemistry lessons. The participants were drawn from an Independent high school located in a Metropolitan city in Brisbane, Australia. The sample of the study consisted of 12 males and 9 females (15-16 years) studying Chemistry as part of a general science course in year eight, nine, and ten. The researcher used two types of experiments that involved the use of MBL and covered topics such as: boyle's law, pressure-volume relationship in gases, and pressure-temperature relationship in gas.

These scholars used video recordings, tape recording and face-to-face interviews to collect data. At the end of the experiment the data were analysed and the results showed mixed responses. In the first place, the subject teacher supported the use of MBL to learn science but was not ready to change her methods of teaching science. She believed in a teacher-centred approach. For example she responded "I feel most comfortable with a teacher-centred environment" and "I only feel comfortable when its' teacher-centred," Moreover, some students responded positively. One student said "I like how we are being taught" ---practical work is used "to prove theories that we are doing in class"- -most of them are done to prove a point"- - "it's a break from the textbook" - -"more than anything else they are more enjoyable." At the same time some students did not like the use of Microcomputer-Based Laboratories. One of the students said "I just saw the computer as a measuring device."

Such opposing views about the new technologies indicate that there is need for background studies to be undertaken before an experimental study is carried out. Starting from the teacher would be an ideal approach. Once the teacher is comfortable with the technology, the students will also be willing to use the computer because they will have seen the teacher using it in teaching them. The experience of the teacher is also an important factor to consider. In this experiment the teacher was not trained in computer applications and did not regard the technology as a potential medium to improve students' scientific knowledge. Therefore, for any meaningful learning to take place in an innovative venture like the use of MBL, the role and experience of the teacher needs to be examined carefully. The implementation of computers in education cannot be effective if teachers are not ready for using the technology. Teachers' beliefs and fears about new technologies like the MBL in learning science need to be addressed first before an experiment is undertaken.

Although computers have been widely recognised as a potential tool for teaching and learning science subjects, the effective utilisation of the program is required if students and teachers are to benefit. Hargrave and Kenton (2000:47) feel that what has been lacking is instructional methods that take advantage of the computer and engage students in advanced ways of thinking. The educational value of computer programmes depends on many factors in a similar way to traditional instruction. Some of these factors include: the content of the program; its relevance; the teachers' ability

to use and to guide the students; students' own ability and interests to learn; and the different application techniques employed by the teachers.

The availability or non-availability of the above factors contributes to the success or failure of computer program integrated learning. In this connection however, Hargrave and Kenton (2000: 47-56) report some procedures to be followed in which the teacher's role is only to guide the students, prepare the learning environment and take part in the program with the students. They highlight specific value attached to effective ways of using a computer simulated laboratory that involve:

- Preparatory activities on the part of the teacher,
- Pre-Instructional simulations and
- Post-Instructional simulations

According to Hargrave and Kenton (2000:47) computer simulations are used to teach students many topics in science subjects, because the "mental and physical dexterity required to use a simulation that engages students in learning." Hargrave and Kenton (2000) report that simulation is often used to stimulate students' interest in a topic in order to promote active learning of problem solving and the study process. As such, computer simulations have been employed in science education to teach students about "cardio-vascular circulation, fire, heat, velocity and electricity." All these require careful planning and preparation by the teacher in advance. Effective use of computer simulations depends upon the teachers' ingenuity in bringing to bear on the materials those aspects of their students' experience that make the program important and significant for them. Hargrave and Kenton (2000) recommend that when the teacher plans to use computer simulations the students should first learn the content of the lesson. They suggest that the teacher needs to use appropriate traditional teaching methods such as lecturing to present the essential important information to the students. Then the computer simulation is used either to supplement the content or to reinforce what the teacher has taught. The scholars also believed that an appropriate computer simulation could be the main source of information and understanding for students.

2.12.2.1 Pre-Instructional Simulation

Pre-instructional simulations are one special form of pre-instructional strategy, that is a strategy for preparing students to learn. In a general sense, pre-instructional strategies fall into four categories: overviews, advance organizers, questions and statements of learning objectives. Each of these strategies can be an effective way of focusing students' attention on the important things they are to learn and motivating them to engage in learning.

Furthermore, Hargrave and Kenton (2000:50-51) explain that pre-instructional simulations provide students with the opportunities to develop new conceptions. For example the scholars explain that before formal teaching "about photosynthesis, students in a fourth grade class use a computer simulation about how plants receive nutrients." Hargrave and Kenton (2000) believe that using the simulation prior to formal instruction allows the students to activate or test their experience about plant nutrients or start to develop a personal conception about plant nutrients. In this usage, pre-instructional simulation can serve as a foundation for further learning and assist in the development of students' detailed knowledge about the topic. During this time the teachers' role is to provide more assistance to the students to learn effectively from the simulation program.

2.12.2.2 Post-Instructional Simulations

Hargrave and Kenton (2000) explain that post-instructional simulation is used to test students' knowledge of content. They also emphasize that post-instructional simulations place students in unique and specific learning roles in which they must activate or utilize previously acquired knowledge. They give a vivid example of how computer simulation could be used after the teacher has taught a lesson on the respiratory system. Students in a biology class use a computer simulation to review the functions of each organ in the respiratory system. So in this way, these scholars report that simulation is used to reinforce students' knowledge of the content presented during formal teaching. I support their point of view with my experience with using media like cassette tape recording that teachers can use either to introduce the lesson, as the main part of the lesson or to reinforce what the teacher has taught. During post-instructional simulations there is a need also for the teacher to assist the

learners to benefit from computer simulations by checking if they are identifying specific points discussed before and clarifying what was not understood by the students so as to elaborate on it.

2.12.3 Learning social studies with computers

Computers have also been used successfully in teaching and learning social studies. This includes using technology to teach subjects like economics, geography, history and languages to mention a few. Some of the early studies found positive gains in secondary students' performance and attitudes towards the subject matter, and in using computers for storage and retrieval of information compared with using traditional teaching methods. According to Berson (1996:489) computers have been integrated effectively into learning games and simulations in social studies. He reports that computer simulation enables students to engage in activities that are not easily taught adequately by traditional approaches. For example Berson (1996) reports on the secondary school students involved in the creation of computer-based simulations to represent system dynamics. The students in an experimental course on War and Revolution were introduced to the Structural Thinking Experimental Learning Laboratory With Animation. The students engaged in model construction that required the use of analytical and problem solving skills. Berson (1996) noted that students created and revised models of political-social events. The impact of this curricular approach on students' content knowledge and higher order thinking skills was not determined empirically. Berson (1996486-487) believed that simulation facilitates the development of students' problem solving skills, and puts them in the role of decision-makers. By using the computer students can gain access to expensive knowledge links and broaden their exposure to diverse people and perspectives. He feels also that simulation improves students' higher level thinking skill development, and exposes learners to information that widens their knowledge about the content area. Berson acknowledges the power of computer simulation to motivate students, and to improve their intellectual curiosity, sense of personal control and perseverance.

In addition, Berson (1996:491-493) states that the major reason for integrating computers into the social studies curriculum is the belief that computers encourage problem solving and facilitating an inquiry-driven approach to leaning. A study by

Crozier and Gaffield (1990: 72-77) cited in Berson (1996:493), found that integrating computers into the social studies curriculum aids learners in the development of "historical imagination, skills of critical analysis, and understanding of complexity of American history." Further results indicated that students increased their imagination and creativity and the computer encouraged them to develop insight, to examine relationships and to analyse patterns reflective of their thinking about historical processes. This is a clear example of the ability of appropriate computer simulations to engage students in higher order thinking-one of the important aspects of productive teaching and learning.

Moreover, in a recent study on the use of computers to learn social studies, Addison and Fridman (1997:157-160) carried out research with students from Westridge High School in South Africa to examine the use of specialist software in teaching accounting. The aim of the study was to contribute to an understanding of ways in which computers might be employed to address pressing educational concerns in South Africa, and in particular the use of the new software for teaching Accounting skills in secondary schools. The sample of the study included 22 boys and 33 girls. The researchers used a special locally developed accounting software package for three to four weeks. The students worked in pairs. At the end of the study, the students were each given a questionnaire based on the study package. Data analysis showed that student's knowledge of accounting increased and the students were motivated and enjoyed using computers to learn accountancy. Despite the learning gains by most of the students, the researchers noted several problems such as lack of enough facilities in the computer centre for all students to work comfortably and independently, the weaker students did not benefit, and students' attention was also distracted by the noise from the printer. Furthermore, the researchers compared the results of the students at Westridge High School with the result of a similar group of students from another school who did not use computers and there was no significance difference in their achievements. However, the students who used computers showed positive gains. The use of a specialist software package improved students understanding of Accounting principles, their understanding of the relevance of Accounting for a business, and the software enhanced interest in learning Accounting at schools. As a result of the positive gains of the pilot study, the researchers recommended another study to cover more schools. A similar comparative

study conducted by Klein and Doran (1999) on the use of computer simulation in accounting indicated high performance but that the students who worked individually expressed significant gain. This finding confirms the potential of computers for individualized instruction as reported by Ellington and Race (1993: 222).

2.12.4 Using computers to improve learning foreign languages

There is a good reason to believe that computers can be used to improve and promote the development of students' communication skills, more so in learning foreign languages such as English (Crook, 1994; Heinich et al. 1996; Herman, 1995, Hurst 1996 and Barbara 1994). From my own experience, the computer can provide the learners with a ready-made dictionary. The student does not waste time looking for a book dictionary. The computer dictionary gives the learner instant access to word meanings without a time-consuming search and with less disruption of reading the text. It is motivating and easy for students to refer to it in all reading and vocabulary development.

The value of computers is also noted in teaching and learning sentence construction, comprehension, composing and in creative writing. Heinich et al. (1996:242) recognize the ability of the computer in teaching English language and report that "spelling and grammar checking are available to students. A thesaurus makes it easier for them to find the right word for a specific situation." Far back in 1990, Ken and Anderson also recorded the capabilities of the computer as a tool to teach students communication skill and stated that:

> Computer communications provides students with an enormous amount of motivation for writing. There are many opportunities to develop skills in typing, reading comprehension, written composition, and oral communication. At a personal level, students begin to feel that they are in control and are responsible for the decisions they make (p.69)

Thus, using computers for teaching and learning languages helps students to have confidence in effective communication that requires careful integration into all language programmes taught in secondary schools. In fact Carol (1997: 52-59) felt that integrating computers into teaching English language was an ideal step. Carol

(1997) carried out a survey in West Midland Secondary Schools in England. She used a questionnaire survey method to examine the use of computers in modern language teaching. Two hundred and fifty secondary schools received questionnaires but only 87 Heads of Department responded and the analysis revealed several important issues concerning computer integration and classroom use in the sample schools. Carol (1997) noted that school policy, departmental policy, availability of hardware and software, access, policy on planning and use of the computers by teachers from the language department were crucial. However, with regards to the utilization of computers in learning modern languages, 56% of the departmental heads replied that computers were an integrated part of their schemes of work. 28% were working towards the integration and 14% said computers were not integrated into their departmental schemes of work. 4% of the 14% indicated that it was up to the individual teacher to integrate computers into teaching and learning languages. Furthermore, sixty-two of the departmental heads reported that they had a whole school policy on the use of computers. Some of the heads recommended that integration of computers was best by subject topic areas, and half of the departmental heads suggested specific topic activities and relevant software in their schemes of work. Carol found also that computers were used mostly in revision work, vocabulary and producing text, especially writing letters. Pascoe (1994:615-617) qualitative and quantitative research reported similar findings but he noted specifically high gains on students' composition work.

So the computer as a tool for teaching and learning has been successfully integrated into English language classes to help improve teaching and learning English in schools. The use of computer technology in language teaching could be motivating to students in Kenya, especially if it can be employed in teaching the Kiswahili language in secondary schools in Nyanza province where the standard of written Kiswahili is low.

2.12.5 Using computers to learn graphics

According to Heinich et al. (1996), graphics are two-dimensional non-photographic materials designed to communicate a specific message to the viewer. Graphics are instructional material that summarizes significant information and ideas through a

combination of drawings, word symbols and pictures. Graphics include display materials such as charts, graphs, diagrams, posters, cartoons and comics. In teaching and learning, graphics assist in focusing attention on core information and in conveying ideas in a manner that is easy to capture and retain in memory. Many researchers have also reported the ability of the computer as a tool for teaching and learning graphics (Crook, 1994; Heinich et al. 1996; San Jose, 1995). However, Alessi and Trollip (1991:38) add that new software for microcomputers makes it increasingly easy for teachers and students to produce graphic materials for teaching and learning. Alessi and Trollip (1991:38) state that there are many ways a teacher can employ graphics in lesson presentation. Some of these approaches include: using graphics as the primary information: for example, the picture can be used as the source of primary information. They can also be used as an analogy: the picture could be the main concept and as a cue, the graphics could be used for focusing attention on important text information. Alessi and Trollip believe that a computer integrated education approach excels in graphical expressions.

Crook (1994:22) shares these views with Alessi and Trollip. Crook (1994) reports that using computers as tool can offer a different and distinctive kind of experience in graphic media. Crook (1994) cites his own research on young children using screen-painting programs. This study suggested that the computer tools could cultivate a more editorial attitude towards graphic creations. Crook (1994) noted that using computers to produce or learn graphics extends the learners' experience of drawing, writing, classifying and calculating. This seemed an exciting enterprise to the students. Crook (1994) observed that students' classroom activities involved production of geometrical shapes. Moreover, Crook (1994) found that the resources of Logo-based turtle graphics provided learners with a new device for manipulating some of the familiar graphic products that generated visual patterns though controlled execution of various computer commands and procedures.

Consequently, San Jose (1995:211) believes that a computer integrated education approach is the best for teaching students graphics skills. He also points out that in the field of drawing and design, many professional graphics artists now rely on the power of computers. San Jose feels that any curriculum attempting to be complete must include the use of computer aided design and drawing.

2.13 Summary

After examining all the research work reviewed, it is important to point out that computers offer the potential to greatly enhance teaching and learning in the classroom. But due to their complex technical nature, this potential has not always been realised to the full. This has been as a result of the slow pace of integrating computers into curriculum instruction. Teachers need to be encouraged to use computers so as to improve the quality of learning, to motivate students and to provide variety in lesson presentation rather than using only traditional methods of teaching.

In this chapter I have described the research findings on the use of computers as productivity tools within existing school subjects or in special courses. This has included instruction in computer literacy skills-the ability of students to use word processors, spreadsheets, database management and programming. It has also been established that computers are widely used as a tool for direct instruction in subjects like mathematics, science, language, and in social studies. The integration and use of computers illustrates how it is possible to bring another teacher into the classroom to help to reduce the monotony of the classroom teacher's voice and in order to avoid students' boredom. In this usage, teachers need to be conversant and competent with the classroom use of technology. The emphasis should be on the need to integrate and use computers to help meet certain educational and specific individual needs of students in relation to instructional objectives and the country's national goals of education.

Thc use of computers is now an integral part of classroom instruction in most of the developed countries and is regarded as a valuable tool for teaching and learning. The integration and use of computer has been widely argued to be capable of providing uniform education to all learners in the class. Students differ widely in their ability to learn and comprehend concepts or ideas in classroom teaching. So the use of computers helps to meet individual learners' needs. However, like all other media meant for teaching and learning, computers have disadvantages as a medium of instruction. For example, computer-based instruction lacks face-to-face contact. It cannot cover a wide area of the syllabus, and some programmes could be unsuitable to students (especially commercially produced programmes).

Despite some of the limitations, computers furnish fresh curricular resources. They can provide teachers and students with opportunities to learn by discovery, and to improve in various subjects. In science for example, computers are useful in carrying out complex scientific experiments. They excel in graphical expressions. Computers encourage students to want to learn. The use of computers has enabled many students to improve their communication skills. If used appropriately, computers could help teachers and students to improve the quality of learning. Consequently, effective utilization of classroom computers requires a dynamic integration process, whereby programs and uses are adapted over time to increase total instructional efficiency. To achieve this, computer software applications need to provide relevant and quality materials to be integrated into teaching and learning.

The main purpose of this review was to identify and examine various ways in which computers have been used and integrated into teaching and learning. It has examined previous studies in developed and developing countries which merit further investigation in relation to Nyanza Province. This review has indicated that the computer is a powerful tool capable of improving the quality of learning science, mathematics, and excels in graphical expressions. The review has supported my research work by identifying two main questions to be explored in the case studies in Nyanza Province, Kenya. For example, the study by Clark (2000), and Zhang (2000) indicated that computers were used into the classroom teaching and teachers were actively involved, and collaborated with learners. In my studies, I will investigate and examine how teachers use computers and explore issues of whether computers are integrated and used for similar reasons in Nyanza Province. In the next chapter, the researcher examines the factors that encourage and affect the integration and use of computers in teaching and learning.

CHAPTER 3

FACTORS FACILITATING AND AFFECTING THE USE OF COMPUTERS IN SCHOOLS

3.1 Introduction

In this chapter the researcher discusses the factors facilitating and affecting the implementation of computer education in schools. It is concerned mainly with identifying and describing the key factors through a review of literature. As in Chapter 2, the factors are derived from research work in developed and developing countries, and other factors have been cited where necessary from my own experience. The factors are reviewed according to a two-fold classification of categories of factors: factors at school level, and factors at teacher level (Veen, 1996:69). In addition, factors identified by (Anandra, 1998; Carol, 1997; and Chiero; 1997), and other scholars are examined. For ease of the review of related literature, the chapter is organised as follows: First the chapter examines the factors related to the need to improve the quality of teaching and learning (or dissatisfaction with existing curriculum) and, the preparation of students for the future. The second factor concerns the knowledge and skills in computing that exists among teachers to implement computer technology in the schools. This is followed by a review of the availability of resources for implementing innovation. The next factor considered concerns time set aside for effective use of technology in teaching and learning. The chapter then examines the need to provide incentives or reward to encourage teachers to take part in the implementation process. Effective implementation of computers in schools requires support from school administration, commitment by all the parents, and the support from the Ministry of education. The other factors that affects the use of computer includes lack of teacher training and preparation in the use of technology; negative attitudes of teachers towards the technology, lack of equipment and other resources; access to resources; lack of time; technical support; motivation; cost and cost-effectiveness; and the organisational factor. Finally, the chapter ends by summarising the different effects of these factors on the effective integration and use of computers in teaching and learning.

3.2 Factors that encourage the introduction and use of computers in schools

3.2.1. The need for educational reform

When the government in a developed country realises that there is something missing in the provision of the education offered to children in schools, or there is some dissatisfaction with the present education system, a common response is for the Ministry of Education to conduct an evaluation of the existing patterns of education. This helps to provide more information about whether educational policies and activities have been successful or not. Then the need for change or reform is advocated by those affected. The demand for curriculum innovation can come from the parents for their children to receive the type of education offered to other children elsewhere, or the government can initiate the innovation. In recent years any analysis of the need for changes concerned identification of some needs related to computer technology. For example, Mizukoshi, Kim, and Lee (2000) report that in Japan, the Ministry of Education suggested several reforms in the formal education sector. Some of the innovations stated that computer education was to be included in the curriculum. The others indicated that teaching methods were to change, teaching materials were to be developed, technical training was to be provided, and a support system was to be developed. It included also the improvement of physical facilities, conducting scientific research and provision of the Internet to over 40, 000 schools. The most important factor was the Ministry of Education's support for the innovation that included also compulsory computer education to all junior high school students and Internet connection to all primary and secondary schools by the year 2001.

Similarly, in South Africa, the government white paper of 1997 section 9.7 discussed technology education. The paper noted the need for technology education in schools and initiated "a pilot project to be implemented in the general education phase." The White paper report indicated support to "assist the Department of Education in developing a technology education programme for schools."

The need for educational reform cited above were important and seems to be similar to the process of curriculum innovation in Kenya. For example, prior to 1984 the general education was organised into four sectors: primary school (seven years); lower secondary (four years); upper secondary (two years); and university education

(at least three years). This pattern of education came about after there was an outcry about the education system that was not meeting the needs of the learners due to problems related to poor methods of teaching, teacher education, resources and the curriculum content. The government appointed a commission of inquiry (the Ominde commission of 1964) to collect views and suggestions from the public and made recommendations for the new curriculum. This included evaluating the existing curriculum and teacher training programmes. The Ominde commission of 1964 recommended the restructuring of the curriculum and the introduction of the use of school radio programmes to improve methods of teaching and learning in schools. When there was another complaint from the public about the quality and scope of education offered to the children, the Government appointed a commission in 1981 chaired by Mackay to seek views from the public and compiled a report. The Mackay Report (1981) recommended restructuring the school system from 7.4.2.3 nomenclature that is: seven years of primary education (grades 1-7), four years of secondary education (Forms 1-4), two years of higher education (Forms 5-6), and a minimum of three years university education, to an 8.4.4 system. The new education system (8.4.4) comprised of eight years of primary education (grades 1-8), four years of secondary education (Forms 1-4) and a minimum of four years of university education. The main objective of the new system of education was aimed at diversifying the curriculum of the entire education. The government accepted the recommendations and directed the Ministry of Education to make preparation for the implementation of the revised curriculum in 1985. So a new system of education was introduced which extended primary course to 8 years, a single four–year secondary course was created, and the minimum period of university education raised to four years (Mackay Report 1981). Therefore, the needs for any educational change start from the parents and the society at large and must be examined by educators and researchers in an attempt to provide possible solutions.

3.2.2 Teachers' knowledge and skills are necessary for curriculum innovation

Teachers who implement any curriculum innovation related to computers must posses sufficient knowledge and skills to teach computer literacy skills. This factor is very essential. Teachers must be competent to deliver the required knowledge. The public may demand computer knowledge to be imparted to their children but if teachers have

no skills, then it becomes difficult to implement computer education. Teachers must be competent with the use of computers in order to teach students how to use and learn with the computer tools. Therefore, knowledge and skills must be present for any technology innovation to take place effectively (Chiero, 1997; and Carol, 1997). Similarly, Opie and Katsu (2000:81) reporting from Britain noted the concern of the Department For Education and Employment (DfEE) "to equip every newly qualified teacher with the knowledge, skills and understanding to make sound decisions about when, when not, and how" to use computers effectively in teaching particular subjects.

In a similar study, Dexter, Anderson and Becker (1998:36) stressed that "for teachers to implement any new instructional strategy, they must acquire new knowledge about computer and then weave this together with the demands of the curriculum, classroom management, and existing instructional skills." In this connection, Sandholtz (2001:368) gives an example of how teachers who acquired knowledge and skills of using computers led to increased levels of classroom implementation of computers as one teacher reported "I was a nonuser of computers. Turning one on took major effort. Now I can use one well enough for classroom use, as well as help students do essays, etc. on them." Another teacher said " I gained a feeling of excitement and being capable. I gained a sense of accomplishment a feeling that helped me try new ways to use technology." Consequently, teachers' knowledge and skills facilitates the subsequent integration of computers into classroom instruction. For teachers to make informed choices, Heinich, Molenda, Russell, and Smaldino (2002:212) state Teachers "need to be familiar with the various computer applications-games, simulations, tutorials, problem-solving programs, word processing, graphics tools and integrated learning system."

Teachers can acquire knowledge of computing skills through in-service courses, self-instructional programs, tutorial assistance and formal training. Teachers should be encouraged to continue their professional development in computing.

3.2.3 The necessity of resources for teaching and learning with computers

The teaching and learning materials required to enabled technology innovation to work should be easily available. This factor is the key requirement of all curriculum

innovation including technology. Without the hardware and software it is impossible to implement changes that require such support and other teaching and leaning materials. According to Mizukoshi, Kim, and Lee (2000), resources are tools, and the support materials that are used to learn computer skills in order to acquire learning objectives must be provided. These materials include computers, software, diskettes, printers, teachers' guides, students' manuals and computer textbooks. Clark (2000: 190) reported a common finding that "teachers wanted more software and equipment in their classrooms." Similarly (Zammit, 1992:59) found that "the second most important factor that encouraged teachers in the seven schools to start using computers was software availability." Therefore, based on the research findings from these scholars, it is apparent that provision of computers in schools would definitely encourage teachers to use them.

3.2.4 The availability of time for the use of computers in teaching and learning

Teachers must have time to implement the new technology. They need enough time to learn, adapt, integrate and reflect on what they do in the class with the students. Teachers need time to try things out, and reflect on their success and failures. They also need time to attend in-service courses, they need time to practice with new materials; and time to try out and evaluate new teaching procedures and to attend to their daily teaching load (Carol, 1997; Chiero, 1997; Dawson, 2000; Zammit, 1992).

A study by Dawson (2000:67) indicated that teachers were least satisfied with time for the use of computers. Availability of time is very important for teachers to plan and work effectively. Carol (1997:138) found that availability of computers was perceived as the most vital factor in building up staff confidence to integrate and use computers in the classroom. Other researchers have also expressed similar sentiment (Ertmer, et al. 1999; Hung and Chen, 1999: and Zammit, 1992). Therefore, time is an important factor in the successful adoption of any curriculum change. For example, a report by Coatzer (2001:72) indicated that the "time framework laid down for implementation of C2005 in South Africa in all grades by the year 2005 was unrealistic, because curriculum reform is a slow process" that requires enough time for teachers to train and digest the new curriculum.

3.2.5 Provision of incentives and encouragement to teachers using computers in teaching

The implementation of new technology in education requires concentration and devotion to duty. For some teachers, performing such work to their satisfaction is enough incentive, but for others it may mean providing them with more assistance such as advice, better facilities or financial benefits and professional development opportunities. It is possible for failure to occur in any innovation if teachers are not recognised and rewarded for the work they do. There must be adequate facilities and consideration of the role the incentives play on the implementation of new technology (Struddler et al.1999; Hung and Chen, 1999; and Parr, 1999) supported the need for reward and recognition for those who use technology. In this connection, Ertmer, Addison, Lane Ross and Woods (1999:65) report that as result of job satisfaction a teacher in their study reported how exciting and motivating computers were for the students and noted "That's my incentive-they get more excited." Another teacher described her own enjoyment in using computers and becoming more competent and remarked that " I'm so much more comfortable with it." Therefore, incentive varies for the individuals and reward for a well-done job could be an effective incentive to encourage a teacher to use computers, while others might need to be provided with material reward.

3.2.6 Teachers' participation in the initial computer technology innovation

The success of any technology innovation program depends strongly upon the support and attitudes of the teachers who will perform the implementation. There is need for shared decision-making that incorporates teachers' input and other educators in educational technology innovation. However, on many occasions, education innovation decisions on new programs are often made by others and handed down to the classroom teachers for implementation. Even if there are policies spelt out regarding innovation procedures, practices at classroom level are another thing. Unless teachers who are expected to implement the changes have a say in what to teach to students at what level it is unlikely that the innovation will be implemented with fidelity and enthusiasm. Classroom teachers' role and co-operation in the implementation of computer education have serious implication for teaching and

learning. Parr (1999:280) suggests that teachers need to be "involved in decisions about the place of information technology in the school in order to define their own objectives."

3.2.7 Commitment by the school authority to the use of computers in teaching

Curriculum or computer technology implementation in any school needs support and commitment from the school administration. Supportive leadership from the school authority remains essential in overcoming the fears and negative attitudes of teachers towards the use of technology. Even though teachers act alone in classroom teaching, they need inspiration and support from the Principal and Heads of Department. The Principal needs to provide funds to purchase the necessary materials, and to encourage teachers by helping them to attend seminars, workshops and training in order to obtain relevant information on technology.

The Principal also needs to provide suitable facilities for effective use of the computers (Parr, 1999). A study by Yee (2000: 291) found that the Principals portrayed a passionate commitment to providing appropriate ICT (computers) professional development support for their staff members. Yee (2000) noted that "each Principal was a very skilful entrepreneur who used a carefully constructed social network to locate creative sources of ICT (computer) hardware, software and expertise." Such commitments encouraged teachers to implement computer technology in teaching and learning. But if the style of administration within the school exerted no effort for computer technology implementation, very little will be done by the staff. Effective computer education development requires Principals to provide strong leadership support as reported by one Principal in the study by Yee (2000) "The teachers believe it is my job to find ways for us to do things (with ICT). I never take no for an answer....even if I run into a dead end. If it's really important to us, they know I'll make it happen."

3.2.8 Commitment by the government to the use of computers in schools

Computer education implementation in schools needs to be a government commitment for it to be achieved by all schools. If the government initiates computer programs, there is need to provide schools with necessary resources and to spell out clearly to the teachers how the program is to be implemented. There is need for

constant consultation, exchange of ideas that will encourage teachers' participation, and communication when they are faced with any major problem in curriculum innovation. This will ease the implementation of computers without any major difficulty. Coles, Richardson, Wilson, and Tuson (2000:167) gave an example of the Department for Education and Employment in Britain that increased the number of computers in schools and provided basic training in computers for practising teachers that reflected a commitment by the UK Government to integrate computers into teaching and learning. Pearson (2001:179-290) also reports similar commitment by the Hong Kong Government to computer education in all schools. Pearson noted that each primary school was to be supplied with 40 computers and each secondary school was to receive 82 computers. In addition teachers were to be trained and resources provided to teachers. However, it is not clear whether availability of computers in these countries and training of teachers resulted in the successful implementation of computers in teaching and learning. Research studies reported by Clark (2000); Albion (2001); Crawford (2000); Opie and Katsu (2000) and (Coutts and Drinkwater 2001) indicate that very few teachers use computers in teaching and learning. These scholars reported lack of resources, lack of teachers' commitment, and lack of proper training in the use of computers.

3.3 Factors that affect the use of computers in teaching and learning

Just as there are many factors that encourage the introduction and use of computer technology in education, there are also several factors perceived by teachers using computers as hindering the use of computers in schools. Some of these factors are teacher related others are concerned with the school administration and the government at large.

3.3.1 Lack of teachers' preparation to integrate and use computers in teaching

If the integration and use of computer technology in the classroom is to be effective, the inherent problems of teachers need to be examined so that a possible solution could be found. Otherwise schools will continue to face the inadequate utilization of computers for instruction. Teachers are the backbone in any curriculum innovation. They have a central role in integrating computers into schools. Therefore they must be trained properly in the use and integration of technology into the curriculum. Well-

trained teachers are the foundation of effective curriculum instruction. An effective strategy would be to concentrate effort on initial training through pre-service and in-service course programmes in computing skills.

Research conducted in developed countries like America, Australia and in Britain indicates that there are not many teachers qualified to use and integrate computers into teaching (Albion, 2001; Clark, 2000; Coutts and Drinkwater, 2001; Crawford, 2000; Opie and Katsu 2000; and Parr, 1999). These scholars reported that most of IT teachers were not qualified in the subject and the quality of teaching computers was not up–to- date. Coutts and Drinkwater (2001:227) noted that teachers lacked the knowledge or skills that would allow them to integrate computers into the classroom learning or to think about how ICT could be used to transform learning and teaching. Therefore, despite the pressure on teachers to increase the use of technology in education, progress towards integrating computers into the curriculum and subsequent widespread use in the classroom remains limited (Abbott, 2000 and Young, 2000).

Consequently, the success of integrating computers in education in developed and developing countries like Kenya depends strongly on how teachers have been prepared to use computers. The inadequate training of teachers in the use of computers has been claimed to be a major factor affecting the integration and effective utilization of computers in teaching and learning. Many studies have therefore, argued that in order to integrate and use computers in the classroom, all teachers should be trained in their use (Clark, 2000; Ranae and Troy, 1999 and Cameroon 1999). A study by Macaro and Erler (1998:89) carried out at the University of Reading in England reported complaints from the participants that "gaining experience and confidence, particularly in the use of computers and software was seen as the main current deficit in the use of computers in schools." Moreover, another study by Chiero (1997:135) found that lack of training was a problem frequently mentioned by teachers as the second highest obstacle to the integration of computers into teaching. Scheffler and Logan (1998:308) also noted that "teachers' lack of confidence in their computer skills and their ability to integrate computers into the classroom hampers effective computer implementation." In addition, Carol (1997:57) found that "teachers needed to be trained not only in personal computing skills but in the practical application of the skills, for example in the incorporation of a computer

into classroom use, in planning and in preparing schemes of work." Similarly, Abbott and Faris (2000:150) argued that the amount of computer experience provided to students during their training might affect the extent to which they will implement technology in their own teaching.

Nevertheless, Kay, Caffarella, and Tharp (1999) report the results of a case study that investigated the use and integration of educational technologies within pre-service education. Kay, et al. (1999) noted that teachers needed to be trained to change their role and responsibility from the "dispenser of knowledge to facilitators of knowledge acquisition to manager of information resources." Kay, et al. (1999) identified the inadequacy of pre-service course program that hindered the effective utilization of educational technology in the classrooms such as time, expertise, accessibility to equipment, resources and support materials. Kay et al. (1999) were convinced that if properly trained, the power of technology lies in the teachers' ability to appropriately select, integrate and evaluate computer tools to support learning. They gave an example of a way to integrate and use computers that required students to create "Hyper studio" and practice how to use the technology. This illustrated an important issue in the implementation of computers into teaching and learning, namely, the teachers' attitude and beliefs about the technology. When teachers develop confidence in using the technology, they will act more as facilitators by helping students access information, process it and communicate their findings (Dexter, Anderson, and Becker, 1998).

Effective teacher training in the use of computers has also been found to be very valuable to beginning teachers. A report by Stetson and Bagwell (1999) indicated the need to train teachers in the effective use and integration of technology. This will enable them to develop confidence to use computers at their own time, to feel comfortable and to have the ability to use technology successfully. The results of this report demonstrated clearly that if teachers are trained to use computers and to integrate them into their schemes of work and lesson plans then this might influence them to integrate technology into classroom instruction. Although training institutions in developing countries may not be well equipped to provide effective training in the use of computers an alternative approach should be devised. This could be offered through a general course in computer skills followed by special training at subject

level. In addition, it might be necessary to have an effective in-service course programme either at school level or at various centres to strengthen the pre-service course programme and to continue assisting serving teachers to integrate and use the computers.

One problem with the integration of technology, not only computers but even with media like audio and video, is that serving teachers' attitudes or beliefs towards the technology in some schools are not supportive. Most teachers are reluctant to employ them in teaching once they qualify from training institutions, so the newly trained teachers posted to such schools also tend to do the same. Young (1999:280) noted the problem and argued that "teachers often resists new technology partly because, they did not feel confident to use it." They also did not see its relevance for improving the teaching and learning process, and some teachers gave lack of quality software in their subject area as the reason for not using computers. Therefore, it can be argued that teachers need good programs of high standard, something new and special that will motivate them to use computer technology. They also need support and training to positively integrate computers into their classrooms. These training programmes must not be designed just to improve their skills with computers but should also aim to help them to change their attitude towards the use of instructional computer technology (Clark, 2000:182).

3.3.1.1 The training of teachers to integrate computers into teaching subjects

As schools introduce computer technology into teaching and learning, teachers must learn how to integrate computers into their curriculum and instructional strategies. Since hardware and software are changing rapidly, teachers need to be taught both computer skills and skills in designing and implementing curricula using computers. Tiene and Ingram (2001:254-255) report that as schools become wired and acquire a wide range of equipment, teachers will have to be able to make good use of e-mail, web browsers, databases, spreadsheets, word processor etc. Teachers must gain new and improved skills in using these technologies. Teachers need to know how to integrate computer technologies into their teaching subjects. Tiene and Ingram (2001) add that teachers need to be conversant with hardware and software. They report that computers have new capabilities and new requirements. For example "new input and

output devices such as scanners, cameras, and printers will require set up, basic trouble shooting and competent use." All these new developments in computer technology require training. Heinich, Molenda, Russell and Smaldino (2002:313-314) feel that teachers need to be trained to understand that their role has changed from information presenter to learning resources co-ordinator, and to serve as facilitators, managers, counsellors and motivator. They believe that training will enable teachers to learn that " their new role frees them to work more independently with individuals and small groups while computers do the formal lesson presentations." Therefore, training teachers in computer integration should be approached through pre-service training, in-service or in house training or workshops.

3.3.1.2 Pre-service teacher training course in computer-integrated education

Many formal pre-service courses have been often offered. Yet the feeling often expressed within the profession in developed countries is that it is not enough and often not of the right character (Crook, 1994; Coutts and Drinkwater, 2001; Vanatta and Beyerbach, 2000). The opportunities for teachers to gain confidence with the new technology across the period of initial training are often limited. There is need for students to be trained to integrate technology into their teaching subjects and practice using it during teaching practice. Many teachers have only superficial pre-service exposure to new technology by the time they complete training. Research on teacher preparation at pre-service course indicates that many students-teachers have not been properly trained to integrate and use computers. According to Vannatta and Beyerbach (2000: 145), a technology course on basic skills does not adequately prepare pre-service teachers to constructively integrate computers into their future classroom. Teacher education programs must therefore be designed to prepare students to move to their classrooms with confidence to integrate and use computers, and this will require more than just a basic literacy course. Preparation of teachers on the use of computers should also be a continuous process, through school-based training and in-service course programme. This can be achieved through retraining courses and workshops or seminars.

3.3.1.3 In-service teacher training on the use of computer-integrated education

Effective in-service training of teachers is essential to ensure successful implementation of computers in teaching and learning. It should aim to serve the needs of classroom teachers by updating their professional qualification, increasing their knowledge on various education issues and improving their classroom practices. In-service training helps teachers learn how to teach the skills of computer technology, and to keep them abreast of current development in the use of computers. Teachers must be adequately informed in the new specialised knowledge, and skills, and posses relevant competencies to use computers. Yet research findings indicates that in-service course programmes seemed to be inadequate for serving teachers (Carol, 1997; Crook, 1994).

Even in developed countries, in-service courses in the use of computers need to be intensified for classroom teachers. They should be given an opportunity to attend many short courses, not just a few. In-service provision can be a quick way to create an impact. However, the hope that those who receive training on intensive short courses will go back to their institutions and pass on their expertise to the rest of the staff members is not always realised. Hence the call for opportunities for many teachers to attend seminars and workshops organised at school level to up-date their knowledge on the use of computers.

3.3.1.4 School-based workshops/seminars for serving teachers on computer integrated education

Organising workshops or seminars for teachers designed to extend their professional capabilities at school level would be an important step towards effective use of computers in schools. The need to provide school-based training geared towards the improvement of teachers' teaching techniques and general awareness of computer equipment used in teaching would benefit all the staff and students. It would also serve as an exhibition of computer equipment for people to learn and exchange ideas with computer experts (Nisan-Nelson, 2001: 89; Stetson and Bagwell, 1999). For example, Mccannon and Crews (2000:115) found that 97% respondents in their study had been offered staff development courses in computers, and 54% participated in word processing training. They also reported that software staff development classes

included training in "Accelerated Reader, Writing to Write and Gradebook." The researchers noted that teachers benefited in word processing classes and were ranked as the most beneficial staff development classes by the majority of the respondents. They also found increased computer usage. Ninety-two percent of the respondents indicated that their computer use increased after participating in computer staff development classes. In conclusion, the researchers noted that since computers is now being offered in teacher education programmes, administrators should use staff members with experience to train other teachers in computing. They believed that with right training, all teachers in a school could enhance their teaching with computers.

3.3.2 Attitudes of teachers towards computers in education

The success of any curriculum innovation depends on the attitudes of teachers towards the innovation. For example, when teachers were asked to implement the Outcome Based Education in South Africa, many teachers adopted a very negative attitude. They did not understand why they were being asked to change their approaches to teaching, so they resisted the changes (Jansen and Christie, 1999). Research has also shown that the attitude of teachers towards computers in education is an important factor in the effective integration and use of such computer technology in teaching and learning (Abas, 1995; Young, 2000). Attitude has been defined by Anandra (1998:284) to encompass various relationships, from simple like and dislike of computers to complex attitudes such as computer anxiety and apprehension. Therefore, one factor in the successful integration of computers in the school curriculum is teacher acceptance of the new technology. Teachers' acceptance is believed to depend on their attitudes towards the technology, since decisions about whether and how to employ the computer technology in teaching are heavily influenced by teachers' views and attitudes and by their perceptions of the value and benefits of computers in motivating students to learn. Having computers in the school will not mean that teachers will integrate them into their teaching subjects. However, previous computer integration experiences and use was one of the factors that significantly relate to more positive computer attitudes (Clark, 2000).

Furthermore, research has shown that teachers' attitudes about computers can positively or negatively influence their students' attitudes towards computers in

education and that low users of computers tend to have a more negative attitude towards computers (Anandra, 2000:292). Moreover, increasing amount of computer experience has been associated with positive attitudes towards computers (Abbott and Faris 2000:156). Similarly, research has indicated that attitude towards the use of computers is related to other attributes such as the relationship with gender. For example, a study by Comber, Colley, Hargreaves and Dorin (1997:123) in Britain found that male students from both age groups reported greater experience with computers and had more positive attitudes towards computers than female.

Thus, factors such as gender, amount of computer experiences, and beliefs matters a lot in the development of both positive and negative attitudes towards integrating computers in schools. To explore this issue, Young (2000:204-211) carried out a study of 462 middle high school students to provide more evidence on gender differences in attitudes towards the usefulness of computers for schools. The researcher examined factors such as confidence, perception of computers as a male domain, positive and negative teacher attitudes, and perceived usefulness of computers. The main objective of the study was to examine the patterns of gender differences in the use of computers. A total of 48 attitude questions rated on a 5-point Likert scale type-response format was used. In addition, ten background questions were designed and administered to 220 girls and 242 boys to determine gender access to computers on a weekly basis. The overall results showed that male students were more confident with computers than girls but the girls rejected the claim that computer were a male domain. Comber et al. (1997) reported similar findings. Since attitudes can be modified or changed, it is expected that teachers and students may become more positive towards the use of computers once their attitudes are identified and steps are taken to challenge these attitudes if necessary. Based on the above research findings, teachers could develop negative attitudes towards computers due to lack of experience with the computer technology, lack of interest and lack of support from school administration.

3.3.3 Lack of computers for teachers to use in teaching and learning

In order to integrate computers into the school curriculum, there is need for all schools to have an adequate supply of computers and other related resources. It is difficult to define what might be necessary as an "adequate" level of computing

equipment in a classroom because it will depend very much on how the computers are to be used by the teachers and the students. If the teacher is going to use the computer to demonstrate things to students then one computer might be enough. If students are to work on the computers themselves, then maybe they need one computer for each student. Certainly, when students are trying to learn how to use computers (e.g. for word processing) it is very difficult if they do not each have a computer. Effective use of computers in teaching and learning in the classroom requires sufficient availability of computers, software and support materials such as textbooks, students manuals and teachers guide notes.

Research findings have indicted that lack of equipment was a major barrier to the effective integration and use of computers in the classroom (Carol, 1997; Mellon, 1999; Peggy, 1999 and Zammit, 1992). A study by Ertmer, Addision, Lane, Ross and Woods (1999:66) confirmed that lack of equipment was a barrier to the integration and use of computers in the classroom. Other findings indicated that teachers in the study wanted more computers so that they could get the groups involved in working at the same time. They needed "enough computers for at least six to eight kids to work on it." One teacher argued that "one computer is basically worthless with the way I organise my room I need enough for a small group." Another said "having more computers would let me do more of what we are doing but do it more efficiently." In conclusion, Ertmer et al. (1999) noted that lack of equipment held different meaning for these teachers and affected what they accomplished with current resources in different ways.

In addition, lack of availability of software and other support materials such as teachers' guide notes and students' manuals have been reported as another factor affecting the use of computers. Carol (1997:55) study found that the "use of computer was often linked to availability of software for the particular topic being covered." She further noted that teachers wanted to be made aware of the availability of software and its potential for real enhancement of language learning along with guidance on how to assess its contribution in the classroom.

Zammit (1992:59) also found that 'software availability' encouraged teachers to start using the technology. Zammit noted that teachers were often disappointed by the quality of the software that was found to be pedagogically weak or inappropriate. The

study revealed that teachers were looking for software that fitted into their curriculum and that extend the work done in class. Therefore, effective integration and use of computers in educational setting lies in the way in which teachers are enlightened about the software tool and its possible use in their teaching. Therefore, lack of dissemination of information on the availability of equipment and all the necessary support materials and quality software relevant to the curriculum, will probably mean that the integration and use of computers in teaching and learning cannot be fully effective. In fact the resources must be available in sufficient quantity to help teachers in advance planning and lesson presentation (Becker and Ravitz, 1999). The problem of availability of technology has continued to affect the use and integration of computers in the classroom. A recent study by Vannatta and Beyerbach (2000:150) found that technology infusion in the curriculum was still difficult to implement in American schools because of inadequate equipment and software. There is need for the stakeholders to plan and provide adequate funds to be set aside for the purchase of technology so that teachers and could use them as required.

3.3.4 Accessibility of computers and resources for teaching and learning

Collins dictionary defines access as "the state or condition of being approachable or easy to enter" and the second one refers to access as "the right or privilege to approach, reach, enter or make use of something." These definitions fit very well with the concept of "access" to computers meaning the opportunities afforded to all students and teachers to interact with computers and to the removal of barriers that might stand in the way of these opportunities being taken up. The issue of access to technology and software is vital in the effective utilization of computers into education. Clark (2000) and Millar (1997) noted difficulties in access to technology that have resulted in low levels of computer utilization. In fact access to computers for integration and use in teaching and learning stands out prominently and remains a big challenge even in developed countries.

Given the relative high cost of computers, access to computers tends to favour wealthy schools and students. For example, a study by Barron, Hogarty, Kromrey, and Lenkway (1999) in Florida State in America shows exactly how rich countries can afford large number of computers. The study indicated that more computers were supplied to schools to help fight the high rate of crime and poor behaviour of students.

In addition, Clark (2000) reported that in the USA the report by the Office of Technology Assessment (OTA 1995) estimated that the number of computers in K-12 schools increased by 300,000 to 400,000 per year in the 1980s. Nevertheless, even with this large number of computers in the USA there are still problems of access. Strudler (1996:255) found that lack of access to computers and software was a major impediment to technology integration. In a nutshell, I can say that the extent to which teachers and students can use computers in teaching and learning depends to a very large extent upon how accessible the technology is to them when they want to use it with the students. Again, even if the computers were available to the teachers, there is also the issue of timetabling and booking the computer lab that has to be done in advance (Carol, 1997:52). Besides, as Carol (1997) noted, access to technology does not just mean obtaining a computer, but it includes getting it and using it as required. Therefore, access to computers is a major issue in both developed and developing countries. The school can purchase many computers "to support teaching, but if students cannot access the technology, all the investment is wasted" (Bates, 2000:85). Thus, with easy access to resources and adequate information about them, teachers could be sufficiently motivated to use them. Moreover, access is also a function of the teacher's knowledge and skill-a teacher could have several computers in the classroom, but if he/she does not know how to use them the technology is not "accessible."

3.3.5 Technical support for effective use of computer in schools

The issue of technical support and maintenance of educational technology equipment is one of the major factors militating against the integration of computers in the school curriculum, especially in developing country like Kenya. A decision to include computers in teaching and learning must consider the maintenance. There is also need to consider whether the performance of the computers will be maintained under normal working conditions and whether the equipment is reliable or not. The problem posed by heat, humidity, dust, and access to electricity to use computers poses some of the problems faced by developing countries with poor electrical supply. It is also important to find out if the type of technology to be purchased can easily be repaired by the local technicians. For example, donation of certain types of computers from the industrialized world to developing countries raises the questions of where to get spare

parts should such equipment need them. Because after donating the equipment, the maintenance work is left in the hands of the school with no technician around. As a result, some of the computers donated to schools have been rendered in-serviceable and become obsolete (Report from my students during media lectures 2000).

However, even in developed countries, the issue of technical support and maintenance of computers has been reported by researchers, though computers are used in an environment where maintenance and use of infrastructures are well developed and market services are available. Veen (1996:177) reporting on the situation in Netherland noted that "the support of the technical assistant is essential for teachers." Veen (1996) believes that teachers count on the support of the technicians for tasks such as use of software and in collaborative work during the lesson in the laboratory. Similarly, Carol (1997:56) found that the support provided by technical assistants and co-ordinators were very valuable to teachers. The participants in her study in England reported that coordinators provided helps in "trouble shooting with machinery and software, organising departmental access to computers, supporting bids, installing software and advice on specific software." Furthermore, Carol (1997) found that some schools had computer technicians permanently based in the computer room to help teachers and students. Similar findings on technical support have been reported by (Andris, 1996; Chiero, 1997). Availability of technical support would be an ideal help for integration and use of computers in schools in Nyanza province, but due to lack of funds this could still be a problem. Schools with computers might need to organise fund raising to employ even part-time technicians.

3.3.6 Lack of adequate time to use computers in teaching and learning

Researchers indicate that lack of time for teachers and students to use computers effectively in teaching and learning is another factor that inhibits effective use of computers in the classroom (Andris, 1996; Chiero, 1997 and Struddler, 1996). For example, Strudler (1996), pointed out that the participants in his study complained of being burdened with teaching load and planning duties and other school work such that they had no time to learn, to keep up with and plan to use the new software. At the same time, Chiero (1997:138) found that 82% of the respondents in her research had no time to learn and use computers. At the same time, Ertmer et al. (1999) pointed out that time was a barrier that affected motivated teachers' efforts to use

computers in teaching and learning. For example, time was wasted if students had to move from their normal classroom to a special computer room. Furthermore, Ertmer et al. (1999:66) found that "lack of time was interpreted differently by different teachers depending on classroom practices and beliefs about the role of computers in teaching and learning." One of the participants in her study saw time as a barrier in relation to the need to learn new software and the desire to have children create products on their computers. Karen, (1999) and Struddler (1999) report similar findings. However, the problem of lack of time may come about due to lack of time management skills. If teachers plan their daily work in advance and make time available for each important school activity, then there could be plenty of time to incorporate technology in teaching. Teachers who are committed to their work will always find time to incorporate computers in their teaching. They can also store the required teaching/learning notes in computers and make arrangements with the students to access them at their own free time. Teachers could as well devise methods of team teaching in order to share the time available for computer lessons. Rice, Wilson and Bagley (2001:218-219) report on the research finding of a teacher who made an effort to overcome the barriers to the use of computers in teaching and learning despite discouragement by the Principal. They report that the teacher's interest in technology and his belief that students would need technological skills in the future, made him willing to spend much of his own time outside of school to learn technology. The teacher also made an effort to look for funds and studied ways to use the computers within his curriculum. Similarly, Mcrobbie and Thomas (2000:137-180) discuss how a chemistry teacher "Anne" collaborated with the head of science regarding the introduction of MBL technology into the school's Chemistry laboratories for use in experimental work and prepared her own teaching materials. It seems that teachers who are motivated to do so can find time to integrate computers into their teaching.

3.4 Other factors to be considered in the use of computers in education

3.4.1 The use of computers to motivate students to learn

According to Heinich, Molenda, Russell and Smaldino (2002:363), motivation is an internal state that leads people to choose to pursue certain goals and experiences. Many researchers (Christman, Budgett and Lucking, 1997; Carol, (1997) have found

that motivational factors are indisputably important in education. Heinich, Molenda, Russell, and Smaldino, (2002:58) report that "various emotional factors have been found to influence what we pay attention to, how long we pay attention, how much effort we invest in learning, and how feelings may interfere with learning." In classroom teaching, for example, lack of motivation is a barrier to effective learning. Many students do not perform well in school subjects due to lack of interest and end-up dropping out of school. Therefore, if teachers can create an enduring fascination for the subjects under discussion, then students can learn more effectively. Heinich et al. (2002:58) report that "researchers have found that intrinsic motivators are generally more effective. Students who are intrinsically motivated will work harder to learn more because of their personal interest in the materials." The studies reviewed earlier, Carol (1997); Christman, Budget and Lucking (1997), have suggested that the computer can be an ideal medium for developing such motivation. Furthermore, the motivational function of the computer has been considered an important factor in many computer-based instructional programs (Barron, Hogarty, Kromrey, Lenkway, 1997; and Johnson, 1996). These studies show that intrinsic features of the computer such as immediate feedback, animation, sound, active interaction, and individualization are more likely than any other media to motivate students to learn.

At the same time, a study by Johnson (1996:79) found that computers were good motivators that heightened students' interest and enjoyment and were also seen to have a positive effect upon the status of the subject. Furthermore, Christman, Badgett, and Lucking (1997:333) noted that computers provide opportunities for students to engage in self-directed learning activities, which can promote intrinsic academic motivation. Barron, et al. (1999) also found that in addition to motivation to learn, students experienced increased self-esteem and self-confidence when using computers. Similarly, Carol (1997:59) noted that several Heads of Department who took part in her study reported the benefits of the technology in terms of pupil motivation gained from the use of computers.

Motivation for learning is an essential factor in any meaningful instruction. If the use of computers in teaching and learning can help students to learn effectively then it is worth investing in computer education. The integration of computers in the curriculum can help to heighten students' motivation to learn and introduce them to

variety of new learning experiences. Motivation can also do much to increase students' interest thereby helping them to learn difficult subjects like science and mathematics. This can be emotionally stimulating as well as being intellectually rewarding and can encourage them to want to learn more. But the learners' own effort to learn is very important. Mellon (1999:31) points out that "no matter how much technology is available, no matter how well it is integrated into instructional content, it is the learners willingness or ability to learn that is paramount.

3.4.2 The cost of using computers in teaching and learning

The cost of purchasing and operating computers in schools is the main reason why computers have not been widely used in developing countries like Kenya. But even in developed countries like America the infusion of technology into education and integration to all schools has been difficult due to lack of enough funds to provide computers to each student. Costs are difficult to estimate. The use of computers has been consuming a large proportion of the annual budgetary allocation in developed and developing countries with an aim that their use would improve the cost-effectiveness of methods of teaching. What then are some of the costs involved in the integration and use of computers in the classroom?

A study by Clark (2000) found that lack of funds was one of the major factors affecting the integration of computers into teaching and learning. There have been a number of attempts to estimate the costs of using computers in teaching and learning. One such attempt by Sheffler and Logan (1998:306) concluded that the "cost for technology extend well beyond the purchase and installation of hardware and software." Sheffler and Logan (1998) believe that technology training and professional development for teachers is part of the cost. According to them the training programme must be an on-going process, and this can be expected to require 30% or more of the school budget. They also feel that "teacher preparation technology course should be based on competencies essential for designing, developing, delivering, managing and evaluating instruction," that will also require additional funding. In addition, from my own experience, the cost of integrating and using technology also includes purchase of textbooks, students' manuals, teachers' travel to and from in-service training centres, maintenance and repair, electricity supply, and recurrent expenditures

In Kenya, Eshiwani (1997:23) noted that the introduction of computer education in secondary schools is too expensive for most Kenyan parents. It means therefore that only a few financially capable private and National schools will be able to acquire and integrate computers in education. The issue of funding computer technology in education in developing countries is a big problem because budgetary data are often inadequate for a detailed study of costs that sometimes could be immense. For example, Barron, et al. (1999:98) report that a total of 4.8 billion has been spent to integrate technology into K-12 schools in Florida State in USA. It is not clear whether this figure include training of teachers or just for the purchase of computers and software. Besides, Carol (1997:58) studies in England found that funding for the integration of computers in teaching was a major issue particularly with the provision of commercial software that are not good value for money. Therefore, the problem of expenditure on educational computing is not unique to one country, so schools need to find other sources of funding the integration and use of computers in addition to funding from the government.

3.4.3 The cost-effectiveness of the use of computers in teaching and learning

Despite the high cost of integration and use of computers in teaching and learning, it is believed that computers can be a cost-effective way of teaching some things, but not all things (Christman, Budgett, and Lucking 1997; Herman 1995; and Klees 1995). According to research by Karen (1999), the use of computers fosters the use of more student-centred learning strategies. This is learning by doing that encourages creativity and thinking skills, the learners are able to recall what they learn from computers and improve their communication skills.

There is also some evidence that computers improve students' achievements through increased instructional quality and productivity (Mills and Ragan 2000). Research on CAI indicated that students "receiving traditional instruction supplemented with CAI attained higher academic achievement than did 57.2% of those taught through traditional method" (Christmann, Budgett and Lucking, 1977:328). Moreover, computer delivered instruction has the capacity for motivating learners, thus helping to improve learning of different subjects compared to than traditional approaches. Using computer allows students to enjoy being actively engaged and being able to

make mistakes without embarrassment and computers give students the feeling of being in control. Students persist in tasks requiring higher-order thinking skills as they work with computers and their self-esteem increased tremendously.

Recent research by Clark (2000:189) in the United States of America confirmed cost-effectiveness of the use of computers in teaching and learning. According to Clark (2000), it was reported by one of the teachers in his study that students were motivated to practice and review skills on the computer. The teacher also noted that students often create their own products on the computer, were exited and proud of what they could produce using the computer. The teacher confirmed that the use of computer helped to improve students' learning of various subject topics such as sciences, mathematics, languages, geometry, and helped to increase students' academic performance.

Although the use of computers in teaching and learning has been regarded as cost-effective in developed countries, it should also be an important issue to be considered in developing countries like Kenya that have very limited budget for education. There is need for further investigation to examine if the use of computers could also be cost-effective in schools in Kenya. If it is cost-effective, then developing countries should spend money to provide computing education. If it is not cost-effective (as compared with other media such as radio programmes, video programmes and other visual media) then perhaps it is very unwise for developing countries to invest heavily in computer education in schools

3.4.4 Support from the school for the use of computers in teaching and learning

Another factor that influences integration and use of computers in teaching and learning is the support from the school administration. The scope and mode of integration and use computers relies heavily on the head of the school. The part played by the head of the institution in the whole school policy on the use of educational technology helps to determine effectiveness, efficiency and shape the manner in which computers are integrated and used in the school. The Principle is the one who sets the ball rolling and formulates computer technology policy to be executed by departmental heads. The Principle is also the one responsible for providing funds for departmental heads to purchase resources for teachers to use in

teaching. This is a major responsibility. Teachers need considerable support from whole school information technology and training to positively integrate computers into their classroom (Clark, 2000). Principals are therefore encouraged to work out modalities of supporting teachers to integrate and use computers, occasionally interacting with them in the lab and rewarding them. This will help to provide emotional support that teachers need to work effectively.

3.5 Summary

An attempt has been made to highlight those factors facilitating and affecting teachers' use and integration of computers into teaching and learning. The list is not exhaustive since the objective of my research is not on those aspects of the factors, and again, each factor would vary within different situations and in different countries. Only a few factor groupings have been discussed in relation to this study in Nyanza Province. The use and integration of computers in the classroom is strongly influenced and determined by the beliefs and the skills of teachers. Teachers have a responsibility to make decisions concerning pedagogical approaches consistence with their beliefs and their skills. Hence their preparation in advance in computer skills would greatly increase their use of computers in teaching and learning. However, studies revealed that most of the teachers even in developed countries have not been adequately trained in computer education as part of their academic studies.

Another factor identified was the attitudes of teachers and the Principals towards computers. No matter how advanced the techniques or methods were employed, only through positive attitudes of both the administrators and teachers could the benefits of the technology be realised. Negative attitudes affect the use and integration of technology into curriculum instruction. Reports from the research reviewed indicated that the majority of both teachers and policy makers had positive attitudes towards the use of computers. Similarly, the basic conditions for successful teaching and learning with computers such as the availability of the equipment and suitable computer software for learning literacy skills, other support from the government and the parents were identified as major limitations to the effective use of technology.

Accessibility of equipment and software was also a very important factor noted to encourage the teachers to use computers. In fact, lack of access to equipment,

software, and other support materials were identified as a major obstacle to computer technology integration and use in teaching and learning. Moreover, lack of skills and confidence in handling technology places more constraints on teachers' use of computers. Studies reviewed indicated that reliability of technology was a major determinant of its acceptability in the classroom utilization. Many teachers lose interest as soon as they have problems with computers and regard it as a waste of time and an embarrassment in front of students. Every teacher needs direct classroom support as well as adequate technical support related to the use of computers in teaching and learning.

Time was another limiting factor reported by some scholars as a barrier to effective use of computers. Teachers complained that in order to make good use of technology, they needed time to learn, time to pre-view programs and prepare the lessons, time to plan ways of integrating computers into their class work and time to develop their expertise. In addition, motivational factors can have a positive or negative effect on students to learn with computers. Lack of motivation was noted as a barrier to effective learning. It interferes with students' attention and concentration during and after learning. Research showed that the use of computers in teaching and learning was quite motivating and stimulating to students to learn mathematics, science, communication skills and other computer literacy programmes.

The cost of purchasing technology was another barrier to the implementation and use of computers in schools, especially in developing countries. Although the integration and use of computers is believed to be an ideal medium of classroom instruction, its cost-effectiveness has not been fully realised.

Therefore, the infusion of technology in the curriculum and subsequent use in teaching and learning will continue to be difficult if the factors identified by researchers are not examined critically, more so in developing countries like Kenya that lack suitable classrooms and reliable sources of electricity. Effective integration and use of computers in the whole school requires full support of the school administration, backed by clear policy at all levels of education. Chapter 4 continues with the description of how researcher conducted the investigation and collected more information to provide evidence on the use of computers in secondary schools in

Nyanza Province and the problems encountered by the respondents in the use of computers in teaching and learning.

CHAPTER 4

RESEARCH METHODS APPLIED AND CONTENT VALIDATION OF THE QUESTIONNAIRES

4.1 Introduction

This chapter synthesises the literature dealt with in chapters one, two and three, and describes how the study was conducted. It provides a summary of the information and the data collected, and how they were gathered, both qualitatively and quantitatively. The chapter also provides details of specific objectives of the field research, the sources of data, the research questions, and the interview topics. The chapter ends with a summary and a discussion of the plan for analysing the data.

The ultimate goal of social science research is to produce an accumulating body of reliable knowledge. Such knowledge enables us to explain, predict, and understand empirical, logical and quantitative phenomena and data that interest us. This study therefore, approached theory by using research methods that are grounded empirically. Nachmias and Nachmias (1992:47) identified the following four steps to serve as guidelines in research projects:

- investigate a phenomena and delineate its attributes,
- measure the attributes in a variety of situations;
- analyse the resulting data to determine if there are systematic pictures of variation and;
- once the systematic patterns are discovered construct a theory.

On the basis of the general objectives set out for this study, and the findings from the review of literature, the collection of data combines four methods: the review of literature, structured interviews, questionnaire surveys and case study using semi-structured interviews (Cohen and Manion, 1994:123; Sharp and Howard, 1998:147). The collection of data was carried out in four stages. The first stage concentrated on a review of relevant literature. This was a key activity in the effective management of this research project as shown in chapter two and three. The second component of the study involved interviews with key individuals from the Ministry of Education and

the Kenya Institute of Education (Curriculum Centre). This was followed by an application of a questionnaire on the Principals of secondary schools and Heads of Department and lastly the conduction of semi-structured interview with computer teachers.

4.2 Planning for field research

Cohen et al. (2000:88-89) point out the importance of thorough planning for a field research project and suggest a four-point model as a guide:

- identify the purpose of the research;
- identify and give priority to the constraints under which the research will take place
- plan the possibilities for the research within these constraints;
- decide the research design.

This plan helped the researcher to consider the types of research instruments to be used to collect data at what stage and with different participants. The main issues involved in the planning for this field research included:

- identifying the objectives for the research, and giving priority to the constraints under which the research took place;
- Planning the possibilities for the research within these constraints and deciding on the research design;
- Discussing the objectives of the field research. This included time of the research, costs involved, physical facilities, materials, administrative expenses, participants, main focus of the research and ethics of the research;
- Considering specific objectives of the field research, research questions, focus of the research, validation, and kinds of data required;
- Deciding on the number of participants, and other sources of data, and how to verify the data and data analysis;

- Lastly, considering how to achieve coherence and practicability in the research design.

Cohen et al. (2000:88) and Sharp and Howard (1998:130) emphasise the usefulness of planning because it exposes key features of the research and enables the researcher to have a clear plan of action. Sharp and Howard (1998: 130) feel that whatever is involved in gathering the data, the process by which they are recorded often sets a definite limit on the rate at which they can be gathered, and the ease with which they can be covered. This obviously requires planning time and skills.

4.3 Specific objectives of the field research

This study comprised a series of embedded qualitative and quantitative studies involving the use of documentary analysis, interviews and questionnaires to collect data. The field research aimed to achieve the following objectives:

- The identification of the sources of data;
- The distribution of the questionnaires and arrangement for their collection in a reasonable time, and
- The collection of the required data from the participants using the instruments designed for this purpose.

4.4 Formulating the research questions

According to Grinnell (1993:27) the process of formulating research questions can be described in terms of the following four phases;

- gathering information;
- categorising ideas and questions;
- selecting research questions and ;
- constructing operational definitions of the concepts and variables represented in the questions.

The researcher was involved in an extensive study to identify and gather information on the specific aspects of the problem area proposed for this research. This included reading the literature and brainstorming to uncover ideas from previous survey reports

of earlier research. Such information helped the researcher to describe the research problem area, to construct specific research questions and record them. Table 4.1 summarises the main research questions and key issues the researcher investigated, and the type of date collected.

Table 4.1: The main research questions and sources of information

A Policy Factor	Data required	Sources of information
Is there a policy on the use of computers in schools in Kenya?	Documentary or anecdotal evidence of policies	Iuterview with officers from the Ministry of Education and KIE, documentary evidence and research publications (see Chapter 2)
Are schools implementing this policy?	Doeumentary reports or anecdotal evidence of implementation of computer policies	Interview with Senior education Officers (see Chapter 5), and response from Principals of sehools, Heads of Department (see Chapter 6), and evidence from previous research (see Chapter 2).
How are the schools implementing this poliey?	Information on the use of computers in secondary schools	Response from Prineipals and HODs questionnaires (see Chapter 6) and previous research (see Chapter 2).
What are the eosts of supplying and maintaining computers and software packages in secondary schools?	Documentary evidence of Government financial involvement in the purchase of computers and evidence of expenditure by schools.	Interviews and diseussion with officers from the Ministry of Education (sec Chapter 5) and documentary evidence from official reeords and previous research (see Chapter 2).
How are these costs financed?	Evidence of sources of finance for purchase of computers, software, textbooks, and other support materials.	Interviews with officials from the Ministry of Education (see Chapter 5), response from Principals (see Chapter 6) and previous research (see Chapter 2).
How do secondary schools use computers? How many of them	Documentary evidence on curriculum guidelines for the use of	Interview with Ministry of Education Officers and

us computers in teaching and learning?	computers in secondary schools. Evaluation report from schools with computers.	Curriculum specialists (see Chapter 5).
How many secondary schools have computers?	Information on the number of schools supplied with computers from the Ministry of Education and those purchased by the schools.	Interviews with the Ministry of Education Officers (see Chapter 5). Discussion with Principals (see Chapter 6).
B. School Factor	**Data required**	**Sources of information**
How do schools purchase computers and support materials?	School policy and practice on purchase of computer equipment.	Discussion with the Principals and responses from questionnaires (see Chapter 6).
Are computers and other resources available in schools	Information on the number of computers and related resource materials available in the schools to be investigated	Report from Principals and Heads of Departments questionnaire surveys (see Chapter 6).
Are teachers using computers for teaching and learning?	School policy regarding the use of computers in teaching and learning.	Response from the Principals and Heads of Department questionnaire survey (see Chapter 6).
What difficulties do they experience?	Nature of problems encountered by teachers with CIE in the classroom	Response from Principals and Heads of Department questionnaires (see Chapter 6).
C. Training Factor	**Data required**	**Sources of information**
Are teachers trained in the use of computers?	Evidence of training in computer education (Certificates and courses attended).	Interviews with Ministry of Education, and Officers from KIE (see Chapter 5), Response from Principals and HODs questionnaires (Chapter 6) and interviews with computer teachers (Chapter 7).
D. Departmental Factor	**Data required**	**Sources of information**
Do school Department have policies on the use of computers in teaching and learning?	Information on departmental commitment to computer education programme. Computer timetable and availability of resources.	Responses from Heads of Department questionnaire surveys
E. Classroom Factor	**Data required**	**Sources of information**

What type of software packages are used in secondary schools?	List of software available in secondary schools	Principals and Heads of Department questionnaire results (see Chapter 6), interview with computer teachers (see Chapter 7).
How are teachers using computers?	Availability of the syllabus and other resources.	Interviews with teachers who use computers in teaching and learning (see Chapter 7)
Are teachers integrating computers into teaching traditional subjects?	Subjects into which computers have been integrated.	Interviews with teachers who use computers in teaching and learning (see Chapter 7).
What are the variables influencing the use of computers?	List of variables encouraging and affecting the use of computers in schools.	Principals, HODs and teachers comments on problems and benefits of computers in teaching and learning (see Chapter 6 and 7).
What are the views and attitudes of teachers towards the use of computers in teaching and learning?	Evidence on opinions, attitudes and views concerning the computer as a tool for classroom instruction.	Response from Principals, HODs and teachers' opinions, views and attitudes reported in Chapter 6 and 7).

4.5. The content validation of the questionnaires

In addition to the field research questions, Cohen, Manion and Morrison (2000:105) report that before the research instrument is used in data collection, there is need to examine the validity of such instruments. According to Wallen and Fraenkel (2001:89) validity "refers to the degree to which the evidence supports any inferences a researcher makes on the basis of data collected with a particular instrument." But the "degree to which a research tool is valid depends on the amount and type of evidence available to support the interpretation that researcher wishes to make on the basis" of the data collected. Furthermore, Cohen et al. (2000) explain that a research instrument is said to be valid if it measures what it is supposed to measure. However, determining an instrument's validity is not an easy task because there are different kinds of validity and, again, validity is a matter of degree as well as kind.

Consequently, in this study the researcher considered the validity of the tools used in field research. The researcher was guided by addressing three questions: being a qualitative and quantitative study what kind of validity should this tool have? And to what extent must the instruments demonstrate this type of validity? Does the instrument provide useful information regarding the topic or variable as defined by the researcher? (Wallen and Fraenkel, 2001).

The validation of research instruments is an important requirement for both qualitative and quantitative study. Wallen and Fraenkel (2001) report that validation of a research tool refers to the process of collecting evidence to support inferences that will be made about the data gathered with the instrument. These inferences should be appropriate, meaningful and useful. Despite the general demand that validation must demonstrate that a particular research tool measures what it purports to measure, Cohen et al. (2000:105) report that in qualitative studies validity might be addressed through the honesty, depth, richness and scope of the data achieved. This also includes the participants approached, the extent of triangulation and the objectivity of the research. Moreover, Cohen at al. (2000:105) explains that in qualitative data the subjectivity of participants, their opinions, attitudes and perspectives all contributes to a degree of bias. Furthermore, Cohen et al. (2000:105) report that in qualitative data validity might be improved through careful sampling, appropriate instruments and appropriate statistical treatment of the data. However, Cohen et al. (2000), point out that qualitative research possesses a measure of standard error that is inbuilt and which has to be acknowledged. The content validity of the instruments used to collect data for this study were verified by my supervisors and the Department of Statistics of the University of Pretoria. The following sections describe the validation process.

Content validity refers to the extent to which the information incorporated in the research instruments are a representative sample of characteristics it is designed to measure. Content validation also includes the format, clarity of printing, size or type, adequate of space for writing (if needed) and appropriateness. In addition, Cohen et al. (2000): 109) and Wallen and Fraenkel (2001:91) state that the tools to be used to collect data must show that it fairly and comprehensively covers the domain or items that it purports to cover. They also point out that it might not be possible that each

issue could be addressed in its entirety due to time available or the participants' motivation to take part in the study or to complete the questionnaires if the researcher uses this tool. Therefore, the researcher had to ensure that the main issues covered in the study were both a fair representation of what is being investigated, and that the elements selected for the study sample are addressed in detail. This required a careful sampling of items to ensure their representation. Thus in the research instrument I have designed for the Ministry of Education Officials, Principals of secondary schools, and Heads of Department dealing with policy on computers in education, the information was relevant to studies reviewed in chapters one and two. This includes studies by Alkin (1992), Alverez (1995), Baron et al. (1999), Cornu (1996), Davis (1994), Mizukoshi et al. (2000), Pearson (2000), Rovisk and Kommune (1995), Sakamato and Miyashita (1996) and San Jose (1996) that indicated availability of government policy on the use of computers in teaching and learning. The importance of a clear policy on compute technology is a prerequisite for effective implementation of computer in education. There is a need for specific national policy on computer-integrated education that must be formulated in consultation with all the stakeholders, and should be guided by broader goals of education.

4.5.1 Questionnaires 1, 2, 3: background information of participants and school

All the research questions 1,2,3, in section A and B of the research instruments (see Appendices 3-5) were designed to collect biographical information about the participants and the case study institutions, and to provide quantitative data. These questions were designed by the researcher and were very useful since the study was to be carried out in mixed gender groups with different teachers of different ages drawn from urban, suburban and rural schools. In some cases, comparisons were made between the responses of these groups, or within the sample. For example comparing responses from newly trained teachers and the senior ones or teachers of different age groups. Coutts and Drinkwater (2001), Gobbo and Girardi (2001), Mccannon and Crews (2000), Myhre (1998) and Yee, (2000) all noted that teachers' use of computer technology often depends on their experience. Consequently, the questions in section A were developed from the ideas from the contribution of the above scholars.

4.5.2 Questionnaires 1, 2, 3, 4 on policies and the use of computers in schools

Some of the ideas for the design of the research questions on policies on the use of computers in schools were obtained from various sources. The first one was from the research by Baron, Hogarty, Kronrey, and Lenkway (1999:98), Christmann, Badgett and Lucking (1997:135-136) and Clark (2000) on the American policy on computers in schools. The second one was taken from the contribution of Mizukoshi, Kim and Lee (2000:101) about the government of Japan and Korean policy on Information technology in secondary education. The third one was obtained from the review of a study by Dawson (2000) concerning the British government policy on the use computers in schools, and lastly from Pearson (2001) about computer policy in Hong Kong. The questions contained in section C on the school policy about computer integrated education number 1 to 8 of the instrument designed for Principals of secondary schools were constructed from the research findings by Carol (1997:54-59), and Millar (1997:81) reviewed in Chapter 2. These questions were meant to generate information concerning school policy and practice on the implementation and use of computers. Sources of data came from interviews with the Principals and from documentary reports on policy and curriculum guidelines on the use of computers. The data obtained provided qualitative data on a wide range of evidence to show positive or negative commitment by Principals towards the use of computers in secondary schools. A study by Carol (1997:54-59) found that there was a whole school policy on the use of computers in British schools. A similar finding was also reported by Millar (1997:81). One of the objectives of this study will also be to determine whether there is such a policy in secondary schools in Nyanza province.

Questions 1 to 6 in section B and C on finance and resources were designed after the researcher reviewed literature by Sheffler and Logan (1998:306) indicating that the cost of technology extends well beyond the purchase and utilisation of hardware and software. A study by Barron et al. (1999:98-99) discussed in Chapter 2 indicated that the American government set aside 4.8 billion dollars during 1990s to purchase computers for secondary schools. Alkin (1992) and Mizukoshi, Kim and Lee (2000) reported similar financial arrangements for computer education in Japan, Korea and Russia. Thus the questions were constructed to investigate and provide evidence on school budget allocation for the purchase of computers and software. This included

sources of funds (donations from external sources, through fund raising, students' contribution that is Parent Teachers Association and Board of Governors decision, and contribution by politicians or individual personalities in the community). Data were obtained through questionnaires completed by the Principals.

Questions 1 to 7 contained in section D on the availability of computers in schools and related materials was designed after a review of literature from studies by Vannatta and Beyerbach (2000:150) and Peggy, Paul, Molly, Eva Ross and Denis (1999:66) reported in Chapter 3. These studies indicated that the lack of equipment was a barrier to the integration and use of computers in the classroom. The questions were designed to investigate and provide evidence of computers, software and other resources for use by teachers. The questions enabled the researcher to elicit qualitative and quantitative data.

Fifteen questions dealt with the use and integration of computers in teaching amd learning. These questions were contained in sections E, B, and F of instruments 1, 2, and 3 respectively. Most of the information contained in the questions is reflected in Chapter 2 of this report that discusses the roles and use of computers in teaching and learning computer literacy and traditional subjects. For example, a study by Azita (1999:33) recommended that greater attention be devoted to understanding why the potential of computers for teaching and learning remained unexplored. Consequently, Christman and Badgett (1997:136) suggested further studies to determine whether computers were effective in teaching difficult subjects. Pedretti (1999:33) suggested more qualitative studies that looked into the adoption and integration of computers by teachers. Therefore, questions 1-15 in section F-instrument 2, and B-instrument 3 were designed to provide qualitative data on the use of computers, its effects and the impact on students' learning.

Twelve questions addressed the issue of teacher training in the use of computers in teaching and learning. These questions were contained in sections F, G, and F of instrument 1, 2, and 3 respectively. Most of the information contained in the questions is reflected in Chapter 3 Section 3. 3. 1-2 of this report.. Adequate teacher training is an important factor in the effective integration and use of computers in teaching and learning. A study by Chiero (1997:135) found that lack of training was the highest obstacle to the use of computers by the teachers. Struddler et al. (1999:125-12)

suggested further studies to document specific current practices and level of teacher preparation, and to identify specific approaches that promote effective implementation of computers by beginning teachers. The questions in this section were designed to collect qualitative and quantitative data on this issue.

Questions 1 to 10 in section H on technical difficulties and physical problems also come from the review of literature in Chapter 3 Section 3.6. Andris (1996) and Chiero (1997) report that the problem of maintenance, repairs and technical support for teachers as a barrier to the use of computers in teaching and learning. For example, Veen (1996) noted that the support of the technical assistance was essential for teachers in the use of computers. The questions designed from these studies were meant to investigate and provide qualitative and quantitative data on the problems associated with the use of computers in the classroom.

Question 1 to 10 in section J on attitudes and views about the value of computers in teaching and learning were designed from research findings reviewed in Chapter 3. A study by Anandra (1998:284) noted that teachers' attitude towards technology was an important factor in the implementation and use of computers. Abbot and Faris (2000:159) suggested further research to increase the depth and breadth of information about participants' attitudes and beliefs associated with instructional technology and the integration of computers into teaching and learning. The questions designed from these studies provided qualitative data on the attitude of the Principals towards the use of computers in their schools.

The last question in all the three instruments was designed by the researcher to allow the participant to give any suggestions or recommendations for further improvement or development on the use of computers by the teachers.

4.5.3 Questionnaires 1 and 2

The information contained from the research findings of Millar (1997) and Carol (1997) reviewed in Chapter 3, was applied in the construction of eight questions (question1-8) related to policy issues and implementation of policies by teachers.

The information contained in questions 1 to 4 in section C for Heads of Department, and section D questions 1 to 6 for Principals on finance and resource allocation were

drawn form the studies reviewed in Chapter 3 Section 3.9. The questionnaires sought information on financial involvement on the use of computers in schools. Some of the questions were relevant to research studies by Barron et al. (1999), Mellon, (1999), and Scheffler and Logan (1998) reviewed in Chapter 3. These studies indicated the need for funding to purchase and maintain computers and other related resources.

Effective us of computers in teaching and learning depend on the availability of sufficient equipment. Adequacy of computers, software and the support materials is an important factor in the implementation of technology. Chapter 3 section 3.4 indicated a lack of computers cited by several researchers including Becker and Ravitz (1999), and Vannata and Beyerbach (2000). The information in section D instrument 1 and 2 containing questions 1-6 also were relevant to the findings of these studies.

The information incorporated in questions 1 to 15 on the use of computers in section E of instrument 2 and 3 were also obtained from research findings reviewed in Chapter 1 and 2 on the role and function of computers in teaching and learning. The questions were designed to provide information on how schools use computers in teaching and learning. The questions are relevant to the research findings and studies reviewed in Chapters 1 and 2 (Heinich et al.1996: 232-245; Christmann and Badgett, 1999; Clark, 2000; Cornu, 1996; Mills and Ragan, 2000; Azita, 1999; Hargrave and Kenton, 2001; Karsten and Roth, 1998; Abas, 1996 and Zhang, 2000). The use of computers in teaching and learning should help students to learn and teachers to teach more effectively. To design such programs there is need for the designers to take into account the needs of students and teachers. Since they do not teach in schools and, therefore, cannot understand what teachers and students want because they are out of touch with them, the information needs to be revealed by research studies. The quality of computer programs is certainly an important factor in the successful use of educational technology in teaching and learning. Both the content and the style of presentation can highly influence the effectiveness of such programs. The questions in this section contained similar information aimed to reveal the role of computers in teaching/learning. Questions on the impact of computers on students learning were also relevant to Liu, Macmillan and Timmons, (1998:189-201) and Weller (1996: 461-485).

The questions dealing with effectiveness of computers in teaching and learning were relevant to Jones and Paolucci (1999:17) and, Higgins (1999:425) who stated that the effectiveness of any instructional program depends on how it is used, for what purpose it is used, and with whom it is used.

Questions 1 to 10 contained in instrument 2 for Heads of Department on the integration and use of computers and those in instrument 3 section B were based on the research findings reviewed in Chapter 1 and 2. The information was obtained from studies reported by Cornu (1996), Clark (2000), Dockstadder (1999), Heinich et al. (1996), Mills and Ragan (2000), and Woodrow (1998). The questionnaires designed by the researcher aimed to investigate if teachers in the study integrated computers in teaching traditional subjects.

Questions on teacher training in section F- (question 1) section G- (question 2) and section F- (question 3) were obtained from the review of literature in Chapter 1, 2 and 3. These questions sought information on pre-service and in-service teacher training. A study by Vannatta and Beyerbach (2000:132) reported that teachers were not adequately prepared to integrate and use computers in their classrooms. Shruddler et al. (1999) suggested further studies to document current practices and levels of teacher preparation and identified specific approaches that could promote effective implementation of computer education by beginning teachers. Teacher education programmes as a whole appeared to fall below expectation in their goal of providing pre-service teachers with appropriate skills or techniques due to insufficient exposure to teaching practices. Shrumm and Dehoney (1998) reported that computer programs should be incorporated into the teaching methods courses and teacher education preparation skills should be extended to classrooms. The information in the questions on teacher training was relevant to these studies.

Questions 1 to 9 on technical problems and physical facilities under section G of instrument 1 and 2 were also relevant and the information were obtained from studies by Andris (1996), Carol (1997), Chiero (1997) and Veen (1996) reviewed in Chapter 3 Section 3.6. The questionnaires were designed to provide data on the situation for comparison with other developed and developing countries.

A number of questions also dealt with the views and attitudes of teachers on the use of computers in teaching and learning. These questions were designed from the literature reviewed in Chapter 3 and were contained under section H of the first and second instrument and under section E of the third instrument. For example, the data from studies by Anandra (1999), Comber et al. (1998) and Young (2000). Some of the studies indicated favourable attitudes towards the use of computer programs. The questionnaires I designed sought information to determine the attitudes, opinion and views of teachers on the value of computers as a tool for classroom instruction.

The last question was designed by the researcher to elicit more information from the participants on future development and improvement of computer-integrated education in secondary schools in Kenya.

4.6 Collection of data

After designing the research questionnaires and considered where to draw the data, and what type of people could provide the information, I had to identify the participants. This was necessary because the location of data sometimes becomes very difficult and the researcher could be unsure of what the source will be (Sharp and Howard, 1998:130). Consequently, the first group of people to provide data consisted of policy makers and curriculum developers at national level. The others consisted of Principals, Heads of Department and computer teachers implementing the programs. Kane (1995:90) described an appropriate sample as one that " reflects with reasonable accuracy the opinions, attitudes or behaviour of the entire group." Four groups of interviewees were chosen to act as participants in this study. At the Ministry of Education, a Senior Education Officer and an Inspector of schools in charge of computer education in schools in Kenya were interviewed. Similarly at the Kenya Institute of Education the Director of KIE and the Curriculum specialists responsible for computer education for all schools in Kenya were also interviewed. The field investigation was conducted in schools with computers and Principals and HODs and computer teachers participated in the investigation. The case study schools represented rural, suburban and urban areas.

However, since gathering of data requires time, the criteria for the choice of secondary schools was based on:

- Accessibility
- Schools with computers
- Urban, suburban and rural areas; and
- Schools willing to take part in the study.

4.6.1 Choosing the sample

According to Wallen and Fraenkel (2001:128), a sample "refers to any group on which information is obtained." Often, it is selected from a larger group called a population. To select schools for the study, I obtained a list of 524 secondary schools in Nyanza Province from the Provincial Director of Education. Out of these schools, only 30 had computers. The researcher therefore decided to use the 30 schools as a sample but realized that the size of the sample would not meet the desired expectation of the researcher (see appendix 10). Nyanza Province is extremely diverse in terms of socio-economic development. Most of the schools in rural areas lack electricity and other physical facilities for the use of computers. Because the sample included all the schools with computers, it was representative. An attempt was made to ensure that each subject in the defined community was able to participate effectively by interviewing participants involved with the use of computers in schools to build a sample that was satisfactory for the purpose of the study.

In addition, this study was conducted in Nyanza Province because of the following reasons:

- Nyanza Province is the researchers' home province. The researcher knew the location of the schools so it was easy to access the schools that had computers;
- The students the researcher trains at Maseno University in Educational Technology practise teaching in some of the schools investigated. It was important to identify schools with computers so that the students could use computers during teaching practice;
- To serve as a role model for teachers and lecturers in the area and the students at Maseno to conduct future research in CIE in the province.

Consequently, the original plan for collecting data was to interview 30 Principals, 150 Heads of Department and 30 computer teachers. The number from each group was chosen to be a fair representation of the targeted study. However this was not possible due to the following reasons. Firstly, only 25 Principals completed their questionnaires and returned to the researcher. Secondly, the researcher received 89 completed questionnaires from HODs. Thirdly, during my visits to schools to distribute questionnaires to the Principals and Heads of Department, the researcher identified only 20 teachers teaching computer education. So a sample of 20 computer teachers was used for the study. Fourthly, five schools did not have computer teachers and were not using computers for instruction. However, Bell (1993:83) noted that researchers are sometimes obliged to interview anyone from the total population who is available and willing at the time of the interview because unavoidable circumstances might force the researcher to modify the size of the population as well. Briefly the three groups of participants were as shown in table 4.2.

Table 4.2: Number of respondents representing the stndy schools

Participants	Rural	Urban	Suburban	Female	Male	Total
Principals	15	7	3	15	10	25
Heads of Departments	62	21	6	26	63	89
Computer Teachers	14	3	3	3	17	20
Total	91	31	12	39	95	134

As can be seen from Table 4.2, a total of 20 computer teachers from rural, urban and suburban took part in exercise, while 25 Principals instead of 30 completed and returned the questionnaires, and 89 Heads of Departments instead of 150 also completed and returned the questionnaires. The response rates of 83% from Principals and 59% from HODs were considered acceptable. The lower response rates from HODs may have been because many HODs who were not directly responsible for computer education did not consider the questionnaires relevant to them. Gender disparity was also noted. A total of 39 female respondents compared to 95 male participated in the study as displayed in table two above. At the same time there were

more Heads of Department from rural schools compared to those from urban and suburban schools. These factors were beyond the control of the researcher.

Therefore, the total number of the participants in the case study was determined by the situation in the field. Furthermore, with regards to the actual size of the sample, Cohen et al. (2000:93) and Wallen and Fraenkel (2001: 128) state that "there are no clear-cut rules for deciding on sample size." Consequently, the correct sample size depends on the purpose of the study and the nature of the population under scrutiny. Small samples are also more appropriate in an educational study that involves in-depth interviews. Sharp and Howard (1998) and Wallen and Fraenkel (2001:437) support the idea of a small sample. The small number in this case study can also be justified because a study that probes deeply into the characteristics of a small sample often provides more knowledge than a study that gathers less detailed data from a large number of participants (Borg and Gall 1994). The participants included both Senior Education Officers from the Ministry of Education as well as Curriculum Specialists from KIE, Principals, HODs and classroom teachers. Table 4.3 shows the total number of respondents who participated in the investigation.

Table 4. 3: Total number of respondents who participated in the investigation

Participants	Male	Female	Total
Ministry of Education/KIE	3	1	4
Principals	15	10	25
Heads of Department	63	26	89
Computer Teaehers	17	3	20
Total	98	40	138

The data indicated in Table 4.3 were the only ones available at the time of this study and the researcher decided to settle at the figure representing schools that had computers after considering suggestions by Cohen and Manion (1994) and Wallen and Fraenkel (2001). Their suggestions that thirty participants is a reasonable number for a study encouraged the researcher to settle on the present sample for schools. The sample of participants from the schools represented rural, urban and suburban areas.

4.7 Data collection procedures

When gathering both primary and secondary data it is necessary to be systematic. Sharp and Howard (1998:317) suggest that researchers should use the following check-list to ensure that data collected will be of an appropriate high standard so that:

- The data actually measures what they purport to measure;
- Proper attention is paid to measurement error and the reduction of its effects;
- A suitable sample is used, in particular that it provided a basis for generalisation; and is large enough for the effects of interests to be detected and;
- Data are properly recorded.

Considering the above points the researcher ensured that the conditions under which the data were gathered were properly identified and that suitable data recording methods were used and efforts made to detect errors and eliminate them during recording. As a result of this I adopted four strategies for collecting relevant field data. I chose the process of data collection that included consideration of: the research question, existing data, research assumptions, the resources and the participants as shown in Table 4.4.

Table 4.4: Methods of collecting data for the study

Method	Souree of data	Purpose
Literature review	Primary and secondary literature	To get previous relevant information on the use of computers in schools
Structured interview	Ministry of Education and KIE	Policies and curriculum on the use of computers
Semi-structured interview	Teachers	Classroom practices
Questionnaires	Principals and HODs	General approach to computing in secondary schools

The first phase of data collection consisted of a selective review of previous research literature on the use of computers in secondary schools. The second phase concentrated on interviews with key officers in the Ministry of Education and the Kenya Institute of Education. The third phase was concerned with a survey using questionnaires distributed to Principals and Heads of Department in secondary schools in Nyanza Province of Kenya. The last part involved visits to participating schools to carry out interviews using in-depth semi-structured interviews and tape recording with computer teachers. The field study was conducted between July and November 2001 in Nyanza Province of Kenya.

4.7.1 The consideration of the review of literature

The first phase of the data process concentrated on the objectives and purposes of using computers identified from various sources in secondary education. This was necessary in order to form key questions for the field research. In addition, a review of the literature was carried out to accomplish the following four purposes:

- To be come familiar with the background and history of the problem;
- To identify possible ways to study the problem;
- To assess the strengths and weakness of previous studies; and
- To develop a conceptual framework and rationale for the present study.

Therefore, a search of the relevant databases was carried out. The researcher conducted different types of literature searches. The first one was concerned with specific subjects closely related to the topic under investigation, and the second was based on methodology (Sharp and Howard, 1998). The literature search focused on four main areas:

- Policies on teaching and learning with computers in secondary schools;
- Integration and impact of computers on students' learning;
- The use of computers to improve the quality of teaching and learning, to motivate students, to widen access to education, and teaching and learning computer literacy skills;

- Factors encouraging and affecting the use of computers and training of teachers in the use of computers.

The review of literature involved assessing methods and research findings relevant to my study, especially looking into the use of programs such as word processing, spreadsheets; databases and programming to allow for comparison where possible with my field work. The review also focused on the advantages and disadvantages of computer as a tool for instruction.

I used secondary and primary sources of information that included electronic media such as ERIC, INTERNET, and USENET to collect the data. All of these were in an attempt to identify and review the aims and objectives of employing computers in secondary education. Secondly, to examine the problems affecting the effective utilisation of computers, since the literature review is a key tool for providing information on what is new, important, reliable, and useful. The review of literature enabled the researcher to draw on the findings developed by others, and to assess the work already accomplished. The findings of the review of literature are reported in Chapters 2 and 3.

4.7.2 Use of structured interview method to collect data

As mentioned in chapter one, the first phase of field research to collect data involved visits to the Ministry of Education and Kenya Institute of Education. Data were collected using interviews to elicit qualitative and quantitative (materials) responses from key policy makers (Educational planners/administrators) and curriculum developers. The aim was to identify government policy for the use of computers in secondary schools. I used the interview method because it has some distinctive advantages. For example, it is possible to achieve a complete response with different interviewees directly and ensure the validity of the results, and to clarify the responses on the spot as the researcher interacts with them during face-to-face discussion. Interview method is also flexible. The researcher can use the responses of the interviewees to alter the interview situation. A researcher can probe for more specific answers and can repeat a question to the interviewees. This happens when the response indicates that the respondent did not understand the question (Bailey, 1994; Borg, Gall, Walter and Gall, 1996; Murioki, 1995; and Wallen and Fraenkel, 2001).

Moreover, the interviews involved the collection of data through direct verbal interaction between individuals. Face-to-face encounters enabled the researcher to evaluate the respondent and judge the truthfulness of their responses. It also gives a better response rate than mailed questionnaires.

I therefore developed a blue print to guide the qualitative study. This was a general interview guide outlining the issues and research topics that were to be covered and some general questions that were to be asked during the interview. Howard and Sharp (1998), Murioki (1995) and Mayan (1996) also report that an interview guide ensures that all relevant topics are covered, while enabling the researcher to build a conversation by adapting the interview to each situation and the participants. Mayan explains that having a guide keeps the interaction focused and makes the best use of the limited interview time available while permitting individual perspective and meaning to surface.

Two different interview guides were used in the investigation. The first was used to obtain information from the Ministry of Education, and the other for the curriculum developers at the Kenya Institute of Education. The interview schedules used for the field research are attached as appendices 8 and 9. The topics and questions differed at various levels. Although the two lists of questions differed in certain respects, they covered various issues so that direct links could be made. The topics for the interviews with the Ministry of Education were concerned with policy formulation and implementation and financing of computers studies in secondary schools. The topics for the interviews with the curriculum developers were concerned with curriculum guidelines for the use of computers in secondary schools. It also included aims of computer education in schools, guidelines for integrating computers into traditional subjects, support materials, evaluation reports, budget for computer workshops/seminars and problems encountered with computer education programmes. The interviewees were assured of confidentiality and anonymity.

4.7.3 The application of the questionnaires during the investigation

The second phase of the field research involved a questionnaire survey developed to collect information and to elicit quantitative and qualitative data on computer education in secondary schools. The questionnaires were hand delivered to the

participants and collected by the researcher. This was necessary so that the researcher could interact with the participants attend to any outstanding issues, and to cross check misinterpretation of the questionnaires. The researcher collected data from 25 Principals and from 89 Heads of Department. Due to circumstances beyond the control of the researcher, data from 5 Principals and 61 Heads of Department were not returned to the researcher as mentioned in section 4.6.1. This was because some Principals and Heads of Department were not available to hand in their questionnaires despite the researcher's visits to these institutions more than three times. At the same time, seven schools had no technical department (consist of subjects like Art and Design) and therefore no HODs to run such department. No questionnaires were therefore received from these schools.

There were two different sets of questionnaires. The first questionnaire was administered to Principals of secondary schools, and the second one was designed for Heads of Department (see section 4.5.3). Although the two questionnaires differed in certain respects, they contained many common topics to allow direct links and comparisons of responses. The questionnaires were piloted in four secondary schools and since there were no problems identified these questionnaires were included in the main data collection.

I used a questionnaire surveys because the method is generally accepted as useful in measuring participants' attitudes and opinions. The method is also useful in providing numerical data, and enables comparisons to be drawn across groups in a small sample (Cohen and Manion, 1994; Sharp and Howard, 1998). Moreover, Nachmias and Nachmias (1992) report that it is useful to administer questionnaires because it reduces biasing errors that might result from the personal characteristics of the interviewer and variability in their skills. The absence of an interviewer provides grater anonymity and it permits wider geographical contact at minimal cost. However, Wallen and Fraenkel (2001:434) point out that in qualitative study, it is possible to use questionnaires or tests but "any instrument used should be grounded in the data that is used, because they can help to further understanding of the life experiences of the participants."

Therefore, with these contributions from scholars the researcher designed the questionnaires containing similar themes for all the participants. Each Principal and

Head of Department completed the relevant questionnaires containing a series of questions that could allow cross-references to be made with information obtained from the teachers of computer education. The researcher felt that a questionnaire of this type would be easy to administer and would reveal the most essential information required for this study. The items in the two different questionnaires were grouped into nine sections to correspond with the key issues that were to be investigated (see appendices 8 and 9 and section 4.5.3 in this chapter).

4.7.4 Use of semi-structured interviews to collect data

The last phase in data collection during the process of interviews were conducted in twenty public secondary schools where computers were used for teaching and learning. I decided to use this technique of gathering data because of its capability to generate insights to be investigated further. Bell (1993:8) argues that the semi-structured method is especially suitable when one aspect of a problem needs to be studied in some depth within a limited time-scale. Similar views are expressed by Borg and Gall (1994), Cohen and Manion (1994), Murioki (1995), Sharp and Howard (1998) and (Yin 1994). Furthermore, Cohen et al. (2000) report that the use of semi-structured interviews can help to establish cause and effect. While Wallen and Fraenkel (2001:437) state that sometimes much can be learned from studying just one individual, one classroom, one school or one school district. Therefore, the contributions of these scholars were taken into account by the current researcher. The field research was conducted in Nyanza Province of Kenya between the months of October and November 2001. The choice of techniques for collecting data was also influenced by the following factors:

- This was a suitable period of the school term as teachers were in session and had completed most of the course work so they were free to participate in the interviews and discussions without much pressure for classroom teaching.

- It was also easy to find the teachers and make arrangements with them to take part in the interview.

Techniques such as in depth interviews, long interviews, audio tape recording, participant observation and open ended-question are all very useful in collecting required information (Bell, 1993; Borg and Gall, 1994; and Cohen et al. 2000). I

decided to employ semi-structured interviews after reviewing the contributions of Bell (1993); Sharp and Howard (1998); and Yin (1994). For this study, the semi-structured interview method was appropriate because it enabled the researcher to use a diverse range of techniques to collect the data and to analyse them both quantitatively qualitatively. Using the semi-structured method I employed tape recording of in-depth interviews and open-ended discussions to collect the data. Through careful motivation of the interviewees and maintaining a rapport with them, it was possible to collect the information within a short time. The use of semi-structured interviews, as indicated in Chapter 1, enabled me to employ a detailed topic guide and a number of predetermined questions on specific topics; while at the same time the participants are allowed to digress and the interviewer was able to employ unscheduled probes.

Moreover, the use of semi-structured interviews enabled me to include most of the supplementary sub-topics or items derived from my own experience with the use of technology. There were no questionnaires constructed before hand, but a list of topics was developed to act as a 'framework' for the interview (see appendix 12). This method allowed me to tackle each topic in a flexible manner and the interviewees were also free to elaborate on their responses and to give their views at their own pace. I also used careful 'probes' to encourage and motivate the interviewees to feel relaxed while trying to reduce bias (e.g. trying to avoid leading questions that might encourage interviewees to offer views acceptable to the interviewer).

I started by making an 'outline,' listing all of the main issues in the subjects being studied. This preliminary listing was classified to create seven separate topic areas for the interviewees that I used to develop the general format of the interview schedule. Next I created a list of headings for each category of information to be addressed in the interviews. Under each heading items, statements and phrases like "types of software used" or just a question on a specific topic were listed and arranged in a specific sequence. With the assistance from my supervisors, I checked on the wording, technical level of language, subject content and pattern of questioning. This was necessary because of the diversity of the participants and the interview environments. The interview questions and topics aimed to probe interviewees' experiences and present patterns of using computers in teaching and learning.

The interview topics and questions were those that I hoped and expected would enable all of the respondents to contribute freely and express their views and attitudes openly about how they use computers in teaching and learning in the classroom. It also sought to identify the needs of teachers and schools in order to use computer technology effectively.

4.8 Administration and application of the instruments

Once the field research instruments and topics were ready, arrangements were made with various groups of the participants before any investigation into the research problem was undertaken during the month of July and November 2001 (see Appendix 13 for tentative field research programme). The researcher made arrangements to visit the Ministry of Education, Kenya Institute of Education and secondary schools as explained in 4.8.1 to 4.8.3. This was important for four reasons. Firstly, the objective of the study had to be explained to the interviewees. Secondly, I had to seek permission to visit schools to distribute questionnaires and conduct interviews. Thirdly, I had to apply for access and for copies of relevant official publications or documents on computer education in secondary schools. Fourthly, I had to assure the interviewees of confidentiality and anonymity of their contributions.

4.8.1 Seeking permission to conduct interviews

Before any investigation into the research problem was undertaken, I had to obtain the consent and co-operation of the people selected to participate in the investigation. This was an important stage in the research project because of the type of data that were to be gathered. Permission to conduct the research was absolutely essential. Bell (1993:52) noted the importance of consent to conduct a study and states that "no researcher can demand access to an institution, and organization or to materials." It was also essential for me to give the people concerned a clear picture of what the research entailed, stating clearly:

- The purpose of the visit;
- The objective and nature of the study;
- Its practical application;
- The design, methods and procedures to be used;

- The categories of participants who were to be interviewed and;
- The time for the interview and any other data to be collected (see Chapter 1 for details).

Three different letters were written and addressed to the interviewees (see Appendices G-J). One letter was addressed to the Principals of schools. It was an information letter concerning the intended visit and subsequent distribution of questionnaires and interviewing of teachers. The second letter sought permission from the Director of the Kenya Institute of Education to obtain data on curriculum regulations regarding the use of computers in schools. The third letter was addressed to the Permanent Secretary of the Ministry of Education. It sought information mainly on the Kenyan government policy on computer Education in secondary schools and requested that I meet with an appropriate Ministry Official.

Upon approval of the draft list of interview topics, by my supervisor, I drew up a tentative schedule for my fieldwork in Kenya.

4.8.2 Pre-interview arrangements

I started my fieldwork by visiting the Ministry of Education and Kenya Institute of Education to check if they had received my letter, to make an appointment for an interview and to collect an introductory letter to the Provincial Education Officer of Nyanza Province. Next I visited the Provincial Education Office to present the letter from the Ministry of Education and to collect another letter from them to visit the schools. Administration of the interview questionnaires was undertaken only after making appointments. Such briefing entailed obtaining permission from the school to conduct the interviews.

After receiving the letter from the Provincial Director of Education in Nyanza Province, I visited the schools to deliver the letters explaining the reasons behind the research project. This included distributing questionnaires to the Principals and Heads of Department, and making arrangements with the computer teachers for a suitable date for their interviews.

4.8.3 Interviews with Officials from the Ministry of Education, KIE and teachers

Before the interview, the interviewees were informed about the purposes and objectives of the study. I explained to the interviewees the importance of the study that was designed to examine firstly, the government policy and investment in computer education and secondly why computers are used in secondary schools, and thirdly to identify any problems they face with utilisation of the programmes.

The interviews were carried out in two phases during the month of August and November 2001. The first one involved senior officers from the Ministry of Education and Kenya Institute of Education. The second one concentrated on classroom teachers. In order to ensure maximum co-operation, the interviewees were assured of the confidentiality and anonymity of their contributions. I emphasised the need for accuracy and that they could modify their responses if necessary. I used note taking to record the data obtained from the Ministry of Education and Kenya Institute of Education. The responses from teachers were tape-recorded and some interviewees wrote their responses on note cards. The specific answers from the participants are presented in the analysis and discussion of the results in Chapter 5 and 7.

4.9 The general plan for data analysis

All of the information that I collected from the secondary and primary sources were subjected to analysis by either referring to the literature review chapters or to resources included elsewhere. However, with regard to the analysis of the data obtained from interviews using note taking and audio tape recordings, both basic descriptive statistics and qualitative techniques were used to demonstrate to the readers or users the different groups of data, their characteristics, range and averages. The data collected by questionnaires from Principals and Heads of Department was analysed by the Department of Statistics of the University of Pretoria using "Statistical Package: SAS Version 8."

I was obviously guided by the aims and objectives of the study in the analysis of the data. For the investigation institutions, and the participants (Principals, Heads of

Department and computer teachers) this included the general background information of the schools and the participants. I was particularly concerned with the following issues (among others):

- The school policy and practice on the use of computers in teaching and learning;
- Availability of computer equipment and support materials in schools;
- Availability of software and the type used in the school;
- The actual use of technology and involvement of students in computer education;
- The perceived value, views, impact and problems of using technology in secondary education;
- The training of teachers in the use of computers and the financing of this training.

A similar plan was also arranged for the analysis of data from the Ministry of Education and the Kenya Institute of Education. It focused on government policies on computer education in secondary schools and the supply of computers, financial involvement, curriculum regulation relating to the use of computers in secondary schools, etc. The analysis of the data is presented in Chapters 5, 6 and 7.

4.10 Problems with data collection and field research experiences

The data were collected between the months of July and November 2001. An interview schedule for visits to each institution was developed. Unfortunately this could not be followed strictly due to some problems encountered such as lack of transport, and bad weather that rendered some roads impassable. However, there were few problems in the data collection exercise, since all schools were informed by telephone or in person well in advance and were very co-operative. There was only one or two instances where there was a communication break down between the researcher and the schools. The researcher had to make another appointment to meet the Principals and explain the purpose of the investigation. The other problem concerned the questionnaires that were not returned to the researcher.

The participants were assured that the findings would in no way be used for any other purpose apart from this research. Once the teachers were convinced on this point and the intentions of the study were clear, there was no difficulty in completing the questionnaires. All of the participants that co-operated were motivated and wanted more computer equipment and support materials.

4.11 Summary

This chapter has described the methods, techniques and procedures employed to collect data for this investigation. Information of how data were gathered at the various stages of the research has been presented. The specific objectives of the study, research questions and sources of evidence and assumptions about the use of computer programs have been identified and included. The choice of participants for the interviews, questionnaire surveys and interview topics have also been explained. Information was gathered through structured interviews using note taking and open ended discussion with Senior Education Officers from the Ministry of Education and KIE, questionnaires completed by Principals and heads of secondary schools, and through semi-structured interviews using audio tape recording with computer teachers. In addition, arrangements and general plans for data analysis for Chapter 5, 6 and 7 has been outlined. In the next chapter, I present the research findings from interviews with Officers from the Ministry of Education and Kenya Institute of Education on government policy regarding the use of computers in schools and curriculum materials available for the use of computers in teaching and learning.

CHAPTER 5

INTERVIEWS WITH MINISTRY OF EDUCATION OFFICERS CONCERNING THE INTRODUCTION OF COMPUTERS IN PUBLIC SECONDARY SCHOOLS

5.1 Introduction

This chapter reports the research findings of a study that was part of the field research to collect data on how computers are used in public secondary schools in Nyanza Province, Kenya. It sought evidence on Government policy and curriculum regulations regarding the implementation of computers in teaching and learning. The data for this study were collected through structured interviews (see appendix 8 and 9) with key Education Officers and Curriculum specialists in the Ministry of Education. These officers were the only ones who were in a position to provide data about the school computer program in Kenya because they were the ones in charge of computer education in public schools. They had to explain government policy and curriculum regulations before I visited Nyanza Province to investigate whether the computer policy was being implemented in public secondary schools. The officers from the Ministry of Education were invited to participate in a face-to-face interview freely without any coercion from the researcher.

The data collected through these structured interviews were complimented by a questionnaire survey on the role of the Principals and Heads of Department on the use of computers in their schools (findings presented in Chapter 6) and semi-structured interviews with twenty computer teachers that is reported in Chapter 7. This chapter begins with a brief overview of the government decision to introduce computers into public secondary schools. Then it examines policy issues and challenges as the Officers perceived them and the findings of the investigation are presented in the relevant sections. The issues discussed include an overview of the current government policy, the reasons for introducing the policy, policy implementation and resource allocation, financial implications, benefits and limitations of the policy, curriculum regulations relating to computers in schools, development and distribution of support materials, and assessment. The other findings reported include problems and difficulties encountered

with implementation of the policy on computer technology. Drawing on the findings, the chapter ends with a summary of the main points.

Since this chapter is based on a qualitative study that involved data in the form of text, phrases, or symbols describing or representing people, actions and events in social life (Neuman 1998), data analysis has been based on themes, concepts or similar features. The findings have been reported using simple tabulation of responses where necessary and descriptive analysis. However, when analyzing a policy to determine whether it can meet or has met the needs that it seeks to address, the researcher considered how the policy was initiated, reasons for the policy, the impact and benefits. The other concern was whether the policy could be implemented, and whether the resources and skills are available to implement the policy (Pillay 1999:245). The researcher also examined policy implementation and financial involvement because these were identified by (Jansen 2001: 274-275) as being important influences on the effectiveness of government policy.

5.2 An Overview

The decision by the Kenya Government to introduce computers in public secondary schools was influenced by two major educational resolutions and policies. The first was in 1996 when the Ministry of Education announced that it had approached UNESCO to fund the project and train teachers to teach computer education. The Ministry of Education published a circular guideline NS/B/37/1/118 in 1997 approving the teaching of computer education in schools, and computer companies were requested to enter schools to display their products to promote the use of computers and announced that the subject would be examined in 1998. The Minister for Education noted that computer education was to be included in the timetable and in the curriculum where possible; teaching materials were to be developed and physical facilities were to be improved. It was noted also that implementing computer technology in public secondary school would bring about widespread changes in the school system, teaching strategies and teachers beliefs and improved physical facilities. The report further indicated what was missing (e.g lack of computers, trained teachers and physical facilities).

A crucial part of my research was to examine the content and context of government policy on computer education in secondary schools, and to analyze how effectively this policy was being implemented in public secondary schools. This was important since the government formulates educational policies and sets the overall structure and methods of implementation of the educational system in the country. A policy is a statement adopted by the government to provide a uniform plan for action or guide to action. In this connection, Pillay (1999:240) explains that a policy is developed to influence or shape the way people behave and that policies are the result or outcome of some need, so the need must be clearly understood by those concerned.

The other purpose of the study was to examine government policy on financing computer education. To do this it was necessary to obtain clear information from the government and Kenya Institute of Education (KIE) on the use of computers in schools, and the support materials supplied to schools before I visited secondary schools to get an insight into what actually happens in these institutions. This was necessary since teachers are expected to implement government policies and curriculum innovations, and the ways in which computers are used in secondary schools depend on the Principals, Heads of Department and classroom teachers. The interview questions were designed to explore these issues and this chapter presents findings and conclusions based on a number of personal interviews with officials in the Ministry of Education and the Kenya Institute of Education.

5.3 Current Government Policy on Computer Education in Secondary Schools

In an interview at the Ministry of Education at Jogoo House in Nairobi in August 2001, a senior education director was asked to explain current Government policy on computer education in public secondary schools. In response, the officer reported that there is a government policy stating that "computers can be used for teaching purposes." This policy is based on the Education Act of 1968 Chapter 211 that included the use of resources in teaching and learning. However, he stated that there was no separate written policy document on the use of computers. The current policy guideline on computer education is contained in the Ministry of Education circular letter Number

INS/ME/A/2/14/5 of 31st January 1997 stating that "Schools are encouraged to offer computer subjects depending on the facilities available." Moreover, in a recent development, Aduda (2002) reports in the Daily Nation Newspaper indicated that the Ministry of Education issued another statement to confirm that computer education is to be offered in schools as an optional subject to be examinable at Kenya Certificate of Secondary Education (KCSE). During an interview with one of the Kenyan Directors of Education at the Commonwealth of Leaming (COL) Conference in Durban on 30th August 2002, it was confirmed that the policy document on the use of computers was still being formulated.

In comparison with other developing countries, Kenya's progress towards formulating policy to guide the implementation of computer education programs in public secondary schools is not typical. In an interview with an Education officer from Nigeria at the COL conference about the use of computers in secondary schools, she indicated that Nigeria was still conducting pilot studies in a few schools and the policy was still being formulated. Similar information was obtained from the Minister for Education in Sycheles. However, an Officer responsible for Technology in the Ministry of Education in Malaysia indicated in a private conversation at the COL conference that they have a policy on the use of computers. A report by Pearson (2001:280) also noted that Hong Kong has a policy document titled "*Information Technology for Learning in a new Era. Five Year Strategy 1998/99 to 2002/03* (herein *Strategy*) to promote the use of computers in schools. Therefore, many developing countries have embarked on developing policy statements on the use of computers in teaching and learning.

Even though there is no formal policy document on the use of computers in secondary schools in Kenya, the government officials that I interviewed assured me that the Kenya government supports the idea that computer education is important.

5.3.1 Reasons for adopting a computer policy for schools in Kenya

The interviewee revealed that the government gives high priority to the use of computer technology in schools in view of the fact that the "the country wants to be industrialized

in the year 2002." Consequently, the officer reported that the government has to exercise control over the introduction and use of computers in public secondary schools in order to:

- *protect schools from being treated unfairly by various computer firms;*
- *guard against confusion on the type of software and teaching/learning materials from computer companies or individuals;*
- *oversee the implementation of computer education in schools.*

In view of these reasons, the interviewee reported also that the Ministry of Education mandated the Kenya Institute of Education to design computer education syllabi for secondary schools. In addition, the interviewee pointed out that the KIE through its technical education panel started a 'computerization' program on radio broadcast to create awareness of computer education in 1997.

5.3.2 Steps taken for implementation of the computer policy

Apart from the value placed on school computing by the Government, effective utilization depends on how computers can be integrated into school subjects, planning and changes in the teachers' role. The interviewee was asked what steps have been taken to implement this policy. In response the interviewee replied that the government appointed an officer to be in charge of the computer project and to work with District Education Officers and inspectors of schools to monitor the implementation process. He also emphasized that the Education Act CAP 211 of 1968 is still in operation with amendments in 1980 and 1990s. The Officer summarized the information and stated that:

> *The law requires an officer inspecting a school to have a*
> *special regard to the maintenance of educational standards*
> *and to compliance with any regulations of the Education Act.*
> *This gives the officers power to inspect the use of computers in schools.*
> *Computer education were started as a means of promoting computer literacy*
> *in secondary schools and to provide computer education to many*
> *people in the country.*

It was noted also that through the government's specific policy plan, some of the National Secondary schools were supplied with computers donated by UNESCO. The Secondary Computer Syllabus was also provided. He explained also that UNESCO and officers from the Ministry of Education mounted an in-service course on computer literacy skills to Principals and some teachers in secondary schools in 1997.

According to Pillay (1999:240) a policy is usually created in response to some need, and the need may have to be clearly understood by all stakeholders before any action is taken. A crucial factor relating to teachers' use of computers is the availability of the facilities, computer equipment and the personnel. The extent to which the curriculum and technology are implemented depends on clear policy guidelines and regulations. Knupfer (1993) noted that the teachers' existing attitudes, skills, and working conditions have great influence on their acceptance, style of implementation, and outcome regarding educational computing. The interviewee was asked to indicate who was responsible for implementing the policy and how the implementation was being monitored. In response the interviewee said that secondary school teachers and the inspectors of schools implement the project. He also stated that the Ministry of education (MOE) established the Kenya Institute of Education to design and develops national curriculum for schools, including the use of technology, and to work closely with supervisors of schools so that a uniform Secondary Computer Syllabus could be produced. In addition the officer reported that a second in-service course was organized at provincial level all over the country for computer teachers in 1998.

The officer noted that in order to supply computer equipment and books, the government allowed various computer firms to display their computers and relevant materials in secondary schools, to conduct workshops and seminars on computer awareness and to give demonstrations in liaison with District Education Officers.

5.3.3 The success of the implementation of computer policy in schools

The success or failure in the implementation of computer education policy in schools depends more on the effectiveness of the preparation of teachers, their willingness to use computers in classroom instruction than the nature of the hardware or software. Bitner and Bitner (2002: 95) point out that while attention to choosing appropriate hardware and software for classroom use is a prerequisite, "it is the skill and attitude of the teacher that determines the effectiveness of technology integration into curriculum." But this is not an easy task because change can be intimidating and threatening. If computer education is to be truly beneficial and remain a valuable part of the educational system there must be good teaching techniques and sound innovational strategies, critical planning and evaluation throughout implementation. From my experience with the use of educational technology in Kenya (radio and television programs) it is evident that unless teachers have a definite plan for implementing computer technology in a meaningful way all the government efforts in any educational project will not be fruitful. Clark (2000) also found that teachers were not implementing computer education in classroom instruction. A report by Zhao and Cziko (2000:7) in UAS indicated that very few teachers used computers regularly in their teaching and the impact of computer integration on existing curricular was still very limited. This was because of lack of suitable training, technical and administrative support, a systematic incentive and lack of access to equipment, traditional pedagogical beliefs, and resistance to change. Thus, Bitner and Bitner (2002:96) listed eight factors that have been identified to be important to enabled teachers to implement computer technology into teaching and learning. These included:

- Fear of change: fear, anxiety, and concern that teachers have about change must be addressed;
- Training in basics: training must provide teachers with knowledge of the very basics of computer use;
- Personal use: personal productivity skills can be used as a means to foster the teacher's interest;

- Teaching models: teaching models using technology as a tool in the classroom to help students achieve must be provided;
- Learning based: learning should be the impetus that drives the use of technology in the school;
- Climate: a climate must be created that allows teachers to experiment without fear of failure;
- Motivation: motivation to endure the frustration and turmoil of the change process must be present;
- Support: support that is ongoing and onsite must be provided." Teachers need support in the technical area and in the curriculum area.

For the above reasons, I asked the interviewee "What data exists on the success of the computer policy?" The response from the officers indicated that:

- By the year 2000, the Ministry of Education had allowed only one firm to supply computers to schools;
- The Ministry started a radio program on 'computerization in schools' to create awareness of computers in schools in 1998;
- There are records of Inspectors of schools' visits to schools in provinces from 1997 to monitor the use of computers and to assess the implementation of computer education and any problems encountered;
- In-service courses organized on basic computer literacy were attended by Principals and teachers in secondary schools during 1997 and 1998;
- The Kenya Institute of Education produced Secondary Computer Syllabus in 1996 for all secondary schools. Computers are available in some secondary schools and used in teaching and learning computer skills;
- Students have sat for Computer education examination at the end of Form iv- Kenya Certificate of Secondary Examination (KCSE) in 1998 to date;
- Inspectors of schools and curriculum developers are involved in marking the KCSE and carry out curriculum evaluation.

Arrangements were being made by the Ministry of Education and KIE to produce relevant course books that schools could use in teaching and learning computers. This detailed response from the Ministry of Education officials suggested that appropriate steps were being taken to introduce computer education to schools and that some monitoring procedures had been established. However, the official was unable to provide specific data about the success of the computer policy. For example, the officer did not have a list of the Principals and teachers who attended the computer in-service training course. Secondly, the curriculum specialist at KIE was not involved in the training programme, and had no evaluation report on the impact of the in-service computer literacy course.

5.3.4 Problems and difficulties with the implementation of computer policy in schools

Effective implementation of computer education in secondary schools requires clear policy guidelines of how to integrate the technology in teaching and learning. When there are no policy guidelines, or when the guidelines are vague, as they were in Kenya at the time of this study, it is unlikely that teachers will embrace the new ideas enthusiastically. The interviews with teachers referred in Chapter 7 indicated that a large number of teachers in schools were not aware of any policy documents available for the use of computers. When government officers pronounce education policies, they rarely make reference to how teachers will implement the policy. According to Jansen (2001), in most cases the implementation agenda is never on the policy agenda. Jansen (2001:274) feels that there is need for the government to make " concrete steps that would be taken to implement such policies, and such implementation plans need not accompany the immediate policy announcement but would typically follow thereafter." Furthermore, the success of any such implementation effort will depend largely on the teacher who determines the daily school activities. Therefore, the personnel and professional relationships among teachers, students, and administration can have a great influence on the future of any curriculum innovation. UNESCO (2002) clarifies the issue of implementation and points the need to provide teaching and learning resources and

training of teachers in computer technology as discussed in Chapter three Sections 3.2.2 and 3.4. Lack of training is the greatest barrier of all that limits the integration and use of computers in teaching and learning. These factors identified in developed countries also apply to developing countries like Kenya.

In order to obtain more information on the integration of computers, the officer was asked to identify any problems and difficulties experienced with the implementation of the computer policy. The answer to this question was in two parts. The first one related to finance. The officer noted that computers are expensive to purchase and maintain, and it can be a heavy budget commitment for the government to supply all institutions training secondary school teachers with computers and to re-train the teachers. The interviewee stressed that the high cost of computers was causing a lot of concern to the government and that it could not afford to purchase computers for schools and to train teachers. In order to help solve the first problem of lack of computers, the government allowed computer companies and consultants to carry out computer awareness for teachers and some schools made arrangements with computer firms to loan them computers for teaching and learning. In the process, the government realized that the outcome was not encouraging because:

- *The Fees charged by computer firms were very high. For example, some computer firms charged [1] KShs 1000 per student per term for the use of computers.*
- *There was a problem with maintenance and repair of computers;*
- *There were not enough computers and software supplied to schools;*
- *Many teachers were not qualified to teach about computers, so computer firms hired their own teachers;*
- *The computer support materials such as software applications were sometimes not suitable.*

[1] At the time of this research 1 US$= Kshs 78.00

Consequently the government had to identify funds from external sources to finance the project. The officer noted also that when computer education was introduced in the1990s, the government had a high hope that the cost of purchasing computers would decrease so that institutions and schools would buy enough computers for use. But up to now, no specific tangible step has been taken to help solve this problem. The government does not have any financial commitment to supply computers to schools and other institutions of higher learning. The general world economic climate has been damaging to Kenya with the World Bank and the IMF putting tough conditions on financial support. However the officer noted that Non-Government Organizations (NGO) could donate computers and schools are free to seek funds and purchase computers within their financial limits.

The second major problem experienced by the government was a lack of trained teachers with computer literacy skills amongst those already employed. The Officer noted that *the number of teachers in schools is so large that proper training in computer literacy skills would require considerable funding.* However, teachers need considerable support in order to integrate computers into their teaching subjects. If funding is available, this can easily be done through in-service training to continually update them on changes in computer technology and the software products. Although this requires time to organize and run the courses, and the time to plan lessons that incorporate technology, it could be cost effective. In addition, the interviewee reported that *lack of computer rooms and rural electrification to all secondary schools were delaying the implementation of the policy.* From my experience, the majority of secondary schools have not put up computer rooms or had an extra classroom for computers since the time the government decided to introduce computer education in public secondary schools. Most of the schools in rural areas also lack a reliable source of electricity, and some have no source of electricity.

5.3.5 Financial policy on the use of school computers and resources allocation

In another interview question, the Officer was asked to state what resources have been allocated to computing in schools. The response from the Officer indicated that the Ministry of Education has not allocated *any* money for school computing. This has been due to continued financial difficulties. Nevertheless, the interviewee was asked whether

there is an investment policy and resources allocation for the implementation of Computer education. There was a negative response but the Officer reported that the government gives grants for development and expansion of school activities. Schools are expected to arrange with the Board of Governors (BOGs) and Parents Teachers Associations (PTAs) to obtain computers and other support materials. However, the interviewee noted that this policy has not worked well with some of the disadvantaged schools that cannot afford to buy computers. The Officer cited some of the reasons that inhibit some schools from funding computer education:

- *Some communities are poor and may not raise enough funds for computers; and in some schools there are low student enrollments so schools may not save and have enough money to buy computers;*
- *Negative attitudes of Heads of schools towards investment in computer education;*
- *Teachers' resistance to change, and general fear of the computer technology.*

Policy makers in education need to consider the cost benefit of investing in computer technology and assist all schools to provide computer education. An important strategy should contain a clear budgetary commitment from the government to support the development of support materials as well. This is one of the major reasons why computers have not been widely used in public secondary schools. According to Woodhall (1997:78) those officials responsible for allocating government funds or school budgets are unlikely to respond with extra funds and resources without convincing evidence that this will be cost effective. Woodhall (1997) points out that such evidence is lacking in Africa. Hence the need now for the formulation of policies that can work for the betterment of schools. Policies that are not properly formulated affect the capacity of schools to purchase the computer technology for teachers to use in teaching and learning. One of the difficulties in trying to convince governments, parents, NGO's or donors to fund the purchase of computing equipment for schools in developing countries is that the benefits are very hard to define. On the one hand, there can be general claims that when students gain computer skills they become more employable. But on the other hand there may be no jobs available. Similarly, there may be claims that integrating computers into

the study of traditional subjects (such as Business Studies) is a more efficient way of teaching, but this is very difficult to prove. Finally, there is the important question of whether or not the benefits of CIE in developed countries (where most of the research on CIE has been done) can be achieved in a developing country.

5.3.6 Evidence available on the use of computers in schools

One of the objectives of introducing computers into public secondary schools by the government was the desire to help Kenyan youths become computer literate, and to ensure students graduating from secondary schools were equipped with computer literacy skills to enable them to compete for jobs in the world market. In this connection, the officer was asked the question "What evidence is available on the use of computers in schools and its effects on teachers and students?" In reply, the interviewee confirmed that some schools, especially the National schools and others with adequate funds, do use computers. He further added that schools are guided by national government goals and objectives in the formulation of their policies on the utilization of computers which states that "the system of education should produce citizens with skills, knowledge, experience and personal qualities required to support her (Kenya) growing economy." Computer education are undertaken to produce learners to participate effectively in the economic development of the country. Computer education is subjected to evaluation just like any other regular school subject so there are evaluation reports from:

- *Provincial Director of Education's annual report to the Ministry of Education;*
- *The inspectors of schools' reports;*
- *National examination registration and results; all of which provide the government with information about the implementation of computer education in schools.*

The interviewee reported that an evaluation on the use of computers was carried out in one of the secondary schools and a special report was issued on the introduction of computers. The Official was unable to supply details of this report, and it was not

available to the researcher. However, the Official indicated that this report revealed that private firms had invaded schools and given software packages that were not approved by the Ministry of Education so the Ministry advised the school to wait for the right syllabus and other computer support materials.

Regular evaluation reports help to improve the quality of teaching and learning with computers and inform the government about the teachers' views and what takes place in the schools. The decision by the Ministry of Education to try to control the software that was being used in schools has both advantages and disadvantages. According to Heinich at al. (2002:74) media materials should be appraised prior to use in teaching and learning. However, when there is no official mechanism for such appraisals, teachers need to be able to make their own judgements.

5.3.7 Number of schools using computers and software available

Information was collected from the Ministry of Education about the number of schools using computers and the type of software available. The interviewee reported that a list of schools offering computers by district from 1995-1999 indicated that 30 National schools had computers. In Kenya, secondary schools are categorized into National, Provincial and District schools. The National schools were former government grant aided schools. These schools admit students from all parts of the country. At the time of the interview the Officer estimated that the number of National schools with computers could have risen to over 200, but there was not an up-to-date list. With regards to type of software used, the interviewee said that the government recommended *Word processor, Database, Spreadsheet and Programming packages but some schools use other software applications such as graphical packages, desktop publishing and computer accounting packages.* Besides, the officer reported that the government sent out a letter to all secondary schools indicating the requirement for a secondary school to start computer classes. The government recommended:

- Sufficient computers for staff and the number of students per computer to be in the ratio of 1-2 students;
- Computer rooms/classrooms must have appropriate furnishing such as carpets, and computer covers to protect computers from dust;
- Availability of fire protection device for emergency in case of any accidents during computer lessons;
- Sufficient ventilation. The rooms need to have windows with curtains because computers require rooms that are free from humidity;
- Enough space for electronic media library;
- Students and staff to have access to e-mail and the Internet;
- Supportive electrical suppliers for computer networking
- Enough diskettes, printers and metallic diskette holders;
- Manuals for teachers and students for effective use of computers;
- Relevant computer textbooks for students and teachers.

In addition there should be a syllabus for Computer education and teachers should be computer literate.

5.3.8 Reasons for introducing computers in public secondary schools

There is growing awareness that computers can be turned to educational advantage as a tool for instruction, as a source of information and as a subject matter in their own right. Many students have a natural interest in and are motivated to use computers. This positive attraction towards the medium lends it a real potential as a powerful learning resource. Heinich et al. (2002:214) also report that the computer has the ability to provide "rich learning experiences for students, giving them the power to influence the depth and direction of their learning. It has the ability to integrate a variety of media-still and motion pictures, graphics, and sounds, as well as printed information. The computer can also record, analyze, and react to students' responses typed on a keyboard or selected with a mouse." With all these capabilities of the computer, the researcher asked the interviewee to give reasons for the use of computers in public secondary schools. In response the interviewee stated that "many schools offer computer lessons for literacy

purposes, so that our country could have computer literate manpower to be in a state of preparedness for industrial take off in 2002." For this reason, programs of instruction have been suggested to include *hardware; and Software packages such as word processing, spreadsheets, databases and programming.* The interviewee stressed that curriculum specialists and officers from the Ministry of Education and Kenya National Examination Council are involved in writing the syllabus and getting ideas to write textbooks.

The reasons that the interviewee gave for introducing computers into secondary schools were quite vague. They were based on the general idea that it would be good for the country if school students became computer literate. He did not support these general claims with any evidence that these vague benefits had been achieved in any other developing country. Nor did he seem to be aware of the specific ways in which developed countries were using computers in schools.

5.3.9 The role of computers in secondary schools

The introduction of computers in secondary schools in Kenya is one of the most significant changes in the school system in recent years. The interviewee was asked to state the major role of computers in secondary education. In reply the interviewee reported that computers play an important role firstly in *school administration: to keep school fees records, store information for correspondence, and to process examinations. Secondly, is used for teaching students computer literacy skills. Thirdly, is used for training teachers and the community in computer literacy.* Heinich at al. (2002) in USA report similar roles the computer plays in schools.

Furthermore, the officer noted that as a result of the introduction of computers in secondary schools, the schools' administration are now producing their accounts in an organized manner and more easily than before.

5.3.10 Financial implications of the government's policy on computers in secondary schools

The last question in this section concerned the financial implications of computing in secondary schools. The information obtained indicated that the operation and financing of school computing had a definite implication for the government's budget and for the budgets of individual schools. The interviewee reported that: *there were no funds allocated for the use of computers in schools. The head teachers are free to look for funds and provide Computer education. It is an optional subject.* However, the researcher feels that if the government wishes to develop computer education properly, there is need for funds to be set aside for technology in schools.

Educational expenditure has risen sharply in Kenya in recent years, causing a budget deficit for schools. As a result of the deteriorating economic conditions in the schools, only secondary schools that are financially capable will offer Computer education. This leaves most of the schools to conduct theory classes which have a negative effect as far as the objectives of Computer education developed at the Kenya Institute of Education is concerned (i.e. to develop skills in the safe use of computers and software packages (KIE 1996:iii). This will also increase educational inequality in secondary education and bring imbalances such that very few students will get access to computing. Klees (1995) noted that using computers in education could necessarily increase inequalities within a country. This raises a serious question for the success of computer education in all secondary schools in Kenya, a point that will be addressed further in Chapter 6 and 7.

5.4 Kenya Institute of Education

Kenya Institute of Education is a curriculum development center, charged with a responsibility to conduct research, design and produce teaching and learning resources for schools and teacher education below university. Therefore, after interviewing the Officers from the Ministry of Education who confirmed that there was a computer policy for the use of computers in secondary schools for teaching purposes, the next step was to interview the curriculum specialists at the Kenya Institute of Education. The purpose of

the interview was to get information regarding the computer materials available for teachers and students. The government established Kenya Institute of Education (KIE) in 1957 to conduct research, design and develop curricula for schools and to provide teacher education below university education. Curriculum specialists are responsible for designing and producing teaching and learning resources for all the subjects taught in public schools. It was therefore important to talk to the officers in order to get a detailed picture of curriculum implications and to identify curriculum regulations relating to the use of computers in secondary schools. Therefore, the Director of KIE was asked a question "Do you have curriculum guidelines concerning the use of computers in secondary schools? In response, the interviewee said that there were regulations and explained:

> *KIE develops curriculum for school subjects in partnership with the Ministry of Education Officers. In the process we provide guidelines in respect of key issues in computer education programs such as ratio of computer to a child; curriculum issues; information from the syllabus of how many periods per week; and number of hours per topic.*

In addition, the interviewee explained that since Computer education falls under Applied Subjects, the number of hours per week for Computer education remains the same as for Technical Subjects (about 2 hours and 15minutes). Furthermore, the officer emphasized that KIE has the mandate to ensure the program is relevant and up-to-date, and able to adapt to the challenging needs of computing education in the country.

5.4.1 Reasons for the computer curriculum guidelines

Another area of investigation concerned the reasons for developing computer guidelines. In response, the Director of KIE reported that the computer guidelines were developed to promote the quality and uniformity of Computer education in all secondary schools. The interviewee stressed that the guidelines:

- *Are a policy document stating why a curriculum is set for schools;*

- *Provide a foundation for further exploration of the computer subject;*
- *Provide learners with information to learn on their own;*
- *Look into what would be the best mode of computing in schools; and to restructure it if there is a change in teaching instead of revising the whole curriculum.*
- *Aim to avoid variations in schools due to available materials.*

Furthermore, the Officer stressed that in any curriculum development process such as the computer studies in schools, the Inspector of schools chairs the meeting. He also noted that Inspectors of schools are members of the course panel and represents the Ministry of Education in put into all curriculum innovation.

5.4.2 Pedagogical theory that underpins computer education in schools

In another interview, the Director of KIE was asked what pedagogical theory underpins Computer education in schools. This question was asked in order to identify how the computer syllabus was intended to influence the teaching of computing in schools. The information obtained emphasized the following points:

- *The highly centralized curriculum provides uniformity;*
- *All schools use the same syllabus;*
- *Learning objectives are the same for all students;*
- *Expected learning outcomes are similar in all classes;*
- *The syllabus emphasizes both theory and practical;*
- *Schools use similar teachers' guide notes;*
- *Teachers are using similar training course materials;*
- *Time allocated to Computer education is similar in each school;*
- *The students sit for the same examination at the end of the course; and*
- *Teachers also sit for a similar examination (computer literacy courses run by commercial colleges or institutions offering computer education)*

The officer's answer focused on the "technical" aspects of the syllabus, he did not provide any theoretical rationale or refer to any theoretical approaches such as outcomes-based education or constructivism.

5. 4. 3 Goals of Computer education in secondary schools

Another important factor relating to teachers' use of computers is the goals of Computer education in secondary schools. According to Davis (1993:27) a goal is the foundation of all instructional activities. It determines what will be included in the course and helps teachers to select the knowledge that has most worth. In this connection, the Director of KIE was asked to state the goals of Computer education in secondary schools. In reply, the officer reported that the goals of Computer education are included in the syllabus and are summarized as follows:

- *To develop skills in the safe use of computers and other support materials;*
- *To help students to be acquainted with fundamental concepts of computing;*
- *To enable students to appreciate programming and acquire the knowledge to write and run simple programs;*
- *To help the learner to acquire a firm base for further education, training and the world of work;*
- *Above all, to provide the learner with a firm foundation of computer literacy*

(KIE-Secondary Computer Syllabus1996:iii-iv)

Looking at the above points, it can be seen that Computer education aims to provide the foundations for learners for professional jobs and to participate adequately in a technological information society. Button et al. (2002) from USA, and Kirkman (2000) in UK and the South Africa National Curriculum Statement for Grades 10-12 (Schools) Information Technology (2002) expressed similar purposes of computer education in schools.

5.4.4 The role of the curriculum developer in computer education

In another discussion, the KIE Curriculum Specialist was asked to explain the role he plays in the introduction of computer education for schools. In reply the officer stated that he "*plays a major role in the coordination of Computer education for schools.*" In this regard he "*calls relevant educators and computer experts to research and develop the Computer education Syllabi and other materials,*" *and to suggest the textbooks to be used in the teaching of the subject.* In addition, the interviewee reported that a Computer education committee was appointed at KIE in 1995 to carry out the following activities:

- *To initiate and guide appropriate curriculum development;*
- *To keep under constant review the existing syllabus in the subject or curriculum area and make necessary recommendations to the course panel;*
- *To keep under constant review all examinations conducted in the country in the relevant subject or curriculum area and make recommendations to the course panel;*
- *To review and recommend books for use in Computer education.*

5.4.5 Reasons for establishing the computer education committee

The Curriculum Specialist was asked to state the reasons why the Computer education committee was established. In response to this question, the Curriculum Specialists stated that "*at KIE if there is curriculum to be developed, it has to be with the members of the panel.*" The interviewee explained that the Computer education committee is composed of representatives from the experts in the subjects, lecturers from the university, and professionals from industries. The officer noted that the committee produced the Computer education syllabi used in secondary schools and the students taking the Computer education subject sat for a National Examination that was written with input from the panel.

5.4.6 Integration of computers into traditional subject teaching

Many research reports discussed in Chapter 2 (e.g Cornu, 1996; Van Veer, 1996; Cameroon, 1999) have emphasized the value of integrating computers into the teaching of school subjects. The interviewee was asked to comment on this topic in relation to secondary school subjects. In reply the officer noted the importance of integration and suggested "*computer integration into the teaching of secondary schools subjects", arguing that it will help a lot to promote the use of computers in teaching and learning. The interviewee suggested that KIE would invite subject teachers, University lectures, computer specialists, and the Officers from the Ministry of Education to attend a Course Panel to identify specific topics that could be integrated into computer programs. The subject Panel would then work out how the integration would be and to write a guideline for implementation.*

5.4.7 Production and supply of computer support materials

Educational use of computers is usually associated with support materials. Some of these resources include:

- Computer syllabus
- Teachers' notes that give a short statement of the main points of a program and indicate how it is to be used.
- Students' materials such as pamphlets, worksheets and tasks, and other visual media produced to reinforce or extend the medium.

Previous studies from developed countries (Becker, 1999; Carol, 1997; Vannatta and Beyerbach, 2000) indicated that lack of computer materials was one of the factors affecting effective utilization of the technology in teaching and learning. In an effort to establish a clear picture of the supply situation, the interviewee was asked to state what Computer education materials are produced and sent to schools. In reply, the officer reported that "*only the syllabus for the Computer education program has been produced*

and schools are expected to purchase copies at the institute." The officer stressed that "*due to liberalization the public can develop computer materials.*" In such a situation, "*any book written for Computer education for use in public schools must pass through Kenya Institute of Education for vetting.*" Although the Kenya Institute of Education has an obligation to research and prepare students' manuals and teachers' guide notes this has not been possible. The interviewee reported that the *Kenya Institute experienced a lot of financial problems, lack of equipment and personnel to develop computer education materials, the computer course requirement is extensive and needs a lot of time, and that the subject was not a priority at present.*

In another related question regarding the supply of the Secondary Computer Syllabus to all secondary schools, the interviewee reported that *"only schools that were instructed in 1996 to offer computer education received the 1996 computer syllabus free. However many other schools purchased their own computer syllabus but there was no up-to-date record."*

These responses suggest that the curriculum specialist did not place a high priority on the use of computers in secondary schools. He seemed unwilling to explore ideas such as using the expertise of a few trained computer teachers to produce guidelines, seeking funding from donors, or establishing a computer center within KIE.

5.4.8 In-service course organized by KIE for computer teachers

Another function of KIE is to organize in-service courses and workshops for teachers involved in the implementation of curriculum. Implementation is one of the most complex tasks in the curriculum innovation process. Well-trained and enthusiastic teachers are essential for the success of the curriculum innovation. Consequently, classroom teachers need to know how to incorporate computers into their teaching strategies and other activities in addition to knowing how to use the software. The interviewee was asked to state how often computer in-service course or workshops are organized for teachers? The interviewee reported that these workshops are held once a

year for each subject. The number of people invited ranges from 20 to 30 for a period of two weeks. The cost estimates are shown in Table 1.

Table: 5.1 Cost estimate of running a computer seminar at KIE

Item	Kshs	Period
Accommodation	1000.00	Per night
Lunches	150.00	Per day
Supper	200.00	Per night
Allowance	100.00	Per day
Total	1450.00	14 days Kshs 20,300

(Based on one person the cost of travel to and from school, and that of facilitators, but the cost of support materials are not included.[1]

Furthermore, the interviewee was asked to provide information regarding budget allocation for computer meetings and seminars. In response, the Officer indicated that the *KIE gives one budget for the department and this is difficult for a detailed study since the cost covers all the departmental expenditure and it is not easy to account separately for computer seminars or meetings*. The interviewee reported also that *money for all the departmental expenditure was estimated at Kshs 500,000 per year and that was not enough for organizing seminars or workshops*.

It is important that the curriculum specialist in charge of computer education organize seminars to review the progress or problems teachers come across with the implementation of the computer materials such as the syllabus and the programs obtained from commercial computer firms. Such a forum would enable teachers to exchange ideas and improve the curriculum as required. However, this appears to be difficult to achieve within the current budgetary arrangements at KIE.

[1] At the time of this research 1 US$= Kshs78.00

5.4.9 Evaluation report on the use of computers in secondary schools

The last question in this section was about evaluation reports on the use of computers in secondary schools. Evaluation is an essential element in curriculum innovation. Indoshi (2001:20) believes that evaluation "would show the worth of a project as it progressed as well as all the success after its completion." Evaluation of a curriculum program like Computer education should take place during and after the project is implemented. One of the functions of KIE is to carry out evaluation of materials developed at the curriculum center. The evaluation enables curriculum specialists to determine the extent to which the resources developed are meeting the teaching and learning objectives for which they were designed. The second function is to provide KIE with feedback information on the basis on which it can improve the course for the benefit of the learners. This involves reviewing the objectives, the content and organization, methods of teaching including media and assessment of the course (Bunyi, 1995:147).

Consequently, the interviewee was asked to provide information about evaluation reports available on the implementation of the Secondary Computer Syllabus. In response, the interviewee recognized the role that evaluation plays in the improvement and development of new materials, but there was no report. The officer explained that due to lack of personnel and funds, there has been no visit to schools to get feedback on the use of computers or the implementation of computer education. He also indicated that "*as an applied subject there are problems such as lack of facilities and teachers do not have sufficient guides for teaching. Our understanding of the reasons for teaching this subject is to provide professional skills. It is not clear whether it is to be an expert or what? And all these problems affect evaluation of the subject.*"

Accountability in formal educational practices is an area of concern. Scholars and authors such as Heinich, Molanda, Russell and Smoldino (1996, 2002) and Ellington, Percival and Race (1993) noted that accountability is a demand for some form of public demonstration that schools do what they are supposed to do, and that they do it effectively. Teachers are accountable for what takes place in their classes, and the public

is concerned with both the value for money and the cost-effectiveness of employing any medium. This can only be determined by evaluation exercises. This is extremely important when the curriculum innovations are expensive and funds are limited. In order to keep ideas and information flowing to provide the basis for computer education, curriculum specialists need to visit secondary schools to meet the teachers and school administrators to exchange views and collect data on the use of computers in teaching and learning.

5.4.10 General comment on the obstacles to integration of computers into subjects

The main area of comment made by the interviewee related to lack of facilities in schools for teaching and learning with computers. This included unsuitable classrooms and a lack of computers, suitable programs for CIE. The KIE officer noted the need for the government to come up with policy guidelines for all schools to put up suitable rooms for computers. Furthermore, the main concern of the KIE was lack of trained manpower to design integrated computer resources. Since KIE is responsible for curriculum development the interviewee felt the need to have a computer center for in-servicing teachers on CIE and for developing support materials.

5.5 Summary

This chapter has described and presented the results of the interviews with Senior Education Officers at the Ministry of Education and Curriculum Specialists at KIE concerning the introduction and use of computers in public secondary schools. The research findings identified the aims and policies of the Ministry of Education in Kenya on the use of computer in teaching and learning in secondary schools. It has produced six important findings regarding the government views and policy on computing. The first is that there is a very general policy contained in the government policy document number INS/ME/A/2/1A/51 of 31st January 1997 stating that schools are encouraged to offer computer subjects that will provide vital skills required by employers. The Ministry of Education appointed an officer to coordinate and oversee the implementation of

Computer education in schools. It was also reported that the Ministry of Education organized in-service courses for Principals and teachers on the use of computers. Secondly, the results revealed a lack of computers and relevant support materials. The government reported having no funds to purchase computers for schools. Schools were encouraged to look for funds or computers to implement the computer education policy. Thirdly, there was evidence on the use of computers in public secondary schools though there was no up-to-date list of the schools implementing the computer policy. However, the significant aspect of this policy is that computing is seen as essential for all students and not just an activity to be pursued by just a small group of privileged or exceptional students. It has also been established that schools do integrate computers into teaching and learning traditional subjects on a small scale, but computers were used mainly to teach computer literacy, and students sit for national examinations that are set with input from curriculum developers.

Fourthly, it was noted that the Kenya Institute of Education appointed a Curriculum Specialist to design and produce curriculum materials for the use of computers. It was established KIE had only produced a Secondary Computer Syllabus (SCS) for all secondary schools, in order to provide a uniform standard of computer education in secondary schools, and to promote the quality of computer education in schools. In addition, the findings indicated that KIE had not organized any writing workshop or seminars for teachers on the use of computers in teaching and learning. However, it was noted that the Ministry of Education and KIE started a radio programme on computerization in schools to create awareness of computer education to all teachers, students and the public.

The fifth, finding concerns training teachers in the effective use and integration of technology. The data obtained indicated that teacher training in computer education has not been conducted adequately. There was no indication of any plan for developing teacher education curriculum for pre-service training. It is essential that initial training must occur early in the teacher education course to introduce the basics of computer use. These computer basics should include training in relevant subjects and software

appropriate for use in secondary schools should also be included in this training (Stetson and Bagwell, 1999: 47).

Although various approaches have been adopted to re-train teachers in the use of computers, this has been inadequate. KIE curriculum specialists need to be trained to design computer materials for schools. It is also important that all serving teachers be trained in computer skills. This will enhance and promote the use of technology in schools.

Another important findings concern evaluation report. The findings indicated that there was no evaluation report on the use of computer education syllabus developed at KIE. There was also no report on how schools were using computers in teaching and learning. However, it is important to note that evaluation is an indispensable part of curriculum development. Evaluation report would provide feedback on the impact and benefits of computer education programme to the students in secondary schools. The results of the evaluation would help in the improvement of the quality of the content of Secondary Computer Syllabus, and to inform the government about the teachers' views on the effectiveness of CIE in schools.

Finally, it is commendable that the government policy provides a framework for the introduction of computers and computer education in Kenyan schools. However, there are many practical difficulties that prevent these policies being put into practice. Nevertheless, the information obtained in this part of the study provided a useful starting point from which it was possible for the researcher to investigate what takes place with the use of computers in secondary schools. In the next chapter, Chapter 6, the researcher presents the research findings on the implementation of the government policy on the use of computers in teaching and learning in public secondary schools in Nyanza Province.

CHAPTER 6

THE ROLE OF THE PRINCIPALS AND HEADS OF DEPARTMENT IN COMPUTER INTEGRATED EDUCATION: POLICY AND PRACTICE

6.1 Introduction

This chapter presents the findings of the data collected from the questionnaires completed by Principals and Heads of Department regarding Computer Integrated Education (CIE) in their schools. The aim of the questionnaires was to examine the role played by Principals in the implementation and use of computer integrated education in their schools. In Kenya, Principals are responsible for overall management and organization of the school, formulating the school policy, standard of education, performance of students in examinations and they are in charge of revenue and expenditure in a school. The questionnaires for Heads of Department were also designed to provide information about their departmental use of computers in teaching and learning. Heads of Department are responsible for organization of their subjects throughout the school. They are required to assist teachers, advise them on teaching of departmental subjects, setting and marking examinations, keeping students' records and directing them to useful reference materials (Eshiwani, 1993: 124).

This chapter therefore, provides evidence of the roles played by the Principals and Heads of Department in the introduction and use of computers in their schools. It also explains the availability of school and departmental policies on the use of computers in teaching and learning. This includes also finance and resources allocation, availability of computers and support materials, the use of computers in a school, integrating computers into teaching and learning, training teachers in the use of computers, technical and physical problems, attitudes and views about the value of computers. The chapter ends by providing a summary of the main points.

The data analysis combines qualitative and quantitative methods. Qualitative data analysis has been used because it allowed the researcher to examine patterns of relationships and also to create new concepts and theory by blending together empirical evidence and

abstract concepts in order to come to terms with their diversity for the interpretation of data (Neuman, 1998:240). This included examining, sorting, categorizing, evaluating, comparing, synthesizing, and contemplating the coded data and graphical presentation of responses to different points. Both basic description and qualitative techniques have also been employed in order to demonstrate to readers the different groups of data, their characteristics, range and average. The questionnaires were scanned digitally using Statistical package: SAS version 8 and compiled by the Department of Statistics unit of the University of Pretoria. The data were then coded as appropriate for each item. Descriptive statistics were compiled for each variable and analyzed, and the findings reported using simple tabulation, graphical expressions and descriptive analysis of responses.

6.2 Research Findings

As indicated in Chapter 4 Section 4.5.3 the participants in the study were Principals and Heads of Department from public secondary schools in Nyanza Province. Although 30 Principals and 150 Heads of Department were initially sampled, data were collected from 25 Principals and 89 Heads of Department who completed and returned the questionnaires to the researcher. The results of the study about computer integrated education (whole school integration) is presented in the following section.

6.2.1 Information about responding institutions

All the Principals in the study were asked to provide information about their schools. This was regarded as an important point for this study since schools differ in terms of management and facilities for the implementation of computer education. In this response, all the Principals reported that their schools were public institutions that belongs to the community, and are run by Parent Teachers Association (PTA) on behalf of the parents, and the Board of Governors (BOG) on behalf of the government. The parents oversee the general welfare of their children in schools, in terms of academic performance, health care, and security and assist the school with funding. Similarly, the BOG has the duty to

oversee how the school is managed, academic matters, financial expenditure, school discipline, physical development and staff and students welfare. But the Principal is the manager of the school and secretary to the two boards. The Principals indicated also that public schools are not funded by the government, but receive bursary funds for bright students whose parents cannot pay the school fees. The information about the age of the schools is displayed in Table 6.1

Table 6.1: Age (Years) of schools that participated in the investigation

No of years	Frequency	Percentages
0-10	1	4%
11-20	4	16%
21-30	2	8%
31-40	12	48%
Above 41 years	6	24%
Total	25	100%

From the data in Table 6.1 it can be seen that most of the schools were more than 30 years old. The ages of schools were considered an important issue to be investigated because older schools were the former Missionary and Government schools that admits students from all parts of Kenya and could have more resources and better facilities for effective implementation and use of computers. Because some of the national schools (ages 41 and above) were supplied with computers donated by UNESCO to introduce computer education in secondary schools as indicated in Chapter 5. Secondly, the other information obtained from an interview with the Officer from the Ministry of Education indicated that some of these old schools are the National schools that were supplied with the Secondary Computer Syllabus. Thirdly, from my experience, some of the older schools have better resource centers. The findings indicated that one of the old girls' schools had 20 computers and a good computer center; one boys' school had 12 computers and a good computer room. There was also another girls' school that built a new computer room and had 10 computers. Further responses regarding the location in which the responding institutions were situated are summarized and shown in Table 6.2

Table 6.2: Location of the schools that participated in the investigation

Location of school	Frequency	Percentages
Rural	19	76%
Urban	3	12%
Suburban	3	12%
Total	25	100%

The data obtained indicated that the majority of schools that participated in the investigation were located in rural areas, but a few were in urban and suburban locations. This distribution of schools reflected the general situation in Nyanza Province because there are very few urban centers, and most public secondary schools are situated in rural areas. Because the field sample was small (only 25 Principals) a statistical comparison between the responses of Principals from rural, urban and suburban schools was considered inappropriate. Likewise, a statistical comparison of the responses from Principals of Girls and Boys schools was considered inappropriate. Descriptive comparison of responses has been made where this adds to the interpretation of the data.

6.2.2 Category of schools that participated in the investigation

The field research was carried out in three different school settings. The Principals were asked to state the categories of their schools. Their responses are shown in Table 6.3

Table 6.3: Category of schools that participated in the investigation

Category of schools	Number of schools	Percentages
Girls boarding schools	11	44%
Boys boarding schools	12	48%
Boys days schools	1	4%
Mixed Day school	1	4%
Total	25	100%

The above Table 6.3 indicates that more boarding schools than other schools participated in the investigation. In Nyanza Province, over 80% of secondary schools are boarding. The larger number of boarding schools could be attributed to a number of factors. Firstly, there is the historical development of secondary school education in Nyanza Province that dates back to the colonial period when Christian missionaries established boarding schools to educate boys and girls away from non-Christian and illiterate community influence. Secondly, the persistence of boarding schools is due to the widespread geographical location of secondary schools situated far away from homes of students attending them. Thirdly, parents approve the system because Kenya is a multi-ethnic society and boarding schools enable students from various regions to interact, share ideas and discuss social, economic and education issues such as computer technology. Fourthly, boarding schools also provide students with better facilities such as electricity for studying at night, and adequate time for studies. Lastly, boarding schools also provide security and good education particularly for girls who would opt for early marriage since the rate of girls school drop out is high in Nyanza Province and in Kenya as a whole. Although boarding schools charge high fees, the parents organize fund raising and the government provides bursary to bright students from poor families.

6.2.3 The number of students in the schools that participated in the investigation

Information concerning the number of students in each school was an important issue to be investigated. The data obtained were to provide a base on which to examine the ratio of students to computers and the facilities available in the schools that were investigated as discussed in section E of this chapter. The results were summarized and displayed in Table 6.4

Table 6.4: The number of students in schools that participated in the investigation

No of Students	Girl schools	Boys schools	Boys Day school	Mixed school	Total
From 200-400	5	2	0	1	8
401-600	3	5	0	0	8
601-800	1	5	0	0	6
801-1000	1	1	0	0	2
Above 1000	0	0	1	0	1
Total	10	13	1	1	25

Table 6.4 displays the number of students in the schools that participated in the investigation. The Table indicates also that there were more Boys' schools than Girls' schools who participated in the study. From the Table, it can also be seen that population of boys was larger than that of girls. The smaller number of girls in secondary schools in this study is not unique to Nyanza Province alone. The problem of girls' education in Kenya at all levels of learning has been a major issue. From my experience, most girls do not join secondary education due to three main reasons. Firstly there are cultural expectations. Traditional cultures in some communities who are still illiterate expect girls to perform family responsibilities such as looking after young siblings, helping the mother with domestic work and gardening, etc. So traditional cultural practices, values, beliefs and attitudes of some parents in Kenya frustrate the girl-child education and efforts to join school are stifled. Even with the recent government policy for compulsory education for all primary school children in Kenya the changes may not be effective unless the parents are forced to send all children to school and those who fail to do so are punished. Secondly, there are financial obstacles. Many parents are too poor to pay fees for secondary education even if the girls complete primary education and are willing to proceed to secondary school. The high cost of secondary education contributes to girl-child school drop out and so few girls proceed to higher education institutions, this results in few female teachers as indicated in this study. Ironically, although the tuition costs are a serious hardship for these families, the government has not come up with an alternative solution to encourage more girls to continue with secondary education. There is need for the government to attempt to reduce fees for girls in secondary school and higher education institutions to motivate more parents to educate their daughters. Thirdly, there is lack of parental guidance with regards to social problems during the critical period of girls' teenage life, with the result that there are many early marriages. Therefore, in order to reduce the disparity in girls' and boys' education, there is need for a review of fee structures, re-examining of the financial requirements of girls schools, and a re-assessment of out-dated cultural practices that inhibit girls' education. Educational planning and administration could also involve more women to ensure that decisions are made with a consideration of gender issues. There is a need for the government administration, religious organizations, and education institutions to intensify the

campaign to raise consciousness and awareness of the need for girls' education so that the females can catch up with formal education at all levels. Unless such changes are initiated, any attempts to make Kenya's population computer literate will have a very strong male bias.

6.3 Personal details of participants in the investigation

Since a whole school investigation approach was adopted for this study, the participants' background was another important factor to be considered in the integration and use of computers. It was therefore necessary to establish their identity and level of representation in the study by location. The information obtained was considered useful for comparison and further research. The findings revealed that the respondents were drawn from Girls, Boys, and Mixed secondary schools that were using computers at the time of the investigation. Table 6.5 summarizes the demographic data collected and information gathered on participants by location and gender.

Table 6.5: Participants in the study by gender and location

- Response from Principals in the schools that participated in the investigation

Location of school	Principals	Male	Female
Rural	17	10	7
Urban	5	4	1
Suburban	3	2	1
Total	25	16	9

- Response from Heads of Department in schools that participated in the investigation

Location of school	HODs	Male	Female
Rural	53	40	13
Urban	22	16	6
Suburban	14	9	5
Total	89	65	24

The data in Table 6.5 indicate that a total of 64% of Principals and 73% Heads of Department were male. This reflects that the teaching profession especially at secondary

school level in Nyanza Province is male dominated. This situation has led to concern about gender disparity in teacher training institutions, and the problems of girl child school drop out that is prevalent in Nyanza Province and in other parts of Kenya. A total of 68% of the Principals were from rural areas. Urban areas were represented by 20% of the Principals while suburban had only 12% Principals in the study. The majority of Heads of Department 60% were also from rural, areas and 25% of them were from urban areas.

6.3.1 Population of the teaching staff in responding institutions

In addition to the above information, all of the Principals were asked to provide demographic data about the teachers in their schools. The findings indicated that seven schools each had between ten to twenty one teachers, and eight schools had between twenty five to thirty four teachers, while nine of the schools each had between thirty five to sixty seven teachers. However, further analysis of the percentage of teachers by gender were as shown in Table 6.6

Table 6.6: Percentage of teachers by gender in the investigation schools

- **Responses from rural areas**

Rural schools	Age of school (Years)	No of teachers	Percentage of females	Percentage of males
1. School A	74	38	60	40
2. School B	60	37	60	40
3. School C	60	35	25	75
4. School D	46	31	32	68
5.School E	39	35	15	85
6. School F	36	25	12	88
7.School G	36	17	29	71
8. School H	34	31	29	71
9. School I	33	29	7	93
10. School J	32	26	31	69
11. School K	29	30	27	73
12.School L	23	28	35	65
13. School M	20	16	38	62
14. School N	17	18	50	50
15. School O	16	34	21	79
16. School P	12	10	40	60
17. School Q	3	11	20	80

- **Responses from urban area**

Urban schools	Age of school	No of teachers	Percentage of female	Percentage of male
1.School R	68	67	30	70
2. School S	54	64	54	46
3. School T	40	40	25	75
4. School U	38	63	63	37
5. School V	38	30	40	60

- **Responses from suburban area**

Suburban schools	Age of school	No of teachers	Percentage of females	Percentage of males
1. School W	39	38	32	68
2. School X	35	21	33	67
3. School Y	33	20	50	50

From Table 6.6 it can be seen that there were differences in the percentages of male and female teachers in the schools that participated in the investigation. For example in schools A, B, S and U there was a high percentage of females than males, in schools N

and Y there were equal numbers, while in all other schools there was a higher percentages of male teachers.

6.3.2 Age distribution of Principals and Heads of Department who participated in the investigation

All of the participants who took part in the study were asked to state their age-range, because it was felt that teachers' use of computers may be related to their age. Younger teachers could have more skills in computing than older teachers because some of the younger teachers teaching mathematics and science subjects who graduated from the universities during 1990s were exposed to computer technology skills. The findings of this study are shown in Figure 6.1

Figure 6.1: Age (Years) of respondents who participated in the study

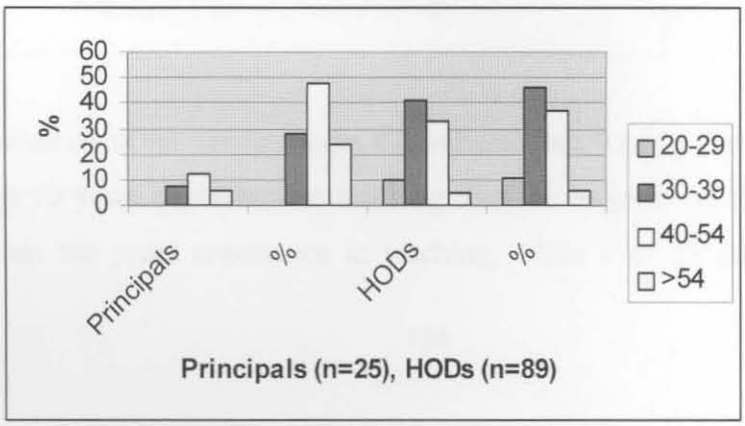


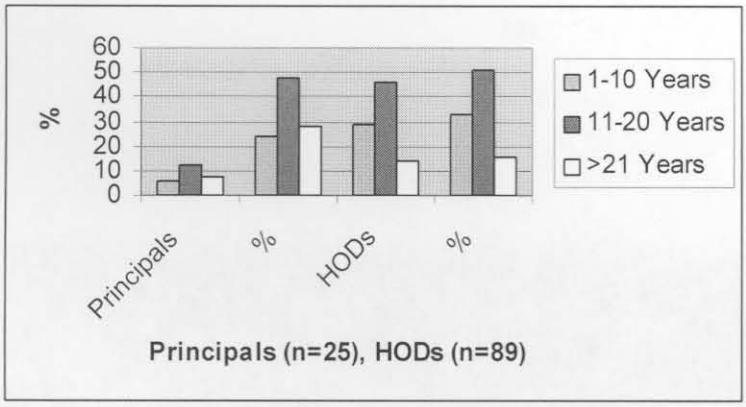
Figure 6.1 shows that of the 25 Principals who completed the questionnaire, the majority (48%) was between 40 and 54 years. In the age bracket of 54 and above there were 6 (24%) and the age group of 30-39 there were 7 (28%) Principals. The Heads of Department consisted of 89 participants, and 10 (11%) were in the age group between 20-29 but the majority of them 41 (46%) were in the age group of 30 to 39, while the other category of Principals in the age of 40-54 was represented by 33 (37%), and 5 (6%) represented above 54. These findings reflected the expected trend that Principals would be older than HODs. In Kenya teachers can be promoted to Head of Department after serving

as senior teacher, and as assistant teacher for some years. To become a principal of a secondary school in Kenya a teacher must have been a Head of Department for some years, and a Deputy Principal for not less than three years in addition to several years of teaching experience. So the length of time in a specific position, effective teaching, seniority and training play important roles in the appointment of teachers to various positions in school administration.

6.3.3 Participants' years of teaching experience

Experience on the job can help teachers to relate to new situations, to solve classroom problems (such as students' discipline during computer classes) and to help them find practical approaches to learning. Experience enables a teacher to draw upon professional insights and skills that include sensitivity to the specific interests, needs and abilities of students. The participants were asked to indicate their experience in teaching. This was important information because lack of experience in teaching normally interferes with teachers' confidence and professional competency. This happens mostly when newly appointed teachers are assigned to teach the subjects they are not particularly conversant to teach. Figure 6:2 demonstrates the position of participants in relation to their length of service in teaching.

Figure 6.2: Participants' experience in the teaching profession



The data contained in the above Figure 6.2 indicate that 6 of 25 (24%) of the Principals had less than 10 years experience in teaching. But the majority of them 12 of 25 (48%) had more than ten years experience in teaching, while 7 of 25 (28%) had more than

twenty years of experience in teaching. The findings for Heads of Department indicated that 29 of 89 (33%) Heads of Department had taught for less than ten years. While most of them 46 of 89 (51%) had more than ten years in the teaching profession, and only 14 of 89 (16%) had more than twenty years of teaching experience. However, it is worth noting that the large number of Principles with 10-20 years of teaching experience is in accordance with one of the requirements for one to be appointed to be a Principal and the same applies to Heads of Department' as mentioned in Section 6.3.2.

In addition to background information about the participants, they were asked to indicate the classes in which they taught and the subjects they taught. This question was asked to provide information that could be used to examine the subjects into which computers are integrated into teaching and learning in the schools investigated. The findings were summarized and revealed that 82% of HODs taught Form One, 72% Form Two, 79 Form Three and 84% Form classes, but most of the Principals taught in all classes in secondary school. Only a few Principals 48% taught form two classes. In addition, Heads of Department were asked to list the subjects they teach. Table 6.7 displays the results.

Table 6.7: Subjects taught by HODs in schools investigated

Departmental Subjects specialization	Number of HODs	Percentages
Sciences	22	25%
Languages	20	22%
Mathematics	22	25%
Humanities	25	28%
Total	89	100%

From Table 6.7 it can be seen that Heads of Department in the study were distributed fairly evenly across the four subject areas. Further analysis by departments indicated that in Mathematics Departments most of them had a combination of Chemistry, Mathematics and Physics, while in Humanities most of them taught Accounts, Commerce and Business Education, Geography and History. However, in Languages, the majority taught English language, and some taught Literature and Kiswahili. However, in Science the majority taught Chemistry and Physics, and had a combination of Biology and Agriculture. This

trend for teachers to be teaching in more than one subject area (such as Mathematics and Chemistry) reflects the requirement in Kenya for secondary school teachers to have two subject specializations.

6.3.4 Principals and HODs' experience with the use of computers

In addition to years of experience in teaching, the participants were asked a question " Do you have experience with the use of computers?" This question was asked to elicit information regarding the number of Principals and Heads of Department who were computer literate as a background basis to the introduction and use of computers in the study schools following the government directives that computers should be taught in secondary schools. The Principals and Heads of Department were provided with three options to use when answering the question. Their responses are summarized and presented in Table 6.8

Table 6:8: Principals and HODs experience with the use of computers

Statements	Principals	Heads of Department
I have no experience	28%	36%
I have some experience	72%	63%
I have a lot of experience	0	1%

The prior computing experience reported by the Principals and Heads of Department was varied. Seven of 25 (28%) Principals did not have experience. Eighteen of 25 (72%) Principals had experience with the use of computers and of these 13 were male and 5 female. The results of Heads of Department showed that most of them (63%) had experience with the use of computers but a few (36%) had no experience. Only one (1%) reported having a lot of experience in the use of computers. This shows that the participants' experience was based on the training they received during the in-service course run by the Ministry of Education at Provincial level when computer education was introduced and since then very few of them have attended advanced training in computers. There were also Principals and Heads of Department who did not attend the

in-service courses organized by the Ministry of Education. This could have been due to lack of information regarding the computer in-service course hence the large number of participants with no experience in the use of computers shown in Table 6.8 above.

6.3.5 Principals and HODs' years of service in computer education in the schools that were investigated

The Participants were also asked to indicate for how many years they had been using computers in their schools for teaching and learning. Table 6.9 summarizes the findings as reported by the participants.

Table 6.9: Number of years Principals and HODs have used computers in their schools

Length of service	Principals	Heads of Department	Total
Nil	7	45	52
0-1 Years	10	31	41
1-2 Years	2	6	8
2-3Years	3	2	5
3-4 Years	4	3	7
5 Years	0	1	1
Total	25	89	114

The above Table 6.9 demonstrates that most of the Principals (40%) had been using computers in their schools for only one year, and 2 of 25 (8%) had used computers for two years. While 12% of Principals had 3 years and 16% had four years experience in computer education but 28% had not used computers at all. However, the findings from Heads of Department indicated that 34% had used the computer in their teaching for up to one year, and 7% for two years. While another 2% had used computers for three years. There were also 5% Heads of Department with four years of working in computer education and one who had used computers for five years. 51% had not used computers in

their teaching. This shows that most of the participants' started to use computers at the time when computers were introduced in their schools.

6.3.6 Highest academic qualification attained by the Principals and HODs in the schools that participated in the investigation

All of the participants were asked to state the highest academic qualification they had. The results indicated that the majority of the Principals (96%) had a university education. Only one of them was a diploma holder. The response from Heads of Department showed that 77% were university graduates and 18% had Diplomas. None of the participants had a PhD degree. Table 6.10 displays participants' qualifications and academic certificates.

Table 6.10: Principals and HODs academic qualifications

Highest qualification	Principals	Heads of Department	Total
Diploma Certificate	1	16	17
B.A degree	1	3	4
BEd degree	18	63	81
BSC degree	3	5	8
MA/MBA/MEd/MPh	2	2	4

The above academic qualification displayed in Table 6.10 was typical of Principals and HODs in Kenya. It is a requirement for one to have a degree to be appointed as a Principal in addition to seniority in the position of Deputy principal, being an effective academic leader in terms of students' performance in national examinations, being a competent teacher and school administrator. But teachers with a Diploma in subjects where there are no teachers with degrees and other requirements could be appointed as Heads of Department.

6.3.7 Principals' professional training

In addition, the participants were asked a closed question "Are you a trained teacher?" Their responses indicated that all of the Principals were trained teachers and (95%) Heads

of Department were also trained but (5%) Heads of Department were untrained teachers. Table 6.11 provides more information.

Table 6.11: Number of participants who are trained teachers

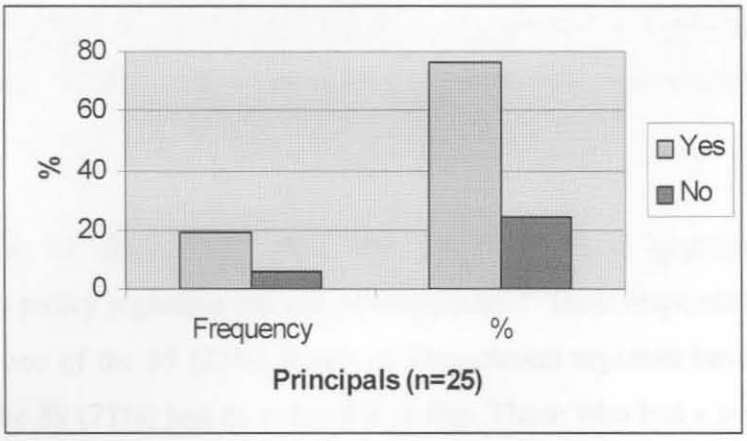
Responses	Principals	Heads of Department	Total
Trained	25	84	109
Untrained	0	5	5
Total	25	89	114

From the above Table 6.11 it can be seen that only five Heads of Department were not trained as teachers. They were mainly in the sciences, technical and mathematics subjects where Kenya has a shortage of trained teachers.

6.4 The introduction of computers in schools: Policy and practice in the schools that participated in the investigation

As discussed in Chapter 2 Sections 2.2 and Chapter 5 Sections 5.3, the question of policy and practice in the implementation of school computing has been an issue that runs through all educational sectors in developed and developing countries. Rudd (2001:212) feels that it is the responsibility of educational researchers and practitioners to evaluate such policies vigorously and in meaningful ways. In this connection, this section reports the findings on how the government policy on computer education was being implemented by the Principals of the schools investigated in Nyanza Province. Therefore, the Principals were asked a closed question "Does your school have a policy on computer education?" The responses were summarized and reported in Figure 6.3

Figure 6.3: Schools with policy for computer education



It can be seen from Figure 6.3 that 19 of 25 (76%) of the Principals had a computer education policy and only 6 of 25 (24%) of them had no policy on the use of computers. But none of the Principals who reported having a computer policy had a written policy document, so these policies were not well defined, and hence not realistic. Therefore, the Principals whose schools had a policy on the use of computers were asked an open-ended question "What is the essence of the school policy on computers in education." Their responses were summarized and presented:

- Computer study is compulsory in Form One and Two but Form Three and Four learn specific programs such as spreadsheet.
- All students are supposed to be computer literate by the time they complete secondary education.
- Computer programs to be integrated into curriculum subjects areas where necessary and to be taken by all teachers.

Although these Principals did not have a written policy, they had some idea of what would be included in the written policy document. So the researcher noted that at each point in the policy implementation process, a policy is formulated as individual schools interpret and act on it.

The six Principals who reported having no policy were asked to give reasons why they did not have policy on the use of computers? In response, one Principal from an urban school reported that they did not have a policy but "in practice, computers have been used and confined to teaching and learning computer literacy skills as recommended in the computer syllabus." Another two Principals reported lack of enough computers for students and teachers, and one Principal complained of lack of competent computer teachers arguing that teachers are computer illiterate and cannot integrate computers into teaching and learning their subjects. Two Principals indicated that computers had just been purchased and not yet installed and parents are not aware of the need to finance computer education and employ teachers. But the overall findings indicate that all Principals who participated in the investigation supported the government computer policy and noted the need to have a clear policy guiding the implementation and use of computers in their schools.

In addition, Heads of Department were also asked a closed question "Does your department have a policy regarding the use of computers?" Their responses gave different pictures. Twenty-one of the 89 (23%) Heads of Department reported having a computer policy but 68 of the 89 (77%) had no computer policy. Those who had a policy on the use of computers were asked another open-ended question "What is this policy?" Their replies were analyzed and reported as shown in Table 6.12

Table 6.12: Departmental policy on the use of computers

"Yes" response option	Frequency	%
Computer taught according to Government policy	30	34%
All students to be computer literate	17	19%
All teachers to attend computer courses	13	15%
To provide computing materials	10	11%
All official paper work done on computer	4	4%
Students' assessment tests to be computerized	7	8%
Examination results analyzed and stored in computer	8	9%

Although there were no written Departmental policies on the use of computers, the statements in Table 6.12 indicate that HODs had thought about the issues that would need to be addressed in a written policy. They were also trying to make their departments follow the government policy statement on the use of computers in schools.

Furthermore, Heads of Department who reported having a computer policy in Table 6.12 were asked another question to give more information regarding the reasons behind the formulation of the Departmental policy. Their replies were summarized and seemed to be reasons for using the computers and not for having a policy. But since the word "reason" has several meanings, the reasons given by the HODs could still be the reasons for having a computer policy as indicated in Table 6.13.

Table 6.13: HOD' reasons for having a policy for the use of computers

Reasons	Frequency	%
No responses	33	37%
To teach students basic computer literacy skills	25	28%
To ensure students fit into technological world	10	11%
To access new learning resources	6	5%
To produce neat and attractive work	6	7%
To improve teaching/learning various subjects	5	6%
To keep records of students' work	4	5%

From the above responses, it can be seen many Heads of Department did not have a computer policy. So they were asked an open–ended question to give the reasons why they did not have departmental policy on the use of computers. They gave several reasons that were summarized and presented in Table 6.14

Table 6. 14: HOD' reasons for not having a policy for the use of computers

	Frequency	%
Lack of access to computers	35	42%
Not yet decided	27	30%
Installation system not done	17	19%
Computers recently introduced	10	11%

The response in Table 6.14 indicates the reasons of not having departmental policy on the use of computers in teaching and learning. From this it can be seen that most of the HODs who responded to the question reported having problems with computers as the main reason for not having a computer policy.

However, a look at the responses from Heads of Department indicates that in some schools the heads did not have a departmental policy on the use of computers, while the Principals stated clearly that the school has a policy so there seems to have been a contradiction of responses. This can be interpreted to mean that in some schools computers were used for administrative work only so the heads had not included computers in their departmental scheme.

6.4.1 Priority given to computer-integrated education in study schools

Question 4 for the Principals sought information on the priority given to the integration and use of computers in teaching and learning in their schools. Table 6.15 shows their responses.

Table 6.15 Priority of CIE in the schools that participated in the investigation

Rating	Frequency	Percentages
High	11	44%
Average	8	32%
Low	6	24%
Total	25	100%

Most of the Principals regarded computer integrated education as important and rated the integration very high, but some of them were not very keen on the idea of computer-integrated education in their schools. This could be due to the beliefs of some teachers that the use of computers would replace them from teaching, negative attitude towards computers, and lack of understanding of the benefits of computers in teaching and learning, since some of them were not computer literate. However, those who responded

positively were asked to state the reasons why they gave a high, average and low priority to the integration and use of computers in teaching and learning in their schools. The reasons stated by the Principals were summarized and included in Table 6.16

Table 6.16: Principals' reasons for giving high priority to the use of computers

Reasons	Frequency	%
To make all students computer literate	10	40%
To improve quality of teaching/learning subjects	5	20%
To provide computers for teachers/students to use	4	16%
No response	6	24%

Some of the findings in Table 6.16 are similar with the research findings of Dexter et al. (1998) and Ertmer et al. (1999:65) indicating that the use of computers helps to improve the quality of learning. In addition, the Principals who had no priority for computer-integrated education provided the following reasons as shown in Table 6.17

Table 6.17: Principals' reasons for not having a policy for CIE

Responses	Frequency	%
Lack of finance to start computer education	3	50%
Teachers have not learnt computer skills	2	33%
Computers are few	1	17%

The above finding indicates that 50% of Principals who had no computer policy gave lack of finance as one reason for not having a policy. But looking at Tables 6.16 and 6.17 it can be argued that most of the Principals had a good reason for the need to have a computer policy. This means that the majority of Principals who participated in the investigation had a vision of the need for a policy to guide the implementation of computer education in their schools, although some of them had various problems as indicated in Table 6.17

6.4.2 The implementation of school policy for the use of computers in teaching and learning

The Principals were asked another open-ended question to indicate the steps they have taken towards the implementation of a policy for the use of Computer Studies in their schools. This question was asked because Principals of schools in Kenya are supposed to implement National Educational policies and to prepare teachers and students for such changes in curriculum innovation. In order to implement government policies the Principals are expected to formulate school policy and provide plans for the implementation programme. The data obtained from the question were analyzed and summarized in the following Table 6. 18

Table 6.18:Steps taken by Principals to implement a computer policy in their schools

Responses from Principals	Frequency	%
All teachers / students have access to computers	20	80%
Included computer studies in school curriculum	6	24%
Acquired some new computers and printers	5	20%
Appointed computer teacher	3	12%
Started teaching computers in Form One classes	2	8%
Built computer room/laboratory	2	8%
Asked parents to support computer education	2	8%
No steps taken	5	20%

As can be seen from the list in Table 6.18 most of the Principals had taken different steps to implement the school policy. Two 8% of them in particular had put the matter before the parents to organize fund raising for purchasing computing equipment. However, there were also 20% of the Principals who had not taken any steps to implement computer policy because they had not introduced computers in teaching and learning.

In addition to the different actions taken by the Principals to ensure that the government computer policy was implemented in their schools, they were also asked another a closed question to state if teachers were implementing the policy for computer education. This question was asked to provide information about the use of computers in the study schools, and to help in identifying schools in which teachers used computers in teaching

and learning as discussed in Chapter 7. The responses from Principals were analyzed and displayed in Table 6.19

Table 6.19: Principals response on teachers' implementing computer policy

Responses	Frequency	Percentages
Yes	20	80%
No	5	20%
Total	25	100%

The majority of the Principals (80%) reported that teachers in their schools were implementing the computer policy as stated by the government and only 20% were not implementing the policy. Although the schools did not have a written policy document, the Principals who reported having a computer policy were clear about what policy requirement was all about and decided to implement the government policy statement on computer education. In Kenya, education is highly centralized and Principal of schools are the Ministry of Education administrators at school level, and the Government policy automatically becomes the school policy. The policy intentions are accepted and implementation is a matter of the technical ability and will of the implementing schools, together with availability of physical and other teaching and learning resources. There can be no deviation or resistance to the educational policy messages.

Nevertheless, Principals who responded "yes" were asked another closed question to rate how effectively teachers were implementing the school computer policy. The replies are shown in Table 6.20

Table 6.20: Rating of effective implementation of computer policy by the Principals

Rating	Frequency	%
Very effective	6	24%
Effective	14	56%
Fair	5	20%
Not effective	0	0

Most of the Principals rated the implementation of computer policy as effective while some of them rated the implementation very effective, but a few of Principals reported that teachers were implementing the policy fairly. Some of the Principals indicated that due to lack of competent computer teachers, the policy could not be implemented effectively.

6.4.3 Priority given to implementation of school departmental computer policy

In addition to the responses from the Principals on policy issues, the Heads of the Departments were asked a similar question but in a different format. They were asked to rate the priority they gave to the implementation of their departmental policy on computer education at their schools? Their replies were summarized in and presented in Table 6.21

Table 6.21: Rating of Computer policy implementation by the departments

Responses	Frequency	%
High	16	18%
Average	13	15%
Low	14	16%
No response	46	51%

Most of the Heads of Department did not respond to this question. This could have been due to the fact that some Heads of Department might have not been aware of what should happen with policy implementation and the need to have a departmental computer policy. Secondly, there was no computer policy guidelines provided to HODs on how to implement the policy and in some schools the computer was used for teaching computer education and did not fall under their departments. But as Table 6.21 indicates some Heads of Department had high regards for the implementation of the policy. Some of them had computer policies different from that of the Principals. For example, seven of them reported that "all examination results must be analyzed and stored in the computer, and another one said "all students tests must be computerized." At the same time some of them gave average priority, but there were also those who reported low priority. Furthermore, Heads of Department were asked another open-ended question "How are

teachers in your departments implementing the computer policy? The findings are displayed in Table 6.22.

Table 6.22: Response from HODs on teachers implementing computer policy

Responses	Frequency	%
To ensure all students take computer literacy course and CIE	42	47%
Storage and retrieval of students marks	7	8%
Process and print teaching materials	6	7%
Use computers to analyze students' marks	5	6%
Teachers train in computer literacy	5	6%
No response	24	26%

Most Heads of Department who responded to this question indicated that teachers implemented departmental computer policy to teach computer literacy and to integrate computers in teaching and learning traditional subjects. Some of them reported using computers in administrative work. The findings support the review of literature on functions of the computers in the school discussed in Chapter 2 Sections 2.3.

6.4.4 Guidelines for the implementation of computer education in the schools that participated in the investigation

The last question in this section for the Principals sought information on the guidelines for the teachers to implement the policy in the classroom. The findings were as shown in Table 6.23

Table 6.23:Types of teaching materials teachers' use to implement computer policy

Responses	Frequency	%
Teachers use the computer syllabus for reference	20	80%
There is a timetable for computer lessons	16	64%
They use computer manuals, guidelines, handouts	10	40%
Teachers use computer textbooks for reference	4	16%
No response	5	20%

The findings from the Principals regarding the use of Secondary Computer Syllabus to implement computer policy concur with the response from the Curriculum Specialist at Kenya Institute of Education reported in Chapter 5 Sections 5.4.7.

6.5. Finance and resources allocation for the use of CIE in schools

Section D of the Principals' questionnaire and section C of the Heads' of Department questionnaire (See appendices 3 and 4) contained questions about finance and resources allocation regarding CIE. The Principals were asked an open-ended question " Computers are expensive to purchase and maintain, whom do you think should be responsible for the cost of computers in your school?" This question generated various responses as shown in Table 6.24

Table 6.24: Who should finance CIE in secondary schools

Responses	Frequency	%
The Ministry of education	10	40%
The parents of the students	5	20%
The school and politicians to organize fund-raising	5	20%
Board of Governors/Parents Teachers Association	3	12%
Non-governmental Organization and well-wishers	2	8%

As shown in Table 6.24, most of the Principals believed that the Ministry of Education should provide funds for computer education in secondary schools. However, the findings reported in Chapter 5 Section 5,3.6 from an interview with Senior Education Officer indicated that the government had no funds to finance computer education in secondary schools. So Principals were asked another question to justify their responses to the answers in question one in section D and their replies are contained in Table 6.25

Table 6.25: Principals' justification to responses in question one in section D

Responses	Frequency	%
Ministry of Education has a policy of cost sharing	12	48%
Parents are the source of funds	5	20%
Politicians and the school can organize fund-raising	3	12%
Their children benefit from computer education	3	12%
It's an expensive project, needs external funding	2	8%

From the above findings, it can be seen that all the Principals provided answers to justfy their responses listed in Table 6.24. For example one Principal from an urban school stated that the Ministry of Education should provide funds "to show that the government

is committed to computer education because this is the only source of guaranteed finances." Another Principal from a rural area reported that "Parents are the main source of funding in schools, and their children are the beneficiaries." Still another Principal from a suburban school said that "Parents must take positive responsibility despite high cost. It is inevitable, one cannot do without computers."

However, when the Principals were asked a closed question " Do you think the Ministry of Education should provide funds for computer education in your school?" Almost all of them 23 of 25 responded positively, and only 2 of 25 gave a negative answer. But when the Principals were asked another open-ended question "Why do you think so?" They provided varied answers as shown in Table 6.26

Table 6.26: Why the Ministry of Education should provide funds for CIE in schools

Responses	Frequency	%
Ministry of Education should provide computers for teachers	10	44%
To subsidize parents effort to purchase computers	5	20%
To enable schools to purchase more computers and software	4	16%
Computers are too expensive, and parents cannot provide funds	4	16%

As can be seen from the responses to this question, the Principals were able to provide more information why they felt the Ministry of Education should finance computer education in schools. One of the Principals argued that "other countries have gone far in IT so we cannot be left behind in the modern world so the government should provide funds" Another one said "Parents are overburdened with school fees, the government should assist them." In conclusion, the researcher noted that the information contained in Table 6.24, 6.25, and 6.26 indicated that the views of the Ministry of Education on who should provide the funding for computer education in schools was different from the views of the Principals. The Principals felt the government should finance computer education in schools but the government said there are no funds for computing in schools.

6.5.1 The cost of purchasing computer equipment

Question five in this section sought information on the cost of purchasing each of the computers available in schools. The participants were given a list of Figures to choose from, and the findings revealed that 30% of Principals spent about Kshs [1]60,000.00, 40% of the Principals used about Kshs 50,000.00 and 20% spent 30,000.00 to purchase each computer. Only 10% of the Principals reported spending less than Kshs 30, 000.00 to purchase each computer.

Furthermore in question 6 of this section, the Principals were required to provide information of the percentage of their school budget they allocate for purchasing new computers, software, repair and maintenance, and other materials. The data obtained indicated that 52% of the Principals had set aside 11% of their budget for purchasing new computers, software packages, related print support materials and for maintenance and repair. However, it appeared as if the purchasing of new computers as well as maintenance and repair made up a very small percentage of the annual school budget. But the other findings revealed that less than a half of the Principals 48% did not have a budget for computing equipment. The problem could be attributed to the fact that secondary schools in Kenya get money from school fees that they save for the purchase of equipment in addition to the support from the Ministry of Education cost sharing programme. Schools with few students may not have adequate funds for purchasing new equipment. However, researchers (Carol, 1997; Clark, 2000; Eshiwani, 1997; Scheffler and Logan, 1998) also reported the problem of lack of adequate funds for computer education.

Similarly, Heads of Department were also asked to state the finance and resources allocation for the departments. The findings revealed that 57% of them did not have any departmental funds for computers because the school purchases equipment for departments. But 43% Heads of Department reported that the school allocated to them funds that was not adequate for purchasing computers. So they were asked another

[1] At the time of this research during July and September 2001, 1US$ =Kshs 78.00

question "What is the source of this funding?" Their responses were summarized and the common answers included school fees, and donations from people.

However, the Heads of Department who did not have funds gave different reasons for not having departmental funds for computer materials that were summarized and presented in Table 6.27.

Table 6.27: Departments' reasons for not having funds for computing equipment

Responses	Frequency	%
Computer education has not been introduced in the school	20	23%
No funds available in the school for computer equipment	16	18%
The school purchases equipment for departments	15	17%
It is not a priority in the department	10	11%
The school does not allow departments to handle funds	8	9%
The school has not considered integrating computers in subjects	7	8%

From the above response, it can be seen that some Heads of Department gave two answers. Some of the responses such as "computer education has not been introduced in the school" and "it is not a priority in the department" support the earlier findings regarding five schools that were not implementing computer education policy reported in Section 6.4.2.

6.5.2 Amount of money allocated to departments for computer equipment

In another question, the Heads of Department who responded positively to question one in this section were asked to provide information about the amount of money allocated for purchasing departmental computer equipment and materials per year. In most cases, the amount allocated was very little, and was not sufficient to purchase any computers. For example, one Head of Department indicated that out of the total school budget for computer education, his department was allocated only 10% of the school budget to purchase computer materials. However, given the economic situation in Kenya that affects schools' financing, the amount set aside was not even adequate to purchase most of the support materials. For example, one Heads of Department reported having Kshs 6000 and spent Kshs 3500.00 for purchasing ink and diskettes. It is hoped that this

position will change for the better once the schools get enough funds to provide resources for computing in schools. There is a need for school management to look for funds to provide adequate departmental resources so as to encourage teachers to plan for computer integration.

6.6 Availability of computers and support materials in schools that participated in the investigation

Each of the 25 Principals in the study were asked to indicate how many computers were currently available in their schools, and to explain their state of operation. This question was asked in connection with the review of literature in Chapter 3 Section 3.2.3. The question was considered important because availability of computers would encourage teachers to integrate and use them in teaching and learning. Table 6.28 presents descriptive information on the number of computers per school for those schools with such equipment.

Table 6.28 Number of computers and other resources available in each school

School	Computers	Software	Diskettes	Books	Teachers' manuals	Students manuals'	Secondary Computer Syllabi
A	20	6	40	15	5	10	1
B	15	4	30	20	2	20	1
C	11	5	50	20	10	20	1
	11	5	40	10	2	2	1
E	10	6	50	10	5	18	1
F	10	4	26	4	2	3	1
G	9	4	30	6	3	5	1
H	8	5	70	15	2	0	2
I	8	4	20	3	1	3	1
J	7	6	40	10	0	6	1
K	7	3	60	12	5	10	1
L	6	4	40	20	2	15	1
M	6	4	20	3	2	4	1
N	6	4	10	0	0	0	0
O	5	4	50	5	2	20	1
P	5	4	20	0	0	0	0
Q	4	4	20	2	2	3	1
R	4	3	20	5	3	6	1
S	4	2	10	6	2	3	1
T	4	2	0	0	0	0	0
U	2	4	25	2	2	3	1
V	2	4	20	2	2	2	1
W	2	4	15	0	0	2	1
X	2	3	5	0	0	0	0
Y	2	3	5	0	0	0	0

Two important points emerged from the figures displayed in Table 6.28 and Table 6.29 Firstly, there is considerable differences in the number of computers available in various institutions. This is true even when the size of institutions is taken into account. Some of the schools investigated had only 2 computers for over 600 students. This poses a problem during computer education period, when a teacher uses two computers for example, with a class of 45 students as shown in Table 6.29

Table 6.29: Schools with computers and number of students per computer

School	No of students	No of computers	Number of students per computer
A	800	20	40
B	600	15	40
C	800	11	72
D	600	11	55
E	800	10	80
F	400	10	100
G	400	9	44
H	1000	8	133
I	500	8	63
J	600	7	85
K	600	7	85
L	600	6	100
M	400	6	99
N	500	6	83
O	500	5	100
P	500	5	100
Q	450	4	112
R	400	4	100
S	Over 1000	4	250
T	100	4	25
U	500	2	250
V	300	2	150
W	450	2	225
X	500	2	250
Y	400	2	200

Table 6.29 displays the number of students per school and the computers available for students to use. However, the ratio of students indicated in the Table is for the whole students population in a school. From my experience, the number of students per class is supposed to be 35 or 40. So in a computer education class the ratio of students per computer, for example would be 20 students per computer for a school with 2 computers. Nevertheless, the overall findings from the Principals revealed that all schools

investigated had computers, software and diskettes to use in administration and in teaching and learning.

Similarly, the Heads of Department were also asked to indicate the number of computers and other related materials in their departments. This question was asked to elicit more information about CIE because Heads of Department are the academic leaders in their departments and could have obtained some CDs for teaching traditional subjects. However, the results showed that HODs did not have departmental computers but used the same computers used by the students. The predominant item available in the department was the Secondary Computer Syllabus (SCS) mentioned by 42% of Heads of Department, but 48% did not have this syllabus. The Secondary Computer Syllabus is an important document because it contains all computer application software topics that students must learn in computer education from Form One to Form Four classes.

In addition, further analysis indicated that 35% percent of the HODs had four software packages, and 30% had only two, while 20% had 6 respectively. As a result of these responses, the researcher concluded that some schools had not installed the software. For example in one of the schools, I found that three of the computers that were donated did not have all the components. Secondly, it could have been due to lack of funds to purchase all the required software. Therefore, lack of adequate software for effective use of computers could be due to the fact that most of the schools in Nyanza Province have not fully implemented the use of computers in teaching and learning.

Table 6.29 further shows that very few schools had support materials for effective use of computers. Only 19 of 25 (76%) of the Principals responded to this question and indicated that teachers' manuals were very important in the effective use of computers in teaching and learning. But when the Heads of Department were asked a similar question, the findings showed that 33 Heads of Department had teachers' guide notes. However, the problem of support materials was experienced in all schools investigated. The extent to which teachers can use computers in teaching and learning depends mostly upon availability of support materials. These could be teachers' guide notes, students' manuals,

computer textbooks, the Secondary Computer Syllabus and handouts on the use of programs in the classroom. However, the differences in responses could also be attributed to lack of awareness of the availability of computer support materials in schools due to lack of proper management of teaching and learning resources, because they are not centrally stored for easy access by the whole school. Availability of support materials like the Secondary Computer Syllabus was examined here because its absence affects the use of computers as recommended by the Ministry of Education.

In another related question, the Heads of Department were asked to provide information on how they obtained the computers for their departments. About 33% of the Heads of Department reported that the departments used the computers that were purchased by the school, and about 35% reported that they used computers that were donated to the school. But 32% of the HODs did not respond to this question.

6.6.1 The Present conditions of the computers available in study schools

In another question, the Principals were required to provide information about the working conditions of the computer in their schools. This question was asked to provide more information about the computers in schools that could be used as a base for the semi-structured interviews with computer teachers reported in Chapter 7. The Principals were provided with a rating scale and the responses are shown in Table 6.30

Table 6.30: Conditions of computers in the study schools

Rating	Frequency	Percentages
Very satisfactory	19	76%
Satisfactory	5	20%
Unsatisfactory	1	4%
Total	25	100%

From Table 6.30 it can be seen that the majority of the Principals reported that the computers were in good condition. In general the computers that were regarded as not in good condition were those that had been donated to the schools. During my discussion

with one of the Principals at the time of the research, it was revealed that some of the donated computers had missing components, such as a mouse, and could not be used.

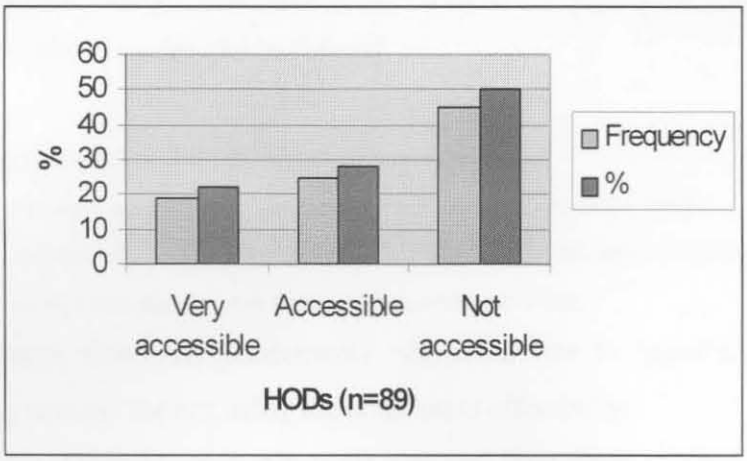
6.6.2 Number of computers used by the staff in schools that participated in the investigation

The participants in the study were asked a closed question "How many computers are available for use by the administration, teachers and the students in your school?" The findings indicated that 80% of the Principals had computers that teachers and students use for teaching and learning. While 52% of the Principals had computers for administrative work but 28% of them did not have specific computers for administration. They reported that they did not have computers in their offices but used the ones for teaching students for administrative work as needs arose. However, the Principals who did not respond to this question (20%) had a number of reasons, for example lack of funds to purchase computers, or most of the computers available are incomplete or need upgrading and others reported that their computers were not yet installed.

6.6.3 Accessibility of computer equipment to teachers

In connection to the above response from Principals about computers available for use by members of the school community, Heads of Department were asked to rate how accessible the computer equipment was to teachers in their departments to use in teaching and learning. This question was asked in connection with a review of literature in Chapter 3 section 3.5. Effective utilization of computers in teaching depends on how accessible computer equipment is to the teachers at the right time when they wanted to use it for teaching and learning. The findings are illustrated in Figure 6.4

Figure 6.4: Accessibility of computer equipment to teachers who participated in the investigation



The overall findings of this investigation revealed that 19 of 89 (22%) of the Heads of Department indicated that computers were very accessible to their teachers, and 25 of 89 (28%) said computers were accessible. But 45 of 89 (50%) of them had problems of access and gave various reasons. Some of them said they were not able use the computers even if they were available because of the crowded timetable. They also argued that they were not able to use computers due to lack of sufficient computers. Other Heads of Department related problem of access to lack of programs to integrate into their subjects. Carol (1997), Millar (1997) and Struddler (1996) report similar research findings.

6.6.4 Principals' general comments on the use of computers in their schools

One of the objectives of this study as set out in Chapter 1 Section 1.4 was to investigate the use of computers in secondary schools. After the findings of the role played by the Principals and Heads of Department to provide computer equipment it was necessary to determine whether and how the computer equipment were used in the schools that participated in the investigation. The question was asked to provide data to establish if computers were used in teaching and learning according to the government policy discussed in Chapter 5 Sections 5.3. Therefore the Principals in this study were asked a closed question "Are the computers being utilized to their full capacity in your school?" The findings are displayed in Table 6.31

Table 6.31: Level of computer usage in study schools

Responses	Girls school	Boys school	Total	Percentage
Yes	8	9	17	68%
No	4	4	8	32%
Total	12	13	25	100%

As indicated in Table 6.31 the majority of the Principals reported that computers were utilized to their full capacity, and reported that the computers were used in teaching and administrative work. But some Principals reported that the computers were under utilized in their schools and gave various reasons such as "They are used only by the computer club and also for processing examination results" and another one said " Some computers are old types which lack spare parts." However, the positive response can be interpreted to mean that the Principals in the study schools agreed to implement the Ministry of Education policy that "computers can be used in schools." The Principals with positive responses were asked to explain how the computers were used in their schools and the responses were summarized as follows:

- Teachers and students have regular computer lessons;
- Computers are used for data analysis and storage of students' marks;
- Computers are used by the computer teacher to teach students computer literacy;
- Teachers and students use them to learn computer skills;

At the same time, the participants whose answer to question 7 was 'no' gave the following reasons for not using the computers effectively:

- Lack of trained teachers to teach use computers in teaching;
- Lack of printers to so teachers and students cannot print their work;
- Teachers are not yet ready to integrate computers into teaching traditional subjects;
- The computer programme is not fully operational since it's one year now;
- Some computers are old type and lacks certain components;

Other researchers Bitner and Bitner (2002) and Zhao and Cziko (2001) also reported similar findings especially that of "Teachers not ready to integrate computers into teaching."

6.7 Principals' responses on teachers use of computers in teaching and learning

The use of computers requires accountability on the part of the administration. This includes care, security of the equipment and other resources, and academic leadership. This requires also the Principals to "portray a passionate commitment to providing appropriate computer professional development for their staff members" (Yee 2000). In this connection, the Principals were asked a closed question with multiple choice answers to state who is in charge of computer education in the school. The findings revealed that various people were assigned to take care of the computers in the study schools. About 5% of Principals reported that the deputy principal was in charge of the computer center and 24% indicated that this task has been allocated to the curriculum coordinators, while 33% said Senior teacher, and 5% assigned technicians to be in charge and take care of computers. However 33% had not delegated the responsibility to any particular person. The result of this question suggests that there could be a serious threat of access to computers for teaching and learning, for example, if the Principal is away and failed to delegate the responsibility to the computer teacher. Secondly, it would be time wasting for a teacher to keep on looking for whoever is in charge of the computer room each time he wants to use computers for teaching or when he wants the students to do some remedial work. An ideal situation would be for a computer teacher or a technician to be in charge of the computer room. Nisan-Nelson (2001:93-95) reports similar findings in which the computer teacher was frustrated because the computer lab was located in the library and the librarian had limited access to the equipment, and was not present and successfully acting as a controlling person.

6.7.1 Current use of computers by teachers in schools that participated in the investigation

To gain further information about how computers were used in the teaching and learning process, Principals were asked to respond to the following question: "Are teachers

currently using computers in teaching and learning?" This question was asked to provide evidence on how many schools use computers to teach students computer literacy skills according to the Ministry of Education policy requirement discussed in Chapter 5, Section 5.3 and Principals' positive response that the computer policy was being implemented in their schools as reported in Section 6.4.2 in this chapter. The data obtained indicated that according to the Principals 80% of secondary schools in the study were currently using computers in teaching and learning, while 16% reported using computers for administrative work but 4% of the schools had not started using computers.

Heads of Department were also asked to respond to a similar question: "Are teachers in your departments using computers?" In response, 37% of the HODs reported that their teachers used computers, but 63% of them said their teachers were not using computers. However, the overall findings indicated that the Principals and HODs gave different answers. This was due to the fact that the 20 Principals reported the computers were used to teach computer literacy in their schools, but in some departments teachers were not using computers since they had not integrated computers into their subjects. Table 6.32 gives a clear picture of the responses from Principals and Heads of Departments.

Table 6.32: Principals' and HODs report on the use of computers in teaching and learning

Responses	Principals	Percentages	HODs	Percentages
Yes	20	80%	33	37%
No	5	20%	56	63%
Total	25	100%	89	100%

Table 6.32 displays the above information concerning the schools using computers in teaching and leaning, and the departments that integrated computers into teaching and leaning.

Further, the Heads of Department who indicated that their teachers were using computers were also required to state when the teachers in their departments started to use

computers. About 42% of them reported that their teachers started using computers this year (2001), but 44% of them stated that their teachers started to use computers last year (2000). While 13% of Heads of Department said their teachers started using computers in 1999. The responses from HODs are similar to the findings reported in Section 6.3.5. This suggests that most of the schools that participated in the investigation started to use computers in the year 2000. The Heads of Department also gave various reasons for using computers in their department as shown in the following Table 6.33

Table 6.33: Departmental reasons for using computers in departmental teaching

Responses	Frequency	%
No response	15	17%
To improve students' communication skills	14	16%
To teach students computer literacy as in the syllabus	12	14%
To improve the quality of teaching and learning of subjects	10	11%
To save and retrieve students' records and marks	10	11%
Used for administrative work	10	11%
For faster analysis of students examination results	8	9%
Computers facilitate easy and faster acquisition of knowledge	7	8%
To access new information	6	7%
To enhance mathematical and science learning	5	6%
For computation, demonstration of difficult topics	4	4%

The data in the above Table 6.33 indicates that some of the HOD's gave more than one response so the total is greater than 89 and the % total is greater than 100%. Some of the above findings such as teaching students computer literacy, to enhance mathematical skills, to improve quality of teaching, and communication skills also concur with other research findings by Abas (1995), Azita (199) and Rudd (2001), reviewed in Chapter 2 Section 2.9.5.5.1.

6.7.2 Kinds of computer programs used in schools that participated in the investigation

The type of computer application used in schools was another area of investigation. Principals who provided positive responses to question two of section F were asked another question to elicit more information about the kinds of program teachers' use in teaching and learning. In response, some of the Principals gave more than one answer, but the majority of the Principals (72%) reported that computers were used for teaching and

learning computer literacy skills. About 16% of the Principals indicated that computers were used for teaching traditional subjects such as Science, Accounts and Mathematics, and 28% of the Principals did not respond to this question. So the Principals who declined to comment on this were asked to state the reasons why the teachers were not using computers programs. In response, the Principals reported lack of enough computers and relevant software, teachers are not computer literate and cannot handle computer programs effectively, lack of computer support materials such as syllabus, computer textbooks, and teachers' guide notes.

However, when the Heads of Department were asked a similar question "Which type of computer software program do teachers use in the department?" The findings were: Ms word, MS Excel, spreadsheet, MS Doss, Database, Power point, Publisher, Computer Aided Design (CAD) and Programming. The results from HODs and Principals were different because HODs are the academic leaders in their departments and had more exposure to the programs used by teachers and students. Millar's (1997) studies reported similar findings in South Africa.

In order to get more information on the use of computers in schools, the Heads of Department were also asked to explain how the teachers use computers. This question was asked to provide information regarding one of the objectives of this study stating "to establish how teachers use computers in teaching and learning in secondary schools in Nyanza Province" reported in Chapter 1 Section 1.4. Their responses were summarized and are contained in the following Table 6.34

Table 6.34: Heads' of Department comment on how teachers use computers

Response	Frequency %	
As a tool for teaching computer programs like word processor	32	35%
For storing and processing students and staff records	10	14%
Typing and printing examination questions	9	10 %
To store notes for students to study at their own time	7	8%
To prepare lesson plans and other documents	6	7%
To study materials and facts from the Internet and Web	5	6%
To use computers in teaching/learning traditional subjects	5	6%

The above report from Heads of Department indicated that teachers used computers for teaching and learning and secondly to keep students' examination records. However, there was no response from16% of Heads of Department.

The Heads of Department were then asked another related question "Which of the following computer software tools are useful for your students?" They were provided with multiple-choice answers. The findings were summarized and displayed in Table 6.35

Table 6.35: HODs comments on useful software for students in study schools

Responses	Frequency	Percentages
Word processing	74	84%
Spreadsheet	42	47%
Database	36	40%
Programming	27	31%
Games	25	28%

The data in Table 6.35 indicate that the majority of Heads of Department (84%) thought that it was useful for students to learn word processing before learning other computer applications. The other programs mentioned by the participants included Database, Programming and games. Karsten and Roth (1998) studies also noted similar findings. These results can be interpreted to mean that teachers considered that word processing was a very useful tool for most of students in lower forms who used it to learn various literacy skills such as writing skills, composition and languages (Zhang 2000), Heinich et al. 1996 and 2002).

6.7.3. Computer skills learnt by students

One of the objectives of introducing computers into public secondary schools in Kenya was to teach students computer literacy skills. In this connection the Heads of Department were asked to list the skills the students in the study schools in Nyanza Province learn. They were provided with a list of multiple-choice answer to choose from. The results are shown in Table 6.36

Table 6.36 Computer programs that students learn during computer lessons

Skills learnt by students	Frequency	Percentage
Word processing	42	47%
Spreadsheet	35	39%
Database	27	30%
Programming	26	29%
Others	9	10%

From Table 6.36 it can be seen that majority of students leant word processing skills, and some students were taught how to use spreadsheets especially in mathematics, business education and accounts subjects. In some schools students were taught how to use databases and programming was currently taught in a few higher Forms 3 and 4 classes as an elective course. The studies of Crook (1994), Heinich et al (1996 and 2002) and Zhang (2000) reviewed in Chapter 2.9 Section 2.9 report similar usage. However, it is worth noting that the data in Table 6.37 and 6.38 look alike, but in Table 6.37 HODs were asked to state the computer programs they thought would be useful for students to learn. While in Table 6.39 they were required to list the computer programs the students were actually learning in their schools.

6.7.4 The role of computers in departmental teaching and learning

Heinich et al. (1996, and 2002) and Anderson (1991) reviewed in Chapter 2 Section 2.3 listed a number of roles of computers in teaching and learning. Some of these roles included that of an object of instruction, a tool for composing and data retrieval, a tool for classroom instruction, to help students learn specific skills and a catalyst for learning. The same roles of the computer were investigated in the present study. The Heads of Department were asked to describe briefly the role of computers in their departmental teaching and learning. Their responses were summarized and presented in the Table 6.37

Table 6.37: The roles of computers in teaching and learning in schools that participated in the investigation

Responses	Frequencies	%
To teach students the application of computer programs	30	34%
For computing and analyzing data of students' marks	15	16%
A tool for teaching/learning to improve students' learning	8	9%
For storage and retrieval of students' records	7	8%
It is an aid in guiding and updating knowledge to the users	6	7%
For preparing teaching notes and in setting examinations	5	6%

From the data in the above list, there were similarities in the findings with those reported by Heinich et al. (2002) reviewed in Chapter 2 Sections 2.9. The data obtained from this study can be interpreted to mean that the respondents have also recognized the important roles that the computers can play in teaching and learning as well as in school administration. However, there were no responses from 20% of Heads of Department. Nevertheless, when looking at the responses from the participants in Table 6.13, 6.15, 6.21 and 6.33, there are three common themes regarding computers as tools for educational use in schools. The first one concerns teaching students computer literacy skills. The second one is for teaching traditional subjects and thirdly, for administrative work such as keeping records. These contributions from Principals and HODs support the literature reviewed in Chapter 2 Section 2.3 on the functions and roles of computers in schools.

In addition to the roles of the computer in the departmental teaching, the other information sought from the Heads of Department was about the impact of computers on students' learning. According to Berson (1996: 486) computer-based learning has the potential to facilitate development of students' decision-making and problem solving skills, data processing skills, and communication capabilities. In this connection, Heads of Department were asked an open-ended question to "Describe briefly the impact of the computer program you use on students learning?" The general response was quite positive. The Heads of Department reported the use of computers as shown in Table 6.38

Table 6.38:The impact of computer programs in departmental teaching and learning

Responses	Frequencies	%
Increase attention in learning various skills among students	22	25%
It has helped students to improve their communication skills	22	25%
Knowledge of programs prepares students for job opportunities	11	12%
Students can access databases and acquire relevant information	8	9%
Students recall what they have learnt, and passed their examination	5	6%

The above data is supported by the contribution of Berson (1996), (Brush and Saye (2000), Klein and Doran (1999) and Woodrow (1998) reviewed in Chapter 2 Section 2.9 indicating that by using computers, students can gain access to expansive knowledge links. This helps to broaden their exposure to various learning resources and diverse people and perspectives. However, twenty-one (23%) HODs did not respond to this question.

6.7.5 Advantages of using computers during facilitation of learning in the classroom

In order to continue using computers, teachers need to be convinced of the benefits they derive from it in the mediation of learning. It is important that computers offer clear pedagogic benefits that are relevant to departmental programs and needs in teaching various subjects. The Heads of Department were therefore asked to list all the advantages of using computers in classroom teaching. The findings are summarized and included in of the following in Table 6.39

Table 6.39: Advantages of using computers in teaching and learning in schools

Responses	Frequency	%
It motivates students as a tool to learn with	10	11%
It extends the scope of knowledge of scientific discovery	10	11%
It arouses learners' curiosity and creative thinking	9	10%
It involves learning by doing-student-centered, is interesting	9	10%
To provide stimulus variation	8	9%
To reinforce the understanding of concepts	7	8%
Promotes efficiency and accuracy in calculation of mathematics	6	7%
It is convenient for storing, retrieving and updating information	6	7%
It is convenient, can be used in place of the teacher	5	6%
It enables the sharing of ideas through e-mail or Internet	5	6%

From the above Table 6.39 it can be seen that the Heads of Department identified sufficient benefits of computers to consider integrating them into the subjects they taught. The research findings contained in the list are also similar to the findings of Bitter (1989), Dexter et al. (1998), Heinich et al. (1996 and 2002) and Slabbert (1999) reviewed in Chapter 2 Section 2.9. Thus, the benefits of computers in classroom instruction reported by HODs make the use of computers more compelling and suggest that they are really to promote effective CIE in schools. Moreover, Heads of Department also reported that the use of computers contributes to students' learning as indicated in Table 6.40

Table 6.40: How the use of computer contributes to students learning

Responses	Frequency	%
Providing valuable practical approach to learning by doing	22	25%
It improves their communication skills and prepares them for further studies	11	12%
It keeps learners abreast with modern information technology	10	11%
It increases students' thinking skills	10	11%
It improves reasoning ability of students, makes them serious learners	8	9%
Prompt attention, interest and development of ambition to learn more	5	6%

The identified contribution of computers to students learning in Table 6.40 are similar to previous research findings reported by Ertmer et al. (1999) and Rice Wilson and Bagley (2001).

6.7.6 Availability of the computer education timetable in schools investigated

Given the importance of good planning, organization, management and school administration, there should be in place a workable school programme of activities. This also applies for the daily teaching and learning activities. So there should be a proper school timetable for all the subjects indicating time, teachers, place, classes, classrooms for all academic subjects and extra curricular activities to guide teachers and students when to attend to teaching and learning. Therefore, Principals were asked a closed question "Does the school have a timetable for computer lessons?" Table 6.41 displays the responses.

Table. 6.41 Availability of computer timetable in the schools

Responses	Frequency	Percentages
Yes	16	67%
No	8	33%
Total	25	100%

The result of the study in the above Table 6.41 clearly indicates that most of the schools had a computer timetable. However, some of them did not include computer education in their timetable. It is likely that some of these schools were those not teaching computer education because out of the 25 schools that returned the questionnaires 5 were not using computers for teaching and the other three might have not had the timetable ready at the time of this research. However, it is important that all schools draw up a timetable for computer education as with other subjects such as mathematics showing the time and number of periods per week per class for computer lessons. Copies of the computer timetable should be placed in each classroom indicating where the lessons are held so that teachers and students are well informed in advance. Teachers can then plan to use the computers for additional CIE lessons as the need arises. Millar's (1997) study in South Africa also found that the computer room had a timetable for computer lessons and the subjects were also included in the timetable.

Another area related to the timetable for the school that was investigated concerned the number of periods allocated to computer lessons. All of the Principals of the schools that responded positively to the question in sections 6.7.7 were asked to state the number of periods (hours) allocated to computer lessons per week. Though all Principals reported having a computer timetable, 56% of them indicated having four periods (each of 45 minutes) for computer lessons for each class per week. However, there were differences in number of periods allocated to computer lessons reported by other Principals. Some of the schools seemed to have provided more time during the evening and weekends for students to access computers. Such schools reported having up to 18 periods per week. The findings from these respondents can be interpreted to mean that either uniqueness of the new technology was motivating teachers and learners or the teachers were strongly committed to the use of computers.

In addition to the above response, the Principals were asked to rate "how often the four main programs (Word processor, Spreadsheet, Database, and Programming) were used by teachers in their school." The findings were summarized and displayed in Table 6.42

Table 6.42: Principals' rating of how often teachers use types of computer software

Rating	Word processor	Spreadsheet	Database	Programming	Others
Daily	8	3	2	3	1
Often	6	8	7	1	0
Sometimes	0	1	4	5	3
Not used	9	9	9	9	9

The finding in Table 6.42 shows that the highest level of use reported by Principals was for word processing having eight periods per week. Dugdale (1994) reports similar findings in a study conducted in the USA. Furthermore, in order to get a clear picture of whole school integration of computers, there was a need to investigate the role of Heads of Department regarding their computer timetable.

6.7.6.1 Departmental computer timetable in schools investigated

Effective integration of computers into teaching and learning requires that users be well informed in advance of when, and where computers are available. Coordination of academic subjects takes place at departmental level. The Head of Department needs to have a timetable for teachers and students to refer to as needed. The Heads of Department were therefore asked to state if they incorporated computer lessons into their departmental timetable. Table 6.43 summarizes their responses.

Table 6.43: Number of HODs who included CIE in their departmental timetable

Responses	Frequency	Percentage
Yes	49	55%
No	40	45%
Total	89	100%

The result in this Table 6.43 indicates that just over half (55%) Heads of Department had included computer-integrated education in their departmental timetable. The findings illustrate that Heads of Department can greatly influence the adoption of computers into subject teaching by having the subject included in their timetable, or could block the integration through inaction and resistance to change. Nevertheless, those who responded positively were asked to indicate the number of periods allocated to computer lessons and the findings were the same number of periods as those reported by the Principals shown in Table 6. 43. But those who did not have the timetable cited several obstacles to having a computer education timetable such as access to computer equipment, lack of manpower and relevant computing skills.

6.7.6.2 Frequent use of the computer by departmental staff

The frequency of use of computers by the departmental staff was another important area of investigation aimed to reveal how adequately Heads of Department supported the use of computers in teaching and learning. If departments make little use of computers available then the chances that students will use them effectively is likely to be slim. Availability of computers on the timetable does not necessarily mean that teachers will use computers in teaching and learning. So Heads of Department were asked to indicate how often teachers in their departments used computers in teaching and learning. The findings are shown in Table 6.44

Table 6.44: HODs comments on frequent use of computers by departmental staff

Responses	Frequency	Percentages
Once a week	8	9%
Twice a week	15	17%
Thrice a week	7	8%
Four times a week	7	8%
Five times a week	6	7%
No response	46	51%

The above Table 6.44 indicates how frequently teachers used computers in their departments. However, most of the HODs did not respond to this question. This can be interpreted to mean that either computer had been integrated into very few departmental subjects or the Heads of Department did not have adequate information regarding how frequently teachers used computers. Perhaps some Heads of Department did not consider Computer Studies part of their responsibility since they were not teaching the subject. However, Heads of Department are the academic leaders in their subjects. They need to be well versed in all academic matters in education and have vision for any curriculum innovation in order to advise teachers in their departments with regards to any academic activity in the school (Eshiwani, 1993). So there is need for a further investigation on this issue.

6.7.7 Principals' comments on the integration of computers in subject teaching

The other objective of this study indicated in Chapter 1 Section 1.4, was to investigate computer-integrated education in schools. Many researchers (Cameroon, 1999; Hargrave and Kenton, 2001; Heinich et al. 1996 and 2002; Mills and Ragan, 2000); reviewed in Chapter 2 Section 2.9 noted the need for computer integrated education in schools. The issues raised in their studies were also investigated in my study. The Principals in my study were asked a closed question "In which subject areas would you say your teachers make the greatest use of computers?" This question was considered to be important because of the benefits of CIE reported by previous researchers such as using computer application to teach specific topics. The results of this question are shown in Table 6.45

Table 6.45: Principals' report on the use CIE in their schools

Subjects	Frequency	Percentages
Administrative work	9	45%
Accounting	8	32%
Secretarial subjects	7	28%
Mathematics Education	5	20%
Technical/Graphics education	3	12%
Science Education	2	8%
Language Education	2	8%
Social Studies education	1	4%

It can be seen from the above Table 6.45 that some of the Principals reported that their teachers integrate computers into teaching and learning various subjects but mostly commercial subjects such as Accounting, and secretarial subjects. This could have been due to the fact that both these subjects are Technical/Applied subjects taught in secondary schools in Kenya as an elective for those preparing to take them at the national examinations. The data obtained confirmed the whole school integration of computers into education as recommended by Cornu (1996) and Dockstadder (1999) discussed in Chapter 1 Section 1.5.

In another question related to the use of computers in various subjects, the Principals were asked to give the reasons why the teachers use computers in teaching those subjects. This question was asked after considering a review the literature by Ertmer et al. (1999) reported in Chapter 2 Sections 2.9. The participants gave various answers that were summarized and presented in Table 6.46

Table 6.46: Principals' reasons for teachers' use of computers in teaching and learning

Responses	Frequency	%
To improve the quality of teaching/learning subjects	10	40%
To impart new knowledge from computer programs	8	32%
Keeping students' record and examinations result	4	16%
For computation, demonstration of difficult topics	3	12%

Some of the data contained in the above table concur with the research findings reported by Ertmer et al. (1999:65), although the findings of Ertmer et al. included motivational factors. In that study, the teachers reported that the use of computers motivates students and makes the lesson more interesting to students. Ertmer et al. reported also how teachers described their enjoyment in using computers and becoming more competent. In conclusion, Principals were asked to give their overall opinion about the impact of the use of computers in their school.

6.7.8 Principals' comments on the value of computer programs in teaching and learning in their schools

While the benefits of computers in teaching and learning cannot be disputed, the question of its worth was another area of investigation. It was important to establish whether the use of computers was useful and how teachers felt about the computer as a tool for instruction. The Principals were asked a closed question "Do you consider computer programs to be of value in making learning more effective in your school?" Table 6.47 displays the findings.

Table: 6.47: Principals rating of the value of computer programs to teaching and learning

Rating	Frequency	Percentages
Very valuable	11	44%
Valuable	7	28%
Not valuable	2	8%
No response	5	20%
Total	25	100%

Table 6.47 indicates that most of the Principals rated computer programs very valuable to the students, while some of them rated it valuable, and a few of them rated the programs not valuable. But others declined to comment. It is possible that the Principals who rated the computer programs not valuable had no experience in the use of computers because the findings in Section 6.3.4 indicated that (28%) of the Principals had no experience with the use of computers. They may not understand the value of computers as a tool for

teaching and learning. At the same time, Principals gave various reasons for rating the programs as indicated in the Table 6.47, and these reasons are summarized in Table 6.48

Table 6.48: Principals' reasons for rating computer programs used in schools

Responses	Frequency	%
It is faster and convenient, accurate and saves time	6	24%
Students acquire computer literacy skills	6	24%
Computer makes students more inquisitive learners	5	20%
It helps weak students to improve in language work	4	16%
Computer assist to enhance and simplify learning	4	16%

It is evident from the above contributions that Principals recognized the potential and capabilities of computers in education. They also expressed high opinions concerning the use of computers to help improve learning in schools. Furthermore, those who rated computer programs not valuable reported that their teachers were not computer literate and were not using computers. However, in conclusion, Principals were asked to state their overall opinion about the impact of computer-integrated education on students' learning of traditional subjects. Their replies were analyzed and presented in Figure 6.4

Figure 6.5: Principals' opinion on the impact of computers on students learning

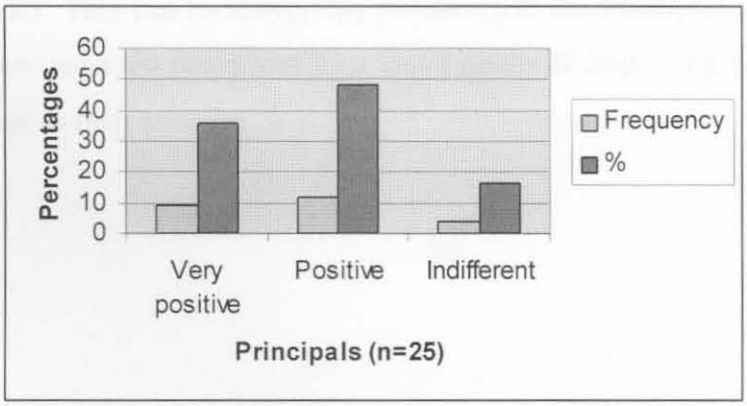
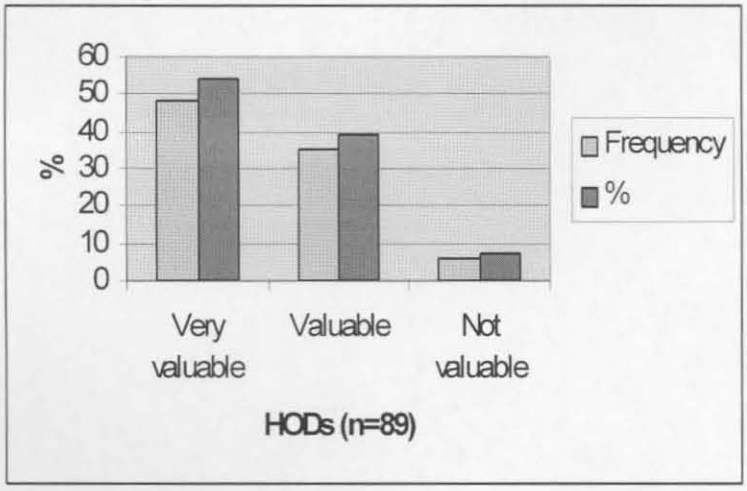


Figure 6.4 indicates that 9 of 25 (36%) Principals expressed a very positive opinion about the impact of computers on students learning, but 12 of 25 (48%) of them were positive, while 4 of 25 (16%) were indifferent

6.7.9 HODs' views about the value of computers as a tool for teaching and learning

In order to get more information about the value of computers in education, Heads of Department were also asked to explain how valuable computer integrated education is to their departmental teaching and learning. This question was asked because Ertmer et al. (1999:55) argued that if the computer does not teach what the teacher emphases or "teaches things the teacher does not require it is unlikely that the teacher will assign high value to its use." But if the teacher perceives that the computer addresses important instructional and learning needs, the perceived value will be higher. The findings are summarized and presented in Figure 6.5

Figure 6.6: HODs views about the value of computers as a tool for instruction



As can be seen from the above Figure 6.5 most Heads of Department 48 of 89 (54%) agreed that the computer was very valuable as a tool for instruction. While 35 of 89 (39%) of them rated it valuable and only 6 of 89 (7%) did not value the use of computers as a tool for teaching and learning. The responses from Heads of Department concur with those of Principals in Section 6. 9 and those of computer teachers reported in Chapter 7 Section 7.4.3. This can be interpreted to mean that the Principals, Heads of Department and teachers regarded computers as a tool capable of improving the quality of teaching and learning in their schools.

6.7.10 Implementation of computer-integrated education in secondary schools

According to Nisan-Nelson (2001:84) research has repeatedly pointed to the need for teachers to integrate computers into teaching because there is a tendency for teachers to resist or stay with instructional strategies with which they are familiar and comfortable. Consequently, the Principals in my study were asked an open-ended question "To state objectively all the concrete measures that your school has taken in the implementation of computer integrated education?" The data collected on this issue indicated that the Principals had taken adequate measures for the implementation of computer-integrated education in their schools as shown in Table 6.49

Table 6.49: Steps taken by Principals for CIE implementation in study schools

Responses	Frequency	%
Planned for computer integrated education	3	12 %
Allocated computer lessons on the timetable	10	40%
Employed a teacher for computer education	2	8%
Availed computer equipment, and built computer room	3	12%
Inducted teachers and students to computer education	2	8%
Allowed them to access computer for teaching and learning	5	20%

The information contained in the above table indicated that the Principals were committed to the introduction and use of computers as was required by the government policy discussed in Chapter 5 Section 5.3. The role of the Principals in computer-integrated education is an important factor in the implementation of computer studies by the teachers. The findings of this study concur with that of Yee (2000:293) stating that Principals are the keepers of the schools' vision and "the ability of a leader to transmit a vision or sense of mission and to create enthusiasm in followers is also characteristics of charisma, a transformational leadership factor."

In addition to the above responses, the Principals were asked another open-ended question "From your experience as a head and professional teacher, list the measures you would take to ensure that computers are integrated and used effectively in your school?"

This question was asked to establish whether the Principals hold a vision for CIE and supported teachers towards the use of computers. The responses from the Principals were summarized and presented in Table 6.50

Table 6.50: Specific measures Principals would take to ensure CIE is implemented in schools

Responses	Frequency	%
To make computer education compulsory for students	10	40%
All teachers to learn computer literacy skills	5	20%
To build a computer center for the school	5	20%
To provide teaching and learning materials for teachers	3	12%
To computerize all departmental work	2	8%

The information from the Principals on computer integration was essential because according to Azita (1999:31) teachers need to be assisted in building curricular models that integrate the use of computers. Furthermore, Yee (2000:293) reported the need for the Principal to have a clear vision, and personal investment in the idea of using computers for teaching and learning, because there has to "be a passion in the Principal's mindset that this is something that is going to improve the achievement, and the education of students." The above findings in Table 6.52 support the suggestions of Azita (1999) and Yee, 2000), particularly the information about making computer education compulsory for all students, all teachers to learn computer integrated skills and providing teaching and learning materials.

Similarly, Heads of Department were also asked to explain the steps they have taken to integrate and use computers in their departmental subjects. This question was asked in order to obtain information from Heads of Department because they are the academic leaders in their subjects and are expected to advise and provide assistance to teachers in any curriculum innovation (See section 6.1 in this chapter). The answers they provided were analyzed and presented in Table 6.51

Table 6.51: Steps taken by HODs to integrate computers into their subjects

Responses	Frequency	%
No response	30	34%
Computer subject is included in the timetable	20	22%
Purchased computers and support materials	10	11%
Seeking ways of acquiring more computers	8	9%
Acquired programs useful for computer integration	8	9%
Departments train teachers how to integrate computers	7	8%
Some teachers have trained in computer integration	6	7%

Taking into account the newness of computer technology in schools, it can be said that Heads of Department have made progress towards the integration and use of computers. It is therefore suggested that Principals of schools should work closely with all heads by providing them with adequate resources to promote effective integration of computers in all schools.

6.7.11 HODs evaluation of CIE in departmental subject teaching

In another question, Heads of Department were asked to rate the integration and use of computers in their departmental teaching. This question was asked in order to provide information on the subjects into which computers have been integrated. They were provided with multiple-choice answers. The results obtained were not very encouraging as can be seen from Table 6.54

Table 6.52: The results of HODs evaluation of CIE in their departments

Rating	Frequency	Percentages
Excellent	11	12%
Good	10	11%
Poor	27	31%
Very poor	8	9%
No comment	33	37%

Table 6.54 shows that very few HODs rated the integration and use of computers as excellent, and a few rated the integration good. The rest rated the integration of computers into the teaching of subjects in their department as poor. Many of them did not respond to

the question. The findings concur with that of Azita (1999:31) who noted that teachers need to have the knowledge about how and when such computer programs should be used in instruction. Most of the teachers in the schools that participated in my study had not been trained in the integration of computer programs into the teaching of traditional subjects hence the poor rating indicated above. Training can provide teachers with knowledge of the basics of computers and curriculum integration (Bitner and Bitner, 2002; Mccannon and Crews, 2000), and teachers need to be aware of the different kinds of programs that can be used in CIE.

The Heads of Department were asked another open-ended question "In which subjects do you think the teachers from your department could make use of computer integrated lessons effectively?" In response, some of the Heads of Department wanted all subjects to be integrated but others wanted computers to be integrated only into the teaching of accounting and other commercial subjects. The other subjects that were suggested for CIE included languages, sciences and mathematics, and design and drawing.

In addition to the above responses, the Heads of Department were asked to state why they wanted computers to be integrated into the teaching of normal school subjects. The answers were summarized and presented in Table 6.53

Table 6.53: HODs reasons for the integration of computers into subjects

Responses	Frequency	%
No response	32	36%
Computer is programmed in English accurately, better research materials	17	19%
Computer can illustrate details that cannot be done by the teachers in class	15	17%
To cater for students' interest, increase creativity and critical thinking	10	11%
Computer can facilitate the understanding of concepts in the subjects	9	10%
Mathematics deals with graphs, formulas, best done by computers	6	7%

The above findings are similar to research findings reported by Rice, Wilson, and Bagley (2001) from America, indicating that students increased their creativity and learning of history as a by-product of the other things they learnt using computers.

6.7.12 Parents' and Board of Governors' support for computer education in schools

Support from the PTA and BOG for the effective management of school projects is very important. Without good understanding between them and the staff at the school proper curriculum innovations could not be realized. The Principals were therefore asked " Is there cooperation between the teachers, PTA and BOG on the integration and use of computers in teaching and learning?" The responses to this question were varied. The majority of the Principals 87% reported that they get the necessary cooperation from the PTA and BOG committee by supporting the use of computer integrated education. Only 13% of Principals did not get the necessary cooperation from the PTA and BOG. The Principals who received cooperation reported that the PTA and BOG had provided various assistance and support as shown in Table 6.54

Table 6.54: Parents Teachers Association and Board of Governors' support for CIE

Responses	Frequency	%
Provide funds to purchase computers and pay for the services	6	24%
Negotiate with wealthy people to donate computers to the school	5	20%
Organize fund raising for the school computer projects	5	20%
Create school policy guidelines on computer curriculum innovation	4	16%

From the above list it can be seen that some of the BOGs and PTAs are committed to the development of viable curriculum innovation in their schools. Such support takes place in a school where the Principal has academic vision for the school and students' performance. However, the response from Principals not supported by PTA and BOG were also summarized and presented in the following Table 6.55

Table 6.55: Response from Principals not supported by PTA and BOG on CIE

Responses	Frequency	%
The school computer project has not taken off in the school	5	20%
It is not a priority, other essential facilities still lacking e.g. dormitories	4	16%
The parents have not come forward to fund the program	3	12%
Lack of essential facilities for teachers and students to use computers	3	12%

6.7.13 Principals' comments on the use of computers to enhance learning

The last question in this section was concerned with the opinion of the Principals about the use of computers to enhance learning. This question was asked because Principals are supposed to play a decisive role in determining patterns of computer use within their schools. Principals' knowledge about the benefits of using computers in education would encourage the integration of computers into teaching and learning in their schools. In this connection, the Principals were asked an open-ended question "How do you think the use of computers enhances learning in the classroom?" The responses were as follows as shown in Table 6.56

Table 6.56: Principals' comments on the use of computer to enhance learning

Responses	Frequency	%
Makes learning interesting, vivid, and simple to understand	9	36%
Computer arouses interest, curiosity and motivation	6	24%
It has a wide network to cater for all kind of learners	4	16%
Computer is faster, saves time, facilitate interaction with learners	4	16%
It enables students to discover more information in different subjects	2	8%

Principals are key to the effective implementation of computers in education. They need to be role models for teachers and students in their schools. Once the Principal believes that computers can effectively improve learners' high level goals and supports teachers towards achieving the set goals then classroom teachers would do the same.

6.8 Training of Principals and Heads of Department in the use of computers

If Principals of schools are expected to implement computer technology innovation in the schools, they need to be trained in the use of computers. A study by Yee (2000:293) revealed that Principals are keepers of the school computer visions. Yee (2000) noted that "the ability of a leader to transmit a vision or sense of mission and to create enthusiasm in followers is also characteristic of charisma, a transformational leadership factor." Consequently the Principals in my study were asked to state if they have been trained in the use of computers. This question was asked because training Principals in the use of

computers will provide them with the computer skills they could use to guide the implementation of computer integrated education in their schools. Knowledge of computer skills was identified as an important factor that encourages the implementation of computers in teaching and learning reviewed in Chapter 3 Section 3.2.2. The findings of this part of the investigation is displayed in Table 6.57

Table 6.57: Principals and HODs training in computer skills

Participants	Trained	Not trained	Percentage
Principal of Boys school	6	6	48%
Principal of Girls school	5	7	48%
Principals of Mixed school	1	0	4%
Total	12	13	100%

As can be seen from the above Table 6.57, slightly less than half of the Principals were trained in the use of computers. Heads of Department were also asked to state if they have had any kind of training in computer use. The results of their responses are contained in Table 6.58

Table 6.58: Heads of Department training in the use of computers

Responses	Heads of Department	Percentages
Yes	47	53%
No	42	47%
Total	89	100%

As can be seen from Table 6.58, just over half of Heads of Department were trained in the use of computers, but quite a large number of them had not been trained. Lack of training in the use of computers has implications for departmental subject integration and use of computers in teaching and learning. Abbott and Faris (2000), Carol (1997), Chiero (1997), Kay et al. (1999) and Vannatt and Beyerbach (2000) reviewed in Chapter 3 Section 3.3.1 to 3.3.2 also reported lack of training in the use of computers as a barrier to the implementation and use of computers in developed countries.

6.8.1 Type of computer training Principals and Heads of Department received

In another question on training the Principals were asked to provide information on the type of computer courses they attended. A list of courses was given and the results are displayed in Table 6.59

Table 6.59: Computer courses attended by Principals

Computer courses	Principals	Percentages
Administrative	3	12%
Secretarial	0	0%
Subject teaching	0	0%
Computer literacy	9	36%
Others	0	0
No training	13	52%
Total	25	100%

As can be seen from the above Table 6.59, very few Principals had attended a computer administrative course, although some had attended a computer literacy course. But the majority had no training in any course. It is likely that those who attended an administrative course were just briefed on the need to introduce computers in their schools, and general awareness of the importance of computer education in Kenya. The information the Principals gained enabled them to introduce computers in their schools. Yee (2000:289) noted that Principal's knowledge of computer leadership was valued and worthy of study. Therefore, despite lack of training for most of the Principals in Nyanza Province, the findings provided vital information on the changing roles of Principals and the use of computers in their schools. There is a need for further investigation to identify specific training needs of Principals that could promote effective implementation of CIE secondary schools in Nyanza Province.

Heads of Department were also asked to state the type of training they attended. They provided varied responses as shown in Table 6.60

Table 6.60: Computer courses attended by Heads of Department

Computer courses	Heads of Department	Percentages
Administrative	4	5%
Secretarial	2	2%
Subject teaching	4	5%
Computer literacy	34	38%
Others	3	3%
No training	42	47%
Total	89	100%

Table 6.60 displays the types of computer training Heads of Department received. However most of them were also not trained in computer skills and hence would be limited in their capacity to guide teachers' use of computers in their departmental subjects. There is need for all Heads of Department to be trained in computers to serve as a role model to teachers in their departments.

In addition to the above question on training, Principals and Heads of Department were asked to state the duration of the computer course they attended. The overall results were summarized and presented in Table 6.61

Table 6.61: Training period of computer courses attended by Principals

Training period	Principals	Percentages
0-5days	3	12%
1 week-2weeks	7	28%
3 weeks-1 month	1	4%
2months and over	1	4%
No training	13	52%
Total	25	100%

The above information indicates that Principals were trained for a very short period in computers and most of them were for two weeks only. Similarly, when the Heads of Department were asked the same question the responses were examined and reported in Table 6.62

Table 6.62: Training period of computer courses attended by HODs

Training period	Heads of Department	Percentages
0-1 week	7	8%
2weeks–one month	14	16%
2months-3months	17	19%
4months-6months	6	7%
1year-2years	3	3%
No training	42	47%
Total	89	100%

Most of HODs were trained in computers for about three months, although it can be seen that some of them were trained for more than six months.

6.8.2 The importance of training to the Principals

Taking into account the need for training attached to computer education discussed in Chapter 3 Section 3.2.2, the next question in this section concerned the usefulness of computer courses attended by the Principals. The Principals and HODs who had attended computer courses were asked a closed question "How important was the course to you?" They were provided with multiple-choice answers to rate the importance of the training. The response from the Principals was very encouraging as indicated in Table 6.63

Table 6.63: Importance of computer training to Principals

Responses	Principals	Percentages
Very important	9	36 %
Important	3	12%
Not important	0	0%
No response	13	52%
Total	25	100%

A total of 36% of the Principals rated the course very important to them and only 12% of them rated the training important, while no one reported that the course was not important. Yee (2000) also noted the importance of training Principals in computer skills

in order to appreciate and have a vision of how computers can add value to teaching and learning. At the same time knowledge of personal productivity skills such as word processors, spreadsheet, data base and graphics etc, can be used by the Principals to foster teacher's interest in the use of computers.

Heads of Department were asked the same closed question and gave the answers as shown in Table 6.64

Table 6.64: The usefulness of computer training to Heads of Department

Responses	Heads of Department	Percentages
Very useful	38	43%
Useful	6	7%
Not useful	3	3%
No response	42	47%
Total	89	100%

The response from Heads of Department indicated that most of those who received training in computers rated the training very useful, only a few rated the training useful, while a small number did not appreciate the computer training they received. Moreover, HODs who responded positively about the usefulness of training were asked another open-ended question "If the training was useful, describe briefly how it has helped you in teaching and learning?" The findings indicated that most Heads of the Department were happy with the training they received and were able to use computer software packages for data processing and analysis, preparing teaching materials, computing students' marks and position in class much faster. Some of them reported the training enabled them to teach students computer programs, to print neat work, access the Internet and use e-mail services. Many wanted more training in the integration and use of computers.

As a result of the above positive responses from HODs, they were also required to provide information about competency with use of computers. Although lack of competency is difficult to prove, a study by researchers reviewed in Chapter 3 Section 3.3.1 to 3.3.1.3, (Abbot 2000; Erler and Macaro, 1998; Scheffler and Logan 1998)

indicated teachers' lack of confidence in the use of computers as another obstacle to effective use of computers in teaching and learning. In this connection, Heads of Department were asked a closed question "Given your present training do you consider yourself professionally competent to integrate and use computers in teaching in the classroom?" They were provided with multiple-choice answers. Table 6.65 displays the findings.

Table 6.65: Heads of Department' competency with use of computers

Responses	Frequency	Percentages
Very competent	16	18%
Competent	30	34%
Not competent	10	11%
Require more training	11	12%
No response	22	25%
Total	89	100%

The finding in Table 6.65 demonstrates just over half of the HOD's felt competent to use computers. This can be attributed to the fact that much of the training provided to them only emphasized fundamental computer literacy skills, rather than preparation on how to use computers as a teaching tool and how to integrate it into teaching and learning. Furthermore, Williams, Coles, Richardson, Wilson and Tuson (2000:174) reporting from Britain also noted that teachers had limited competency and experience in computing and expressed the need for appropriate training. Consequently, when preparing school leaders in Kenya for effective professional development and the competencies required of them in the light of current expectations for computer education in secondary schools, they should be well informed of changes in the field of computer integrated education. The use of computers in schools has become both a pedagogical and political issue in developing countries, so the issue of the computer competency of school leaders is very important.

6.8.3 Other courses attended by Principals on the use of computers

In order to get more information on computer training, the Principals were asked a closed question to state if they have attended any other course on the use of computers? Although in Table 6.59 Principals provided information on the training they received, this question was designed to elicit data on additional courses apart from the ones listed such as use of e-mail, and Internet. The findings from Principals are shown in Table 6.66

Table 6.66: Other computer courses attended by Principals in study schools

Responses	Principals	Percentages
Yes	7	28%
No	18	72%
Total	25	100%

The findings indicated that a few Principals had attended some courses but the majority of them had not attended any other training in the use of computers. There is need for Principals to be re-trained in the new development in the area of computer technology for use in their schools. Yee (2000:294) reports that a principal needs to be adventurous learner and to demonstrate a desire to be computer literate along with staff members and students. The principal is expected to develop personal competency with computers and to be "willing to experiment with new computer programs and learning strategies" in order to help improve CIE in their schools. However, because the response to the question in Table 6.62 above did not provide information on the kind of training programme attended by the participants, Heads of Department were asked another question but in a different format. "Since receiving your teacher training which of the following courses did you attended please tick what is appropriate?" The responses were as displayed in Table 6.67

Table 6.67: Other computer courses attended by Heads of Department

Responses	Frequency	Percentages
Computer in-service course	10	11%
Computer workshops	7	8%
Computer seminars	5	6%
Computer-based curriculum	1	1%
Any other please specify	8	9%
No response	58	65%
Total	89	100%

From the above Table 6.67 it can be seen that only 35% Heads of Department had attended some of the courses listed, but the majority of them had not attended any other course in the use of computers. Heads of Department are also subject teachers and in order to integrate computers into teaching and learning they need proper training. Bitner and Bitner (2002:97) report that teachers need to conceptualize how the use of various programs can facilitate teaching and learning. They believe that this can be done easily if they actually see students using computers that have been integrated into a curriculum. Consequently, Heads of Department in my study indicated that they needed immediate training since computer integration necessarily changes teaching from a traditional teacher centered to student-centered approach.

6.8.4 Percentage of teachers who are computer literate in the schools investigated

Computer integrated education implementation in schools is one of the most complex tasks in the curriculum innovation process. Teachers are essential for the success of any curriculum innovation. In this regard, Principals were asked the open ended question "What percentage of your teachers are computer literate?" The data obtained were summarized and showed that twenty (80%) of the Principals believed that their teachers were computer literate, but 20% of them reported that their teachers were not computer literate.

Similarly, Heads of Department were asked to state the percentage of teachers in their department who were computer literate. The findings from the Heads of Department

indicated that 48% of their teachers were computer literate but 42% were not. The above findings can be interpreted to mean that most schools investigated had at list some computer literate teachers.

6.8.5 The role of the school in staff development for computer education

The last question in this section sought information regarding the role of the schools in the training of teachers in computer education. The Principals were asked to state "What role should the school play in the training of teachers in the integration of computers in curriculum instruction?" This question was asked because Principals are expected to be the main initiators of curriculum change and change cannot take place if teachers are not involved. Theory of change and resistance to change explains the importance of Principals' support for teachers to be prepared to implement change. From my experience, Principals plays a major role in staff training by nominating teachers to attend certain courses, granting teachers leave to attend in-service courses, organizing seminars, and providing some funds for such short training programmes. Dawson (2000) and Yee (2001) indicate that successful curriculum innovations are backed up by the Principals' support and vision. The Principals' answers to the above question were quite encouraging but varied as indicated in Table 6.68

Table 6.68: The role of the school in re-training of teachers in computer education

Response	Frequency	%
The school to supplement teachers' advanced training in computing	9	36%
To buy enough computers, invite instructors to train teachers	7	28%
To sponsor teachers for computer literacy training	5	20%
The school to supplement teachers' advanced training in computing	9	36%
To avail funds for any in-service course on CIE	1	4%

Similarly, Heads of Department were asked the same question, but in a different format "In your opinion, what role should the department play in the training of teachers in the integration and use of computers in your subject area?" This question was asked to elicit more information from HODs because they are the academic leaders in departmental subjects and are supposed to advise teachers, and assist them as indicated in section one

of this Chapter. Interestingly, Heads of Department had similar responses to those of the Principals but some were curriculum based as shown in Table 6.71

Table 6.69: The role of departments in the training of departmental staff in CIE

Responses	Frequency	%
No response	22	25%
Provide teachers with relevant computer materials	16	17%
Play a key role in disseminating information on effective use of CIE	13	15%
Organize departmental in-service courses for teachers on CIE	12	14%
Take initiative to show that computers are friendly, useful tools for CIE	7	8%
Encourage teachers to attend computer exhibition, training on computers	7	8%
To discuss with the Principal to purchase departmental computers	6	7%
Help in curriculum development and implementation of CIE	6	7%

The above findings in Table 6.68 and 6.69 revealed the vision and plans of the Principals and Heads of Department, and the role they have played in professional development of teachers to integrate and use computers in their schools and at departmental level. It furthers demonstrates the willingness of the administration and the subject leaders to integrate computers into teaching and learning. Holland (2001:247) expressed the need for the administration support for teachers' professional development in the use of computers.

6.9 Technical and Physical problems regarding the use of CIE in schools

According to Albion (2001: 322) lack of technical support, computers and the issue of maintenance and repair of computers are some of the major factors militating against the effective utilization of computer technology in many secondary schools in developed and developing countries. Therefore, Principals in my study were also asked a closed question "What problems are preventing you from implementing computer-integrated education effectively in your school?" This question was asked to provide information regarding the review of literature in Chapter 3 Sections 3.4, 3.6 and 3.7 by Carol (1997), Chiero (1997),

Ertmer et al. (1999), Struddler (1996), Ross and Woods (1999), Vannatta and Beyerbach (2000) and Veen (1996). The responses from the Principals are shown in Table 6.72

Table 6.70: Barriers to effective implementation of CIE in schools

Responses	Frequency	Percentages
Lack of funds	19	76%
Lack of availability of computer equipment	17	68%
Lack of teacher training in computing	14	56%
Lack of appropriate computer support materials	6	24%
Lack of technical support	5	20%
Lack of time to plan and use computers	4	16%
Others	1	4%

On the basis of the data gathered in this study, it can be argued that the integration and use of computers effectively in secondary schools in Nyanza Province require availability of computers, funds, training of teachers, and supply of adequate computer equipment. Opie and Katsu (2000:79) also reported similar findings from developed countries. But when Heads of Department were asked to "Outline the factors inhibiting the use of computers by the teachers in your department" their responses were as indicated in Table 6.71.

Table 6.71: HODS response to factors affecting integration and use of computers

Responses	Frequency	Percentages
Lack of adequate computers	65	73%
Lack of training	63	71%
Lack of computer support materials	33	38%
Lack of time	23	26%
Lack of software packages	20	22%
Lack of interest	18	20%

The finding displayed in Table 6.71 suggests that successful utilization of computer-integrated education is more likely to take place if computers are available and teachers are trained. This means that full integration of computers into the education system is a

distant goal in many schools unless the identified barriers are eliminated. Crawford (2000:190) also noted that very few teachers in United Kingdom have been specifically trained to teach with computers so it was not surprising to find the same situation in the present study. Therefore, knowledge of integration and use of computers needs to be a priority in teacher education programmes. This can be provided through pre-service training for teacher education students, and in-service training or through school bases re-training programmes for serving teachers.

6.9.1 Steps taken by participants to solve the problems

Consequently, in light of the answers in Table 6.72, the Principals were asked an open-ended question "What steps have you taken to solve the problems?" This question was asked because the Principal is expected by the teachers to be the provider of school computer equipment, and demonstrate computer leadership through good planning to assist them to integrate and use computers effectively. The findings were summarized and presented as follows in Table 6.72

Table 6.72: Steps taken by Principals to solve the factors affecting the use of CIE

Responses		Frequency %
Bought computers and software	6	24%
Appeal for any donations of computers	5	20%
Trained a teacher to maintain the computers	4	16%
Inform parents of the importance of CIE for their children	4	16%
Organize fund raising for computer education	4	16%
Take the computers to the technician for servicing	2	8%

The above data can be interpreted to mean that Principals had devised some leadership vision and ability to manage both human and physical resources for the integration of computers in schools. A study by Yee (2000:192) reports similar findings and noted that computer leadership characteristics and practices demonstrated by the Principals also resonated with transformational leadership factors such as charisma, inspiration, individualized consideration, and intellectual simulation.

However, the Heads of Department were more specific when they were asked a similar question regarding the steps they have taken to solve some of the problems they encounter with use of computers. Table 6.73 displays their responses.

Table 6.73: Steps taken by HODs to solve problems of CIE in their departments

Responses	Frequency	%
Purchased computer support materials for teachers	25	28%
Encouraged teachers to train in computer literacy	20	22%
Discussed the issue of computing with the Principal	11	12%
Still budgeting for computer materials for teachers and students	10	11%
The department has acquired one computer for the teachers to use	5	6%
Organized the timeTable for computer studies	4	5%
Started introductory courses on computer literacy	4	5%
Requested the school to purchase computers for my department	2	2%

However, 8 (9%) Heads of Department reported that they had done nothing to assist in the introduction of computers in their departments. The others cited lack of time to promote computer literacy among the staff in their departments, and there were also those who expressed lack of concern from the administration so they were not motivated to introduce computer education. While the responses of these HODs reflect their position, resistance to change or negative attitudes towards computer technology might have prevented them from taking the necessary steps towards the integration and use of computers.

6.9.2 Suitable facilities for the use of computer in schools

The next question covered in this section was concerned with information on the conditions of the facilities for the use of computers. Inadequate physical facilities like classrooms, centers for special subjects like computers, electricity, tables and chairs are some of problems faced by schools in developing countries. The Principals were therefore asked to rate the available facilities by ticking either poor, average, and above average. Table 6.74 shows the findings.

Table 6. 74: Facilities for the use of computers in the study schools

Rating	Frequency	Percentages
Poor	9	36%
Average	14	56%
Above average	2	8%
Total	25	100%

Table 6.74 indicates that the majority of the Principals reported that they had average facilities for the use of computers in their schools. But some of them had poor facilities and only a few of them reported having very good facilities for computer education. However, the absence of suitable facilities like computer rooms creates a problem to the implementation of computer-integrated education in schools.

6.9.3 Technical support for effective use of computers in schools

The issue of technical support was another area of investigation. This was in relation to studies by Carol (1997) and Veen (1996) and reviewed in Chapter 3 Section 3.6 indicating that technical assistance was important for teachers, especially the use of software, and in troubleshooting with computers. Therefore, the Principals were also asked a closed question "Do you have a technician who can assist teachers with operation and maintenance of computers?" The findings were summarized and presented in Table 6.75

Table 6.75: Availability of a technician in school to assist teachers to use computers

Responses	Frequency	Percentage
Yes	11	44%
No	14	56%
Total	25	100%

As can be seen from the above Table 6.75 fewer than half of Principals had employed the services of a technician. The presence of a technician in schools in Nyanza Province would be very useful in encouraging teachers to use computers in teaching and learning. Teachers need support to build up confidence when using computers. Williams, Coles,

Richardson, Wilson and Tusion (2000:175) study in Britain found that teachers were held back from using computers due to lack of technical skills and confidence. As such there is need to have a technician to assist teachers and students. However, the Principals who had employed technicians were asked another question "If you have a technician, to what extent are they able to maintain the equipment?" The responses to this question were analyzed and presented in Table 6.76

Table 6.76:Rating of the services of technician in study schools

Rating	Principals	Percentages
Very good	7	64%
Good	2	18%
Fair	2	18%
Not good	0	0%
Total	11	100%

According to the responses in Table 6.76, most of the eleven Principals who reported having a technician indicated that their services were good. So the Principals who had no technicians were also asked an open-ended question " If you do not have a technician, who provides technical services to your school?" They reported that they take the computers to the technicians for servicing when there is need, hire computer firms to provide technical services or use the computer teacher. However, they were not happy to use outside technical services. They reported that they would rather employ technicians because they need technical support in hardware and software operations and maintenance, expert advice on the packages for integration into teaching and learning subjects, and to train teachers in simple technical work in order to use computers effectively.

In addition, Heads of Department were asked a similar question "Whom do you think should provide technical services to your department?" The most common responses provided by Heads of Department were summarized and presented in Table 6.77

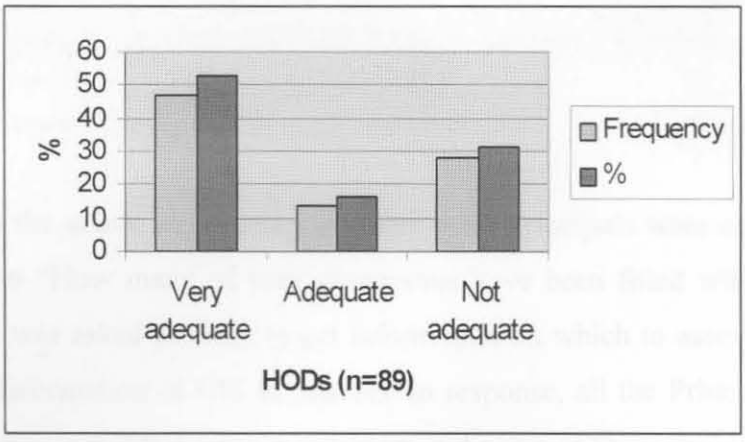
Table 6.77: Responses from HODs on computer technical services in their schools

Responses	Frequency	%
A qualified technician	16	17%
A computer analyst	12	14%
A computer expert	10	11%
Ministry of Education personnel	6	7%
A curriculum specialist	5	6%
The school administration personnel	4	5%

The Heads of Department argued that these people are trained in proper use of computers, have the experience, knowledge of the skills of hardware parts and the software, and are able to provide necessary advice on curriculum integration. Some of the Heads of Department felt that the Ministry of Education should provide technical services because computer literacy training falls under the Ministry of Education. Still others reported it should be the responsibility of the school administration arguing that the school has the funds to finance such projects.

Heads of Department were asked to state what facilities are available for teachers to use computers in teaching and learning. This question was asked to elicit more information in relation to a literature review in Chapter 3 Section 3.2.3. The answers obtained included availability of electricity, computers, software package, and diskettes, computer syllabus, computer room, and printers. This meant that teachers in these schools were able to integrate and use computers in teaching and learning. But the HODs were also asked another closed question with multiple response answers "What is the condition of these facilities for effective utilization of computers?" Figure 6.7 displays their responses.

Figure 6.7 Rating of facilities for using computers by departments



The majority of Heads of Department 47 of 89 (53%) were very satisfied with the conditions of facilities provided for the effective use of computers. But 14 of 89 (16%) of them reported that the facilities were not adequate, while 28 of 89 (31%) said the conditions of the facilities were not good. Arising from the responses on technical and physical problems, the Principals were asked another open-ended question "What measures would you recommend that will ensure that computers remain in constant functioning and usable state in your school?" Their answers were analyzed and included in Table 6.78

Table 6.78: Principals recommendation of how to keep computers in good condition

Responses	Frequency	%
Provide maintenance and proper care of computer from experts	12	48%
Students must handle the machines with care when they use them	6	24%
Employ a technician to attend to any technical problems	5	20%
Train some teachers in technical skills to take care of the machines	2	8%

It is clear from the above responses that teachers in Kenya also need technical support in order to use computers in teaching and learning. Sandholtz (2001:364) reporting from America noted continuous technical problems with the use of computers because many teachers lacked troubleshooting skills, and few had access to manuals that might help them to solve their computing problems. These problems could be expected to be worse in developing countries such as Kenya.

6.9.4 Number of classrooms in schools that participated in the investigation

The use of computers has the potential for transforming traditional teacher-centered classrooms into student-centered classrooms, and collaborative classrooms where the teachers' role would be that of a facilitator or a guide as discussed in Chapter 2. Therefore, Principals were asked how many classrooms are in their schools. This question was asked to obtain information regarding how CIE would be effectively implemented into classroom instruction. The findings indicated that responses to these two questions are shown in Table 6.79

Table 6.79:Number of classrooms available for implementation of CIE in schools

Classrooms	Frequency	Percentages
From 4-8	7	28%
From 9-12	5	20%
From 13-14	5	20%
From 15-16	4	16%
From 20-26	4	16%
Schools	25	100%

In addition to the above information in Table 6.79, Principals were asked another open-ended question "How many of your classrooms have been fitted with a power point?" This question was asked in order to get information on which to assess the possibility of effective implementation of CIE in schools. In response, all the Principals indicated that their classrooms were fitted with power point, but some of them could not use computers in the classroom or computer center because there was no electricity.

Availability of facilities for the use of computers is one of the factors that encourage teachers to use computers reviewed in Chapter 3 Section 3.6, but it might not guarantee that teachers would use computer in teaching and learning. A report by Albion (2001:321-2) indicated that in the USA up to (40%) of the teachers in the survey had never used a computer for schools work. The same in Australia, the research findings indicated that (40%) of the teachers interviewed were not using computers for classroom work, and even in Britain, only (34%) of secondary teachers used computers for classroom teaching

regularly despite availability of suitable facilities and increased number of computers in schools. A further investigation would be desirable to provide more information about why some teachers do not use computers and any other media apart from their notes in classroom teaching.

Nevertheless, in another investigation Principals were asked another open-ended question in the form of a statement "Computers require rooms with enough ventilators, free from dust and humidity, what arrangement have you made for the care of your computers?" All of them reported having a separate computer room, with suitable conditions for computers and a few of them reported having bought floor carpets, window netting and covers to protect the computers from dust.

6.9.5 Availability of electricity in schools that participated in the investigation

Availability of electricity in the school was another issue to be investigated because it was felt to be one of the major factors that could encourage the use of computers in many schools. Although the Principals indicated in question 9 that all their classrooms were fitted with power points, this did not imply that there was electricity in the schools for using computers. So the Principals were asked a closed question "Does your school have electricity?" The findings indicated that the majority 88% of the Principals reported having electricity in their schools and only 12% of them had no electricity. The schools that reported having no electricity used generators for lighting.

Besides investigating the availability of physical facilities for the use of computers in this section, Principals were asked a closed question " Is there a computer network linkage in the computer center?" This question was asked to elicit information of schools with e-mail and Internet services. The results indicated that most of the schools (92%) did not have computer networking. Only 8% of the schools had computer networking, and reported that the computers in the computer center were not connected to a network. So they did not have e-mail and Internet facilities, although they were in the process of installing the required facilities to enable them to access the Internet and use e-mail in the school.

6.10 Principals views and attitudes about the value of computers in education

According to Higgins and Moseley (2001:191) the beliefs that individuals hold are closely linked with the decisions and choices that they make. The same applies here when the Principals were asked a closed question "Please express your overall views about computers education programme in teaching and learning in your school?" This question was asked because Principals of schools are catalysts, initiators and facilitators of change in curriculum innovation and the views about computers is an important factor in the effective utilization of computers in teaching and learning. They play an important role in deciding whether to adopt a particular innovation, and can be equally powerful at blocking changes they do not like. Table 6.80 displays the overall response.

Table 6.80: Principals' views about the value of computers in their schools

Ratings	Principals	Percentages
Excellent	9	36%
Good	6	24%
Fair	7	28%
Poor	3	12%
Total	25	100%

The above Table 6.80 shows that 60% of the Principals were positive about the value of computer education in their schools. But 28% of them said it was fair while 12% rated computer education in their schools poor. This means that despite the challenges faced by the Principals who participated in the investigation most of them were committed to implement CIE in their schools.

6.10.1 Heads of Department attitudes towards CIE in their schools

In addition to the above responses from the Principals, Heads of Department were also asked a similar question "What is your attitude towards the integration and use of computers in teaching and learning?" Their replies were summarized and displayed in Table 6.81

Table 6.81: Attitudes of HODs towards the integration and use of computers in teaching and learning

Responses	Frequency	Percentages
Very positive	54	61%
Positive	22	24%
Negative	1	1%
Not sure	12	14%
Total	89	100%

From the above Table 6.81 it can be seen that the majority of Heads of Department (85%) who responded to the question had a positive attitude about the integration and use of computers in teaching and learning in their departments. Only one percent of them expressed negative attitude but a few of them were not sure of about it.

6.10.2 HODs comments on disadvantages of the use of computers in education

Although the use of computers in teaching and learning has been reported to be very valuable and has several benefits to offer to students, some Heads of Department indicated various limitations of its use in teaching and leaning. The data obtained from the Heads of Department were summarized and displayed in Table 6.82

Table 6.82: Disadvantages of computers in teaching and learning

Responses	Frequency	%
Computer could create unemployment for teachers	15	17%
Computer could not be accessible to all students in Kenya due to high cost	12	13%
Computer does not help students with speaking skills like radio or television	10	11%
Computer needs a lot of time that is scarce to work with	7	8%
It lacks students/teacher relationships/interactions compared to the teacher	6	7%
The computer language is abstract	4	5%
During class work, students might not get time to ask the teacher question	4	5%
Too much interest in computer could lead to neglect of other subjects	4	5%
Over-reliance on computer use could impair mental activity of students	2	2%
It could easily break down, prone to theft, and needs special rooms	2	2%
There is danger of destroying students' eyesight	2	2%

The above findings reinforces the need for the services of a technician to be present in the school as indicated in the Chapter 3 Section 3.9, and the need for a teacher to be a guide

and facilitator during computer lessons. The other important finding from this question was the HODs comment on that "the use of computers could create unemployment to teachers." This comment might have been made out of fear of computer technology. Since most of them have not been trained in the use of computers they could also feel threatened and uncomfortable to interact with the new technology in teaching and learning.

6.10.3 Views about the use of computers to introduce new ideas to teaching and learning

The last question in this section was deigned to examine the views of Heads of Department regarding the potential of computer to programs introduce new ideas to teaching and learning. Some of them were quite positive that computers can introduce new ideas and expressed strong views as indicated in Table 6.83

Table 6.83: HODs views about computer introducing new ideas to teaching and learning

Responses	Frequency	%
Computers enables a lot of work to be covered within a short time	16	17%
Students do effectively and efficiently acquire skills and present information	14	16%
It makes teaching more effective, and promotes quality education	13	14%
Improves students' curiosity, creativity, and language development	12	13%
Provide new knowledge on various subjects and scientific discovery	11	12%
Students access variety of resources to improve on traditional subjects	10	11%
Provides current information, sharing of ideas through Internet and e-mail	7	8%

However, there were other participants who expressed opposing views and argued that computers are good for generating new ideas but should not be used with the view of replacing the teachers, because the teacher is the most important person in teaching and learning since computers only facilitate already established ideas.

6.11 Suggestions for further improvements of CIE in schools

There were several suggestions and recommendations put forward by the participants for the effective integration and use of computers in teaching and learning some of which were as follows:

- All the Principals should have some degree of computer literacy skills to be able to appreciate the benefits of CIE.
- The Government should introduce and make Computer Studies a compulsory subject for all students in secondary schools;
- The Government should employ computer teachers in secondary schools;
- The Ministry of Education should assist schools to obtain computers cheaply, and computer purchased for school use should not be taxed;
- There is urgent need for curriculum developers to design and develop computer-integrated curriculum for secondary schools in Kenya, and all computer support should be available and affordable;
- Proper retraining of serving teachers in the integration and use of computers in subjects areas should be undertaken by the Government immediately;
- Provide intensive training of all pre-service teachers in the integration and use of computers in teaching and learning before they proceed to schools to ensure learning takes place amongst all students;
- Encourage the school community to be computer literate.
- Schools should have enough computers for students
- All teachers should have a positive attitude towards computers and interest in becoming computer literate;
- Secondary schools should put up suitable computer rooms large enough for a class of fifty students

6.12 Summary

The main purpose of this study was to investigate the role played by the Principals and Heads of Department in the introduction of computers in their schools. This included examining availability of the school computer policy; availability of computers, software and support materials; problems and physical facilities; implementation of computer integrated education and barriers to the use of computers in teaching and learning. The research findings indicated that the role of the principal and the particular pattern of leadership adopted within the school were very important in the introduction and use of computers in their schools. Yee (2000) noted that the Principal's computer leadership role

includes that of a provider of computers, to enable teachers and students to access and use computers; and that of a keeper of computer vision and to support the staff towards that vision. It was found that most of the Principals (76%) had formulated a school policy to ensure and enforce effective implementation of computer-integrated education in their schools. Some Heads of Department also reported having a departmental policy for the use of computers, and created a workable environment within which teachers could integrate and use computers in teaching departmental subjects.

The study established also that computers were available in 25 public secondary schools according to the list obtained from the Provincial Director of Education in Nyanza Province, and teachers had access to computers and support materials. The majority of Principals confirmed that computers were used to teach computer literacy skills. However, in some schools computers were used for administrative tasks instead of using them as an integral part of the school learning process. Although the study revealed that schools have indeed progressed in the use of computers, the other findings documented many barriers to effective use of computer-integrated education. Lack of enough computers and support materials, lack of time for planning, lack of trained staff, access to computers, physical facilities and technical support were all reported as major impediments to computer integration. Although some of the Principals reported having some funds for the purchase of computers and support materials they all claimed the funds were not adequate.

Furthermore, the present findings indicated a general positive impact of computer-integrated education on students' learning. It was found that in some schools teachers used computer-integrated education in teaching and learning some of traditional subjects. Both the Principals and Heads of Department supported the use of CIE and regarded computer education as very valuable to students and the teachers because computer applications such as word processors, spreadsheet, database and programming that students learn play a useful part in their future lives. Norum et al. (1999) reported that administrators have a critical role in computer integration and the resulting changes in curriculum practices. The Principals' support or lack of support for computer-integrated

education can be a powerful tool to encourage or discourage the use of computers in their schools. The use of computers will soon be an integral part of teaching and learning in most of the public secondary schools investigated. The researcher observed that these mixed results of the use of computers to teach computer studies and to integrate it into subjects confirms what researchers (Bitner and Bitner, 2002; Cooley, 2001; Nisan-Nelson 2001), reported that integrating computers entails a systemic change. Systemic change refers to a total system change that involves staff in the schools from teachers to Principals, teaching process, practices, policies, and philosophy of the school that would be felt gradually over a period of time. Therefore, much work remains to be done to realize the integration and use of computers so that the potential advantages can be achieved.

While the Principals and Heads of Department were positive about the integration and use of computers into teaching, research findings indicated that most of them were not adequately trained in the use of computers. Yee (2000) reported the need for Principals to have some degree of skills with computers. This was considered to be useful because if the Principals are not trained in the use of computer they will not have an understanding of the benefits of the computers as a tool for classroom instruction. They will also not have any vision of how computers can add value to students' learning in their schools. The present study found that 48% Principals and 47 53% HODs had very limited computing skills. While 52% Principals and 47% HODs were not trained and did not understand the benefits of computers in teaching and learning hence the fear expressed by 17% that the use of computers would cause unemployment of teachers.

Finally, apart from the factors that influence computer integrated education in schools, it has been established that effective CIE implementation in schools also needs positive attitudes of the Principals regarding the values and benefits of computers in teaching and learning. Hence the school environment, political climate, social and economic factors determine the implementation of computers in schools. It was found that most of the Principals expressed positive views and attitudes towards computer integrated education in their schools. Therefore, it would be useful to provide more training for Principals and

Heads of Department so that they can become more competent computer leaders in order to increase integration of computers in teaching and learning. However, it is hoped that the research findings discussed in this chapter will contribute in some measure, to the effective implementation of the government policy on computers in secondary schools in Nyanza Province. The issues dealt with here will again be reflected in the final chapter of the report. In the next chapter the researcher describes in some detail the results of the semi-structured interviews with computer teachers on how they (teachers) integrate and use computers in teaching and learning.

CHAPTER 7

THE USE OF COMPUTERS TO TEACH COMPUTER EDUCATION INTERVIEWS WITH COMPUTER TEACHERS

7.1 Introduction

The main purpose of this chapter is to provide evidence on how teachers use computers in teaching and learning. It presents information collected from secondary schools in which computers are used to teach computer literacy skills. The data were obtained using semi-structured interviews with computer teachers. The sample consisted of twenty classroom teachers in Nyanza Province, Kenya. The data analysis combines qualitative and quantitative methods. Qualitative data analysis has been used for the interpretation of documents, discussions and interviews. The quantitative data analysis has been based on simple tabulation and graphical presentation (where possible) of teachers' responses to different issues. Qualitative analysis has also been employed because it enables more detailed views of the topic to be presented (Neuman, 1999; Yin, 1994).

The first part of the chapter addresses the participants' biographical information. This is followed by findings on the use of computers in teaching and learning. It includes the software used, why and how computers are employed in teaching students, and planning for teaching and learning with computers. The chapter then examines the integration and use of computers into teaching and learning traditional subjects. Particular attention is paid to patterns of use; teachers' knowledge of the computer technology; how students learn with computers; time allocated; value of using computers; the impact of computer technology; and the role of computers in the school. Problems and difficulties with the use of computers are also discussed. The last section deals with factors affecting the use of computers; teachers' views and attitudes towards the computer technology; teacher training in the use of computers; selection of software; suggestions for future improvement; and lastly, a summary of the main points.

7.2 Background information about teachers who participated in the investigation

As reported in Chapter 4 Section 4.6.1, the original plan for this study was to interview computer teachers in 30 schools with computers out of a total of 524 secondary schools according to the list of schools I received from the Provincial Director of Education (PDE) in Nyanza Province. However, after visiting each of the 30 public secondary schools, the researcher found only 20 of them teaching computer education and each school had only one computer teacher at the time of this research. Therefore, these 20 teachers were used as the source of data for this part of the study. The twenty interviews were tape-recorded and the recordings then transcribed. Employing unscheduled probes during the interviews as noted by Bell (1993), Yin (1994), Newman (1999), analysis of data began as data were first collected and continued throughout the study. The demographic data obtained from the participants were analyzed and are presented in the following sections.

7.2.1 Characteristics of schools from which the interviews were conducted

The field research was carried out in three different school settings. The fieldwork took place during the third term of 2001. Table 7.1 shows the type of schools by areas as described by the researcher.

Table 7.1:Types of secondary schools by location in which the interviews were conducted

School Type	Rural Area	Urban Area	Suburban	Total	%
Girls Schools	6	1	1	8	40%
Boys Schools	7	2	2	11	55%
Mixed School	1	0	0	1	5%
Total	14	3	3	20	100%

Table 7.1, displays the number of schools in which I conducted semi-structured interviews with computer teachers. All of the schools that participated in the investigation

were public institutions, sponsored by the parents and the government. However, there was one mixed secondary school catering for the students from the surrounding village and one urban Boys day school. There was no Girls day school. A comparison of study institutions indicated no difference in the number of girls and boys schools with computer teachers.

The respondents were 20 secondary school teachers teaching computer education in schools that had computers. The other five schools indicated in Chapter 6 Section 6.2 used computers for administrative work only and did not have computer teachers. For example, one of the Girls secondary school in a rural area had 31 teachers but only one of them was a computer teacher. However, the data collected indicated that 14 of 20 (70%) computer teachers were from rural schools, while 3 (15% were from urban and another 3 of 20 (15%) were from suburban schools. The majority of computer teachers 17 were male and 3 were female. Only 1 of female teachers were from urban area compared to 10% of females from rural area. There was no female respondent from a suburban area. Similarly, 12 of male respondents were from rural area, and 2 were from an urban area. Suburban schools had 3 of the male respondents. From my experience, the gender and area distribution of the participants in this study is typical of secondary schools in Nyanza Province. There are very few urban centers so most of the public secondary schools are in rural areas.

7.2.2. Age and gender distribution of computer teachers

All of the teachers who took part in the interview were asked to state their age range. It was felt that age might be important in explaining or influencing teachers' interest in the use of computers. In Table 7.2 the total number of participants according to age and gender is displayed.

Table 7. 2: Age (Years) and gender distribution of the interviewees

Years	Teachers	Male	Female	Total	%
20-30	9	7	2	9	45%
31-40	10	10	0	10	50%
41-50	1	0	1	1	5%
Total	20	17	3	20	100%

Table 7.2 shows that of the 20 teachers who were interviewed, the majority (50%) was between 31-40 years. In the age bracket 41-50 there was only one female teacher. From my experience in Kenya, most female teachers do not stay long in service due to family commitments so they tend to retire early. The Principal of one school in the study reported that two of the women teachers who were usually very keen to teach computer education were on maternity leave. Table 7.2 shows also that overall there were more male participants than female. Out of 20 interviewees, seventeen (85%) were male and three (15%) were female. However, the issue of gender differences (especially few female teachers) reported in this section was a subject of detailed analysis in Chapter 6. For example, one of the girls' schools reported having 8 female teachers and 16 male teachers and another boys school had 30 female and 70 male teachers. Gender disparities in the teaching profession could be attributed to girl-child school drop out in Kenya that results in insufficient female students joining teacher-training institutions in Kenya. The Principals also reported gender disparity among the teachers in the schools investigated as noted in Chapter 6 Section 6.3 Table 6.5.

7.2.3 Academic qualification of teachers who took part in the investigation

Academic qualifications were part of the background information sought from the respondents. This was important because the teachers' ability to integrate computers into the subjects they teach is probably influenced by their level of education and teacher training as well as their training in the use of computers. The interviewees were asked about the highest academic/professional qualification they had. The result indicated that the majority of teachers 17 of 20 (85%) had attained university education but three

teachers had a diploma that is also a qualification accepted for joining teaching at secondary level. There was only one teacher with a Masters degree. None of the interviewees had a PhD degree.

Among teachers who participated in the interviews 13 were trained teachers, had teaching certificates and had a Diploma certificate in computer literacy. Out of the 13 trained teachers, 10 had Bachelor of Education (BEd) degree teaching certificate but 7of them had a Diploma teaching certificate. The BEd graduates are trained to teach in secondary schools and teacher training colleges. The Diploma teachers are trained to teach specific subjects such as mathematics, sciences and languages at secondary school level. This is the second grade awarded to those who train to teach in secondary schools. There were also seven untrained graduate teachers who had B.A and BSc degrees. The untrained graduate teachers were employed to teach subjects such as Mathematics and Science in some of the schools that experienced a serious shortage of trained teachers in those subjects. These teachers also had a diploma qualification in computer technology and were employed to teach computer education as well.

7.2.4 Number of students taught by computer teachers

The participants were asked to state the number of students they teach per class. This was important information because of the facilities available for teaching and learning with computers. Table 7.3 gives a summary of this.

Table 7.3: Total number of students in computer classes

Level	Total Number of students	Average per class
Form 1	950	48
Form 11	616	31
Form 111	470	24
Form 1V	420	21
Total	2,456	31

As can be seen from Table 7.3, in Form 1 a total of 950 students (ages between 13-15 years) were taught by 20 teachers which means that an average of 48 students were taught by each computer teacher, while Form II had the second highest number of student 616 (ages 15-16 years). The reason being that in 14 of 20 institutions that were investigated computer education was compulsory for all students in these two forms. However, in Form III, the subject was an elective and offered only to those students who chose to proceed with it to Form IV. At Form Four level the number decreases because it is offered to those registered for the national examination. This is due to the fact that computer education is classified as a Technical and Applied subject and students are free to decide on which subjects in the group to register for in the Kenya Certificate of Secondary Education (KCSE).

In addition, the interviewees were asked to indicate the classes in which they currently teach computer education. Table 7.4 displays the findings.

Table 7.4 Computer classes taught by the interviewees in study schools

Classes	Female teachers	Male teachers	Total	%
Form 1 only	0	2	2	10%
Form 1-2	1	1	2	10%
Form 1,2,3	0	3	3	15%
Form 1&3	0	4	4	20%
Form 3 only	1	2	3	15%
Form 4 only	1	0	1	5%
Form 1-4	0	5	5	25%
Total	3	17	20	100%

As table 7.4 shows, 5 of 20 (25%) participants taught computer education in all Forms. The other teachers taught computer education in one, two or three Forms. However, there was one teacher who taught computer in form four only. In addition to teaching Computer Education, the teachers also taught other subjects such as indicated in the following Table 7.5.

Table 7.5: Other subjects taught by computer teachers in study schools

Subjects	Number of Teachers	Percentages
Mathematics/Science	11	55%
English/Literature	5	25%
Accounting/Business/Geography	4	20%
Total	20	100%

From the above Table 7.5 it can be seen that most of the computer teachers were mathematics and science teachers. The finding also supports the information contained in Section 7.2.3 regarding the untrained graduate mathematics and science teachers.

7.2.5 Teachers' years of teaching experience

Experience on the job can help teachers to relate to new situations, to solve classroom problems (such as students' discipline during computer classes) and to help them find practical approaches to learning. Experience enables the teacher to draw upon professional insights and skills, which includes sensitivity to the specific interest, needs and abilities of the students. Therefore, interviewees were asked to indicate their experience in teaching. This was important information because lack of experience in teaching normally interferes with teachers' confidence and professional competency. This happens mostly when a newly appointed teacher is assigned to teach the subjects they are not particularly conversant enough to teach. Table 7.6 demonstrates the position of teachers in relation to the years of service in teaching.

Table 7.6: Teachers' Experience in teaching and classes taught

No of Years	Rural	Urban	Suburban	Total
0-1	2	0	1	3
2-5	5	1	1	7
6-10	5	1	0	6
11-20	2	1	1	4
Total	14	3	3	20

The above analysis displays the participants' years of teaching experience by location. When looking at the distribution of participants' length of service from rural, urban and suburban schools, the finding indicates that there were more rural teachers than urban or suburban teacher but proportionally the urban teachers were the most experienced. Under the number of years >10 there were 33% urban teachers with experience and only14% of rural teachers in this category, while there were 66% of urban teachers with >5 years of experience compared to only 50% in this category. From my experience, in general, the years of service of teachers in the teaching profession in Kenya range from thirty to thirty five years. However, the difference in experiences of teachers according to location in Nyanza province could be due to frequent transfer of teachers to other regions. The small number of years of service of most teachers could be due to teachers leaving the profession to join other jobs for better payment.

7.2.6 Teachers' length of service in teaching and learning with computers

Teachers in the study were asked to indicate their experience in the use of computers in teaching and learning. This was regarded as essential because the issue of teachers' ability to handle computer education was a vital factor in the implementation and use of computers in teaching and learning that was reported by (Njagi, 1997:25). Table 7.7 displays the finding as reported by the participants.

Table 7.7: Teachers years of experience with computers by location of schools

No of years	Rural	Urban	Suburban	Total
0-1	6	0	1	7
2-5	4	1	1	6
6-10	4	2	1	7
Total	14	3	3	20

Prior computing experience reported by the 20 teachers who participated in the investigation varied as shown in Table 7.7. 35% of the teachers had less than one year experience in teaching with computers, while 30% had between 2-5 years and 35% had

less than ten years experience with the use of computers. There was no teacher with more than seven years experience in teaching computer education. This is due to the fact that the government policy guideline discussed in Chapter 5 was formulated in 1996 and some schools introduced computer education in the same year. This is also in contrast with teachers in developed countries like America and Britain where most of the teachers have many years of experience with use of computers in teaching and learning (Kirkman, 2000; Rudd, 2001; Russell, 2000).

7.2.7 Participants' rating of experience with computers in teaching and learning

Teachers who took part in the interview were asked to rate their experience with use of computers in teaching and learning by providing answers to closed questions on their experience with computers. Table 7.8 shows their responses.

Table 7.8: Teachers' rating of experience with use of computers

Rating	Rural teachers	Urban teachers	Suburban teachers	%
Some experience	8	1	2	55%
A lot of experience	6	2	1	45%
Total	14	3	3	100%

From the above Table 7.8 it can be seen that there was no computer teacher without the knowledge of computer skills, although (45%) of them had a lot of experience with the use of computers than the rest of them. Abas (1995) and Vannatta and Beyerbach (2000) report similar findings from developed and developing countries as discussed in Chapter 2.

7.2.8 Types of software packages used by the computer teachers in schools

Another important area of investigation was the availability of computer software in schools and the types of software that teachers used in teaching computer education. This question was asked because it was necessary to get information about what the schools

have in order to compare this with the kinds of software suggested in the computer syllabus. The responses from the interviewees are shown in Table 7.9

Table 7.9: Types of software packages used by teachers in study schools

Software	Number of teachers	Percentage
MS office packages	20	100%
Lotus 1,2,3,	4	20%
MS Dos	4	20%
Publisher	3	15%
Accounting	2	10%
Other packages	7	35%

From the above Table 7.9, it is clear that all the interviewees reported using Microsoft office packages for teaching and learning. In addition, other packages such as Page Maker, Pascal, Print Artist, Keyboard Skills, Note Pad etc, were mentioned by seven of 20 (35%) participants as being used in their schools. These programs were considered by the teachers to be important to the school because the whole school used them for information storage and retrieval of staff records, salary preparation, students' registration records and examinations results analysis. Teachers also used the programs in teaching specific skills such as word processing and in improving the teaching of accounts and commerce subjects. The software packages named by the teachers were the same as those in the Secondary Computer Syllabus except for Page Maker and Print Artist. Similar computer application programs are contained in Draft National Curriculum Statement Computing (2002) from the Department of Education used by teachers in South Africa to teach students (Grades 10-12) Information Technology, that include also Desktop publishing, Web-page, e-mail and Internet.

7.2.9 The role of computers in the school that participated in the investigation

Teachers were asked to state clearly what they considered to be the major role of computers in their school. This question was asked because teachers' views about the

major role of computers in schools were regarded as having a big influence on their attitude towards using computers. A summary of the responses from the participants is displayed in Table 7.10.

Table 7.10: The role of computers in schools that participated in the investigation

Responses	Participants	%
Educating students, teachers and community	4	20%
Teaching students computing skills	10	50%
Administrative duties, storing students marks	4	20%
Improve teaching of other subjects	2	10%
Total	20	100%

Most of the teachers believed that the major role of computers was in teaching students computer literacy skills (as suggested in the syllabus). Some of them saw the role of computers as that of creating computer awareness among the school population and the community. However a group of them also noted the role of computers as that of administration, office work, used for correspondences, storing of information, setting of examinations, recording students marks and records. A few teachers reported that computers also improve the teaching of curriculum subjects by providing reference materials and remedial work.

7.3 Teachers report on the use of computers in teaching and learning in the class

The main purpose of this investigation using semi-structured interview was to provide evidence regarding the use of computers in teaching and leaning in schools in Nyanza Province, and to identify the extent to which computer programs were actually being used in the classrooms. Therefore, in interviews with computer teachers, the participants were asked to provide information about whether they used computers in teaching and learning in the classroom, and who encouraged them to teach Computer Education? In response to the first question, all the interviewees reported that they were using computers in teaching and learning in their schools. However, in response to the second question about who encouraged them to teach computer subject their reply were as indicated in Table 7.10.

Table 7.11: Response from teachers regarding being encouraged to teach computer Education

Ratings	Frequency	Percentages
Highly encouraged	14	50%
Partly encouraged	4	30%
Not encouraged	2	10%
Total	20	100%

From Table 7.11 it can be seen that the majority of the interviewees (60%) were encouraged by the Principals to teach computer education (as in the official computer syllabus). The findings were very encouraging because a study by Yee (2000:287-301) revealed that teachers need support from the administration in order to use computers effectively. However, 30% of the interviewees indicated that they received partial support from the Principal and were motivated to use computers. But 10% of them said they were not encouraged by the school administration to teach computers. They argued that it was their own interest that led them to teach the subject. The overall findings showed that all the teachers used computers to teach computer education and to store and analyze students' marks. Furthermore, during the discussion with the interviewees, none of them indicated that they were encouraged to use computers as part of teaching other subjects. Some of the teachers who integrated their subject topics into computer programs reported that they did so on their own and were adventurous. They also indicated that through interactions with other teachers from other schools in Kenya they were informed of the availability of computer software for various subjects which some of them obtained for integrating into subjects like science and mathematics. There is need for all teachers to be encouraged and supported by the administration in order to integrate and use computers in teaching and learning.

7.3.1 Why teachers use computers in teaching and learning

Similarly, the interviewees were asked to explain why they use computers in teaching and learning? This question was a very useful one, because teachers need to have a specific

reason for using computers as a tool for teaching and learning. The question yielded a wide variety of answers that are summarized and presented in Table 7.12

Table 7.12: Why do you use computers in teaching and learning?

Summary Points
To teach computer literacy skills: word processing, spreadsheet, database management, programming etc.
Preparing learning materials such as teachers' lesson notes, students' handouts, and examination materials.
Learning, especially from the Internet educational materials on subjects like Biology, Mathematics, and History etc.
To improve the quality of teaching and learning by using the materials not easily available to the teacher.
To prepare students for major economic and social challenges likely to be met after schooling.
To teach students computer science-hardware and software.
To process students results, eg. Ranking of students, assigning grades, analysis of performance index for class and overall performance index.
Computers have high storage and retrieval capacity, it is faster, accurate, convenience, not bulky compared to traditional way of filing so students learn to keep their work in an organized manner.
To motivate students to learn on their own the subjects available in computer programs and to relate such knowledge to curriculum subjects.

In addition, the participants reported that computers are very useful in helping students to master statistics that is covered in mathematics. One of the interviewees reported that *"once they (students) have done statistics in mathematics lesson, they come and process the same information in the computer."* Another one said, it is very useful in teaching English language, especially in *"spelling checking and grammar."* In teaching accounting, the interviewees noted that *"spreadsheets are the same ones used in solving mathematical skills"* Lastly, some participants reported that they used computers for supplementary work outside the curriculum area. Table 7.12 displays the analysis of their responses.

Table 7.13: Teachers' use of computers in teaching and learning

Pattern of use	Teachers	%
Teaching computer literacy skills: word processing, spreadsheet, database, graphic, programming etc.	20	100%
Teaching traditional subjects: Mathematics, Sciences, Languages, Technical etc.	8	40%
Getting new ideas for curriculum subjects like statistics, languages etc.	4	20%
Motivating students to learn on their own.	2	10%
Keeping school records: students examination marks and grade analysis	2	10%
Improving learners' communication skills	4	20%

Table 7.13 shows that all the participants used computers to teach the skills contained in the Secondary Computer Syllabus. However, in other learning areas, the analysis indicated that many teachers used computers for teaching and learning traditional subjects like mathematics and sciences. This finding supported a similar study by Azita (1999) on the use of computers to teach mathematics reported in Chapter 2. However, other teachers also reported using computers for getting new ideas in subject areas not easily available in their textbooks. At the same time, some of the teachers reported that computers were very useful in motivating students to learn on their own. The computer is usually regarded as being accurate and fast with storage and retrieval of information. This point was reported by 2 of the interviewees while four of them used computers to improve students' communication skills. However, findings from this study have provided valuable information indicating how few teachers were making effective use of computers beyond what the syllabus intended. Carol (1997), Ertmer et al. (1999) and Simmt, (1997) reported similar findings from developed countries, and Bitner and Bitner (2002) support the use of computers to motivate students to learn.

7.3.2 How teachers use computers in the schools that participated in the study

One of the purposes of this study discussed in Chapter 1 Section 1.9 was to investigate how teachers use computers. So question two of section B sought answers from the interviewees in relation to how computers were employed in teaching and learning. This was an important area of research because computers were introduced in Kenyan public secondary schools to teach computer literacy skills and there was a need to provide evidence if this was happening in the schools that participated in the investigation. The responses were summarized and indicated in Table 7.14.

Table 7.14: How teachers use computers in teaching and learning

Responses	Participants	Percentages
As a tool/teaching aid	11	55%
For generating of ideas for class work	4	20%
Teachers use it for lesson planning	3	15%
Teaching main part of the lesson	2	10%

Table 7.14 indicates that teachers used computers as a tool/teaching aid to teach computer literacy skills, but some of them used computers for supplementary work. This involved integrating part of the traditional subject topics into computer programs. Teachers reported using computers to introduce a topic, to reinforce a concept or to revise what students have learnt in the class (for example in grammar and spelling, composition, comprehension in English language). Other teachers employed the computer for generating new ideas for teaching their curriculum subjects. However, a few of the interviewees reported using computers for teaching the main part of the lesson, such as when they use it to demonstrate how things are done. For example, in learning word processing they show students how to use computer technology to process information.

7.3.3 Teachers' preparation to teach with computers

The interviewees were asked to state if they prepare for teaching and learning with computers, and whether they have schemes of work and lesson plans. It was necessary to obtain the information on this issue because every teacher is supposed to have a lesson plan and a scheme of work for all the subjects they teach. A scheme of work is a plan derived from the prescribed syllabus for a particular level of education. All teachers must prepare their schemes of work showing how much of the syllabus will be covered within a given period (usually one school term or two terms). The response from the interviewees on this question indicated that the majority of them (80%) prepared for teaching with computers, and 60% had schemes of work, but another 60% of them reported having lesson plans. Similarly, 75% reported using general notes for teaching and did not have lesson plans. Overall, the interviewee noted that the use of computers enabled them to produce neatly written lesson plans and notes that they filed and stored on diskettes for further improvement as needs arise. Table 7.15 provides visual displays of the responses from the participants.

Table 7.15: Planning for teaching with computers

Responses	Participants	Percentages
General preparation	16	80%
Schemes of work	12	60%
Lesson plan	12	60%
General notes	15	75%

Planning for teaching is an important element in teacher preparation. As indicated in Table 7.15, teachers need to prepare in advanced all of the units listed in the above table before using computers in teaching and learning. A good lesson plan will enable teachers to teach students computer skills effectively. If they do not plan properly they might find that the students they teach are more knowledgeable in certain computer skills than the teachers. Therefore, planning to use a computer program in teaching requires teachers to research and prepare relevant materials for lesson presentation orally or practically.

7.3.4 Pattern of using computers in teaching and learning

McCoy (1996) noted that computers have been used for drill and practice, for enrichment, for supplementing the curriculum and as a tutor. In this connection, I asked the interviewees to explain if they used the computer in any of these ways. It was necessary to establish whether each teacher had a particular pattern of using computers, and if all of them employed similar usage. Their responses are summarized in Table 7.16.

Table 7.16: Pattern of using computers in teaching and learning

Pattern of use	Yes	No	Total
Drill and Practice	14	6	20
Enrichment	9	11	20
As a tutor to assist teachers	7	13	20
For supplementing curriculum	7	13	20
To facilitate learning	4	16	20
For remedial work	4	16	20

As indicated in table 7.16 the majority of the teachers used computers for drill and practice. During the interview, teachers indicated that after teaching the students a skill, they do practice on their own. One of the teachers reported that "*Yes I drill them especially for them to be acquainted with the use of keyboard for faster typing of* text, *and also to know where different keys and groups of keys are.*" Another one reported "*you see in form one, I have 21 students, when learning in class, three students share a machine. During practice session, only one student use the machine at a time*" Still another teacher reported that "*after learning in a group, I drill them to compose letters and stories which improves their writing skills.*" There were also some of them who did not use computers for this purpose. When the interviewees were asked to state the reasons why, one of them reported that " *with computers students learn better with drill and practice. They practice on their own after demonstrating to them.*"

Another group of teachers reported using computers for enrichment because the computer provides a variety of learning resources that cut across all traditional subjects students learn in the school. In another response to enrichment, one of interviewees explained that "*I prepare and use the chart to illustrate the points then use the computer.*" Another one reported that "*once the students have done statistics in mathematics they come and work on the computer to solve the same problem.*" Moreover, the other teachers also reported using computers as a tutor. In this usage, teachers indicated that sometimes they prepare some work in the computer for students to learn on their own. At the same time other teachers used computers for supplementary work. They stated that some times they use the computer to access extra information to add to what they teach in the traditional subjects such as science and social studies. The interviewees noted that computer programs could make the learning process easy for students since they learn by doing. Some teachers used computers for remedial work by enabling slow learners to revise the assignments and to access information at their own pace.

7.3.5 Software used by the students in schools that participated in the investigation

The other area of computer use considered was the specific software and applications that were being used by students. The responses from the participants are summarized in Table 7.17

Table 7.17: Software that students learn in study schools

Items	Participants	Percentages
Word processing	20	100%
Spreadsheet	15	85%
Database	14	70%
Graphics	8	40%
Programming	6	30%
Others	7	35%

The findings displayed in Table 7.17 are similar to the one in Table 7.9. But in this question, the interviewees were asked to list specifically the software programs used in teaching students computer literacy skills and not the software available in the school.

Therefore, from the above Table 7.17 it is evident that all the interviewees reported that the students used word processors. This is because word-processing packages are by far the most common application of information technology used in schools in developed and developing countries. Furthermore, word-processing is concerned mainly with the manipulation of information both textual and graphics. It allows students to process information and this is an activity that is at the heart of learning. It is also useful for input, editing, correcting work and presenting text of any kind (Robinson, Bloomfield and Carson 1994). In addition, 85% of the interviewees reported using spreadsheets citing the importance of spreadsheets as a useful tool for improving mathematical operations and accounting. The result of this study supports the findings of Cavendish and Waters (1994:102-107) who noted that a spreadsheet is a tool that can support any activity that involves numerical calculations. They also report that the "most valuable features of spreadsheet is that once the data has been entered into the cells, arithmetic operations can be carried out on whole rows or columns of numbers." Thus allowing learners to explore patterns and relationships that cannot easily be investigated without using a computer.

Furthermore, 70% of the teachers reported their students use a database program. The interviewees noted that database programs allow students to collect and organize data and feel ownership over the data. Underwood, Dickinson, Lee and Lynch (1994) also supported the use of databases in schools arguing that thinking skills are encouraged by the use of a data storage and retrieval system. The other software presented in Table 7.17 above is the graphics reported by 40% of the participants, programming reported by 30%, and other computer programs reported 35% because of their usefulness to particular groups of learners.

7.3.6 Reasons for integration and use of computers in teaching and learning

Previous studies carried out in developed countries (Myhre, 1998; Ertmer et al. 1999) have identified several reasons commonly given by teachers for their integration and use of computers. Some of these reasons can be summarized as follows:

- Important tool to bring a lot of changes in teaching and learning techniques;
- To improve subject matter teaching;
- Development of new knowledge, skills and concepts;
- To bring additional expertise and teaching ideas for teachers who lack experience or confidence in teaching certain areas of the curriculum;
- To present information in an interesting and stimulating way;
- To give access to experiences not easily provided by the teacher;
- To introduce, extend and reinforce areas of learning.

With the above reasons in mind, I asked the teachers in my study to supply the main reason for integrating computer technology into teaching specific topics in their subject area. Their responses are summarized in Table 7.18.

Table 7.18: Reasons for integration of computers by teachers

Reasons	Respondents	Percentage
Links with subject topics in class	4	20%
Well presented, interesting, stimulating	6	30%
Well researched information on various topics	5	25%
Covers subjects not available in class	2	10%
Children enjoy, they learn new ideas	3	15%
Total	20	100%

The main reason that encouraged teachers to integrate computer technology into teaching subjects was that teachers felt computer programs were well researched, well presented and formed links with traditional subjects as reported by 75% of the interviewees. Thus,

it is important from the teacher's point of view that computer lessons need to be well researched, and designed to link to the course work.

7.3.7 Students' knowledge of computer literacy skills

The computer is a technology that cannot be used unless one has some skills to operate it. Teachers who took part in the interview were asked to state their students' knowledge of computer literacy skills by indicating whether their students had basic, average or advanced skills. The results indicated that 40% of the teachers reported that their students had basic knowledge of computer literacy skills. The students were able to operate the machine on their own, use the mouse, keyboard, access files, processing their work and print. However, 40% of the teachers reported that their students had average computer skills and were capable of using a word processor to compose stories, edit, and retrieve files. But the students with advanced computer literacy skills reported by 20% of the interviewees were able to use all the software tools such as word processor, spreadsheets, databases and basic programming. The current research did not attempt to gather evidence directly from students to verify the teachers' claims about the computer skills of their students. This is an issue that would need to be investigated further to verify that the objectives of the Secondary Computer Syllabus were being achieved.

7.3.8 Classroom teachers' level of computer literacy skills

The computer teachers were also asked to state their level of computer literacy. This question was asked in order to assess teachers' knowledge of computers because as teachers of computer education their level of computer knowledge should be above that of the students they teach. The findings were analyzed and presented in Table 7.19

Table 7.19: Computer teachers' level of computer literacy skills

Responses	Male	Female	Total	%
Advanced level	13	1	14	70%
Average level	4	1	5	25%
Basic level	0	1	1	5%
Total	17	3	20	100%

From the above table 7.19, it is apparent that the majority of the interviewees considered themselves to have advanced level of computer literacy skills. This group also felt competent enough to handle computer programs since they trained in the Advanced Information Technology course and obtained a Diploma. The interviewees who were in the category of "average" had also attended a computer literacy course and obtained an Advanced Certificate. Only one of the interviewees had no training in computer literacy but reported having studied some computers in an undergraduate programme and felt capable of assisting students temporarily.

Some important implications from this research were noted. Firstly the study provided strong indications that the implementation of computer education requires teachers who are adequately trained and competent to impart knowledge to learners. Secondly, the finding compares favorably with that of Gobbo and Girardi (2001:68) whose studies in Italian schools indicating that frequent utilization of computers tended to vary with the level of competence of the teachers. While talking about competency, Fraser (2001:68) emphasized that "occupational functions and accompanying performances requires competent practitioners whose skills and expertise are vested within the defined tasks and functions of a profession." Hence computer teachers need to be competent to teach computing applications contained in the Secondary Computer Syllabus. Therefore, there is need for effective teacher training of teachers in the use of computers in teaching and learning.

7.4 How students learn with computers

Many scholars (Heinich, Molanda, Russell and Smaldino, 2002; Gibson, 2001; and Tiene and Ingram, 2001) believe that computers are extremely important because they can encourages students to learn on their own, and to discover new information, ideas and materials useful for learning their subjects areas. In particular, Berson (1996:486) reports that computers can enhance academic learning by improving the effectiveness of instruction by:

- providing immediate feedback to the learner;
- allowing for instruction at individualized pace with specialized modification to promote mastery learning;
- incorporating interactive exercises;
- facilitating cooperative learning to enhance higher order thinking skills; and
- allowing for drills and practice to promote whole class activity.

Consequently, with the above points in mind the interviewees were asked to state how their students learn with computers. All the teachers interviewed reported that their students learnt with computers in small groups. When asked to give reasons why the students learn in small groups, one of the participants replied that "*learners are action based so they do not enjoy so much theory and while in groups they consult one another.*" 50% teachers reported that their students learnt with computers individually when they are given assignments, during practice or when doing examination. In addition, 75% of the interviewees noted that students learnt with computers as a whole class in addition to individual and group work. One teacher remarked "*when I am teaching theory, introducing the students to the working of the machine and types of software I lecture to the whole class.*" Another teacher from a school in rural area reported that "*although I allow the students to use computers individually, I must be present to assist them and guard against those who just play cards or smuggle their diskettes with viruses.*" Still another teacher remarked "*Sometimes I give directions and help learners one by one with using computers to compose stories.*" From this it seems

that the teachers recognized the need to vary their methods of using computers to meet the needs of the students and the demands of what they were teaching.

7.4.1 Number of times teachers use computers per week

Computer teachers were asked to state how often they used computers by indicating the number of periods per week. This question was asked in relation to the previous research findings by Carol (1997) that teachers had no time to plan and use computers in teaching and learning. The results of my study indicated that the amount of time for using computers in the study schools varied greatly. There were those who reported using computers once a week and others used them twice, thrice, four times, five and even over five periods per week. Similar response was also obtained from the Principals and Heads of Department investigation reported in Chapter 6 Section 6.7.6.2. Table 7.20 shows a very high degree of usage among the interviewees.

Table 7.20: How often do you use computers in teaching and learning?

Number of periods	Responses	Percentage
Once a week	1	5%
Twice a week	4	20%
Thrice a week	1	5%
Four times a week	5	25%
Five times a week	1	5%
More than five times	8	40%

As demonstrated in Table 7.20, it is quite clear that computers have an important place in teaching and learning in the study schools. The above Table 7.20 indicates that the majority of respondents (70%) who participated in the investigation claimed that they used computers at least four times a week in the sample of schools. The Secondary Computer Syllabus recommends four periods for Forms 1 and 2, and 5 periods for Forms 3 and 4 periods per week. However, some teachers reported using computers more than five periods per week. For example one of the interviewees said that "*students are so*

much interested in computer education that apart from the time allocated in the school time table, we are allowed to have extra classes in the evening and during week-ends, so we end-up having more than eight periods per week."

7.4.2 Integration of computers into teaching subject topics

Another objective of this study was to investigate whether teachers were integrating computers into teaching subject areas such as science. Each of the interviewees was asked to state the level of integrating technology into teaching and learning. The findings indicated that most of them had not integrated computers into their general teaching and learning processes but one of them responded "*If I am using computer during literacy classes I may make reference to the topic in my subject then the students look at it in the computer.*" Some of the interviewees reported also that they inform the students about the program containing information relevant to a topic in a subject like mathematics, "*then they look for the information in the computer to learn about it.*" Still another teacher reported " *I use the computer to summarize what I have taught by showing some skills in different subjects e.g. sciences and history.*" Table 7.21 gives a summary of the interviewee's responses.

Table 7.21: How teachers integrate computers into subject teaching

Response from teachers	Number of teachers	Percentages
Use as main lesson	2	10%
Use as part of the lesson	2	10%
Use it for introduction	3	15%
Use it for summary	4	20%
No integration	9	45%
Total	20	100%

The findings in Table 7.21 support an earlier study by Liu, Macmillan and Timmons (1998) stating that integrating computers into the classroom has to take teachers personal and professional constraints into consideration. Most of the teachers interviewed had not

been exposed enough to computers to be able to integrate them into teaching and learning. A similar finding by Ertmer et al. (1999) indicated that full integration of computers into the educational system was a distant goal unless teachers are trained, competent and are willing to use computers in teaching and learning traditional subjects. Myhre (1998) also believed that the teachers' use of computer technology could vary tremendously depending on the teachers' experiences, knowledge and beliefs.

7.4.3 Value of using computers in teaching and learning

The other area of investigation was to establish whether computers were really valuable to secondary school teachers. The interviewees in the study were asked to state the degree to which computer programs were valuable to them by giving a categorical rating of their responses as highly valuable, very valuable, valuable or not valuable. The findings are in Figure 7.1

Figure 7.1: Value of using computers in teaching and learning

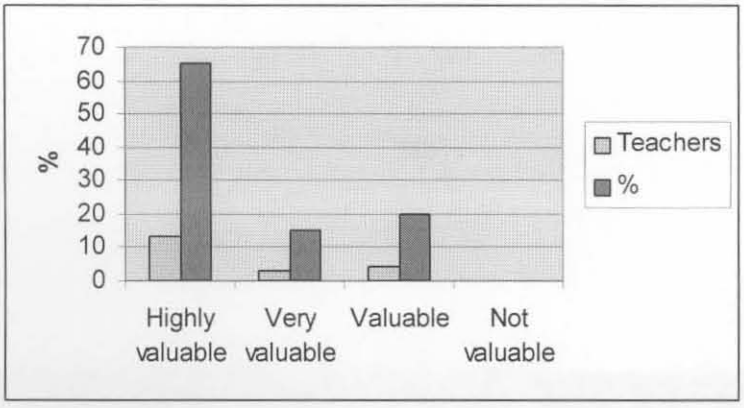


Figure 7.1 indicate that 13 of 20 (65%) of the teachers interviewed regarded computers as highly valuable compared to 3 of 20 (15%) who believed that computer was very valuable. Only 4 of 20 (20%) reported that it was valuable. None of the interviewees found the computer technology worthless. They all agreed that students and teachers learn a lot from computers. However, when the teachers' responses were analyzed by area the pattern was different. Table 7.22 shows the findings by area.

Table 7.22 Teachers' rating of Computer Education by location of the school

Ratings	Rural	Urban	Suburban	Total	%
Highly valuable	0	2	1	3	15%
Very valuable	12	1	1	14	70%
Valuable	2	0	1	3	15%
Not valuable	0	0	0	0	0
Total	14	3	3	20	100%

Table 7.22 shows the responses from teachers from rural, urban and suburban areas regarding the value of computers in teaching and learning. There was no teacher from a rural area who rated computers as highly valuable and none of the teachers rated it not useful. When the interviewees were asked to state the reasons for their ratings, one of them commended the use of computer technology "*especially in productivity, the way the files are kept is exemplary, due to easy access to them, alterations are very easy too.*" Another one reported that *"the computer makes work easier i.e. much better than a typewriter or a calculator."* However, the overall rating of computers in teaching and learning by the participants was that they were very valuable as can be seen from the above Table 7.22.

7.4.4 Benefits of using computers in teaching and learning

Teachers were asked to give their views on the main benefits of using computers for teaching and learning by students and teachers. This relates to some questions regarding reasons for using computers, but here the participants were asked to give their views on the benefits. The most common answers were summarized and presented in the following Table 7.23

Table 7.23: Benefits of using computers in teaching and learning

Benefits of computers in teaching and learning
Explaining and illustrating difficult scientific and mathematical concepts e.g. statistics.
Demonstrating scientific experiments that are difficult to conduct in the class without such aids.
Supplementing teachers' and students' knowledge of some subject topics.
Widening students' scope of knowledge and enabling access to various fields of learning
Computer programs incorporate the best and most up to date information indifferent subject areas, and the content is presented in an organized and stimulating format. Students learn a lot from the Encyclopaedia.
It creates computer awareness and facilitates students' work in class, especially in practical work thereby providing secretarial training as well.
It exposes students to better employment opportunities in future by helping them to get basic literacy skills required for such jobs.
When used as an instructor, it is very consistent and presents the lessons at the learners' pace.
Course materials can be stored and retrieved for future reference.
It allows updating and editing of documents so changes can be easily done without wasting time.
It is faster, accurate, saves time and improves thinking skills.
It is motivating, encouraging and makes one eager to learn.
Provides good filing system by making easy access to files as opposed to the traditional bulky filing system.
Processing and printing neat, attractive and orderly work.
It helps to make learning student based, more friendly and easy to follow.
It helps to generate ideas as students learn with computers

The above benefits indicate a high degree of agreement between all the interviewees who participated in the investigation about the benefits of using computers by teachers and students. The other response, by both female and male participants, was that the use of computers enabled them to access new ideas. Another of the benefits identified by teachers was that using computer enabled them to give students experiences that would be difficult to provide in any other way. Such experience enables students to improve their understanding, for example, by solving mathematical and scientific problems on their own.

7.4.5 Limitations of computers as a tool for teaching and learning

As well as identifying benefits of using computers, teachers were also asked to respond to the question "Are there any limitations of computers as a tool for teaching and learning?" This question was important because computer technology like any other tool for teaching and learning could have limitations to users in different parts of the world. So the question was asked in order for teachers in the study to report disadvantages of using computers in their schools. The most common types of responses to this question were summarized and presented the following Table 7.24.

Table 7.24: Limitations of computers in teaching and learning

Limitations of computers in teaching/learning
Cost of the hardware, software and manpower that many schools cannot afford.
It depends on constant supply of electricity, and when there is power breakdown it cannot be used.
Sometimes programs like windows give problems with responses. Students who are eager to learn do not get it. MS DOS is not as highly responsive and gives learners time. But in Windows if you make a small mistake the whole program goes.
Computer does not take care of individual differences of students compared to the teacher. Some students have problems with poor eyesight.
It needs special room free from dust, humidity, and care must be taken of all computing materials.
It cannot revisit a problem, although it can take a learner step by step. But when the students use computers, there is a limit to a detailed explanation of what the students need in order to understand a concept, or other teaching aids or relates a topic to past experiences or with what happens to learners in any situation.
Computers are very delicate machines, can easily break down so care must be taken to handle them.
It requires training, one must have the skills to use the machine.
It is prone to theft and attack by virus.

As shown above, only a few limitations of computer as a teaching and learning aid were identified. One concern mentioned by some of the interviewees was that computers rely on a constant power supply, so the students cannot use the computers when there is no electricity. Another problem raised by many of the participants was that computers are

expensive. This could be due to a variety of factors such as: lack of funds, demand on time and lack of manpower. However, one of the interviewees reported that *"it is difficult to use four computers with a population of 50 students per class. So sometimes I create extra time for them to practice the skills. After teaching a topic in a subject I also ask students to access related information in the computer to reinforce what they have learnt. But it is a problem to use the computer technology as a teaching and learning resource in subjects because of different abilities of students within their teaching groups."*

7.5 The impact of computers on students' learning

According to Underwood (1994:31) computer packages motivate students, encourage collaboration and social interaction and offer greater parity of access to learning the curriculum. In this connection, all of the teachers interviewed were asked to identify what they felt to be the main impact of computers on students' learning, and to state how the software packages they used contributed to students' learning. They were also asked to state whether they could think of specific examples when students' learning was stimulated or enhanced by computer programs. In response, the majority of the interviewees noted that students are motivated to learn when they use technology. One of teachers reported that *"there is no sleeping during computer class, a sign that they appreciate their use of computers and what they learn from them. It increases students' desire to learn. They are normally very happy and this enables them to learn even more on their subject area."* Some of the interviewees were also able to identify the contribution of computers as indicated in Table 7.25 below.

Table 7.25: Impact of computers on students learning

Responses from teachers	Number of participants	%
Students recall what they learn	4	20%
Discuss with other students what they learn	3	15%
Improve students' communication skills	6	30%
Increases motivation and attention to learn	4	20%
Students learn new ideas	3	15%
Total	20	100%

From Table 7.25, it is evident that all the interviewees recognized the contribution computers can make to students' learning. For example, the interviewees reported that the use of computers in teaching and learning was very useful to students. The learners were able to recall what they have learnt, discuss with other students what they have learnt as well as obtaining new ideas. Some of the teachers also noted that the use of computers increases students' motivation to learn. As discussed in Chapter 3 Section 3.4.1, motivation is an important factor that has been identified by scholars to influence what students pay attention to, how long they pay attention and how much effort they invest in learning. According to Heinich et al. (2002:58) "students who are intrinsically motivated will work hard and learn more because of their personal interest in the materials." However, the discussion on the impact of computers on students' learning generated more topics for analysis as indicated in the following sections.

7.5.1 The impact of computers on students' learning of skills and concepts

Many teachers noted the impact of computer programs to enhance students' ability to learn by doing and concentration. Students learn literacy skills and subject-related concepts particularly in mathematics, sciences, languages, technical and humanities subjects. For example, one teacher from a rural school who teaches accounts described how the students worked on their balance sheet during computer lessons, and after the students resumed their traditional accounting class work, the teacher observed that the students had picked up some ideas from the computer program. A few teachers from

urban areas also found computer programs helpful in promoting students' questioning, discussion and reasoning by focusing on controversial issues in subject areas. For example, one teacher reported that since he started using computers *"some students have developed reasoning powers on issues like cultural practices, health issues i.e HIV/AIDS, they also asks questions on evolution of man etc."*

In addition, the interviewees felt that computers offered particular benefits as a medium of instruction. Teachers who participated in the interview referred to the ability of word processors to improve students' communication skills, such a creative writing, spelling, grammar, and composing stories. They also commented on the ability of the computer technology to put a subject across to learners in a stimulating way through the use of strong visual images. Through their stimulating content and presentation, computers were felt to contribute to learning by enhancing attention, motivation and recall of what has been learnt. In addition to improving teachers' instruction, computers were found to be helpful in teaching students typing skills, developing their general awareness of computer literacy skills and assisting in the development of conceptual understanding.

7.5.2 Recall of what students have learnt

The computer application programs such as spreadsheets, databases, word processors, graphics etc, were the main computer programs that were used by the interviewees to teach students' computer literacy and to integrate computers into teaching and learning traditional subjects. For example, one teacher from a rural area stated that "*in spreadsheets there are mathematics and accounting functions, so the students find it easy to revise what we have covered in these subjects, and when they come across some new ideas they come and ask me. Moreover, I have observed that the students discuss among themselves what they learn from computer technology.*" Because students are exited during computer classes, teachers believed that they learn from the use of computer programs such as word processors.

The comments that teachers made about computers helping students to learn and to recall information were based on the general impression that the teachers gained while using computers in their classes. None of the teachers had attempted to verify these impressions in any formal way such as through research.

7.5.3 Students' attention and interest to learn

Teachers in the study noted that students were keen and interested during computer classes. As one of the interviewees reported that "*once the students are in the computer classroom they do not want to stop working unless they are forced to leave.*" The interviewees also noted that "*the computer is particularly successful in stimulating students to attend to the information contained in the program because it sustains their interest, they are not bored by it, compared to the teachers' chalk and talk.*" Teachers reported also that students enjoyed working on computers and that this was essential in discovering new ideas of solving difficult problems in their subject areas.

7.5.4 Developing confidence in the use of computers

Another contribution of computers to student's learning reported by the interviewees was that the computer technology sometimes encourages learners to gain confidence that enables them to learn other subjects on their own. One of the interviewees stated that "*when the students are in the computer room, they try out new areas of learning in the topics covered by the teachers during normal class time. This helps to reinforce what the teachers taught.*" The responses from the interviewees to the impact of computers on students' learning indicated clearly the capability of the computer as a useful tool for teaching and learning in schools.

7.6. Problems and difficulties experienced by teachers with the use of computers

All of the interviewees who took part in the investigation were asked to state if they had come across any problems with the use of computers. This question was asked because numerous research sources reviewed in Chapter 3 Sections 3.4-3.11, suggest that teachers often face problems when they want to use computers in teaching and learning. The overall response from the interviewees indicated that most of them like to use computers in teaching and learning. But they also reported that there were some problems that prevent them from using the computers all the times whenever they would like to. Their comments were analyzed and displayed in Table 7.26

Table 7.26: Problems and difficulties that prevent teachers to use computers

Responses from teachers	No of teachers	Percentage
Time not enough for teaching students computers	7	35%
Lack of enough computers and software	4	20%
Lack of constant electricity supply	3	15%
Lack of suitable computer rooms	2	10%
Problem of eyesight due to constant use	2	10%
Frequent breakdown and lose of programs	1	5%
Maintenance of equipment	1	5%
Total	20	100%

As can be seen from the table, the most common problem identified by the interviewees was lack of enough time for students and teachers to use computers. This was followed by lack of machines and software. The concern about time tallies to some extent with findings of Chiero (1997); Carol (1997); and Ertmer et al. (1999) discussed in Chapter 3 Section 3.7.

7.6.1 Factors affecting effective use of computers in the classroom

In order to establish why some teachers do not make use of computers effectively in teaching and learning, teachers who participated in the interviews were asked to list some of the practical and philosophical barriers to the use of computers. This question was asked in relation to a review of literature in Chapter 3 Sections 3.3. The responses from the interviewees were summarized and presented in Table 7.27.

Table 7.27: Factors affecting use of computers in the classroom

Comments	Participants	Percentage
High cost of computers and software	18	90%
Lack of teachers and students manuals	16	80 %
Time not enough for all students to learn effectively	15	75%
Lack of suitable software for CIE	10	50 %
Lack of relevant computer textbooks	10	50%
Lack of access to computers	10	50%
Attack by virus	8	40%
Teachers not adequately trained in computing	6	30%
Not enough space in computer room	6	30%
Power backup not adequate	5	25%
Computer lessons not allocated on the timetable	5	25 %
Lack of funds to purchase materials	4	20%
Lack of clear policy for classroom use of computers	2	10 %

Teachers' responses to the first question as displayed in the above analysis showed that high cost of software and lack of teachers' and students' manuals were identified as important factors affecting the use of computers by the majority of the participants. Lack of time was another main issue mentioned by 75% of the interviewees; while the problem of access to computer technology was reported by 50% of the interviewees. This was due to the fact that the number of computers available in the schools for teachers and students to use are few compare to the number of students. For example, in some schools there are 600 students with only 10 computers, so the problem of access is a serious issue. In

addition some of the factors mentioned by the interviewees included lack of enough space in the computer room. This was in relation to the large number of students per class (sometimes 40-50 students per class) and this could not fit in a small computer room.

However, one interesting point is that only two teachers mentioned "lack of policy for computers use" as a factor affecting their use of computers in the classroom. As discussed in Chapter 5, there was no clear information regarding the implementation process of the computer policy contrary to what happened in the past with other curriculum innovation in Kenya. Because curriculum implementation in Kenya is highly centralized, these teachers expected a clear policy directive from the government on the implementation programme. But this problem could have been due to the fact that, "policy intentions are acceptable and that implementations is a matter of the technical ability and will of the implementing units, together with adequate resources. Any deviation or resistance of the policy messages is seen as irrational and a barrier to successful implementation" by the policy makers (Kgobe, 2000:7). So the schools were confronted with the translation of unclear policy into practice and the two teachers in my study identified this as a barrier to the use of computers in their schools.

7.6.2 Factors encouraging teachers' decision to use computers in teaching

As indicated in section 7.6.1 the researcher investigated also a number of factors that influenced teachers' decision to start using computers in teaching and learning. The question was asked to determine which factors had contributed to teachers' use of computers in teaching and learning. The data obtained showed that the most important factors that encouraged the interviewees to use computers included the school policy, teachers' initiatives and demand by the parents and students. Table 7.28 gives a clear picture of the contributions from the participants in the investigations.

Table 7.28: Factors that encourage teachers to use computers

Comments from participants	Teachers	Percentage
The school policy	15	75%
Teachers initiatives	10	50%
Demands from students and parents	10	50%
Availability and access to computers	10	50%
Suitability of programs	8	40%
Information from friends	5	25%

Analysis of the responses indicated that the school policy was the most important factor mentioned by 75% of the interviewees that encouraged them to start using computers. Availability of computers, access to computers and software was reported by 50% of the interviewees. But interestingly, teacher's self motivation to keep up to date with computer technology and the need for students to learn to use the computer also encouraged teachers to teach computer education. The parents' demand for their children to be taught computer was also cited by 50% of the interviewees in the case study.

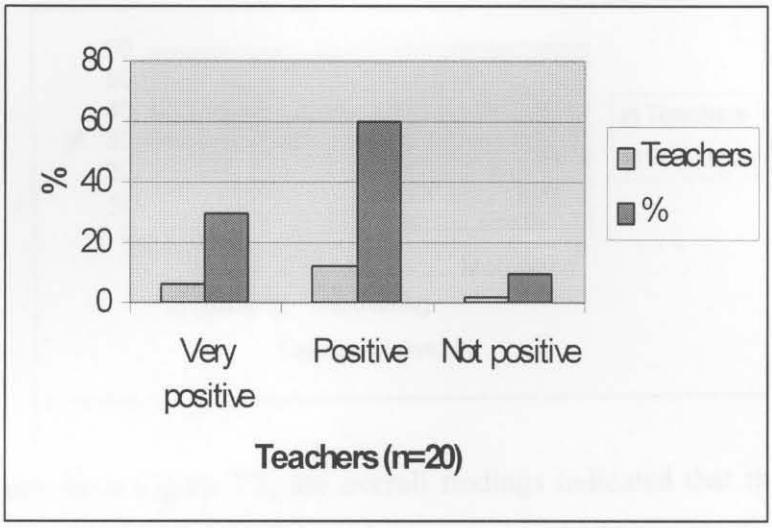
However, during the discussion with teachers from rural areas, one male teacher reported that he was encouraged to use computers by the school administration because *"the chairman of the school board is computer literate. He encouraged the school to introduce computers in the school and selected the programs*." Another male teacher from an urban area also reported that "*the parents felt that the modern world is becoming computerized therefore the students should be brought to fit in it."*

7.7 Teachers' views and attitudes towards the use of computers in teaching and learning

Another objective of the study was to investigate the attitude and views of teachers towards the use of computers in teaching and learning. The attitude of teachers towards the computer technology was considered an important factor in the effective use of computer programs. So the question about attitudes was asked to find out if the

interviewees valued the use of computers as a tool for teaching and learning. The participants were therefore asked to express their opinion by providing answers to the semi-structured questions and to provide reasons for such answers. The first question was aimed at investigating their attitudes. Figure 7.2 shows the responses from the interviewees.

Figure 7.2: Attitudes of teachers towards computer education in schools



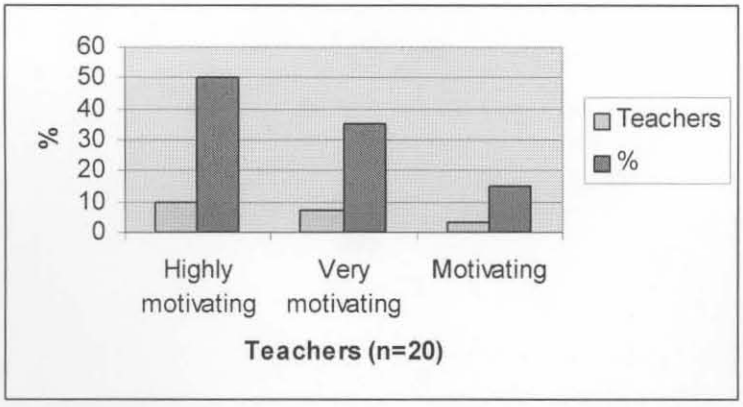
From figure 7.2, it can be seen that 6 of 20 (30%) interviewees had a very positive attitude towards the use of computers. This group comprised those teachers with advanced training in computer technology. Therefore they believed that computers introduce materials to the students that they had not learnt before. But 12 of 20 (60%) interviewee reported having a positive attitude towards the use of computer compared to 2 of 20 (10%) teachers who had a negative and were not interested in the computer subject. However, this group might not have had a negative attitude towards computers as such. I think they could have been suffering from fear of the computer technology as one female teacher from an urban area commented " *Teachers generally have a phobia for computers. They do not assist the computer teacher to help shape the attitude of students towards the computer in the right direction."* Responses to this question revealed that the majority of teachers interviewed believed that awareness of the benefits of the computer

as a tool for instruction influenced their attitudes to be more positive about the computers.

7.7.1 Views about computers motivating students to learn

Many scholars and authors such as Heinich et al. (2002) and Johnson (1995) found that motivational factors are indisputably important in education. If educators can find ways of creating more enduring fascination for all subjects taught in school then students could learn more effectively. The studies reviewed earlier have suggested that computers are very effective in providing learners with such motivation. If the students pay attention to and enjoy working with the computer, then the program may be regarded as effective as well as motivating. In this connection, all of the interviewees were asked about the effects of computers on students' motivation. The responses to this question were summarized and presented in Figure 7.3.

Figure 7.3: Rating of computers motivating students to learn



As can be seen from Figure 7.3, the overall findings indicated that the majority of the interviewees 10 of 20 (50%) believed that computers highly motivate students to learn and 7 of 20 (35%) interviewees rated the use of computers very motivating to students, while 3 of 20 (15%) rated it motivating. For example one teacher from a suburban school reported that the "*use of computers have really increased the students desire to learn. They are normally very motivated and this enables them to learn even more on the*

subject area." Another teacher from a rural area said that "*in mathematics there are computer programs dealing with mathematics that motivate students, so any time they are free they ask me to allow them to go to the computer room to learn with computers on their own.*" Still another science teacher from an urban school noted that "*students are eager to respond to the computer. It has challenged them to search information from the Internet and they come and ask me what they learnt in science.* The findings concur with previous studies by Carol (1997) and Christman et al.(1997) reviewed in Chapter 3 Sections 3.8. In conclusion, most of the teachers interviewed reported that computer programs are presented in simple and interesting manner. Some teachers noted that students are always excited and lively when it is time for computer lessons. They felt that computer programs are organized and involve more practical work linking with what has been covered by the class teachers in the class so the students are stimulated and encouraged to learn.

7.7.2 Views about the use of computers to increase students' knowledge

One of the reasons for the use of computers in teaching and learning discussed in Chapter 2 was to increase students' knowledge of various subjects. So the interviewees were asked to state their views about the capabilities of computer programs to increase students' knowledge. The responses from the interviewees showed that all of them believed computers were effective in this respect. They noted that through the use of computers students have learnt and increased their scientific knowledge. The findings of a comparative study by Kiboss (2000:199) in Kenya indicated that students in the treatment groups learned the concepts and methods in physics better than their counterparts in the control group. The teachers in my case study confirmed, at least through their subjective judgements, that the use of computers increases students' knowledge as summarized in Figure 7.4.

Figure 7.4: Teachers' rating of computers increasing students' subject knowledge

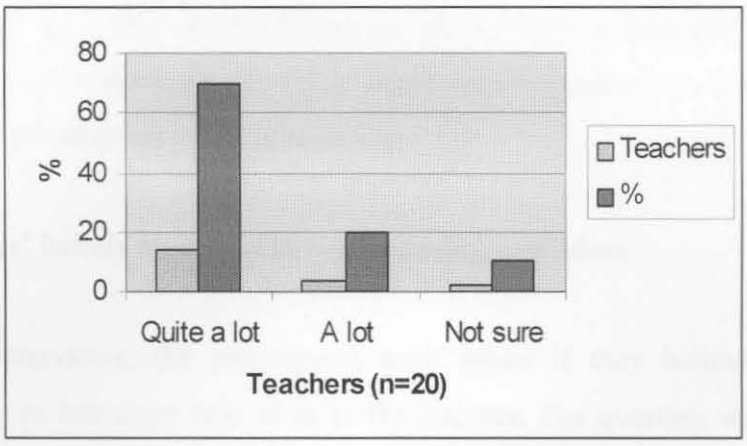


Figure 7.4 demonstrates that overwhelming majority 14 of 20 (70%) teachers believed that the use of computers helps to increase knowledge/information amongst students, but 2 of 20 (10%) were not sure. While 4 of 20 (20%) teachers reported that with use of the Internet, students access information on different subjects from various libraries or databases. As one male teacher from a rural school reported "*yes....it increases knowledge of English subject e.g when students access the thesaurus it gives them new words and alternative words so they learn new things.*" This helps to increase their knowledge of other subjects they learn in class. Christman and Badget (1999) and McCoy (1996) report similar findings.

7.7.3 Teachers' views about the use of computers to widen access to education

The interviewees were asked to give their views about whether computers were useful in widening access to education. All the participants responded positively, but gave different examples of the way it can expand access. The contributions are displayed in Table 7.29

Table 7.29: Responses on computer widening access to education

Responses	Participants	Percentages
It provides various educational programmes	8	40%
It does not discriminate between learners	4	20%
It provides distance education to students	4	20%
Information reaches many through e-mail	2	10%
It provides access to Internet	2	10%
Total	20	100%

All the interviewees believed that the use of computers provides various kinds of learning for students who use it. The interviewees cited programs like spreadsheets that teach accounting, commerce and mathematics, thus reinforcing what the students learn in the class. Two of 20 (10%) believed that computers help to provide more information through the Internet and e-mail to many people thus widening access to education when they share the information and exchange ideas.

7.7.4 Teachers' beliefs on computers introducing new ideas

During the interviews, the participants were asked if they believed that computer programs help to introduce new ideas to the learners. The question was asked to obtain teachers' views regarding the contribution of computers to teaching and learning various skills. This includes learning traditional subjects and general knowledge of what happens in the world. Figure 7.5 displays the responses from the interviewees.

Figure 7.5: Views about computer introducing new ideas

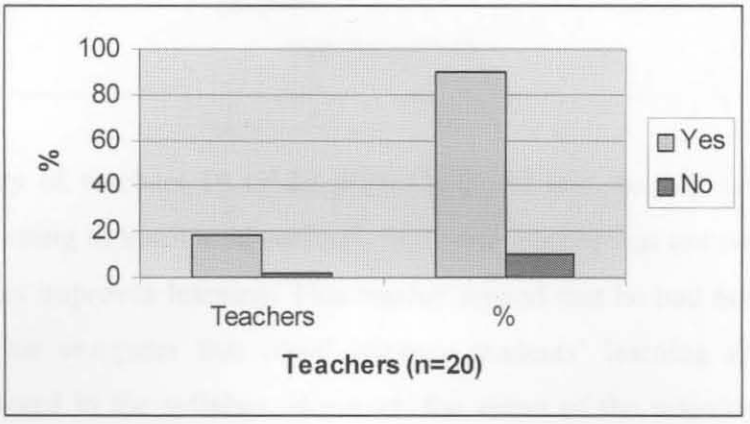


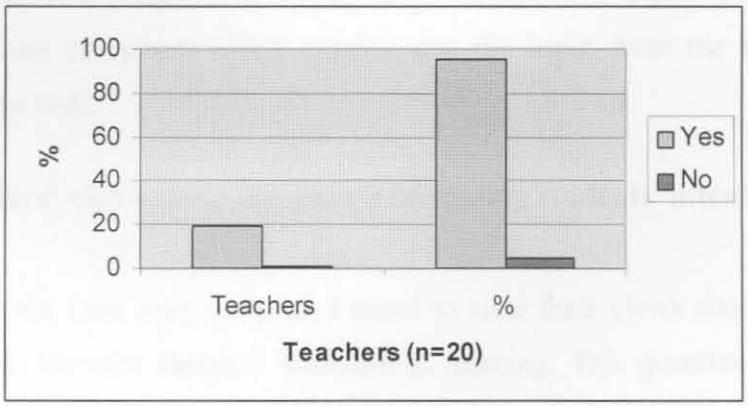
Figure 7.5 reveals that a high proportion of the interviewees 18 of 20 (90%) believed that computers introduce new ideas to teaching and learning. A few of them 2 of 20 (10%) gave a negative response, as this teacher reported *"it depends with what I teach. So I cannot say it introduces new things."* However, the most common responses given by all those who answered positively was that both students and the teachers learn something new from computer programs. For example one interviewee reported that in "*computer new ideas come up every time when you access the help facilities of most programs. Most software and packages also have sample templates and wizards that help in learning new ways of finding things or solving problems e.g Resume Wizard in MS-Word.*" Another one said that in a subject like "*mathematics the computer helps me to teach statistics, graphs, square roots, cube roots, means etc.*"

7.7.5 Teachers' views about computers improving learning traditional subjects

Scholars and authors (Ellington and Race, 1993; Heinich, et al. 2002) noted that most media can perform many teaching functions to a certain extent, although they may vary in their suitability for a particular purpose. Research studies conducted in developed countries (Carol, 1997, Pascoe, 1994) found that the use of a word processor helped to improve students' learning of English language. Twenty participants in this study were asked to express their views about the use of computers to improve students learning and whether they could cite any specific examples when their students' learning was

increased or enhanced by a computer program. A teacher of science reported that "*as a result of using computers students managed to pass their examination in mathematics, science, technical subjects and accounting.*" Another teacher noted that "*the students improved in Biology after I used a computer program because the computer gives vivid information that incorporates visual aids.*" Figure 7.6 shows the responses from the interviewees.

Figure 7.6: Views about computers improving learning of traditional subjects



The majority of teachers 19 of 20 (95%) believed that the use of computers helps to improve learning in traditional subjects. Only one teacher was not convinced that the use of computers improves learning. This teacher argued that he had not identified anything new from the computer that could improve students' learning apart from the usual content covered in the syllabus. However, the views of the majority of teachers whose responses are contained in Figure 7.6 support the findings of Kiboss (2000:199) on the use of computers to learn physics that indicated significant improvements in pupils' learning. Further analysis revealed the following responses in table 7.30.

Table 7.30: Teachers' views about computers improving learning in traditional Subjects

Teachers responses	No of teachers	Percentage
Students improve communication skills	7	35%
Motivates students to learn new ideas	5	25%
Computer programs helps students pass exams	4	20%
Computer programs improve learning subjects topics	3	15%
It has not helped them to improve learning	1	5%
Total	20	100%

It is clear from the above table that an overwhelming majority of the interviewees believed that students learn from computers. It was very important to note that the interviewees held positive views that the use of computers has helped to improve students' communication skills. Other teachers believed that the use of computer programs improves learning specific subjects because the computer motivates students to learn. A few of the interviewees reported that the computer has helped many students to learn and pass examination. However, one of the participants pointed out that students do not learn from computers alone arguing that the input from the teacher needs to be considered as well.

7.7.6 Teachers' views about computers increasing students' attention to learning

Teachers in the case study were also asked to state their views about the importance of computers to increase students' attention to learning. This question was asked because from my experience, many students will pay attention to a lesson if they considered it interesting and presented vividly. Scholars such as Ertmer et al. (1999:65) have also found that computer programs can help to increase students' attention to learning. So in response to the question, the majority of the interviewees reported that students are more attentive when they are in the computer center learning with computers compared to

when they are in their usual classrooms. In fact most of them reported having fewer disciple problems during computer lessons. The responses were summarized and presented in Table 7.31.

Table 7.31: Teachers' views about computers increasing students' attention to learn

Responses	Participants	Percentages
Yes	17	85%
No	3	15%
Total	20	100%

As indicated in Table 7.31, it is clear that the majority of the teachers 17 of 20 (85%) believed that using computers help to increase students' attention to learning. The interviewees who answered yes gave several justifications for their responses. For example, one teacher noted that *"in human anatomy the diagrams are so detailed and well drawn to attract the attention of the* students." Another one said Yes...*in Physics we teach electronics, this enables students to do practical experiments involving electricity without necessarily going to the conventional laboratory...it supplements the existing Physics curriculum.*" Still another one commented *you see in science...especially Physics there are programs closely related to artificial intelligence which forms the basis of computer science."* However, a few of them 3 of 20 (15%) noted that the teachers must be with the students for them to be attentive to learning, otherwise some students will be talking or discussing and not paying attention.

7.7.7 Teachers' views about the computer improving communication skills

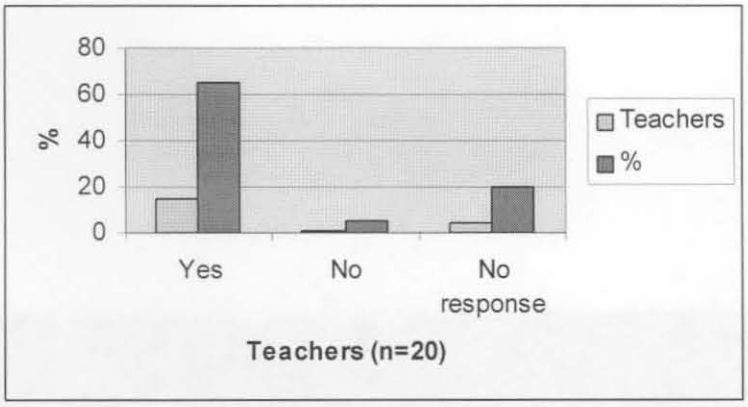
The other question on this theme concerned teachers' views about the use of computers to improve students' communication skills. This question was asked in relation to research findings by Zhang (2000:467) and Synder (1993:58) reviewed in Chapter 2 Section 2.9.6.4 that discussed the use of computers to help students improve writing, reading and composition work. The response from the interviewees indicated that 18 of 20 (90%)

teachers believed that the computer helped to teach students writing skills compared to only 2 of 20 (10%) interviewees who were not convinced that the use of computers could improve students' communication skills. However, one of the participants disclosed that his students "*are able to write letters in German language after being exposed to the computer when they visited Austria.*" Another one reported that "*when you use MS Word the computer indicates if you choose to use British English. It improves spelling, language structure and it exposes them to text to follow instructions. It has helped in learning English.*" A male teacher from a rural school also said, "*since I started using computers and since in form three they (students) use MS Word their language has changed and this has widened their vocabulary.*" These findings tally with similar studies by Carol (1997) and Pasoce (1994) reported in Chapter 2.

7.7.8 Teachers' views about computers facilitating learning

Computers play an important role in providing assistance and additional information during problem solving activities. Computers have also become indispensable in correcting language errors and providing alternative solutions during facilitation of learning. Therefore, the interviewees were asked to state their views about computers facilitating students' learning. The findings are displayed in Figure 7.7.

Figure 7.7: Views about computer facilitating learning



Fifteen of 20 (65%) teachers from rural, urban and suburban areas believed that computers facilitate students' learning. Some of the teachers noted that computers provide students with immediate help and feedback so it makes learning easy for them. One of 20 (5%) did not believe that computers facilitate learning and four of 20 (20%) teachers declined to respond. However, in addition to this question, the interviewees were asked to express their views about the potential of computers to provide remedial work. The research findings indicated that (60%) of the interviewees responded positively, while (30%) was negative, but 10% of them did not respond to the question. Nevertheless, for the majority of the interviewees, the computer was an ideal medium for providing remedial work to students. As reported by one of teachers "*I usually put the notes in the computer so the students come to the computer room and read it. It is like you give them a handout and they learn from it. I believe it helps them to learn on their own.*"

7.8 Teacher training in the use of computers

Another important area of investigation was training of teachers in computer literacy skills. A review of literature from developed countries (Clark, 2000 and Erler, 1998) indicated that teacher training in the use of computers was an essential factor in the integration and use of computer technology in teaching and learning. Teachers need to have confidence and the necessary skills in computers in order to disseminate the same information to students. All of the participants in the interviews were asked to state whether they have been trained in the use of computers during their teacher training courses or since computer education was introduced in their schools. Of the twenty interviewees, 19 of 20 (95%) confirmed that they had received some kind of training in computer literacy courses. Table 7.32 gives a clear picture of the position.

Table 7.32: Number of teachers trained in the use of computer

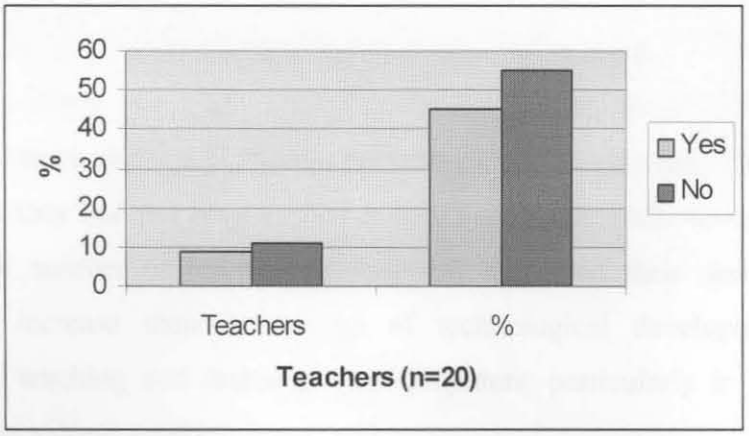
Period of training	Participants	Percentage
0-6months	10	50%
Seven months –one year	5	25%
One year-two years	3	15%
2 years and above	1	5%
No formal training	1	5%
Total	20	100%

From the above Table 7.32 it seems that the majority of the interviewees had a very short period of training in computer literacy since the introduction of computers in public schools. Only one reported having no formal training in computers but had acquired experience by practising from the school computers. However, some of the interviewees indicated that they had formal training at the university and at computer colleges. This group included a female who had MSc degree in information technology (IT), and the others had an advance diploma or had obtained certificates in computers. Further analysis of responses by areas indicated that most of the teachers from rural areas had been trained in the use of computers for less than one year during their teaching career. However, looking at the urban and suburban areas, the finding indicated that all of them were trained for more than one year.

7.8.1 In-service courses attended by teachers on the use of computers

Several researchers (Clark, 2000; Cameroon, 1999; Scheffler and Logan, 1998) report that training of teachers in the use of computers should also include in-service training courses. This will serve the needs of all classroom teachers by up-dating their professional qualifications, increasing their knowledge on various educational issues and improving their classroom practices. All the interviewees were asked whether they have attended any in-service courses on the use of computers organized by the Ministry of Education. The responses are shown in Figure 7.8

Figure 7.8: In-service courses attended by computer teachers



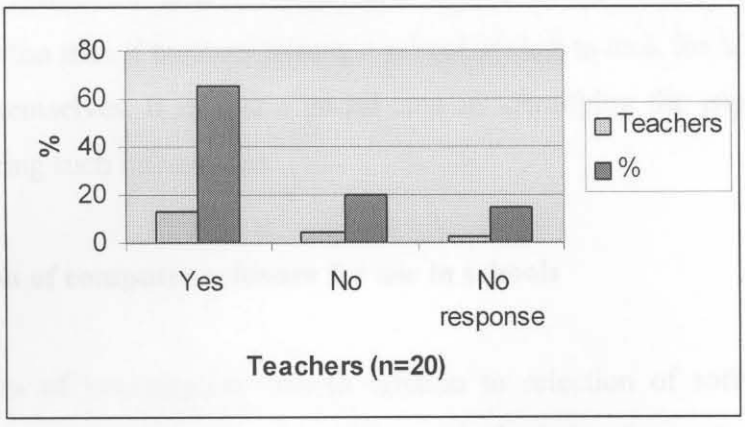
The majority of teachers 11 of 20 (55%) had not attended any in-service course on the use of computers compared to only 9 of 20 (45%) who reported that they had attended any in-service courses. A similar research finding of lack of teacher training in the use of computers was also reported by researchers like Chiero (1997:135) and Carol (1997:57) from developed countries reviewed in Chapter 3 Section 3.3.2. However, it is important that all teachers should be re-trained in any curriculum innovation. Such staff development courses contribute a great deal to teachers' professional development. Re-training programs for teachers also enable them to gain practical ideas about using computers in the classroom.

7.8.2 Workshops and seminars attended by computer teachers

A workshop or seminar for serving teachers designed to extend their professional capabilities is considered to be an important step towards effective use of computer technology in schools. During the workshop participants discuss and produce teaching and learning materials. However, the workshops and seminars that were available for teachers in my study were generally less than one week long and were conducted by computer companies in conjunction with the Ministry of Education. The computer teachers were asked whether they had attended any workshops or seminars on Computer

Education. Quite a large number of the interviewees reported that they had not attended any of the workshops or seminars as shown in Figure 7.9

Figure 7.9: Workshops and seminars attended by the interviewees

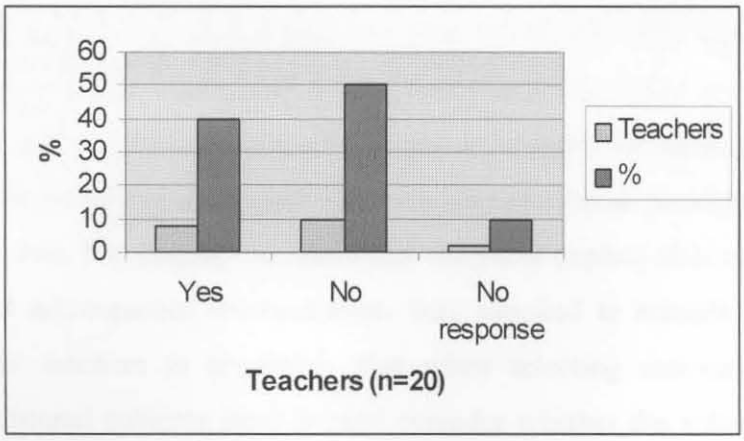


Thirteen of 20 (65%) teachers reported that they had attended workshops on teaching computer education, but 4 of 20 (20%) teachers in the study had not been to any workshop and three teachers (15%) did not respond to this question. Those who answered no stated that they had not been invited to take part in any such workshops or seminars. Quite a large number of teachers interviewed, registered their desire to attend such seminars to increase their knowledge of technological development and general awareness of teaching and learning with computers, particularly in the integration of computers into subject areas.

7.8.3 Induction courses for teachers on use of computers in their schools

The other item of investigation concerning training teachers in computers was induction courses. This question was considered important because beginning teachers and those transferred to other schools need to be inducted into the school system, so that they become familiar with facilities available in school for teaching and learning. Teachers in the case study were asked if they were inducted formally to the use of computers in their present schools. Figure 7.10 displays their reply.

Figure 7.10: Induction courses attended by computer teachers



The findings indicated that 8 of 20 (40%) teachers had a brief exposure to computers available in the school from the Principal. The other ten of 20 (50%) teachers reported that they learnt about the availability of computers in the school from fellow teachers, but 2 of 20 (10) of them did to respond to this question. It is important to emphasize the need to introduce teachers to new developments in the school. This is a more effective way of staff motivation than if teachers joining a school are left to look for facilities and teaching resources themselves. It is also a useful step in identifying the expertise of individual teachers during such interactions.

7.9 Selection of computer software for use in schools

Another area of investigation was in relation to selection of software. According to Heinich et al. (2002:64) there is a need to seek the help of a specialist who can give a better idea of the schools' needs when software is to be selected. This is important because there are various factors to be considered when selecting software for teaching and learning. Such factors include selecting software within the context of the learning outcome. There is also need to consider the content, format and ease of operation, design and completeness of the package (Heinich et al. 2000:229). Therefore, teachers who participated in the investigation were asked to indicate whether they selected the software they use in teaching computer skills. The findings are summarized in table 7.33.

Table 7.33: Teachers' responses on selection of computer software for use in schools

Responses	No of Teachers	Percentage
The computer teacher selected software	12	60%
The Principal of the school selected software	3	15%
Computer Experts selected software	2	10%
Computer teacher and Principal selected software	3	15%
Total	20	100%

Table 7.33 indicates that the majority of the teachers selected the software they use in teaching and learning. This seems to be quite appropriate because the computer teachers are the ones who are in a better position to determine the kind of program suitable for teaching which class as contained in the Secondary Computer Syllabus. However, in some of the schools the Principal of the school selected the software because most of them had been trained in computers and were also in a better position to select software. At the same time, the findings revealed that computer experts also took part in selecting software that accompanied the computers they supplied to schools. Nevertheless, it is important for teachers to remember that when selecting software to integrate into teaching traditional subjects there is need consider whether the software will match the curriculum, be clear, be accurate, be motivating and maintain learners' interest. Since the role of KIE is to develop curriculum materials used in schools and teacher training colleges below university education, to assess non-KIE publications to be used in schools the same would apply to computer materials. This requires KIE to recommend computer programs currently available for integration into different traditional subject and provide selection criteria for schools as they did with Secondary Computer Syllabus.

7.10 Teachers' suggestions on integrating computer programs into other subjects

The participants in this investigation were asked to state their opinion and suggest the subjects they think computers could be integrated for effective teaching. This question

was asked in relation to contributions on whole school integration reviewed in Chapter 2 Section 2.7 (Cornu, 1996). Cornu believed that only when computers are integrated into teaching and learning could their use become natural. Consequently, the interviewees suggested the subjects and topics into which they felt computers could be integrated as shown in table 7.34.

Table 7.34: Teachers' suggestions of subjects that requires CIE

Identified Subjects	Suggested Topics
Mathematics	3 dimensional, calculus, graphs, algebra, digital, trigonometry, statistics
Languages	All areas and Literature
Physics	Floatation etc
Kiswahili	Spelling, grammar, composition
English grammar	Comprehension, spelling, grammar and poetry
Arts, Drawing and Design	All topics
Biology	HIV awareness
Technical and Applied subjects	All topics
Home Science	Nutrition

When the interviewees were asked to state how the integration should be done, they suggested that the teachers, computer experts and curriculum specialists should be involved in designing the programs. They felt that the teachers should be trained in the design of the packages to simplify it for students. One of them argued that "*teachers were in a better position to recommend the nature and depth of a particular program that is suitable to the students so they need to have an input in subject integration. They are on the ground, it would be easy and again for acceptability*" Another one said: "*the programs we have are so general in content that do not meet the needs of students in the curriculum, and will not do what we want.*" From these contributions, it seems that the teachers could identify a wide range of possibilities for integrating computers into the mainstream school subjects. However, they could also see that this would be a difficult and challenging task.

7.11 Teachers' recommendations for improvements to computer education in secondary schools

The last question in this investigation sought information on teachers' suggestions and recommendation for any improvement for effective use of computers in teaching and learning in schools. This question was considered to be very important because teachers are the ones implementing new curricula, and are at the grass root level to provide an insight into how computers could be used effectively. Therefore, in response to the question, the interviewees offered the following recommendations for action:

- **Government Policy:** There is immediate need for the government to identify computer firms to assemble cheap computers for schools so that all teachers could own computers and use the same to up grade skills in computer use.
- **Government Policy:** Teachers should be trained at the government cost on computer based learning approaches, and be certified so that the computer becomes an invaluable tool for teaching both secondary and primary schools.
- **The government** should remove the levy on school computers and related materials immediately so that schools could afford to purchase more computers.
- **In Universities and Teacher training colleges,** computer based learning approaches must be undertaken as an independent subject.
- **Kenya Institute of Education** As reported in Chapter 5 section 5.4 KIE is charged with responsibility to design curriculum for schools. So the interviewees suggested that KIE must design a curriculum that gives room for computer integration as opposed to their current approach where the learning process is assumed to involve only the teacher, student and their expensive textbooks. In other words, there should be a section of the book that directs the teacher to computer-based tasks.
- **Kiswahili language** can be promoted using the computer in the curriculum. Kiswahili teachers should be trained in software design or assisted to write interactive lessons that software designers can put to reality, so that we have interactive Kiswahili lessons on CD and other media.
- **All schools** with computers should be connected to the Internet.

- **For effective integration of computers** schools need to have enough computers to allow or enhance accessibility by all learners and the Secondary Computer Syllabus should explain how to use the computer in implementing the syllabus. This would enhance the use of computer technology.
- **All schools** should make their computing facilities available to the community in order to widen access and to promote the knowledge of computer technology to those willing to be computer literate
- **Curriculum specialists** should visit teachers more frequently to study their problems and suggest how these problems could be overcome.
- **More courses and seminars** should be organized during school holidays and teachers invited to attend so that they learn new concepts in computing. General computer awareness and simple maintenance and repair should be taught to all teachers in colleges so that when they are posted they have an idea on how to use the technology. Teachers also need a forum to discuss their fears and experiences with the new technology.
- **The number of computers** in schools should be increased so that the ratio of computers to students is at least 1:5, and rural electrification should be extended to all secondary schools.

7.12 Summary

This study of the use of computers among teachers in public secondary schools in Nyanza Province has revealed very useful facts concerning how computers are integrated into teaching and learning. While usage figures vary considerably from one teacher to the next, there were also differences in the way in which teachers used computers in teaching and learning. The results showed that, on average, schools allocated four or five periods per week for computer education classes. The majority of them were found to be making adequate use of computers in teaching and learning. In so doing the results revealed that computers are used mainly for the purpose of teaching computer literacy skills. This included teaching and learning word processing, spreadsheets, databases, basic programming and graphics.

In all the 20 schools in which interviews were conducted, the overall findings indicated that the computer programs used by the teachers to teach computer literacy skills were those in the syllabus produced at the Kenya Institute of Education (KIE). In addition, computers were also used for administrative duties such as keeping students' enrollment records, examination marks, and for general correspondence and communication purposes. The growing place of computers within the education circle in schools I visited in Nyanza Province has enabled most teachers to have the opportunity to use computers to analyze examination results in an organized manner. In this context, it was surprising to find that a considerable number of teachers were not integrating computers into their teaching subjects. However, the high profile given to computers in education displayed within the schools I visited, coupled with high levels of learners' expectations that the computer technology could play a major role in education, supported integrating computers into teaching and learning.

The results of the study suggested that teachers were positive about integrating computers into teaching and learning traditional subjects. Most of them reported that some of the computer software such as the spreadsheet links properly with some topics in mathematics subjects, commerce and accounts. Others noted that using a word processor can help students to improve their communication skills. Though many teachers were in the early stages of computer integration, some of them had overcome several major barriers and incorporated computers into teaching traditional subjects.

The other issue concerned students' knowledge of computer literacy skills. The overall findings as reported in Section 7.3.7 of this chapter indicated that in most of the schools, students were able to use the word processor to improve English language and to compose stories. Some of the schools taught students spreadsheet, database and basic programming. The present findings have also revealed that students generally learn with computers in a group of four or five, but sometimes they learn with the computers individually. Teachers also reported using computers for whole class teaching when explaining a point or teaching a new concept.

The computer teachers in the study were in agreement that computer education should be an integral component of teaching and learning. There were general positive views and opinions expressed by teachers on the potential of computers to motivate students to learn. Teachers' views and opinions appeared to directly influence the extent to which teachers use computers in teaching and learning. The overall finding showed that the majority of the interviewees regarded computer programs as very valuable, and believed that computer programs contain good learning materials, and presented it in stimulating and interesting manner that helps to introduce new ideas, widen access to education, and improve teaching and learning.

Another positive result of the study reported by the interviewees was benefits of using computers. All of the teachers believed that computers were beneficial to both the teacher and the students because they introduce a change in methods of instruction from theory to practical work. The computer also motivates students and breaks the boredom of classroom work. A study by Rudd (2001:219) noted similar findings. But further analysis revealed that the use of the computer does not provide students with an opportunity to interact or exchange ideas between the teacher and students compared to other methods of instruction.

In addition the interviews also elicited teachers responses regarding the impact of computers on students' learning. The findings indicated that students' interest during computer lessons was heightened and they were very lively, keen and eager to learn computer skills. Students recalled what they learnt from the computer program and were very attentive and concentrated very much on the machine to learn computer skills. Teachers reported also that after the computer lesson, students discussed what they learnt with their peers and consulted teachers on various points of the topics they learnt.

The research findings on the role of computers in schools revealed two major roles. The first role was to educate students in computer literacy skills, and to make the school community aware of the potentials of computers in education. The second role was for

administrative work, to keep school records, students' marks, official correspondence and communications including use of e-mail services.

The reasons for the different levels of computer usage among teachers were investigated. The reasons cited by the interviewees concerned mainly lack of appropriate software, lack of support materials, insufficient computers, lack of trained teachers in specific curriculum skills and classroom implementation strategies, and lack of enough time to use the computers in teaching and learning. As reported by Chiero (1997) and Pearson (2000), teachers need time to plan, research and use computers effectively. Some of the interviewees reported lack of power and the others experienced problems with inadequate software and lack of support materials. Some teachers were not able to use computers effectively due to these problems and limited access to software not available locally. Despite these problems, most of the interviewees were encouraged to use computers by the school administration.

The present findings have also shown that teachers were not adequately trained to integrate and use computers in teaching and learning. There is a need for a systematic teacher education program to enable all teachers to be computer literate. Although well-designed teacher training programs in computers may not necessarily lead to classroom implementation unless schools adopt specific plans to provide enough computers, it would be the right step towards 'whole' school integration of computers in education.

The issue of selection of software reported by the interviewees indicated that in some schools teachers selected software applications while in other schools the Principal selected programs. While in a few schools computer companies selected programs. Selection of software is an important issue discussed by Heinich et al. (2002:229) who noted the need to consider the format, content, ease of operation, accuracy, the design, completeness of the package, and learning outcome when selecting the software.

Despite the limitation of this current study in terms of small number of participants, the findings indicated that all teachers valued the use of computers in teaching and learning.

Although these teachers were convinced of the relevancy of computers, they could benefit more from full school integration of computers into subject teaching.

Common themes were evident in the teachers' suggestions for various ways to improve the use of computers in schools. High among their lists of needs included a clear government policy on the provision of computers to schools, teacher training in the use of computers, and the knowledge of curriculum issues in relation to computer education. Such suggestions as increased awareness and knowledge of software packages for integration were also cited. From these findings, it would appear that teachers would prefer computer programs with emphasis on subject integration. Therefore, for computers to be used effectively in schools, the existing teacher training courses need to be built around developing teachers' personal skills in computer utilization. Lastly, it is worth to note one important limitation of this study. Teachers told what they were doing with computers but the researcher had no opportunity to observe directly what was happening in their classrooms.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

In this chapter the researcher presents the main findings and conclusions of the research and recommendations for action, improvement, implementation and further research. The conclusions are based on the review of the literature and findings from structured and semi-structured interviews, as well as the findings of the questionnaire survey presented in the preceding chapters. All the research instruments have been attached in Appendices 8-12.

The study set out to explore and investigate the whole school integration of computers and in particular how teachers use computers in teaching and learning in public secondary schools in Nyanza Province, Kenya. Firstly, by looking at previous research studies on the use of computers in teaching and learning, and computer integrated education, both in developed and developing countries. Secondly, by examining various government policies on the use of computers in secondary schools, and thirdly, by field research studies to investigate:

- The implementation of the Ministry of Education policy on the use of computers in public secondary schools in Nyanza Province; availability of computers, teacher training in the use of computers, problems and attitudes towards computer integrated education discussed in Chapter 5 Section 5.3 and Chapter 6 Sections 6.4 to 6.4.4.
- Secondary school computer policies and school departmental policies on computer integrated education in teaching and learning presented in Chapter 6 Section 6.4.
- Why and how teachers use computers in teaching and learning, and integrating computers into traditional subjects examined in Chapter 6 and Chapter 7 Section 7.4

This study provided evidence that computers are integrated and used in public secondary schools in Nyanza Province in teaching and learning and in administrative work but to a

very limited extent. The study consists of eight chapters as briefly explained in the next sections:

Chapter one set out the main research problem, issues and objectives of the study. The methods used to collect data to achieve these objectives included a review of relevant literature on the use of computers in both developed and developing countries. It also included structured and semi-structured interviews and questionnaire survey research in Nyanza Province. Further evidence presented in Chapter one indicates that computers were introduced in public secondary schools in Kenya because computers give students computer literacy skills that are needed in the modern world. It also discussed the significant of the study, clarified the scope and limitation of the study, basic assumptions, and research questions. In addition, the chapter outlined the conceptual framework, sample of the study, data analysis methods, definition of concepts such as cooperative learning and computer-integrated education were described. The chapter ended with a summary of the organization of the thesis.

Chapter Two presented a review of relevant literature that examined the use of computers in teaching and learning in secondary education. It indicates clearly the value attached by educators to computer education as an important tool for teaching and learning and as a supplement to classroom teachers' work in developed and developing countries. Previous research studies suggested that if computers are integrated and used appropriately and effectively it could help to improve students' educational standard and provide more new knowledge of various subjects and confidence in computer literacy skills. Evidence from developed and developing countries reported by Kiboss (2000:119) and Zhao and Cziko (2001:23) also indicates that teachers felt computers helped students to develop accurate and correct communication skills, and perform mathematical calculations, scientific experiments and exploration. Chapter two also explored the functions of computers in secondary education, reasons for using computers in classroom teaching, patterns of using computers, and benefits and limitations of the computer as a tool for teaching and learning. This includes integrating computer education into traditional subjects, teaching and learning computer literacy skills such as word

processing, and using spreadsheet for storing, calculating and presenting information. Teachers reported using computers as tools for generating tables and graphs; creating and using databases for storing and retrieving information; and teaching and learning Programming languages such as Basic and Pascal. They also reported using computers to learn mathematics, science, social studies and languages.

Further evidence presented in **Chapter three** explored factors facilitating and affecting the implementation and use of computers in teaching and learning. This included factors such as need for educational reform, knowledge of skills to implement computer integrated education, availability of computers and support materials, motivation, time for implementation, planning and use, and reward or incentive for teachers. The review of literature demonstrated several factors that inhibit effective use of computers that included lack of suitable training and administrative support, lack of computer equipment, and lack of time to plan and use computers. It also included a discussion on the attitudes of teachers, accessibility to computers, lack of technical support, and cost of computer equipment.

Chapter four explained the methods used to collect qualitative and quantitative information and data. The empirical research for this study was conducted using interviews, questionnaires and semi-structured interviews in Kenya, concentrating in Nyanza Province. The interview method was used to investigate government policies and curriculum guidelines for the use of computers in secondary schools. The questionnaires were used to elicit information on school and departmental policies on the use of computer technology, and semi-structured interviews were used to collect data from computer education teachers. Chapter four also discussed the objectives of the field research, research questions, basic assumptions and sources of data. This includes content validation of the research questions, data collection procedures, choosing the sample, administration of research instruments, general plan for data analysis, problems with data collection and field research experience. This was followed by a summary of the chapter.

Chapter five provided a detailed analysis of interviews with Senior Education Officers from the Ministry of Education and Curriculum Specialists from the Kenya Institute of Education. It explained the research findings on the existing Kenya Government policy on the introduction and use of computers in secondary education even though the policy is not documented. It also presented information on the reasons for the policy, steps taken to implement the policy, implementation procedures, and problems and difficulties encountered with implementation. In addition, the chapter discussed curriculum guidelines for the use of computers, teacher training and evaluation of computer programs.

Similarly, **Chapter six** presented the research findings on the role of Principals and Heads of Department in the implementation and use of computers in their schools. This included evidence on the school and departmental policies guiding the use of computers in teaching and learning, and the role of the Principal and Heads of Department in the effective utilization of computers. The chapter outlined the research findings from Principals and Heads of Department on the use of computers. This consisted of using computers and computer programs to teach traditional subjects, availability of computers and other related resources, their views and opinions on the potential and value of computers to classroom teaching, teacher training in the use of computers and technical and physical problems. As will be explained in this chapter, the research findings generated in Chapter 6 were similar in most cases to those in Chapter 7 and provided a link for whole school integration of computers as suggested by Cornu (1996) and Dockstadder (1999).

Chapter seven described the research findings from semi-structured interviews with computer education teachers. The findings revealed how teachers use computers in teaching and learning. It also reported the types of computer application software that students have learnt, integration into traditional subjects, benefits and limitations of computers, impact of computers on students, and barriers to effective integration and use of computers in teaching and learning.

Lastly, **Chapter eight** provides a review of the thesis chapters, discussion of the main research findings, limitations of the study, implications of the findings for effective CIE in schools, recommendations for improvement, suggestions for further research and conclusions.

The field research was conducted both at the National level, by visiting the Ministry of Education and the Kenya Institute of Education to interview Senior Education officers and Curriculum Specialists about the policy and practice of computer education in schools. Also at the local level through questionnaire survey in twenty five schools, and semi-structured interviews in twenty schools on the use of computer programs in teaching and learning. The results of the study are presented in the following sections.

8.2. Summary of the results of the field investigations

The aim of this summary is to highlight important research findings regarding the use of computers in teaching and learning in secondary schools that participated in the investigations. Firstly, it is established that:

- The Government of Kenya has formulated a policy for the use of computers in secondary schools, but there was no written policy document circulated to schools so the policy was not clear and realistic. There were also no guidelines given to schools for the implementation of the Computer education in schools
- That there were no funds allocated for computer education in secondary schools. Instead secondary schools were expected to find money to purchase computers and support materials.
- There was no government policy on teacher training in the use of computers in teaching and learning. However, the main thrush of the government policy was that, secondary schools should use computers to teach computer literacy.

Secondly, it was evident from the data obtained that:

- Kenya Institute of Education had developed a Computer Education Syllabus and circulated it to secondary schools;

- There were no curriculum guidelines such as computer course books, teachers' and students' manuals and other related materials.
- There were no adequate funds allocated for conducting writing workshops and seminars on computer education for secondary school teachers.
- There was also no evaluation report of suitability of computer support materials used in teaching and learning in schools, or any general evaluation report on the use of computers in secondary schools;

In addition, the findings on implementation of the government computer policy in secondary schools indicated:

- That most of the Principals (76%) had formulated their school policy for the use of computers and practiced "Whole school integration of computer education and used computers to teach computer literacy, traditional subjects and in administration;
- Most of the Principals (80%) confirmed that teachers in their schools were using computers in teaching computer literacy contained in the computer syllabus developed at KIE. This included teaching students word processing, spreadsheets, database and programming;
- That only 48% of the Principals reported having been trained in the use of computers and regarded the training they received very important, but 52% had no training in the use of computers.
- All of the Principals reported having very little money for purchasing computers and other related materials so there was a serious lack of computers and support materials. The other findings indicated that there were technical and physical problems faced by most of the schools that affected the use of computers in teaching and learning such as lack of a technician and suitable facilities for the effective use of computers in the classroom.

Fourthly, the findings from the Heads of Department showed that:

- Most of them (77%) had no departmental computer policy, but 23% of them had a computer policy for the integration and use of computers in teaching and learning traditional subjects;

- Another results showed that 53% of HODs were trained in computer literacy but 47% were not trained in computer literacy. None of them trained in the integration of computers into teaching traditional subjects, although 61% of HODs were very positive about the integration and use of computers in teaching traditional subjects;
- Lastly, the majority of HODs had several problems that hindered effective use of computers by teachers in their departments. 53% of them reported lack of funds, 73% indicated lack of computers, and 71% reported lack of training in computer integrated education, while 60% indicated lack of support materials as some of the main barriers to integration of computers into teaching traditional subjects.

Fifthly, with regards to classroom teachers' use of computers in teaching, the results indicated:

- That 20 teachers from 20 secondary schools used computers mainly as a tool for teaching computer literacy. All of them reported teaching their students' word processing, but 85% used spreadsheets, 70% used database, 40% used graphics and 30% used programming.
- All of them indicated that students learn with computers in a group, but 50% said students learn with computers individually when they are given assignments. 40% of the teachers confirmed that their students had basic knowledge of computer literacy, and 40% said that their students had average computer literacy while20% had advanced knowledge of computer literacy.
- Teachers reported that the use of computers had an impact on students learning, because students recalled what they have learnt, improved their communication skills, and students discusses with others what they have learnt.
- The majority of them (80%) reported that the use of computers increased their students' motivation to learn, and confirmed that their students learnt new ideas about other subjects such as Mathematics, Science, Accounting and English language etc.

- That 40% of the teachers were integrating computers and used the medium effectively as a tool to help students solve complex Mathematical calculations,20% used spreadsheet as a tool for manipulating accounting ledgers in business education

subject, 10% of them reported using databases to access relevant information for learning different subjects., some of them reported using computers for teaching main part of the lesson.

- Moreover, the majority of teachers reported that the use of computers has helped to improve students learning traditional subjects, and improved their attention to learning and helped to teach students communication skills such as writing, grammar, spelling, composition, sentence structure and comprehension;
- Teachers reported lack of computers, suitable software and other support materials such as teachers and students' manuals. Others included lack of adequate time for the teachers and students to use computers, and lack of and training in the integration of computers in teaching as the major problems inhibiting the integration of computers into teaching and learning traditional subjects in their schools.
- The majority of teachers (60%) reported that they selected the software, and all of them indicated that they have MS Office Packages. In addition, some of them used Lotus 1, 2, 3, and MS DOS, Publisher and Accounting Packages. The above findings are discussed in details in the following section 8.3.

8.3 The main research findings and discussion

8.3.1 The Government policy

The research study was designed to achieve five objectives that were listed in Chapter one (see page 5). The first objective was to analyze existing computer integrated education policies in Kenya. The Government policy was analyzed and discussed in Chapter five. With regard to this objective, the findings seemed to be successful. The results indicated that the Government of Kenya has formulated a very brief policy for the use of computers in public secondary schools in accordance with the Education Act CAP211 of 1968 that is still in operation with amendments in 1980s and 1990s. The statement was contained in the Ministry of Education policy circular letter number lNS/ME/A/2/1A/51 of 31st January 1997 stating that the computers can be used in schools. Although there were no written policy documents specifically for computer technology in schools, it was believed that secondary schools would automatically

implement the use of computers to teach computer literacy skills. The Ministry of Education took a short-cut step to introduce computers into secondary schools without having a pilot project on a small scale so all public secondary schools were free to introduce computer education in their schools. This step was probably adopted due to the fact that computer application programs used to teach computer literacy skills were the same as those used in business and had been proved useful. However, the introduction of computer education without prior planning has led to many problems such as lack of implementation procedures, uneven patterns of utilization, difficulties with access to computers and support materials, lack of funds, and poor physical facilities.

The very brief government policy statement did not contain adequate guidelines to schools for effective implementation of computer education. For this reason, it was not realistic and did not take into account the situation in public secondary schools. This had implications for the effective introduction and use of computers in public schools. There were no guidelines about who would provide computers, software packages and other support materials. Teachers were not trained in the use of computers, and there were no adequate physical facilities. This has brought about computer educational inequality in secondary schools and imbalances whereby few schools offer Computer Education subject and few students have access to computer education.

In practical terms, computer education in public schools requires a public policy that clearly expressed the goals, strategies and desired outcomes. But the nature and extent of policy-making for initial and continuing computer education varies from country to country. In some countries the policies for computer education are clearly articulated. In others they are partial or minimal. For example, a study by Mizukoshi, Kim, and Lee (2000) found that there was a policy on the use of computers in Japan. Pearson (2001:279) reported the USA policy for computer education report "Getting America's Students Ready for the 21st Century" and the United Kingdom policy report "Connecting the Learning society: National Grid for Learning." Singapore published "Masterplan" for IT, and in Australia the Victorian Government published "Learning Technologies in Australian Schools 1998." Pearson (2001) noted also that Hong Kong published

"Information Technology for Learning in a New Era: Five Year Strategy 1998/99 to 2002/03." These are just a few examples of policy documents for the use of computers in schools. Such policy documents were not available in Kenya at the time of the interview. However, UNESCO (2002) reports that "some countries are slow to change or revise their policies" while "in others the policies are changed so rapidly and so frequently that those implementing them can be hard pressed to cope." In this connection, a study by Clark (2000) and Albion (2001) from developed countries found that computers were not used in many schools for teaching and learning.

Nevertheless, despite the Kenya government having no detailed written policy on computer education, the research findings confirmed that the government supports the use of computers in public secondary schools because the subject offers vital skills required by employers. So in order to implement the policy, the Ministry of Education authorized the Kenya Institute of Education to design and produced a curriculum guideline and Secondary Computer Syllabus for all secondary schools for teaching and learning computer literacy as discussed in Chapter 5 Sections 5.3.1. The syllabus could be seen as a de facto government policy document. The syllabus contains the aims and objectives of computer education for secondary schools. It was also established that schools should use computers mainly to teach computer literacy skills and students should sit for an examination designed with input from curriculum developers. The other finding indicated lack of a clear government policy on teacher training and distribution of computers to secondary schools.

8.3.2 Government's financial support for computer-integrated education in schools

The interviews at the Ministry of Education explored the issue of financial assistance to schools for computer education programmes. The Officer from the Ministry of Education reported that it was not possible to finance computer education projects for secondary schools because of the general decrease in the government budget for schools. This has affected the introduction and use of computers in many public secondary schools. The Officer noted that there was a fall in the budget for investing in computer technology.

This was as result of the implementation of a series of structural adjustment programs by the Kenyan Government that were imposed largely as a result of advice from the International Monetary Fund and the World Bank indicated in Chapter 5 Sections 5.3.5. The structural adjustment programs were intended to overcome the economic and financial crisis facing the country during the 1990s up to now. This meant that the Ministry of Education could not support secondary schools in their attempt to introduce computer education programmes.

As a result, only a few secondary schools that were financially capable implemented the computer policy. This has left most of the secondary schools with no option but to look for funds from other sources such as fund raising or school fees and donations of computer equipment. But the Kenya National Commission for UNESCO (1993:44) saw the danger of donations of computers and reported that "Developing countries are given no chance in the selection of technology for a particular purpose when the technology is in a field connected with foreign aid." Therefore, lack of awareness of the financial implications resulting from such running costs as maintenance, spare parts, stationary and storage facilities affects the implementation of computer programmes in some schools. This is true with the computers that were donated to Kenyan schools as discussed in Chapter 6. The research findings indicated that some computers had some components missing that could not be found locally, and many of the programs never worked. These issues and financial problems have frustrated most secondary schools in their attempt to implement computer education in their schools. In contrast, in developed countries like USA, funds are increasingly allocated to schools for the use of computers (Dawson 2000). There is need for the Kenya government to devise a strategy to look for alternative funds and to make a clear budgetary commitment to support computer education programmes in all secondary schools.

8.3.3 The Roles of Principals and HODs in the integration and use of computers in their schools

In Chapter 1, Section 1.3 the researcher stated the problem of the study and indicated a lack of information regarding the utilization of computers as tools for classroom instruction in secondary schools in Nyanza Province. The investigation was carried out and various issues concerning the use of computers in secondary schools were reviewed. The findings from previous studies reported by Yee (2000) and Dawson (2000) pointed out the vital roles of the Principals and Heads of Department in the implementation and use of computers in teaching and learning. Issues such as leadership role, policies, provision of computers for use in the school, students' use of computers, amount of use, skills and problems were identified. These issues were investigated in my field research and the empirical research findings were analyzed to obtain information regarding how the Principals and Heads of Department in my study tried to solve them.

The first important issue identified was the school policy and departmental policies on the use of computers. The research findings established that most of the Principals (76%) had some kind of policy for the use of computers and that the computers were used in teaching and learning computer literacy skills, and in administrative work as discussed in Chapter 6 Sections 6.4 and 6.6.4.

However, most Heads of Department (79%) had no departmental policy as shown in Chapter 6 Section 6.4. This could have been due to a number of reasons such as lack of coordination between the Principal's office and the departments, lack of awareness on the part of HODs of their roles as academic leaders to formulate departmental policies, or because some had not introduced computers in teaching and learning. This needs further investigation. It must also be noted that some of the schools investigated were using computers for administrative work only, and some Heads of Department had no access to computers. However, the overall findings established that there were more Principals of Girls' schools with policies than Principals of Boys' schools. as shown in Chapter 6 Section 6.4. This could be interpreted to mean that girls' schools were more positive

about the use of computers in their schools than boys' schools. This finding was contrary to similar previous studies that compared gender responses reported by Comber et al. (1997), Kutnick (1995), and Young (2000) indicating that computer education was a male dominated field.

8.3.4 Implementation of the school policy on the use of computers

According to Jansen (2002:202), the symbolic role of policy is displayed by the ways in which policy pronouncements make reference to issues of implementation. In this connection, the implementation of computer technology into a school system requires proper planning and well-coordinated strategies. Such implementation procedures need to consider educational objectives and related issues like orientation period, training of teachers, supply of computer equipment and preparation for teaching. Failure to address these issues during the implementation period might render the project not being implemented effectively, due to lack of implementation guidelines in Kenya's initial attempt at a computer education policy.

Research studies (Yee 2000 and Dawson 2000) indicate that successful innovations need to be backed up by the Principal's support and vision. Active involvement is a required ingredient for success of computer-integrated education. The research findings from my studies revealed that 80% of the Principals were involved in the implementation of CIE but 20% were not, as described in Chapter 6 Section 6.4. But the results from Heads of Department on the same question showed that 37% of HODs rated the implementation of policy very high, and 30% rated it average but 33% rated it low. The low responses to implementation of computer policy implied lack of adequate preparation for the introduction of computers in teaching and learning, or lack of computer equipment to implement the innovation.

8.3.5 Funding of computer-integrated education in secondary schools

Computing equipment is very expensive. The cost of purchasing enough computers and operating them are some of the main reasons why computers have not been widely used in secondary schools in Nyanza Province. Despite lack of adequate funds for computer education in the schools investigated, the research findings indicated that most of the Principals had set aside some funds for the purchase of computers and support materials. For example, six Principals in the study reported having 46% of their budget of about Kshs 1,000,000 for equipment used to purchase new computers. While five Principals had used 31% of their budget of about Kshs 1,500.000 for new computers. However, the findings from the Heads of Department indicated that 57% did not have any departmental funds for purchasing computing, but 43% had some funds allocated to them for purchasing computers. The overall result showed that very little money was allocated for the purchase of computing equipment as indicated in Chapter 6 Sections 6.5.1 and 6.5.2. What is required now is for schools to work closely with the government and parents to organize fund raising to supplement the government cost-sharing scheme for school equipment

8.3.6 Availability of computers in schools that participated in the investigation

Effective utilization of computers in teaching and learning requires sufficient availability of computers and other related equipment such as diskettes, printers, electricity, and teachers' and students' manuals. In developed countries like America, Britain, Canada and Australia, teachers have guide notes and student manuals are available, and schools have adequate computers (Opie and Katsu 2000:83). This research noted that the study institutions did not have adequate computers and support materials. The participants reported lack of enough computers in the schools. This was an important barrier to the effective utilization of computer education in teaching and learning. Only one school reported having 20 computers that were seen to be adequate for a class of 40 students, but the principal of this school complained of lack of funds to purchase ink, and for repair and maintenance as discussed in Chapter 6 Section 6.6. However, further analysis revealed that the sample of rural schools had more computers than the sample of urban and suburban schools that participated in the investigation. This was due to the fact that

most of secondary schools are situated in rural areas where the majority of people live. Although these findings do not necessarily mean that schools would integrate computers into teaching and learning, they do demonstrate that the nature of usage by teachers is influenced by the availability of computers in schools.

8.3.7 Availability of curriculum study guides and texts for the use of computers

Curriculum study guides and texts such as teachers' and students' manuals, relevant software, a Secondary Computer Syllabus and textbooks provide teachers with information and the guidelines on how to integrate and use computers. Without the necessary support materials the integration and use of computers in teaching and learning cannot be fully effective. Most of the Principals who participated in the investigation reported having a Secondary Computer Syllabus produced by the Kenya Institute of Education. None of the computer teachers had teachers' guide notes from the Kenya Institute of Education because these guide notes were never produced.

However, experience in other countries suggests that teachers could make more effective use of computers and make their lesson presentation effective by using guide notes to help advanced planning and lesson preparation. Teachers noted the importance of support materials and 20 of them expressed their concern about the important role of the teachers' guide notes for the effective use of computers. The majority of the Principals (76%) also reported that teachers' manuals were central to the effective use of computers in teaching and learning as shown in Chapter 6 Section 6.6. The question is who should provide computer support materials to schools. The curriculum specialists at KIE have only produced a Computer Education syllabus for secondary schools. The curriculum specialists at KIE should work out the modalities of how to produce and supply other support materials to secondary schools. This could be achieved easily by involving computer teachers to develop the required support materials and KIE to purchase relevant software for schools to integrate computers into traditional subjects. Moreover, if KIE does not produce computers support materials, schools should try to obtain similar materials from other places. For example, if teachers are teaching word processing they

do not need support materials developed especially for schools in Kenya. They can use support materials that are available in other countries like South Africa or from computer companies.

8.3.8 Access to computers in schools for teachers to use in teaching and learning

It has often been suggested that accessibility to computer equipment influenced the integration and use of computers in teaching and learning (Sandholtz 2001). Access to quality software is also considered to be an important factor that encourages teachers to integrate computers into traditional subject teaching. It is assumed that once the computer equipment is available, teachers would use it for teaching and learning, and this assumption seems to have been made in Kenya. But the nature of equipment and software can also be a factor limiting usage. Furthermore, access to computer equipment does not just mean obtaining a computer or software, but it includes getting it and using it as required. These issues were investigated in my study and the results revealed that 50% of Heads of Department reported their teachers had access to computers but 50% of them reported that their teachers had some problems of access to computers. They complained of lack of enough computers and a crowded timetable that did not allow them to use computers adequately as explained in Chapter 6 Section 6.6.3. Therefore, it can be concluded that lack of access to computer equipment was a barrier to effective computer integrated education in the schools investigated.

8.3.9 The use of computers in the schools that participated in the investigation

Despite the problems reported by Principals and Heads of Department regarding the implementation and use of computers in secondary schools, it is evident from literature (Bitter 1989; Heinich et al. 1996 and 2002) that computers can be used effectively in education. There are many ways in which computers can contribute to improving education and continue to contribute to the process of improved teaching and learning. Firstly, computers can be used as tools to teach students computer literacy skills such as using word processing to compose stories or to improve writing skills. Secondly,

spreadsheets can be used to create work sheets, storing, calculating and presenting information, or to provide mathematical functions such as logarithms and trigonometric or use them as tools for generating tables and graphs. Thirdly, databases can be used for filing, storage and retrieval of information, or access to information already stored. Fourthly, teachers can use computers to teach students the computer programming languages such as Basic and Pascal etc. Fifthly, computers can be integrated into teaching curriculum subjects like mathematics, science, social studies, and languages as explained in Chapter 2 Sections 2.9.5 to 2.9.7, and in Chapter 6 Section 6.7, Chapter 7 Sections 7.2.10 to 7.3.5. Sixthly, computers can be used in administrative work for keeping school records, preparing school budgets and preparing examinations and this also contributes to improved teaching and learning. The research findings from my study indicated that computers were used in these ways in some public secondary schools in Nyanza Province. The participants gave various reasons for using computer programs. They reported that computer programs were used to teach computer literacy skills, and this also helped to improve students' communication skills. This involved using the computer to teach students how to open their files, store and retrieve information, compose stories and save their work. Teachers reported that the use of computers helped to motivate students to learn because students enjoy working with computers. Most of the computer education teachers (80%) noted students are excited when it is time for computer lessons and more interested in computer lessons than in other subjects. Tiene and Ingram (2001:173) expressed similar sentiments when they observed that just getting the opportunity to work on the machine could be motivating to the children. The majority of the Principals confirmed that computers were used in their schools and (80%) reported that teachers use computers for teaching and learning computer literacy and 16% used computer for administrative work. While 37% of Heads of Department confirmed teachers integrate and use computers as a teaching and learning tool as discussed in Chapter 6 Sections 6.7.1 and 6.7.6. However, it must be remembered that the 25 schools from which data were gathered represent less than 5% of the 524 secondary schools in Nyanza Province so, overall, the use of computers in schools in this province was extremely low at the time of this study.

The programs used by the teachers to teach computer literacy skills were those in the Secondary Computer Syllabus produced at the Kenya Institute of Education. However, there were differences in the extent to which computers were used in teaching and learning. Some schools reported using computers at least five times a week, others used computers four times and still others used it two or three times a week as indicated in Chapter 6 Section 6.7.6, Chapter 7 Sections 7.4.1, and 7.4.2. Because of these differences in the amount of computer usage in school, it would be helpful if the Ministry of Education issued clear policy guidelines to schools stating the number of periods per week for computer education. This will enable all students in schools with computers to receive equal time for computer lessons in the same way as time is allocated to other subjects.

8.3.10 Integration of computers into the teaching and learning of traditional subjects

Integrating computers into the school curriculum means introducing new methods and strategies of teaching and learning in the classroom. It provides students with a learning environment that is student centered. Previous researchers supported the integration of computers in the teaching of the traditional subjects (Dockstadder 1999; Mills and Ragan 2000) because CIE offers considerable advantages to students in achieving more balanced learning outcomes. The research findings from my studies revealed that computers have been integrated and used effectively as a tool to help students solve complex mathematics calculations, and to help students to learn specific skills in various subjects. The findings indicated also that teachers used spreadsheets as a tool for manipulating accounting ledgers in a business education and accounting subject. Furthermore, the results showed that with databases, computer integrated education enables students to access relevant vast quantities of stored data on different subject topics as shown in Chapter 7 Sections 7.4.2 to 7.4.3. However, there were many barriers to the full-scale integration of computers into the teaching of traditional school subjects. Teachers reported a lack of training and information guiding the integration, and lack of computers and relevant support materials.

From the above research findings, it can be concluded that computer integrated education has an important part to play as an effective supplement to traditional teaching methods. Computer integrated education has the potential to be effective instructional mode when measured by the results of students' learning achievement. Furthermore, CIE appears to be more effective in individualized learning, group learning, whole class instruction and in problem solving. Another important value is that it involves individual student actively in the learning process. It enables the learner to proceed at his own pace, which has strong implications for the education of both slow learners and the advanced students. In this way, the computer has been viewed as extremely useful for remedial teaching. Since the findings from this study have provided valuable information regarding the move taken by teachers to integrate computers into teaching and learning traditional subjects, it is important that KIE embark on producing well-designed curricula that integrate computer technology into various subjects for effective utilization in secondary education in Kenya.

There is ample evidence in the literature that when computers are integrated into the study of traditional subjects such as science they can improve students' learning. However, the potential for computers to improve learning cannot be realized unless two important things are in place. First, the teachers must be skillful in teaching in traditional ways so that they know how to motivate learners, how to explain things clearly, how to assess learning in appropriate ways, and so on. Second, the teachers must be very knowledgeable about the subjects they are teaching so that they can recognize when it is most appropriate to use computers as a teaching tool. The present study did not investigate either teachers teaching expertise or their knowledge of the subjects they are teaching so it not known how these factors may be limiting the use of computers by the teachers in Nyanza Province.

8.4 How computers are used and reasons for using computers in the classroom

Various patterns of how computers are used in teaching and learning were identified in this research. Firstly, there was instructional use of the computer as a tool for teaching computer literacy skills that was common in all schools. The computer applications listed

in the computer syllabus produced by KIE played an important part in the teaching and learning of different computer literacy skills. This included:

- Using computers for teaching and learning word processing, spreadsheet, database and programming;
- Using computers as a remedial tool for students who lagged behind other students to do extra work or revise what has been taught;
- Using computers for supplementary instruction for average students in the class; and
- Using computers as enrichment for students who are ahead of the rest of the other students in the class;

In addition, teachers indicated conducting classes in a teacher-centered approach and this involved:

- Using the computer mainly for drill and practice, after which students learnt in groups of two, three, or four sharing one machine, and sometimes students used the machine individually during examinations.

Moreover, teachers reported using computers for whole class instruction particularly when introducing students to a new topic, new skills or concepts as indicated in Chapter 6 Sections 6.7.2 and Chapter 7 Sections 7.4 to 7.5.

Secondly, teachers reported using computers to supplement classroom teaching of traditional subjects. Teachers stated that computers were useful tools for teaching some topics in the curriculum such as accounting, science, mathematics and English language especially communication skills, comprehension, grammar and spelling. Some teachers used computers for enrichment and extending topics beyond what is normally available in the curriculum as explained in Chapter 7 Sections 7.3.1.

Some teachers indicated that they use computers because it facilitates easy and faster acquisition of knowledge. However, this study did not seek empirical evidence to support these claims.

This study has also shown that schools use computer programs to meet a great variety of educational needs, both in school and out of school, and that teachers believed that computer programs could make a significant difference in the quantity and quality of learning. Participants reported that computers provide benefits such as giving students experiences that would be difficult to provide in any other way, and providing the teacher with new information that helps to explain subjects such as English language better. Most of the English language teachers and students regarded computers as an important tool that helps students to learn new and difficult words by providing immediate feedback on any mistake they make. So the computer helps students to improve their English vocabulary, spelling, sentence structures, grammar and comprehension. It also helps teachers to vary their lesson presentation, and use practical work that students enjoy. Participants noted that computers stimulate students' imagination and offer experiences not provided by the teacher that help them to build on traditional subjects they learn.

The use of computers is now an important part of secondary school life in Nyanza Province secondary schools where the data were gathered so there should be whole school integration for all subjects in the school. Teachers believed that the use of computers could produce a significant improvement of the educational results if they are appropriately used. However, good results depend on how the computers are used as a tool to help solve classroom problems. For example, one of the computer education teachers reported that "*because my students are not performing well in mathematics, the computer helps me to teach topics such as statistics, graphs, square roots, cube roots and means etc.*" Another teacher reported that *"since I started using computers and since in form three students use MS Word their language has changed and this has helped to widen their vocabulary."* At the same time, a science teacher reported that *"If I am using a computer during literacy classes I may make reference to the topic in my subject then students look at it in the computer."* Moreover, one of them said "*I usually put the notes in the computer so the students come to the computer room and read it. It is like you give them a handout and they learn from it. I believe it helps them to learn on their own."*

Despite the computer being introduced in secondary schools in Nyanza Province only recently, and with all the shortcomings and lack of equipment and software, computers are making positive contributions to teaching and learning computer literacy skills and traditional subjects. There is urgent need for teachers to be supported by the school administration to integrate and use computers effectively.

8.5 Training teachers to integrate and use computers in teaching and learning

Previous researchers (Dugdale, 1994:249; Gobbo and Girardi, 2001:68; Holland, 2001:245) have argued that in order to use computers effectively, successfully and appropriately, all teachers should be trained and need to be competent to use computer applications in teaching and learning. This study suggests that the effectiveness of computers as a tool for classroom instruction could be improved if teachers are trained and are conversant with the stages of the applications of computers in teaching and learning suggested by Jakobsdottir (2001:88-89). These stages include familiarity and confidence, integration and adaptation to other contexts and creative application to new contexts. My research findings showed that the majority of the Principal, and Heads of Department who participated in the investigation had no training in the use of computers, but the majority of teachers (95%) interviewed in the study institutions had some training. However, it must be remembered that the 20 secondary schools that provided data for this study represented just 4% of the total number of schools in Nyanza Province. As far as the researcher could ascertain, none of the other teachers in these schools had any training or experience in the use of computers in teaching and learning.

Training of teachers in the use of computers could be a step forward in motivating them to change their beliefs about the use of computers and help them to utilize computer technology more effectively in teaching and learning. It would enable them to integrate computers into traditional subjects so as to improve lesson presentation. Although Jakobsdottir (2001:88) argues that changes from traditional methods of teaching could be difficult and time consuming, I believe that if all teachers are aware of the benefits and have the skills required to use computers effectively most of them will integrate it into

their teaching activities. In addition, other methods to overcome these obstacles would be to employ computer coordinators at the school level and provincial level to work as change agents, to provide a link between the Ministry of Education and the schools. These coordinators could also train teachers, provide technical support, organize schools' instructional computing programs and advise teachers as needs arise.

Evidence from semi-structured interviews and the questionnaire survey showed that teachers would appreciate training in the use of computers as discussed in Chapter 6 Sections 6.8 to 6.8.2 and Chapter 7 Section 7.8.2. Teachers need to know and apply computing skills relevant to students' abilities and level of education. They also need to be aware of technical problems such as trouble-shooting. Pre-service training of teachers in the use of computers could be promoted if all students in the teacher training colleges and universities were encouraged to use computers during their studies and during teaching practice. All the participants supported the need to attend short in-service courses and workshops. The interviews with teachers revealed that only 45% of them had attended an in-service course on computers. The effective utilization of computers requires up-dating teachers' knowledge on new developments in computer-integrated education.

8.6 Technical and physical facilities, and problems with the use of computers in the classroom.

As with adoption of any curriculum innovation, the use of computers in teaching and learning presents teachers with many problems and challenges. Teachers in the schools investigated experienced several difficulties that made the implementation and use of computers difficult, and sometimes impossible to achieve. Some of these problems included teachers' beliefs or attitudes and others were school-based problems. The findings indicated lack of enough computers for students, lack of teacher training, low level of confidence in the integration and use of computers, and lack of enough funds to purchase computer equipment as major problems inhibiting the effective use of computers in schools. Further results showed that 56% of the Principals had not

employed a technician. However, the presence of a computer technician would be important in encouraging teachers to use computers. All the participants reported that they needed technical support in hardware and software operations, maintenance and expert advice on the integration and use of computers. While some schools had a computer room or center, only 88% of the schools had a supply of electricity that was adequate for teaching and learning with computers. Other schools used power from generators that was not adequate for effective teaching and learning with computers.

8.7 Views and attitudes of the participants about the value of computers in education

The attitude of teachers towards computers as a tool for teaching and learning is an important determinant factor of the effective implementation and use of computer integrated education in schools. Since decisions about whether and how to use computers in teaching and learning are heavily influenced by the teachers' views and attitudes, and by their perceptions of the value and benefits of computer integrated education in motivating students to learn it was necessary to investigate their attitudes. While factors such as accessibility of equipment clearly influence teachers' attitudes, their willingness to incorporate computer programs in their lesson plans is also vital. This study has demonstrated that most teachers in the case study, the Principals and Heads of Department had a positive attitude towards the use of computers in teaching and learning. Some of the Principals (about 61%) rated the use of computers as excellent and good for the students, but 30% rated it as fair while 8% rated it as poor. At the same time, 89% of the Principals had a positive attitude about the impact of computers on students' learning, and 87% of HODs rated computers as valuable tools for classroom instruction. However, a few of the participants showed negative attitudes towards the use of computers in teaching and learning. This could have been due to a lack of suitable school environment for computer-integrated education, or due to teachers' traditional pedagogical beliefs and resistance to change. Therefore, in order to encourage teachers to introduce computer integrated education in teaching and learning administrators need to create a better school environment by providing more training opportunities, more workshops, technical

support and rewards to computer teachers. Then other teachers may eventually be motivated to integrate and use computers in teaching their subjects.

The other research findings indicated that teachers believe that computers contribute to students' learning in various ways. Some teachers believe computers keep learners abreast with modern technology and make them keen and sharper in solving educational problems. Others agreed that using computer applications enables students to gain new ideas on various subjects, perhaps more than would be provided by the teachers. Some of the findings revealed that participants believed the use of computers introduced new ideas to teaching and learning, increased students' curiosity, promoted creativity, provided current information, and encouraged sharing of ideas through Internet and e-mail services. But others expressed opposing views and argued that although the computer is good for generating new ideas, it should not be used to replace the teacher and thereby cause unemployment for many teachers if it is integrated into subject teaching. This view could be attributed to fear of computer technology that some teachers have or due to lack knowledge of how to use computers or due to resistance to change. However, some of the findings suggested that computers do not help students with speaking skills whereas this is an advantage of radio and television/video programs. Others revealed that computers do not allow students/teacher relationships, interactions or face-to-face discussion that can be achieved by a classroom teacher.

The findings of this study have much practical significance for researchers, policy makers and teachers involved in the integration of computers in schools in Kenya. The overall qualitative and quantitative data from my study provide a useful basis from which to reflect upon the need to introduce computers in schools by the government. The study highlighted some of the current realities and future vision for computer-integrated education in Kenyan schools.

8.8 Suggestions and recommendations regarding the use of computers in the classroom

On the basis of the results of this study, the following recommendations are made:

8.8.1 Government Policy

The findings of this study indicated that Government policy for the use of computers in public secondary schools in Kenya is not fully effective due to lack of written policy document and guidelines circulated to schools. Even though there was no official policy document on the use of computers in Kenya, the government officials interviewed reported that the Kenya Government supports the idea that computer is important. *This study recommends that the Kenya Government should publish a policy document for the use of computers in schools, and guidelines on the policy implementation to be issued to all schools and field education officers*. When drafting this policy, the government will need to take into account at least the following issues:

- The need to provide a clear objective rational for requiring Kenyan school students to develop knowledge and skills in computing.
- The question of whether computer skills should be developed in public primary schools;
- The needs for appropriate teacher training. This training should be geared towards pre-service student teachers and re-training serving teachers;
- The value of compulsory computer integration in science and mathematics subjects;
- A clear plan for financing computer education in schools, curriculum development and an evaluation programme.
- Plans for putting up computer laboratories and getting schools connected globally through the Internet.

However, some important implications from this recommendation need particular attention:

- The government must set aside money for purchasing computers or develop realistic strategies for obtaining funds from outside sources;
- The Ministry of Education must work closely with KIE and schools for the implementation of the computer integrated education policy;
- The Ministry of Education must work closely with Faculties of Education at the universities and teacher training colleges to train teachers in CIE

Therefore, the government needs to introduce a policy to make computer education compulsory for all students in secondary schools, and a clear guideline should be provided to Principals for the implementation of this policy. It should contain all the procedures necessary for effective implementation so that all teachers can be aware of what is expected in teaching and learning with computers. Lack of clear and appropriate policy guidelines for teachers affects the implementation of computers in schools. There is need for a policy document for the implementation of computers in schools. This should be similar to the policy implementation guidelines from the USA, UK, Hong Kong, Singapore and Australia (Pearson 2001) that were reported in Chapter 2 Section 2. But the implication is that the government will have to address the following issues immediately if computers are to be used in schools effectively:

- Encourage the training of computer teachers;
- Provide financial assistance to schools for purchasing computers and software;
- The Ministry of Education and Kenya Institute of Education to develop a policy guideline for schools, and provide teachers guide notes, students' manuals and textbooks for effective implementation of CIE.
- The government should encourage the school community to be computer literate. The implication here is that the government will have to establish community resource centers where people could learn basic computer literacy. To seek for donors to assist in developing such centers, and to employ computer teachers. It will also require people to pay some fees for using computers.

8.8.2 Role of Kenya Institute of Education in developing CIE related materials

Kenya Institute of Education was established to conduct research, design and produce curriculum materials for schools and teacher education below university level. This study therefore, recommends that:

- *The Ministry of Education in conjunction with Kenya Institute of Education should design secondary curricula that include the integration and use of computers in different subjects;*
- *Kiswahili language should be promoted by using computers as in other languages such as English and French;*
- *Curriculum specialists need to visit teachers more frequently to identify the problems they are experiencing and receive suggestions for improvements to the curriculum;*
- *KIE needs to identify curriculum areas in all secondary schools subjects into which computers could be integrated and select experienced subject teachers and computer teachers to work with curriculum specialists to design and develop teaching and learning materials for CIE in schools;*
- *Since most public secondary and primary schools may not be able to purchase computers immediately for teaching and learning, KIE should conduct research and develop computer curriculum for all grades that does not necessarily require practical work. This will enable all students to have theory classes in the same way as they do in other subjects to prepare them for practical work in future.*
- *KIE should organize writing workshops for Kiswahili teachers to be trained in software design or assisted to write interactive lessons that the designers of software can use in order to produce interactive Kiswahili lessons;*
- *Schools should be encouraged to look for other relevant computer materials from other countries such as South Africa which they can use in the integration of teaching traditional subjects, as it would be expensive to produce computer materials specifically for Kenyan schools. This would be less costly and a quick way of getting computer resources for many schools.*

- *The Government should establish a National Computer Technology Resource Center at KIE to deign and implement various training programmes, to offer advice to schools; to carry out evaluation of computer programmes in schools; to be involved in curriculum development for computer integrated education in the school curriculum; to act as documentation center for CIE; and to carry out basic research and development in new areas of computer technology; and to set up a link arrangement with international organization, institutions, for information exchange and staff development*

The above recommendations have the following implications:

- Financial implications for organizing writing workshops and production of Computer Education materials such as teachers' guides, students manuals, course books and distribution to schools;
- Time to plan for Kiswahili software project research, design and re-training of teachers, production of materials and dissemination of information and computer materials to schools;
- Project team leaders and recruitment of local staff and resources for the project.

8.8.3 Provision of computers in public secondary schools

According to the Ministry of Education Officers interviewed, the government has no funds to finance computer education in secondary schools. This includes provision of computers to schools, and training of teachers in the use of computers. The high cost of computer equipment and support materials is an issue that needs to be addressed by the government. Firstly to promote the use of computer in the country and to help public secondary schools to implement computer education policy effectively. One of the major factors identified by the respondents that affected the use of computers in schools was lack of computers in schools reported in Chapter 6 Section 6.6. Secondly, since the government of Kenya has no policy for financing computer education in secondary schools and in order to overcome the problem of lack of computers in schools, the study makes the following recommendations for action:

- *There is an immediate need for the government to investigate viable ways of making computers available to schools so that schools could purchase enough computers for students and so that teachers could also own computers and use them at home to up-grade their skills.*
- *The government should approach business communities to donate computers to schools;*
- *The government should remove all taxes on computers imported into the country to reduce the cost so that parents and politicians can donate computers to schools;*
- *For effective integration of computers into teaching and learning, schools should have enough computers so that at least five students can use one computer as was suggested in the Secondary Computer Syllabus supplied to schools to allow or enhance accessibility by all students.*

However, the following implications need to be considered by the Ministry of Education. Firstly, the government will have to use its machinery to solicit funds from developed countries to assist schools with funds to purchase computers and related support materials. Secondly, the government will need to re-examine its budget to allocate some funds for secondary schools for computer-integrated education. Thirdly, the government will need to approach Non Governmental Organization to contribute computers to secondary schools. Fourthly, schools will have to put up large computer rooms for students to work comfortably with computers.

8.8.4 Role of Principals in the integration and use of computers in schools

There is need for each school to have a whole school policy for the integration of computers in the curriculum. By integrating computers into traditional subjects, effective utilization will be realized because many teachers will be involved in computer integration in teaching and learning. Teachers will also use computers to keep students records and analyze examination results. While the Principals will use computers for administrative work such as budgeting, correspondence, staff records, students admission records, examination ranking and other school programmes. It is therefore recommended that:

- *In order to implement CIE in schools, all schools must have a clear written policy for computer-integrated education, and policy guidelines circulated to all departments, parents, PTA members and BOG members.*
- *There is need for Principals to have a clear vision and personal investment in the idea of using computers for teaching and learning. There must be a passion in the Principals' mindset that the use of computers will help to improve the achievement and the education of students.*
- *All Principals must be trained in computer leadership, and management of resources for teaching and learning, and to have some degree of computer literacy in order to appreciate the benefits of computer integrated education in their schools. By being computer literate they will be a role model for the staff and students to emulate for the effective integration of computers into the curriculum.*
- *The Principal must establish a climate for change in the school and school system. The need for change must be clearly understood by teachers, students and the school community. In all CIE activities, collective decision-making should be employed so that everyone in the school community is actively involved.*
- *In order to implement CIE effectively, a school has to involve the community so the Principals parents, PTA, and BOG must work cooperatively to proved computers for use in their schools. This means that important decisions about CIE have to be made by the people most affected and each school has to look at innovation in its own way.*
- *All schools must have adequate funds for computer integrated education. There must be adequate funds for purchasing new computers and maintenance and repairs.*

In summary, there are various implications to the above recommendations that need to be addressed by the school administration. Firstly, since the Ministry of Education have no funds for CIE in schools, the school administration, parents, PTA, and BOG will have to start a school computer project to organize fund-raising for purchasing computers and other related materials. Secondly, Principals of schools will have to look for alternative

solutions to provide computers either by appealing to local personalities such as the politicians, civil servants and business people for donations of computers and other support materials. Thirdly, in order to implement CIE effectively in schools, Principals will need to have proper computer rooms fitted with all the required equipment.

8.8.5 Role of Heads of Department in the implementation of CIE

As mentioned earlier in Chapter 6 Section 1, Heads of Department are the academic leaders of subjects in their departments. From experience, most attempts at effecting change in classroom instruction fail because leaders have no plan at all or have no idea of how to implement the innovation. This study recommends that:

- *In order to support the school computer policy, Heads of Department must have departmental policy for computer-integrated education and all teachers in the departments must be informed accordingly. This includes having a departmental time table and clearly stated objectives for the integration and use of computers in education;*
- *All Heads of Department must be re-trained in computer integrated education in their teaching subjects;*
- *All heads of Departments must be re-trained in the management of computers in education for effective teaching and learning;*
- *All Heads of Department must have at least a computer in the department.*
- *Heads of Department must identify training needs for teachers in their departments and develop a plan that will facilitate staff development programmes in computer-integrated education.*

Based on the above recommendations, the following implications need to be addressed by the school administration: Firstly, the Principals will have to provide funds and time to ensure that all Heads of Department are re-trained in CIE. Secondly, Heads of Department will have to develop an action plan. The plan should identify how and when the goals and objectives of CIE will be achieved and who is responsible. Thirdly, HODs

will have to establish goals and objectives of CIE in departmental teaching. Fourthly, HODs will need to develop a mission statement for the department. Lastly, HODs will have to initiate professional development in the department. This involves creating a framework that encourage teachers to critically examine themselves as professionals by using evaluation format of the lessons and what one needs to be a competent CIE teacher.

8.8.6 Teachers' use of computers in the classroom

Teachers are the most important resource in a school. They play an important role in curriculum implementation. Teachers should be sufficiently involved in computer application in class. Just getting some basic computer skills is not enough and will not provide teachers with computer skills to provide solution to problem of effective computer integration in class. Research from developing countries like USA and Britain suggest that teachers must be prepared to integrate computers into teaching and learning (Bitner and Bitner, 2002; Crawford, 2000; Zhao and Cziko, 2001; and Nisan-Nelson, 2001). Therefore, in order to achieve the goals of CIE in schools, this study recommends strongly for immediate action that:

- *Teachers must be trained to learn how to integrate computers into their teaching process.*

- *Effective in-service teacher training course for serving teachers must be addressed by the government and under taken by the Ministry of Education at Provincial, and District level. The government must draw relevant programmes to ensure that all teachers are trained in CIE for classroom instruction.*

This can be achieved by involving Inspectors of schools and teacher trainers such as computer experts from the computer colleges, and personnel from Faculty of Education offering computer courses to pre-service teachers. In addition, the researcher recommends that:

- *The Kenya Institute of education in conjunction with the Provincial Director of Education in Nyanza Province should organize seminars and writing workshops at district level for teachers to learn and produce computer materials for various subjects, and to exchange views regarding computer-integrated education.*

- *Principals should work closely with computer firms or companies to provide opportunities for teachers to attend workshops or exhibitions aimed at increasing the competency of teachers who are computer literate to receive advice on computer applications software.*

This can be achieved if the Principals getting information from computer firms about displays of new computer and other components, teaching and learning resources, open days, exhibition days and any education programmes useful for teachers to attend. Moreover, it is recommended that:

- *The Principals should adopt a much more flexible school based re-training model recommended in section 8.4 to motivate more teachers to use computers in teaching and learning.*

This can be attained if the school provides administrative support to teachers and to encourage them to have some time to attend computer lessons intended to refine their computer skills. The services of newly trained teachers with computer knowledge could play a vital role in bringing innovative ideas for using computers in teaching and learning. Or the Principals could invite experts from computer training colleges to retrain teachers.

However, the following implications for an effective staff development need to be addressed by the school administration. Firstly, training needs of the staff as a group and the various individuals must be assessed accurately. The Principals will have to use staff appraisal and investigation to identify teachers who really need re-training in computer integrated education. Secondly, training programme will require careful planning, so both

individual and group re-training must focus on recognized needs and must be monitored regularly. Thirdly, high standard of performance must be established and evaluated. The goals will have to be set for all participants. Fourthly, the Principals will need to readjust staff work time programmes to provide time for interested teachers to work in the computer room, and to provide incentive or reward to the newly appointed teachers who provide such services to staff members. Lastly, positive support from the Principal must be provided to teachers.

8.8.7 Need for specific pre-service teacher training in CIE

If teacher-education programmes are to achieve their goals of creating confident and competent classroom computer teachers there is need to consider the necessary components of the required skills and inherent motivation to use the computers effectively and widely in instructional settings. It is therefore recommended that:

- *All pre-service teacher education programmes must include computer literacy courses and CIE in various subjects.*

- *Teacher training institutions and Faculties of Education in universities need to use computers in teaching to demonstrate their competency and serve as role models for their students to integrate and use computers.*

- *Faculties of Education and teacher training colleges need to provide intensive training of all pre-service teachers in the integration and use of computers. Pre-service students must use computers during teaching practice and be assessed before joining the teaching profession. Such training should include special methods of teaching with computers, subject integration, lesson planning and preparing schemes of work, trouble shooting problems, and be able know the basic components of modern computers and peripherals as well as their main functions;*

- *The Teacher education programme at Maseno University as well as in other universities in Kenya should expand pre-service teacher training programmmes to include computer-integrated education for regular and part time students.*

This can be achieved by restructuring some of the present courses offered in the department of Educational Communication Technology and Curriculum Studies to another approach that would effectively provide integrated training programmes for a wide range of teachers. Such courses should include:

- Restructuring the academic programmes for the Bachelor of Education degree and the Post Graduate Diploma in Education to in-corporate computer integrated education;
- Design a new short certificate course programme to improve skills of teachers in methods of teaching and CIE;
- Design a new degree programs such as BEd (Hons) in computer integrated education for serving teachers in specific subjects like Mathematics and Science;
- Design a new Advanced Certificate in Education (ACE) in computer-integrated education.

These new courses suggested are very important and the academic administration needs to consider them for implementation. In summary, there are at least five implications for the above that need to be addressed. Firstly, lecturers will have to be trained in computer-integrated education to be able to train teachers. Secondly, the University will have to recruit new staff and provide resources for teaching and learning. Thirdly, the lecturers will have to design course content for the new degree and certificate programmes. Fourthly, the University will have to provide funds for administration of the courses and staff remuneration.

The other implication for the introduction of new courses is that of time. The training needs of teachers as a group and the various individuals must be assessed accurately.

There is need to consider the amount of time that it will take various individuals to master a concept or skill. Because people learn differently, some people take longer to learn a given piece of knowledge than it does to others. This will require careful planning and a variety of approaches. To alleviate the problem of time, training institutions will have to develop modules for short time and further training for computer teachers that can be conducted during the university vocation, and also to provide evening classes at specific urban centers for teachers interested in the training.

8.9 Re-training model for serving teachers in computer integrated education

Teachers are central to effective teaching and learning in schools. They also represent the Their role in curriculum innovation requires knowledge in methods of teaching and use of resources to help improve classroom instruction. Thus, their preparedness and professional development is necessary for the success of any curriculum innovation. From experience, there are three major approaches to professional development of teachers in teacher education that focuses on serving teachers. These training can take the following forms short and long courses such as continuous on-the job training, short in-service training and the formal part time graduate degree programme that takes long time to be completed. This study recommends that:

- *In order to help more teachers know how to use computers and modern teaching methods, the Principals should organize some short-term training courses for the teachers during school holidays..*

In such a training programme, facilitators should be drawn from computer firms, computer colleges and universities or colleges of education training students in the use of computers. The components of the training contents should be in two parts. One part to concentrate on the basic computer knowledge including operating system (Window 98, Window 2000, Office series (Word, Excel etc) and the use of Internet. The second part should deal with helping teachers to integrate computers into traditional subjects, while those teachers with advanced training in computers should learn to make teaching software. To motivate teachers to attend the in-service training during the holidays,

academic credit should be awarded to those who complete the course, and a certificate offered by a recognized body such as the Kenya Education Staff Institute (KESI).

- *All serving teachers should be provided with on-the-job training in teaching with computers. The training should be offered during teachers' spare time while normal teaching work can be kept as well.*

The purpose of such training should be geared towards helping teachers to acquire the knowledge, skills, attitudes and ability if teachers are to use computers effectively in the classroom. Schools should have their own computer resource persons (experts) to run the course. The school should encourage teachers interested in computer in education to take computer home for the week-end or during school holidays. These and other approaches to staff development in the use of computer in education need to be expanded if computers are to achieve their potential in schools.

Therefore, in order to realize effective implementation of computer integrated education in each school, there is a need for Principals of secondary schools in Nyanza Province to devise a method of staff development similar to the one suggested by Cooley (2001:269-282). The 'Teachers as Trainers Model' is a school based training method that comprises of four interrelated stages that include:

- Needs Assessment;
- Selection of Staff and Planning;
- Process of Training;
- Personnel and Program Evaluation.

These stages of training of teachers in computer technology use are more than the usual staff development organized by the Inspectors from the Ministry of Education. The requirements for TTM include creating a common vision or goal, department and staff empowerment, cooperative planning to establish and maintain trust and credibility, spirited, freedom of communication, continuous assistance, shared responsibility, meaningful program, personnel assessment, and reward or recognition of achievement

(Cooley 2001: 171). The 'Teacher as Trainer Model' is appropriate for implementation in Kenya because it would help to promote effective utilization of computer technology in secondary schools.

The 'Teacher as Trainer Model' is dependent upon creating and maintaining a transformational work environment. It is less costly than out of school in-service course organized by the Ministry of Education at regional centers and sending individual teacher to attend training in local commercial computer colleges. So the model would be suitable for training may teachers in the use of computers. When systematically implemented, the steps involved in TTM would provide an effective base for computer integrated education innovation. For example:

Phase One: Needs Assessment

A needs assessment is the first step in the 'Teachers as Trainers Model.' This requires identification of the subject topic areas that needs to be covered by the use of computer applications as tools for instruction. The purpose of using the tools should be explained clearly if for example they are to be used for mastery learning, motivation, introducing new ideas, teaching computer literacy skills etc. The 'Teachers as Trainers Model' should represent meaningful, honest discussion between Principal and Teachers. The goal of assessment needs to establish a common understanding of the teachers' teaching needs, after which arrangements for training activities are scheduled.

From the need assessment, each teacher's profile could be developed to serve as a road map for future training. Such training could be based on individual need, interest and skill level in subjects and computer technology. The needs assessment staff profile, will also save time and money by focusing on specific subject requirements, at departmental level.

Stage two: Core Team Selection and Planning

The Selection and planning team could consist of Heads of Departments representing subject areas, and senior teachers. Computer technology teachers could take the lead as trainer in training their colleagues on subject integration requirements. The team members should be competent and knowledgeable subject teachers capable of bringing change. They should also have a positive attitude and be able to implement computer-integrated education in the school. Planning for training of teachers could also include sending them to conferences or workshops and exhibitions that would provide them time to plan how to implement CIE in the classroom.

Since Heads of Departments are expected to play a leading role in course development, they need to develop units that respond to students' interest and learning needs, rather than strictly adhere closely to national school curriculum. The team leaders must also work closely with the Principal in all matters of curriculum and staff training. Planning for training sessions, the topics, and other requirements need to be discussed with the Principal for support and encouragement. Principals must be involved because they have a very important role to play in the effective implementation of computer education in the school. Lastly the team members need to discuss with teachers the proposed topics for training and then design appropriate learning needs.

Stage Three: Training session

Stage three of Teachers as Trainers Model is known as "Delivery of Training" and consists of six inter-related components that include:

- **Conceptual framework:** The selected trainers need to explain to teachers the relevancy of the training program in relation to their identified teaching needs. The training session should include opportunity for interaction between teachers and trainers, discussions on the outcome and benefits to learners, and explaining how CIE helps to improve classroom instruction.

- **Guided practice and modeling:** This involves active learning sessions in which trainee teachers deliver their work under the guidance of a trainer. The trainers' role is to provide guided support and encouragement. For example, a trainee might create a program on teaching a topic in accounts or mathematics. The trainers demonstrate how to create the program. The teachers then produce their own program incorporating concepts that will be useful for teaching for improving the subject delivery. The trainers will assess the work of trainees and advice them accordingly.
- **Evaluation pattern:** The next stage in Teachers as Trainers Model is evaluation. It is very important for trainers, teachers and Principals to develop a uniform standard pattern of evaluation of the training aimed at the program goals and intentions. Evaluation plays a powerful role in staff development and is a very useful tool as a basis for assessing each trainee's performance and the success of the training program. It should become a guide for teachers as they put into practice what they learnt during the training session.
- **Psychological and technical support:** Teachers need psychological and technical support after attending a training program. This is necessary because the new ideas and teaching techniques acquired during the course must be put into practice. Trainees need to establish a date and time to meet and discuss experiences with teachers after training, and to address any problems and difficulties with effective implementation. There is also a need for discussion with the principal for the provision of administrative and technical support. A follow-up activity such as attendance at workshops, conferences, or tours to visit other institutions with adequate computer education programs could be quite encouraging and motivating to teachers.
- **Retraining of teachers:** It is important that Education Officers and Inspectors of schools organize and provide adequate re-training courses for teachers in computer integrated education. A short re-training program could provide teachers opportunities to exchange ideas and experiences with other teachers from different schools on the use of computers. To promote change in curriculum innovation, Principals need to allow teachers to attend, provide support, reinforcement for re-training programs that teachers need for effective implementation of CIE.

- **Reward and Incentive:** Incentive and reward after training is the final component in the delivery of training phase. There is need for the administration to acknowledge and appreciate the achievement of teachers after training. Incentives and rewards have a motivational effect that helps to encourage teachers to work hard. This could involve presenting gifts such as certificates of recognition or some kind of present (money or an item) or organized tour. This helps to build positive staff attitude and unity to improve better academic achievement in the school.

Stage Four: Teachers profile and Training evaluation

The last component of Teachers as Trainers Model deals with evaluation of the whole training program. Even if the Teachers as Trainers Model course is successfully carried out, there is a need to evaluate the whole program of activities. This involves examining the time spent on each course teachers need to incorporate their subjects into computer technology as a tool for instruction, the number of computers and support materials to be used, and financial implications. Accountability and evaluation need to be part and parcel of any teacher-training program. Therefore, the Principal needs to design an evaluation form to be completed by all teachers participating in Teachers as Trainers Model in order to involve teachers in decision-making. In this way, the Teachers as Trainers Model could serve as a powerful motivational tool for teachers and the school for effective implementation of CIE in teaching and learning.

8.10 Limitations of the study

This study claims that a comprehensive investigation on computer-integrated education was conducted, and it did make some successful and fruitful contributions on how computers are used in secondary schools in Nyanza Province. However, there were various limitations that came up during the course of the field research.

Firstly, this study was limited to Senior Education Officers and Curriculum Specialists dealing with computers at National level. The respondents provided some

of the information that was required for this study but did not respond to other questions. For example, the Senior Education Officer did not have a list of schools with computers, and the Curriculum Specialist reported having produced only Computer Education syllabi for secondary schools.

Secondly, the research was limited to public secondary schools that had computers in Nyanza Province focusing on Principals, Heads of Department and computer teachers. It excluded the participation of students, Parent Teachers Association, Board of Governors, and National Union of Teachers whose contributions are also important in the successful implementation of any curriculum innovation. This limitation was important because the researcher was able to collect the data within the shortest time. It also provided information required for "whole school" computer integrated education as suggested by Cornu (1996).

Thirdly, there were some limitations in the data gathered from schools. Data were collected from all the respondents who were available and participated in the study. Since many schools in Nyanza Province were not using computers, the number of teachers who provided data was small. This problem was made worse when some of the questionnaires were not returned. The researcher was frustrated by the non-returned questionnaires because the information that would have been obtained form them would have provided varied data to add to the other findings. It also caused a lot of psychological frustration of why the questionnaires were not returned despite my visit to the schools concerned several times.

Besides the small number of respondents, various components of this research limited it being generalized. The research was carried out within a few years of computers being introduced to Kenyan schools. Since the use of computers in administration and teaching is expected to improve over a period of years of experience, the situations reported here may change considerably in the near future. Moreover, the data analysis revealed some limitations within school administration that contradicted quantitative

information. So explaining whether teachers' beliefs and attitudes and practices would change with experience needs further study.

Fourthly, while computer teachers reported their use of computers in teaching and learning computer literacy skills and some of them reported integrating it into teaching traditional subjects, it was not possible to investigate the actual usage of computers. It is possible that some of the teachers may have over-estimated their use of computers. The researcher did not observe teachers using computers in the classroom. It is necessary to understand more about the practices, views, attitudes, and beliefs of computer teachers' experiences with teaching and learning with computers in the classroom. By observing teachers and students, and understanding the pattern of use, researchers might be in a better position to identify other strategies that could help to encourage effective use of computers. This could also help to encourage other teachers to use computers as tools for classroom instruction.

Fifthly, it should be noted that the quantitative findings have a limited duration with regards to relevance. The numerical data collected will be out-dated very soon, because as many secondary schools purchase computers and more teachers are trained in advanced computer skills and subject integration, more schools will implement computer integrated education. Therefore, it will be possible to obtain different results if similar studies are conducted in which teachers are involved in teaching and learning with computers. Teaching methods of the teacher changes with experience. The teachers who participated in the investigation had no prior exposure to computer-integrated education so there was limitation on results on methods of lesson presentation.

Sixthly, the use of questionnaires as a research tool has limitations. For example, in this research, the findings indicated that 28% of the Principals had no exposure with computers, and the researcher was not able to ask them why they did not attend the in-service course like the other Principals who participated in the investigation. So getting all the required information is not always possible from questionnaires.

Lastly, all the participants in the study were involved in secondary education. It is important also to examine the use of computers in other institutions such as primary schools and teacher training institutions to determine how they differ from the secondary schools. For example, how do the factors affecting the use of computers in primary schools or higher education institutions compare with the results reported in this study. This could have provided rich data on various computer applications used by different groups for an evaluation of the effectiveness of CIE in these institutions.

Nevertheless, the above limitations do not imply that this study is not valid. Discussing the limitations of research findings is a healthy exercise in educational research for identifying directions for the implementation of the findings and suggestions. Exposing the limitations also helps to generate and stimulate further investigation into similar problems. The data obtained were very useful and the objectives of the study were achieved since the findings indicated that teachers used computers to teach computer literacy skills and some had started using computer-integrated education.

8.11 Suggestions for further research

On the basis of the findings and limitations identified in this study, the following issues need further investigation.

- Since a clear policy document for the use of computers was lacking, there is need to determine how best to formulate and promulgate this policy.
- There is a need for teacher training policy guidelines to look into whether initial teacher education (pre-service) is sufficient to equip teachers for using computer integrated education or whether a major continuing teacher professional development programme in computing skills at school level or in-service courses would be effective.
- Research is needed to determine whether there is a need for change in the secondary curriculum to accommodate computer technology.

- Research is needed in different school subjects to determine how computer education could be integrated into teaching and learning in the classroom.
- There is a need for research to evaluate the impact of computer education as a subject in secondary school.
- Research is needed to determine whether computers should be integrated into some subjects such as mathematics, sciences, languages and commercial subjects and technical subjects only.
- One of the barriers to the implementation and use of computers identified in the study was lack of computer equipment. Although the research established also that some Principals had hired computers for a fee, further research is needed to establish the cost-benefits of such transactions as opposed to schools purchasing their own computers.
- While this study focused on the responses from Principals, Heads of Department and teachers, further qualitative research is required to examine the perceptions and experiences of students learning with computers in the same schools.
- The study also concentrated on Principals, Heads of Departments and teachers in secondary schools excluding, primary schools, parent teachers association (PTA) and board of governors (BOG). Further research could involve these other groups and use a larger sample to determine if the findings of this study could be generalized.
- Evidence from literature (Rice, Wilson and Bagley 2001:226) revealed that students learning with computers "felt they were better prepared for the demands that would be placed on them by the technological society of the 21st century because of the computer skills learned in their geography and world events classes." Further research is required to evaluate the effect of computers literacy courses on students graduating from secondary schools in Nyanza Province.
- Since this study was a first step in examining the use of computers in pubic secondary schools in Nyanza Province, there is need to conduct a follow-up studies periodically to evaluate CIE in secondary education.
- There is also a need to conduct a study to assess computer-training needs of teachers in primary and secondary schools.

- In view of the fact that the use of computers in schools has become both a pedagogical and political issue in developing countries, so the issue of the computer competence of school leaders is very important and merits an immediate assessment.
- There is need for further investigation to find out why other schools in Nyanza Province were not using computers in teaching and learning.

8.12 CONCULUSION

The results of this study provided a range of information regarding the use of computers in public secondary schools in Nyanza Province of Kenya. Some of these findings concur with previous research findings in the literature. The findings of this study revealed that the government has an important role to play in any new curriculum innovation. In so doing, the Kenya Government developed a very brief policy for the use of computers in public secondary schools, but unfortunately did not distribute it widely, and provided only very limited funds to allow the policy to be put into practice. Consequently this study established that the current government policy towards the promotion of computer-integrated education is not fully effective. I was concerned about the lack of definite government policy guidelines, lack of curriculum guidelines, provision of equipment, and policy regarding teacher preparation on the implementation of computer education in public secondary schools that could encourage teachers to use computers. In the past, many educational technology initiatives have resulted in disappointing outcomes due to lack of clear policy commitment (e.g. the school radio and television programmes). Nevertheless, the majority of the Principals of secondary schools that participated in the study had formulated policies for the use of computers. Some Heads of Department also had departmental policy for use of computers in teaching some of the subjects. The findings from this research have implications for both computer-integration policy and practices.

Furthermore, participants reported various factors that affected the use of computers effectively in teaching and learning. The first one concerned the lack of availability of

enough computers and software, and support materials. Initially, the introduction of computers into secondary schools was established with high hopes that computers would equip students with computer literacy skills similar to those of their peers in other countries. These hopes have been only partially fulfilled because only a few schools in Nyanza Province have computers. Although in 1996, with the assistance from UNESCO donations, the Ministry of Education supplied computers to a few selected national secondary schools and developed the computer syllabus. Some schools also went ahead and purchased their own computers as well but the findings indicated that this was not adequate. At present, however, the effective use of computers in pubic secondary schools is threatened by financial problems, particularly the high costs of purchasing new computers, and repair and maintenance of existing computers to cope with the large number of students in schools. With the rapid expansion of enrolment in schools combined with the financial constraints that resulted in declining government resources there is a serious problem of how to finance the purchase of computers and the repair of existing equipment. Cuts in government spending mean that the question of cost-sharing needs to be urgently addressed and alternative funding for computer integrated education must be devised. Availability of computer equipment would encourage teachers and students to use computers in teaching and learning in order to realize whole-school integration of computers in education.

The study showed also that computers are not integrated and extensively used in the sample of secondary schools that participated in the investigation. However, all of the teachers interviewed were positive about the benefits and usefulness of computers as a medium of instruction. Effective integration strategies need to be devised and have emphasis on computers being used as a tool to improve students' learning of both traditional subjects and computer literacy skills. Some teachers noted that computers could also be used as a way of preparing students for the demands that would be placed on them by the technological world, because computers gives students skills that they need to have to compete for jobs in the world market. A study by Button, Cox, Stough and Taylor (2002:91) found that "companies tend to believe that there are simply not enough people in the IT core occupational fields to meet their growing demands." They

also reported that "economists argue that the IT work force challenge is the expected results of the rising importance of IT in the economy and the consequent demand for highly skilled core IT workers." The research findings from these scholars concur with those of the teachers in my study although it may not be possible for all students with computer literacy skills to get jobs. But given the situation in Kenya where there are few computer literate people, chances are that graduates of secondary schools have a better chance to get jobs if they are computer literate.

Moreover, teachers reported many examples about the benefits of computer integrated education such as, that computer programs had helped to improve students' learning, particularly in language proficiency, communication skills, science subjects, mathematics, accounts and in technical subjects. Computer programs are also widely believed to motivate students to learn. The participants reported that students are keen, exited and more attentive to learn from computers. Although there were positive responses about the integration and use of computers, it should be noted that in any usage it is important for teachers to remember that computers serve limited roles and should be integrated with other tools and media in teaching and learning. The use of computers alone will not provide for all the learning needs of all students. Students can also learn using different resources, including textbooks, libraries, experience, museums, videos, television, radio and audio tape recordings, human and locally available resources that are easily affordable.

Furthermore, the study demonstrated that many teachers had not been trained in the use of computers so they lacked the prerequisite skills to utilize computer application tools in teaching effectively. Although some of them reported having participated in some in-service computer training, they indicated that it was too short and not very useful. Although these teachers had limited training, they were motivated to integrate and use computers in teaching traditional subjects such as mathematics, languages, science and accounts. However, according to Nisan-Nelson (2001:84) research has suggests that there "is a tendency for teachers to stay with instructional strategies with which they are familiar and comfortable" and may not be willing to change their teaching methods. So

preparing teachers to use computers in the classroom goes beyond basic computer literacy. Gibson (2001) stresses that teachers must employ a wide range of computer tools and software as part of their instructional repertoire. Therefore, pre-service training of teachers needs to pay particular attention of how to equip trainees with knowledge of how to integrate computers into the curriculum. Similarly, serving teachers need to be re-trained in the integration and use of computers. This training should begin just a few months after teachers have joined the teaching profession. The training should serve as an evaluation of the practical exposure of teachers to new developments in the field of computer technology programs and to serve as an assessment of the teachers' future prospects in classroom instruction.

The data from both questionnaires and semi-structured interviews confirmed that the computer is a useful tool for teaching and learning. However, it was noted that a number of factors to be considered for the professional support for teachers attempting to integrate computers such as technical support, incentives, motivation and administrative support were very important in the effective use of computers.

Moreover, the study indicated that the use of computers requires teachers to adopt new roles to help students pursue their own inquires when using computers. So teachers' instructional practices change from that of a traditional approach of teacher-centered to that of student-centered, in which the teacher acts as a guide, moves around the class helping students and plays the role of a facilitator of learning, while the learners are actively involved in their own learning; sometimes individually, or in a group or in collaborative learning.

The research findings suggest that there is a need to conduct extensive writing workshops with teachers to design and develop various materials from traditional subjects for computer-integrated education. This could be done at provincial level attended by computer teachers. The participants would then be assigned the role of computer specialists who could provide a link between the curriculum center and the school. Although curriculum specialists based at KIE are extremely active in developing new

curriculum materials, there is not sufficient attention given to the design and production of computer support materials. The study demonstrated that only a computer syllabus had been produced and supplied to secondary schools.

The study, therefore underlines the need for immediate action to improve training of teachers in the production of computer materials, provision of support materials, particularly teachers' and students' manuals, and creation of closer links between the Ministry of Education and school administration. The school inspectors need to identify competent computer teachers to coordinate computer-integrated education to help all teachers.

The research demonstrated that teachers in the case study institutions value the use of computers and would welcome more training in advanced computing skills to include the use of the Internet, and support from the Principals to enable them to utilize computers more effectively. The scope and mode of using computers in schools depends heavily on the Principals. The part played by the Principal in the whole school integration of computers helps to determine the effectiveness and efficiency and shapes the manner in which the computer could be utilized by teachers and students. Therefore, if CIE is to be effectively implemented in schools the teachers need support and they must be well prepared.

The study also underlines the need for more research on the cost-effectiveness of alternative CIE strategies such as online learning and the Internet. Finally, the study confirms previous studies in developed countries (Cooley, 2001:269-283; Maushack, Kelly, and Blodgett, 2001:419; Pritchard, 2001:294; Rice, Wilson, and Bagley, 2001:211-228; and also studies conducted in Kenya by Kiboss (2000:199). These studies reported that the use of computers in schools has considerable potential as a means of motivating students to learn. They also demonstrated that Computer Education helps to prepare students for further studies in computer technology, improving the quality of learning and teaching, widening access to new ideas, increasing students' motivation and raising the standard of education. However, this potential cannot be fully realized unless teachers are

motivated, and trained, and unless steps are taken to address problems identified such as inadequate computer resources, lack of planning time, and lack of support from the administration indicated in the study. These problems require, in turn, the financial implications of computer-integrated education to be fully examined. Only when these problems are overcome will computer-integrated education in Kenya be fully utilized in all schools in the country.

Above all, the study suggests that simply using computers will not bring about all the desired changes in secondary education. The presence of computers alone will not change schools. But computers integrated into an effective learning environment and used with trained and competent teachers with a purpose will help in the improvement of classroom instruction for the benefits of students. The challenge for administrators and teachers is not only to use the computer for the sake of it, but to use it appropriately so that students learn effectively with the computer to realize important educational objectives.

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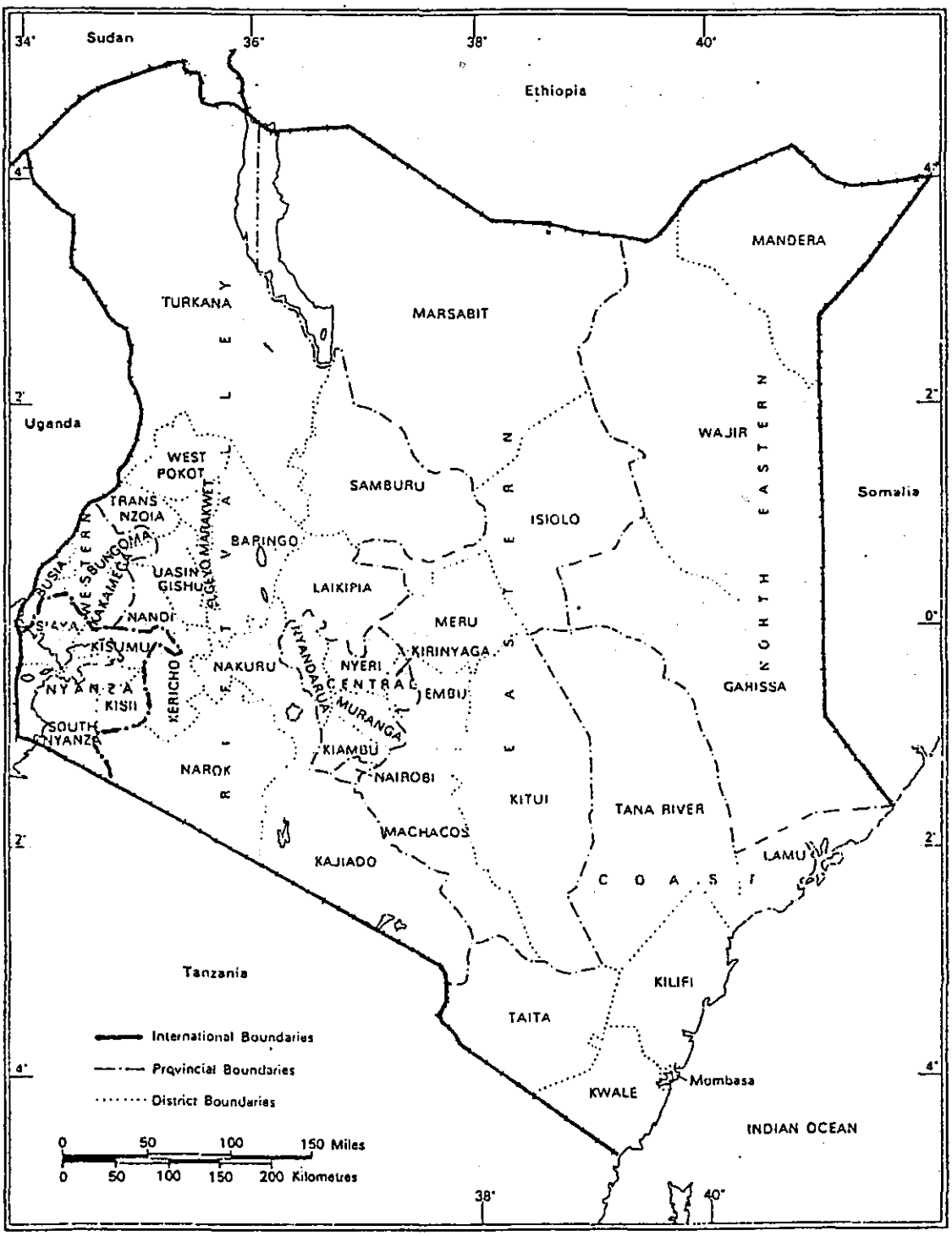
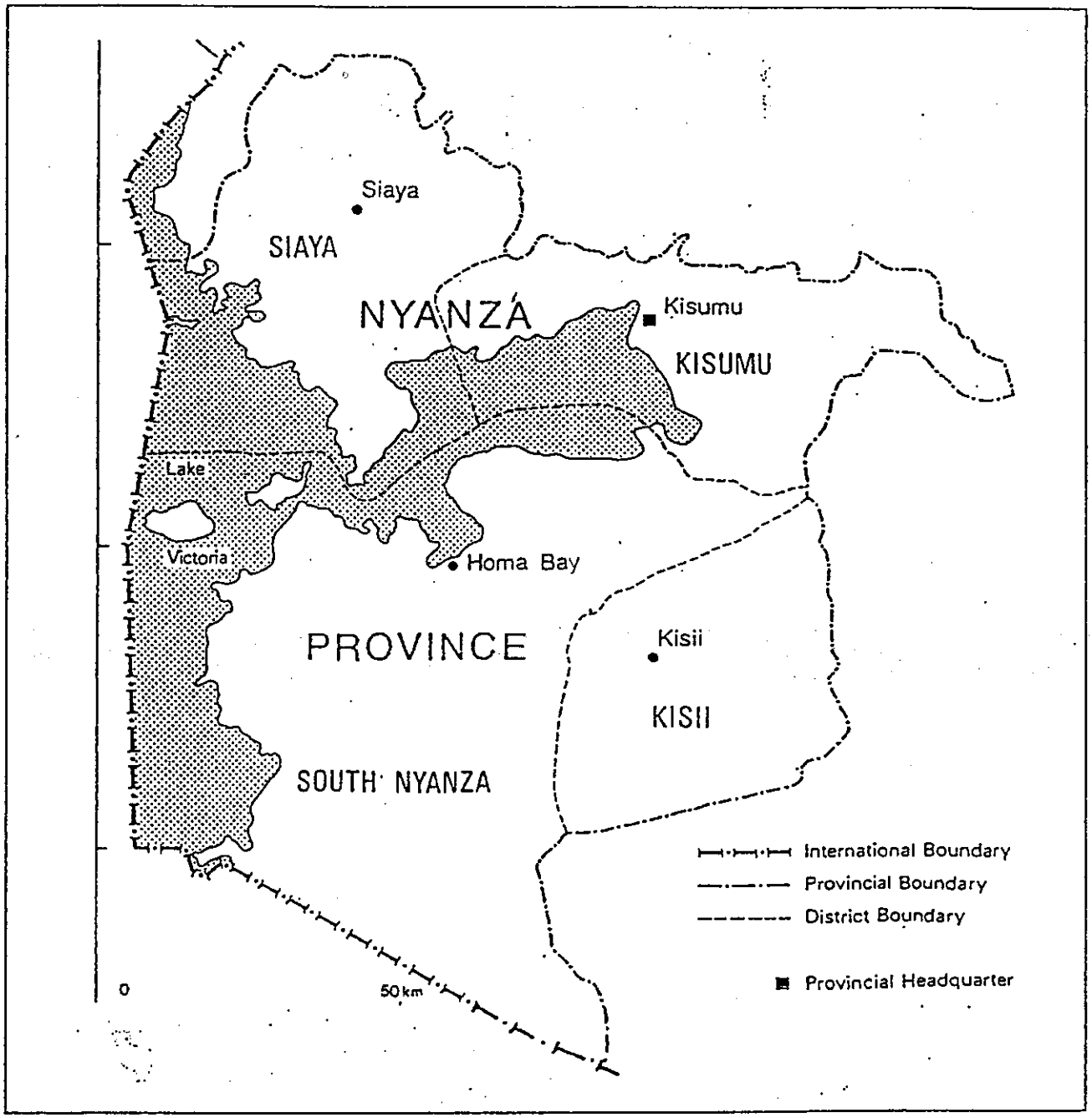
Appendix 1

MAP OF KENYA



MAP OF NYANZA PROVINCE



Appendix 3

9th July 2001
4-13 House Jakaranda
478 Festival Street
Hatfield 0083
Pretoria
South Africa

The Permanent Secretary
Ministry of Education
Jogoo House
P.O Box
Nairobi

Dear Sir

Request to Conduct Interviews on Computer Education in Schools

This is to inform you that I am currently a research student at the University of Pretoria in South Africa studying the use of computers in secondary schools. My research work includes field study to collect data that will form part of my PhD degree. The purpose of this letter is to request you kindly to grant me permission to interview the officers in charge of computer education programmes for schools.

The information obtained from the Ministry of Education will be necessary for assessing how computers are used in teaching and learning in public secondary schools. This is important because one of the objectives for introducing computers in public secondary schools was to ensure that students graduating from secondary schools were computer literate. This includes teaching them computer literacy skills and using computers in teaching and learning traditional subjects. Attached please find a few questions concerning the government role in the introduction and use of computers in public secondary schools in Kenya.

Kindly study the questions carefully and provide answers to each question honestly and objectively. Please do not write your name on the questionnaire. Your response will be strictly confidential.

Thank you in advance for the cooperation

Yours sincerely

Florence Y. Odera (Mrs).

Appendix 4

9th July 2001
4-13 House Jakaranda
478 Festival Street
Hatfield 0083
Pretoria
South Africa

The Director
Kenya Institute of Education
P.O. Box 30231
Nairobi
Kenya

Dear Sir

Visit to Kenya Institute of Education

This to inform you that I am currently a research student at the University of Pretoria in South Africa studying the use of computers in schools. My research work includes field studies to collect information that will form part of my PhD degree. This is to request you kindly to allow me to visit KIE during the month of July 2001.

The purpose of the visit will be to conduct interviews with you, and the Curriculum Specialist in charge of computer education programmes. The interview topics will include curriculum regulations on computer education, pedagogical issues, support materials, evaluation, teacher education and financial implication.

The information collected will be treated confidentially and will only be used for the purpose of this research.

Thank you in advance for the cooperation

Yours Sincerely

Florence Y. Odera (Mrs)

Appendix 5

9th July 2001
4-13 House Jakaranda
478 Festival Street
Hatfield 0083
Pretoria
South Africa

The Provincial Director of Education
Nyanza Province
P.O. Box 575
Kisumu
Kenya

Dear Sir/Madam

Permission to visit Secondary Schools in Nyanza Province for research

This is to inform you that I am currently a research student at University of Pretoria in South Africa studying the use of computers in secondary schools. The purpose of this letter is to request for permission to conduct research in those schools using computers in teaching and learning with effect from the month of July to the end of September 2001. The field research is part of my PhD programme. Your cooperation will be highly appreciated.

Thanking you for the cooperation

Yours Sincerely

Florence Y. Odera (Mrs).

Appendix 6

9th July 2001
4-13 House Jakaranda
478 Festival Street
Hatfield 0083
Pretoria
South Africa

The Principal
_____
_____
_____
_____

Dear Sir/Madam

Visit to your school

I am currently a research student at the University of Pretoria in South Africa studying the use of computers in teaching and learning. As part of my research work for the PhD degree, I will be carrying out field studies in selected secondary schools in Nyanza Province.

The purpose of this letter is to request you kindly for permission to visit your school, first to introduce myself to you and to explain the purpose of the visit. Secondly to distribute questionnaires to you and the Heads of Departments in your school. Thirdly to request you to arrange for an interview with teachers using computers in teaching and learning. The exercise will take place from July to end of November 2001. Could you please inform your teachers and heads of department about my intended visit.

The information collected will be treated confidentially and will be used only for the purpose of this research. The names of the interviewees, and the school will not feature in the research document.

Thank you in advance for the cooperation

Yours Sincerely

Florence Y. Odera (Mrs).

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

Telegrams: "Schooling", Kisumu
Telephone: Kisumu 44157
In reply please quote
Ref No. NP/GA/23/8/(67)
and date

PROVINCIAL DIRECTOR OF EDUCATION
NYANZA PROVINCE
P.O. Box 575
KISUMU

17th July, 20 01.

To

All Headteachers
Secondary Schools
NYANZA PROVINCE.

RE: PERMISSION TO CONDUCT RESEARCH

MRS. FLORENCE Y. ODERA

The above named has sought permission from the Provincial Director of Education to conduct research in schools using computer in teaching/learning in this province with effect from 19th July to the end of September, 2001.

This is to inform you that permission has been granted by this office for the research to be carried out by the above named.

Kindly accord her every necessary assistance.

Mrs. Odera will pay courtesy call on each District Education Officer prior to commencement of the research in a part icular district.

(MWALO M.O.)
FOR PROVINCIAL DIRECTOR OF EDUCATION
NYANZA PROVINCE.

c c

All District Education Officers
NYANZA PROVINCE.

Appendix 8

Interview questions for Ministry of Education Officials

1.Does the government have a policy on the use of computers in schools?

If the answer is yes, what is this policy?

If the answer is no, please give reasons.

2.Do you have an official policy document on computers in education?

3. Why was this policy adopted?

4 .What steps have been taken to implement this policy?
5. Who is implementing this policy?

8.How is the implementation being monitored?

9.What data exists on the success of this policy?

10.What are the major problems experienced with the implementation of the policy?

11.What resources have been allocated to computer education in secondary schools in Kenya

12.What evidence is available on the use of computers in secondary schools?

13.What types of computer software are used in public secondary school?

14. Why are the schools using computers for teaching and learning?

15. What is the major role of computers in secondary education?

16.What evidence are there of any assessment of the actual utilisation of computers in secondary schools?

17. What kinds of plan does the Department of Education have for the effective integration and use of computer in secondary education?

18.Do you have budget allocation per year for the use of computers in public secondary school in Kenya?

Interview questions for Curriculum Development Centre

Section A. Questions for the Director: Kenya Institute of Education (KIE)

1.Do you have curriculum guidelines concerning the use of computers in schools?

If the answer is yes, what is this guideline?

If the answer is no, please give reasons why not?

2. What are the reasons for the guidelines?

5. What is the pedagogical theory underpinning computer education in schools?

6.Have you developed any computer support materials for schools?

If the answer is yes, what type of computer materials have been developed for schools?
If the answer is no, why have you not developed them?

7.How many schools are supplied with computer support materials?

8. What type of evaluation report do you have on the use of computers in schools?

Section B. Questions for Curriculum Specialists in charge of computers at KIE

1.What are the goals of computer education in secondary schools?

2.What is your role in the introduction of computer education program for schools?

3.How many secondary schools use computers in teaching and learning?

4. What types of computer software are used in secondary schools?

5.Which subjects are incorporated into secondary computers education programmes?

6.Why have you integrated computer education into traditional subjects?

7.What steps have been taken to design and produce computer support materials for schools?

8. What kinds of computer materials have been supplied to secondary schools?

9.What arrangements are there for re-training teachers to use of computers in teaching and learning?

10. Do you have a subject panel committee for computers in education?

11. What are the objectives of this committee?

12. Why was it established?

13. How often do you organise workshops for computer teachers to discuss and produce support materials?

14. How many teachers have attended computer in-service course organised by KIE?

15. What evidence is there on students learning with computers in secondary schools?

16. Which computer application programs are they learning?

17. What are the barriers/problems inhibiting the development of computer education programs for schools?

18. What kinds of feedback do you have from schools on students learning with computers?

19. Which topics in your subject area do you think should be integrated into computer education?

20. What is the amount of money spent on the following activities per year?
    Workshops on computer education
    Seminars on utilisation of computer programs at KIE
    Cost of running seminars outside KIE
    Subject panel meetings on computer education
    Production and distribution of computer support materials

21. What recent evaluation report do you have on students learning with computers?

22. What are the obstacles to the integration of computers in teaching and learning in your subject area?

Field Research Instrument (1)

Interview Sample questions for Principals of Secondary Schools

The purpose of this interview is to assess the implementation and contribution of computer-integrated education in your school. You are kindly requested to answer the following questions as objectively as you can. Your response will be strictly confidential.

Participants Number _____

Section A. Personal Details

1.Name and Address of your school:

_____

2. Location of the school:

Urban	
Suburban	
Rural	

3. Gender: please tick appropriate box.

Female	
Male	

4. Age in years: _____

5.Marital Status:

Married	
Single	

6.Classe(s) that you mainly teach: are mainly responsible for:

Form 1	
Form 2	
Form 3	
Form 4	

7.Years of teaching experience _____

8. Do you have experience with the use of computer? Please tick one answer only.

I have no experience at all	
I have some experience	
I have a lot of experience	

9.Total length of service in this school in computer education: _____

FOR OFFICE USE ONLY

V1 [ ][ ][ ] 1-3

V2 [ ] 4

V3 [ ] 5

V4 [ ][ ] 6-7

V5 [ ] 8

V6 [ ] 9
V7 [ ] 10
V8 [ ] 11
V9 [ ] 12

V10 [ ][ ] 13-14

V11 [ ] 16

V12 [ ] 17

10. What is the highest academic qualification you have? Please tick one only.

AT/Diploma	
BA degree	
BSc	
BEd	
MA	
MSc	
MBA	
Mphil	
PhD	
Others.....	

V13 ☐☐ 18-19

Section B. Background Information

1.Information regarding the school

a. How is the school managed?

Public	
Private	
Community	

V14 ☐ 20

b. What is the age of the school? _____Years

V15 ☐☐ 21-22

c. In which area is your school located?

Rural	
Sub-Urban	
Urban	

V16 ☐ 23

d. What is the category of this school?

Girls Boarding	
Boys Boarding	
Boys day	
Mixed day	
Mixed Boarding	

V17 ☐ 24

e. What is the students' population in this school?

200-400	
401-600	
601-800	
801-1000	
Above 1000	

V18 ☐ 25

f. How many girls are in your school?

None	
101-200	
201-300	
301-400	
401-500	
501and over	

V19 ☐ 26

g. How many boys are in your school?

None	
101-200	
201-300	
301-400	
401-500	
501 and over	

V20 ☐ 27

h. How many teachers are in your school? _____

V21 ☐☐ 28-29

i. What is the percentage of male and female teachers in your school?

Female	
Male	

V22 ☐☐ 30-31
V23 ☐☐ 32-33

C. The school Policy on Computer Integrated Education

1.Does your school have a policy on computer education? Please tick one.

Yes	
No	

V24 ☐ 34

2. If the answer is yes, what is the essence of the school policy on computers in education?

_____
_____
_____

V25 ☐ 35-36

3.If the answer is no, please state the reasons why?

_____
_____
_____
_____

V26 ☐☐ 37-38
V27 ☐☐ 39-40
V28 ☐☐ 41-42

4. What priority is given to the integration and use of computers in teaching and learning in your school? Please tick one.

High	
Average	
Low	

V29 ☐ 43

5. What are the reasons and for this policy?

_____
_____
_____
_____

V30 ☐☐ 44-45
V31 ☐☐ 46-47
V32 ☐☐ 48-49

6. What steps have been taken to implement this policy?

_____
_____
_____

7. Are teachers implementing this policy? Please tick one.

Yes	
No	

8. If the answer is 'yes,' please explain how effective it is

Very effective	
Effective	
Fair	
Not effective	

9. If the answer is 'no' please state the reason why it is not implemented effectively?

_____
_____
_____

10. What resources

_____
_____

D. Financial and Resources allocation

1. Computers are expensive to purchase and maintain, whom do you think should be responsible for the cost of computing in your school?

_____
_____

2. Why do you think so?

_____
_____

3. Do you think the Ministry of Education should provide funds for computing education in you school?

Yes	
No	

4. Why do you think so? _____

5. What is the cost of purchasing each of the computers available in your school?

Lower than KShs 30,000	
KShs 30,000-40,000	
KShs 40,001-50,000	
KShs 50,001-60,000	
KShs 60,001-70,000	
KShs 70,001 and over	
Others	

6. What percentage of your budget do you allocate for:

Purchase of new computers	
Purchase of software	
Repair and maintenance of equipment	
Any other please explain	

V33 [ ] 50-51
V34 [ ] 52-53
V35 [ ] 54-55

V36 [ ] 56

V37 [ ] 57

V38 [ ] 58-59
V39 [ ] 60-61
V40 [ ] 62-63

V41 [ ] 64-65
V42 [ ] 66-67
V43 [ ] 68-69

V44 [ ] 70

V45 [ ] 71
V46 [ ] 72

V47 [ ] 73

V48 [ ] 74
V49 [ ] 75

V50 [ ] 76

V51 [ ] 77-78
V52 [ ] 79-80
V53 [ ] 81-82
V54 [ ] 83-84

E. Availability of Media Computer Education support equipment

1.How many of the following equipment do you have in your school?

Computers		
Software packages		
Teachers guide notes		
Students' manuals		
Computer textbooks		
Diskettes		
Computer syllabus		

V55 85-86
V56 87-88
V57 89-90
V58 91-92
V59 93-94
V60 95-96
V61 97-98

2.If the school has computers, please explain their working condition?

Satisfactory	
Fair Satisfactory	
Unsatisfactory	

V62 99

3.How many computers are available for use by the following group of people in your school?

The administration	
Teachers	
Students	

V63 100-101
V64 102-103
V65 104-105

4.If there are no computers available, state the reason why not?

V66 106-107
V67 108-109
V68 110-111

5. Are the computers being utilized to their full capacity?

Yes	
No	

V69 112

6.If the answer is yes, please explain briefly

V70 113-114
V71 115-116
V72 117-118

7. If the answer to number 7 is no, why are they not being used effectively?

V73 119-120
V74 121-122
V75 123-124

F. The Use of Computers in teaching and learning

1.Who is in charge of computer education in your school?

Deputy Principal	
Curriculum coordinator	
Senior teacher	
Technician	
Other please specify	

V76 ☐ 125

2.Are your teachers currently using computers in teaching/learning?

Yes	
No	

V77 ☐ 126

3.If the answer is yes, what kind of program do they use?

Computer literacy programs	
Curriculum-based programs	

V78 ☐ 127
V79 ☐ 128

4. If they are not using computers in teaching any of the programs, please give the reasons why not?

_____

V80 ☐☐ 129-130
V81 ☐☐ 131-132
V82 ☐☐ 133-134

5. Does the school have a timetable for computer lessons?

Yes	
No	

V83 ☐ 135

6. If the answer is yes, how many periods are allocated to computer lessons per week? _____

V84 ☐ 136

7. In which subject areas would you say your teachers make the greatest use of computers? You can tick more than one category.

Mathematic Education	
Science Education	
Social Studies Education	
Languages Education	
Technical/Graphics Education	
Economic/Business Education	
Secretarial Work/studies	
Accounting	
Administrative work	

V85 ☐ 137
V86 ☐ 138
V87 ☐ 139
V88 ☐ 140
V89 ☐ 141
V90 ☐ 142
V91 ☐ 143
V92 ☐ 144
V93 ☐ 145

8. Why do they use computers in teaching these subjects?

_____
_____
_____

V94 ☐☐ 146-147
V95 ☐☐ 148-149
V96 ☐☐ 150-151

9. Do you consider computer programs to be of value in making learning more effective in your school?

Very valuable	
Valuable	
Not valuable	

V97 ☐ 152

10. If they are valuable, please give reasons why you think so?

_____
_____

V98 ☐☐ 153-154
V99 ☐☐ 155-156
V100 ☐☐ 157-158

11. If you think they are not valuable please explain why not?

_____
_____

V101 ☐☐ 159-160
V102 ☐☐ 161-162
V103 ☐☐ 163-164

12. How frequently do your students learn the following programs?

Tick one only	Daily	Often	Sometimes	Not applicable
Word processor				
Spreadsheet				
Database				
Programming				
Others.....				

13. State objectively all the concrete measures that your school has taken in the implementation of computer-integrated education?

14.From your experience as a head and professional teacher, list the measures you would take to ensure that computers are integrated and used effectively in your school?

15. Is there cooperation between the teachers, parents and the board of governor on the integration and use of computes in teaching/learning?

Yes	
No	

16. If the answer is, what is their contribution to the introduction and use of computers in your school?

17. If the answer is no, state the reasons why not?

18.How do you think the use of computers enhance learning in the classroom?

G. Training in the use of Computers

1.Have you ever been trained in the use of computers?

Yes	
No	

2. If the answer is yes, what was the duration of the training? _____

3. What type of the training was it? Please put a tick in the right place:

Administrative work	
Secretarial work	
Subject teaching	
Computer Literacy Skills	
Others	

V104 ☐ 165
V105 ☐ 166
V106 ☐ 167
V107 ☐ 168
V108 ☐ 169

V109 ☐☐ 170-171
V110 ☐☐ 172-173
V111 ☐☐ 174-175

V112 ☐☐ 176-177
V113 ☐☐ 178-179
V114 ☐☐ 180-181

V115 ☐ 182

V116 ☐☐ 183-184
V117 ☐☐ 185-186

V118 ☐☐ 187-188
V119 ☐☐ 189-190
V120 ☐☐ 191-192

V121 ☐☐ 193-194
V122 ☐☐ 195-196
V123 ☐☐ 197-198

V124 ☐ 199

V125 ☐☐ 200-201

V126 ☐ 202
V127 ☐ 203
V128 ☐ 204
V129 ☐ 205
V130 ☐ 206

4. How important was the course to you?

Very important	
Important	
Not important	

V131 ☐ 207

5. If you have not been trained, how did you know about the use of computers?

_____

_____

V132 ☐☐ 208-209

6. Since receiving your pre-service training, have you attended any other course in the use of computer in the classroom?

Yes	
No	

V133 ☐ 210

7. What is the percentage of your teachers who are computer literate? _____

V134 ☐☐ 211-212

8. What role should the school play in the training of teachers in the integration and use of computers in curriculum instruction?

_____

_____

V135 ☐☐ 213-214
V136 ☐☐ 215-216
V137 ☐☐ 217-218

H. Technical and physical problems

1. What problems are preventing you from implementing computer-integrated education effectively in your school?

Limited availability of equipment	
Lack of teacher training	
Lack of funds	
Lack of time	
Lack technical support	
Lack of appropriate computer materials	
Others	

V138 ☐ 219
V139 ☐ 220
V140 ☐ 221
V141 ☐ 222
V142 ☐ 223
V143 ☐ 224
V144 ☐ 225

2. What steps have you taken to solve some of the problems?

_____

_____

V145 ☐☐ 226-227
V146 ☐☐ 228-229
V147 ☐☐ 230-231

3 How would you rate the availability of computers facilities in your school? Please tick one only.

Poor	
Average	
Above average	

V148 ☐ 232

4. Do you have a technician who can assist teachers with the operation and maintenance of computers?

Yes	
No	

V149 ☐ 233

5. If you have a technician, to what extent is he/she able to maintain the equipment?

Very good	
Good	
Fair	
Not good	

V150 ☐ 234

6. If you do not have one, who provides technical services to your school?

_____
_____
_____

V151 ☐ 235

7. What measures would you recommend that will ensure that computers remain in constant functioning and usable state in your school?

_____
_____

V152 ☐☐ 236-237
V153 ☐☐ 238-239

8. How many classrooms are in this school? _____

V154 ☐☐ 240-241

9. How many of your classrooms have been fitted with power points? _____

V155 ☐☐ 242-243

10. Computers require rooms with enough ventilators, free from dust and humidity, what arrangement have you made for the care of your computers?

_____

V156 ☐☐ 244-245
V157 ☐☐ 246-247
V158 ☐☐ 248-249

11. Does your school have electricity?

Yes	
No	

V159 ☐ 250-251

12. Do you have a computer centre?

Yes	
No	

V160 ☐ 252

13. Who is responsible for managing the computer centre? _____

V161 ☐ 253

14. Is there Computer network linkages in the computer centre?

Yes	
No	

V162 ☐ 254

I. Attitude and Views about the value of computers

1. Please express your overall views about computer education programme in teaching and learning in your school. Tick one only.

Excellent	
Good	
Fair	
Poor	

V163 ☐ 255

2. What is your opinion about the impact of computer assisted education on students learning traditional subjects?

Very positive	
Positive	
Indifferent	
Negative	

V164 ☐ 256

3. What suggestions or recommendations would you make for the effective integration and use of computers in teaching and learning?

_____
_____
_____
_____
_____

V165 ☐ 257-258
V166 ☐ 259-260
V167 ☐ 261-262
V168 ☐ 263-264

Heads of Department Questionnaires (2)

The purpose of this questionnaire is to assess the utilization and contribution of computer-integrated education in your department. You are kindly requested to complete this questionnaire as objectively as you can. **Your response will be strictly confidential.**

Respondents Number

FOR OFFICE USE ONLY

V1 [ ][ ][ ] 1-3

A. Background Information

1. Location of the school:

Urban	
Rural	
Suburban	

V2 [ ] 4

2.Gender: Please tick appropriate box.

Female	
Male	

V3 [ ] 5

3. Age in years _____

V4 [ ][ ] 6-7

4. Marital Status:

Married	
Single	

V5 [ ] 8

5. Classes in which you teach:

Form 1	
Form 2	
Form 3	
Form 4	

V6 [ ] 9
V7 [ ] 10
V8 [ ] 11
V9 [ ] 12

6. Subjects you teach

_____
_____
_____

V10 [ ] 13
V11 [ ] 14
V12 [ ] 15
V13 [ ] 16

7. Years of teaching experience _____

V14 [ ][ ] 17-18

8. Do you have experience with the use of computer? Please tick one answer only.

I have no experience at all	
I have some experience	
I have a lot of experience	

V15 [ ] 19

9. Total length of service in this school in computer education _____

V16 [ ] 20

10.What is the highest academic qualification you have? Please tick one only.

AT/Diploma	
B.A degree	
BSc	
BEd	
MA	
MSc	
MEd	
PhD	

V17 [ ][ ] 21-22

11. Professional Qualification:

Trained	
Untrained	

V18 ☐ 23

B. Departmental policy and practice

1.Does your department have a policy regarding the use of computers?

Yes	
No	

V19 ☐ 24

2. If the answer is yes, what is this policy?

_____

_____

V20 ☐☐ 25-26
V21 ☐☐ 27-28
V22 ☐☐ 29-30

3. If the answer is no, please give reasons

_____

_____

V23 ☐☐ 31-32
V24 ☐☐ 33-34
V25 ☐☐ 35-36

4. What are the reasons for this policy?

_____

_____

V26 ☐☐ 37-38
V27 ☐☐ 39-40
V28 ☐☐ 41-42

5.What priority is given to the implementation of this policy? Please tick one only.

High	
Average	
Low	

V29 ☐ 43

6.How are the teachers in your department implementing this policy?

_____

_____

V30 ☐☐ 44-45
V31 ☐☐ 46-47
V32 ☐☐ 48-49

C. Financial and Resources allocation

1.Are there some funds set aside for the purchase of departmental equipment?

Yes	
No	

V33 ☐ 50

2. If the answer is yes, what is the source of this funding? _____

V34 ☐☐ 51-52

3. If the answer is no, why not?

_____

_____

V35 ☐ 53
V36 ☐ 54
V37 ☐ 55

4.What is the amount allocated for purchasing of the following items for your department per year:

Items	KShs	None
Diskettes		
Computer textbooks		
Software		
Computers		
Other related resources		

V38 ☐☐ 56-57
V39 ☐☐ 58-59
V40 ☐☐ 60-61
V41 ☐☐ 62-63
V42 ☐☐ 64-64

D. Availability of Computers and related materials

1.How many of the following equipment do you have in the department?

Computers		V43	66-67
Software packages		V44	68-69
Teachers guide notes		V45	70-71
Students' manuals		V46	72-73
Computer textbooks		V47	74-75
Diskettes		V48	76-77
Computer syllabus		V49	78-79
Calculators		V50	80-81

2. How did you obtain the equipment and the software?

Purchased by the school		V51	82
Donation		V52	83
Supplied by the government		V53	84

3. How accessible are the computers to your teachers for use in the classroom?

Very accessible		V54	85
Accessible			
Not accessible			

E. The use of computers by departmental staff

1.Are teachers in your department using computers?

Yes		V55	86
No			

2. If the answer is yes, when did they start to use computers in teaching/learning?

This year		V56	87
Last year			
Two years ago			
Three years ago			
Four years ago			
Five years ago			

3. What are the reasons for using computers in teaching and learning?_____

_____

V57		88-89
V58		90-91
V59		92-93

4.Which types of computer software program do teachers use in the department?

_____

_____

_____

5. How do they use the programs?

_____

_____

6.What do you see as the major advantages of using computers in classroom instruction?

_____

7. Which of the following computer software tools are useful for your students?

Word processing	
Spreadsheet	
Database	
Programming	
Computer games	

8. One of the objectives of introducing computer education into secondary schools in Kenya is to teach computer literacy skills. Indicate by a tick which of the following skills your students learn:

Word processor	
Spreadsheet	
Database	
Programming	
Any other please specify	

9. How often do the teachers in your department use computers in teaching and learning? Please tick one only.

Once a week Twice a week	
Three Times a week	
Four Times a week	
Five Times a week	

10. Describe briefly the role of computers in your departmental teaching/learning?

_____

_____

_____

11. Describe briefly the impact of the computer program you use on students learning gains?

_____

_____

_____

F. Integrating Computers into the teaching of subjects.

1.What steps have you taken to integrate and use computers in your departmental subjects?

_____

_____

_____

2. How would you rate the integration of computer programmes with your departmental subjects?

Excellent	
Good	
Poor	
Very poor	
No comment	

V60		94
V61		95
V62		96
V63		97
V64		98
V65		99-100
V66		101-102
V67		103-104
V68		105-106
V69		107-108
V70		109-110
V71		111-112
V72		113-114
V73		115
V74		116
V75		117
V76		118
V77		119
V78		120
V79		121-122
V80		123-124
V81		125-126
V82		127-128
V83		129-130
V84		131-132
V85		133-134
V86		135-136
V87		137-138
V88		139

3. In which subjects do you think teachers from your department could make use of computer integrated lessons effectively?

_____

_____

4. Why do you think so?

_____

_____

5. Have you incorporated computer lessons into the school timetable?

Yes	
No	

6. If yes, how many periods per week do the students learn with computers? _____

7. If no, please give reasons.

_____

_____

G. Training in the use of Computers

1.Have you had any kind of training in computer use?

Yes	
No	

2. If the answer is yes, what was the duration of the training? _____

3. What type of the training was it? Please put a tick in the appropriate answer.

Administrative work	
Secretarial work	
Subject teaching	
Computer Literacy Skills	
Others	

4. How important was the course to you?

Very useful	
Useful	
Not useful	

5.If the training was useful, describe briefly how it has helped you in teaching and learning with computers

_____

6. Given your present training do you consider yourself professionally competent to integrate and use computers in teaching in the classroom? Please tick one of the following:

Very competent	
Competent	
Not competent	
Require more relevant	
No opinion	

V89		140
V90		141
V91		142
V92		143
V93		144
V94		145
V95		146
V96		147
V97		148
V98		149
V99		150
V100		151
V101		152
V102		153-154
V103		155
V104		156
V105		157
V106		158
V107		159
V108		160
V109		161
V110		162
V111		163
V112		164

7. Since receiving your pre-service teacher training which of the following courses have you attended please tick what is appropriate:

Computer in-service course	
Computer workshop	
Computer seminars	
Computer-based curriculum	
Any other, please	

8. What is the percentage of teachers in your department are computer literate?

_____

9. In your opinion, what role should the department play in the training of teachers in the integration and use of computers in your subject areas?

_____

_____

H. Physical facilities and technical problems

1.Outline the factors inhibiting the integration and use of computers by the teachers in your de

Lack of adequate computers	
Lack of training	
Lack of software packages	
Lack of support materials	
Lack of interest	
Lack of time	

2. What steps have you taken solve some of the problems?

_____

_____

_____

3.What kinds of technical support does the department need to use computers effectively?

_____

_____

_____

V113 ☐ 165
V114 ☐ 166
V115 ☐ 167
V116 ☐ 168
V117 ☐ 169

V118 ☐☐ 170-171

V119 ☐ 172
V120 ☐ 173
V121 ☐ 174

V122 ☐ 175
V123 ☐ 176
V124 ☐ 177
V125 ☐ 178
V126 ☐ 179
V127 ☐ 180

V128 ☐☐ 181-182
V129 ☐☐ 183-184
V130 ☐☐ 185-186

V131 ☐ 187
V132 ☐ 188

4. Whom do you think should provide technical services to your department? V133 ☐ 189

5. Why do you think so? V134 ☐ 190 V135 ☐ 191 V136 ☐ 192

6. What facilities are available for your teachers to use computers in teaching and learning? V137 ☐ 193 V138 ☐ 194 V139 ☐ 195

7. What is the condition of these facilities for effective utilization of computes?

Very adequate	
Adequate	
Not adequate	

V140 ☐ 196

I. Views about the value of computers as a tool for classroom instruction

1. How valuable is computer-integrated education to your departmental teaching and learning process?

Very valuable	
Valuable	
Not Valuable	

V141 ☐ 197

2. What do you think are the major contributions of computers to students learning? V142 ☐☐ 198 V143 ☐☐ 199 V144 ☐☐ 200

3. Could you list some of the disadvantages of computers as a tool for classroom instruction? V145 ☐ 201 V146 ☐ 202 V147 ☐ 203

4. What is your view about the potential of computer programs introducing new ideas to teaching/learning? V148 ☐ 204

5. What is your attitude towards the integration and use of computers in teaching and learning?

Very positive	
Positive	
Negative	
Not sure	

V149 ☐ 205

6. What suggestions or recommendations would you make for the effective integration and use of computers in teaching and learning in the classroom V150 ☐☐ 206-207 V151 ☐☐ 208-209 V152 ☐☐ 210-211 V153 ☐☐ 212-213

Appendix 12

Secondary teachers semi-structured interviews
List of interview topics

A. Personal Details_____

1.Name of the School _____Address_____

2.Location of the school: Rural ——— Urban ——— Suburban ———

3. Gender: Male ——— Female ——— .

4.Age range_____ 20-30 ——— 31-45 ——— 46 and above ———

5. Number of years of teaching ——— 1-5 ——— 6-10 ——— 11-15 ——— 16+

6. What grades do you teach? ——— .

7.Subjects you currently teach _____

8.Total years of teaching in this school in computer education_____

9. Do you have experience with the use of computer?

I have no experience at all	
I have some experience	
I have a lot of experience	

10. What is the highest academic qualification you have? Please tick one only.

AT/Diploma	
B.A degree	
BSc	
Bed	
MA	
MSc	
MBA	
Med	

11.Others please specify _____

12. Professional qualification:

Trained teacher	
Untrained teacher	

13. Total number of students you teach per class_____

14.Number of computers in your class _____

15.Types of computer software you use _____

B. Classroom use of computers

1.Why do you use computer?

2. How do you use the computer?
3.Planning for teaching and learning with computers
preparation, schemes of work, lesson plan,

C. Computer Integrated instructional applications

1. General applications in teaching/learning

2. Software used by students: kinds of programmes used e.g.
word processing, spreadsheet, database, graphics, programming.

3. Students Knowledge of the basic/advance computer literacy skills:
knowledge of the general computer operations-hardware,
operating system software and the use of mouse;
knowledge of software-word processing, spreadsheet, database and;
basic programming.

4. How students learn with computer:
individually, small group (cooperative learning),
whole class (mass instruction),

5.Teachers' knowledge of the basic/advanced computer literacy skills indicated in number 5 above.

6. How much do you use computer (please indicate lesson/periods per week)

7. How you integrate computer into subjects you teach:
as the main lesson presentation, introduction, enrichmement,
or for summary and remedial work.

8. Value of using computer:
a. how valuable is it to you?
b. benefits and
c. limitations

9. Reasons for integration and use of computer in teaching and learning:

a. literacy skills: word processing, spreadsheet, database, programming.
b. curriculum subjects: mathematics, science subjects, social studies, languages, graphics and any others

10. Impact of computers on students learning, for example:

students recall what they have learnt, discuss what they learn,
helps them pass exams, motivates them to learn, improve communication skills

11.Role of computer in the classroom

to learn about computers, computer literacy,
instructional tools for curriculum subjects, remedial work,
e-mail services, keeping students records.

12. Effectiveness of computer-integrated education in teaching and learning.

Teaching certain topics which are hard to teach without such aids;
Reinforcement tools to teachers work, another teacher in the classroom,
Introduce new ideas and variety into teaching and learning;
Increases students knowledge of the subject
Introduce new teaching methods; makes students pay more attention;
and are motivated to learn.

13. Problems and difficulties with use of computer: e.g.
access to equipment, availability of support materials

C. Factors affecting use of computers: lack of awareness/information;

lack of access to equipment, time factor, cost of support materials
negative attitudes towards the computers.

D. Factors encouraging teachers decision to use computers.

e.g. suitability of programs; school policy, potential appeal to teachers/students; the degree of fit with the curriculum;
information from colleagues.

E. Teachers' views and attitudes towards the use of computers.

Views about its effects on: students' motivation to learn;
Increasing knowledge; widening access to education;
Introducing new ideas; improving learning;
increasing students' attention; improving communication skills (e.g. writing skills, grammar, vocabulary, composition, creative writing);
facilitation of learning and remediation of learning

F. Training in the use of computers

Teacher training courses on computers in education
In-service courses attended;
Induction courses within the school;
Workshops and seminars,
Others please specify

G. Selection of software and other resources

1. By who, where and the quantity and quality

2. Which area of the curriculum would you prefer to be covered by computer-integrated education?

3. How should it be done?

4. What improvements would you suggest for the effective integration and utilization of computers in the classroom?