ADOPTION OF COMPUTER BASED TESTING AND ASSESSMENT IN NATIONAL EXAMINATIONS IN KENYA

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DECLARATION

This Research Project is my original work and has never been submitted for examination or award in any other University nor has it been published in any journal or magazine.

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This Research Project has been submitted for examination with my approval as the University supervisor.

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ACKNOWLEDGEMENT

ABSTRACT

The purpose of this study was to investigate the possible challenges faced by The Kenya National Examinations Council (KNEC) in the adoption of computer based assessment in National examinations. The study examines the stakeholders' attitude towards the introduction of computer based testing and assessment in the National examination, their views on how it will contribute in the elimination of cheating cases and the transition of assessment from paper-pencil to computer based assessment, with the aim of finding solutions to these challenges and improving the testing and assessment process by the Kenya National Examination Council.

The target population consisted of students and teachers in Public and Private schools in Nairobi and Machakos Counties. In order to get a representative sample for the study, the researcher used purposive sampling procedure. Both primary and secondary data was used. Application of questionnaires, observation checklist, and focused group discussions was crucial in gathering relevant data. Both closed-ended and open-ended questionnaires were utilized to gather information from teachers and students. The questionnaires were able to generate the information required because they were designed in tandem with the objectives and research questions, while the interviews covered a range of issues related to the attitude and perception of the respondents in relation to the objectives of the study. Focused Group Discussion was held to corroborate the information gathered through questionnaires and interview. The questionnaires provided an opportunity for flexibility and free flowing of information. Unstructured discussions were expected to reflect genuine opinion, ideas and attitudes of the respondents on the topic under study.

In conclusion, the study highlights the need to review assessment in schools over to electronic media, thereby enriching the testing experience and making the test results more useful for teachers and students. Tests which are more relevant for the needs of the future and which can be adopted to the rapidly changing needs of the global society.

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LIST OF ACRONYMS

CBA   Computer Based Assessment

ICT   Information and Communication Technology

NEPAD   New Partnership for Africa's Development

AUF   Agence Universitaire de la Francophonie

ISPAD   Information Society Partnership for Africa's Development

LMS   Learning Management System

KICD   Kenya Institute of Curriculum and Development

KCPE   Kenya Certificate of Primary Education

KCSE   Kenya Certificate of Secondary Education

YEF   Youth Enterprise Fund

MoEST   Ministry of Education, Science and Technology

FPE   Free Primary Education

KNEC   Kenya National Examinations Council

UPE   Universal Primary Education

MDGs   Millennium Development Goals

EFA   Education for All

ERSWEC   Economic recovery Strategy Paper for Wealth and Employment Creation

KESSP   Kenya Education Sector Support program .

ODE   Open and Distance Education

SAPs   Structural Adjustment Programs

VLE   Virtual Learning Environment .

CHAPTER ONE

1.0 INTRODUCTION

1.1. Background of the study

Computers are now standard and widely spread tools that significantly affect the daily activities of people's lives. In testing and assessment in education, they are increasingly changing the ways in which tests and assessments are developed and administered. Computer based testing has been called the "next frontier in testing" where it is being promoted as the solution to' testing problems in many of countries of the world (Trotter, 2001). With increasing pressure to find more cost effective and less labor intensive approaches to testing, countries are seeing computer-based testing as a way to address the challenging prospect of assessing all students at all levels of learning.

Computer-based testing is viewed with optimism as an approach that would make testing less expensive in the long run, and that would produce better assessments of the wide range of students, from primary level, secondary and even higher learning. In Africa, Kenya included, the integration of ICT to teaching and learning has remained substatially low compared to the developed countries. Integration aims at the use of ICT to support teaching and learning in the delivery of the various curricula to achieve improved education outcomes. ICT being an interactive media, it would facilitates students to develop diversified skills needed for industrialization and a knowledge-based economy as well as allow teachers and learners to proceed at different paces depending on the prevailing circumstances. Yusuf and Yusuf, (2009) on integration of ICT in teaching and learning, recognized the important role it played in preparing students for the demanding job market, and that the education sector needed to be proactive in meeting the requirements for ICT skills in the 21st century platform.

Computer-Based Assessment hereafter referred to as CBA is variously referred to as Computer-Based Testing (CBT), e-assessment, computerized testing and computer-administered testing and is defined as a test or assessment that is administered or delivered on computers, either online or on a local area network, or an equivalent electronic device such as a cell phone or PDA linked to

the Internet or the World Wide Web where responses are electronically recorded, <u>assessed</u>, or both. Bull and McKenna (2004) defines the term that covers all forms of assessment, whether summative or formative, as a software used for educational purposes, to manage the process of setting, collecting, scoring and providing feedback. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams. Pelgrum and Law (2003) in their study, explained why the term 'computers' was replaced by 'IT' (information technology) in terms of the shift of focus from computing technology to the capacity to store and retrieve information. This was followed by the introduction of the term 'ICT' (information and communication technology) around 1992, when e-mail started to become available to the general public (Pelgrum, W.J. Law N. 2003).

ICT in Education is usually for specific purposes, where Gwang-Jo Kim (2009) in his report, cited the following purposes that and Assessment can serve:(a) Restructuring education system, (b) Diversifying teaching-learning methods and practices, (c) Engaging all stakeholders of education and adapt rapidly to changes in society and the environment, and (d) Enhancing education efficiency, effectiveness, and productivity,(e) Efficient gathering of comparable data from large populations, (f) Automated or even instant grading, (g) Acceptance of varied response formats, and the ability to produce individualized feedback.

General advantages of CBA systems over traditional Paper-and-Pencil testing here after referred to as (PPT) have been demonstrated in several comparative works and include: increased delivery, administration and scoring efficiency; reduced costs for many elements of the testing lifecycle; improved test security resulting from electronic transmission and encryption; consistency and reliability; faster and more controlled test revision process with shorter response time; faster decision-making as the result of immediate scoring and reporting; unbiased test administration and scoring; fewer response entry and recognition errors; fewer comprehension errors caused by the testing process; improved translation and localization with universal availability of content; new advanced and flexible item types; increased candidate acceptance and satisfaction; evolutionary step toward future testing methodologies.

In testing, a wide variety of designs and development to meet different purposes and the test specification for computer-based tests should include: the test purpose, the content domain definitions, the content structure for the test items, required response formats for the test items, sample test items illustrating the response formats, the number of items to be developed and administered, scoring and reporting formats and procedures, and test administration procedures which must be clearly specified and documented. Although support for use of computerized testing is gaining momentum, there are those skeptics who voice concern about the trend toward greater use of computers in the assessment process. Some are concerned about the appropriateness of CBA for assessing particular skills such as reading comprehension (Bernhardt, 1996). Others are worried about the fidelity and comprehensiveness of computerized tests (McNamara, 1996). While others are concerned about the degree to which construct-irrelevant variables, such as computer-familiarity or computer anxiety, might be injected into the assessment process to impact examinee performance in negative ways, thus affecting performance. Nevertheless, it seems very likely that computerized testing will continue to be more frequently used in assessment circles in the coming decades.

1.2 Statement of the Problem

In Kenya, examinations are largely administered through the Paper and Pencil mode of assessment but of late the general policy has been shifting toward introducing ICT in disseminating knowledge in the learning institutions and in conducting examinations as one the goals to be attained through the Millennium Development Goals as spelt out in the vision 2030 document. More specifically, the Government of Kenya Session Paper No. 1 of 2005 on "A Policy Framework for Education, Training and Research" outlines the vision of the education sector (Go K, 2008). For the vision of education sector in Kenya to be a reality, there has to be a shift from paper and pencil based testing and examination to computer based testing and assessment. This would necessitate substantial re-organization processes at educational institutions and examination body in terms of administrative staff, IT support staff, head teachers, teaching staff, examiners as well as students.

The shift from one system of testing and assessment to the other would likely face many challenges but if well addressed the rewards would be fulfilling in terms of the country's development visions including the education sector. This study therefore sought to address the issue of challenges to be faced if the computer based testing and assessment was to be successfully implemented in the national examinations in Kenya. The specific questions that were addressed in this study were:

1. What is the attitude of the stakeholders in the shift from paper and pencil based examination to computer based examination?
2. Which would be the most appropriate method to be used in the transition from pencil and paper based examination to computer based examinations?
3. How computer based testing and assessment would assist in elimination of cheating cases in the National examinations?

1.3. Objectives of the Study

The objectives of the study were to:

1. Determine overall attitude of the stakeholders toward the transition from Paper and Pencil assessment to Computer Based Testing and Assessment.
2. Determine the appropriate transition mode from Paper and Pencil assessment to Computer Based Testing and Assessment mode.
3. Determine the extent to which cheating in examinations would be eliminated by the adoption of ICT assessment in National examination.

The objectives were intended to provide a measure of the possibility of adoption of computers based assessment in the Kenya learning and assessment environment and therefore address the issue of the viability of switching from the Paper and Pencil mode of assessment to Computer Based Testing and Assessment. This would necessary in the implementation of the intended transition from one examination mode to another.

The study used the following hypotheses to guide in methodology and achievement of the above stated objectives.

1.4. Research Hypotheses

Study hypotheses were:

1. There is no definite negative attitude by stakeholders toward transiting from paper - pencil to computer based test.
2. There is no preferred method of transiting from paper and pencil test and assessment to computer based test and assessment mode.
3. Adoption of CBA would not affect cheating occurrence in education assessment.

1.5. Significance of the Study

Examinations are a crucial part of both the teaching and learning process and institution's administration procedures as well. IT support of administrative sections of the examination process is common today in some developed countries. Higher education institutions in these countries are gearing towards switching from paper-based examinations into a computer-based environment due to increasing numbers of examinations and candidature as well.

The research sorts to provide insights into the processes and strategies that examination administrators would use to transisit and adopt the use of CBA in testing the National examinations for Primary education. The study would enable the exploration of the limiting variables and how to overcome them.

On-screen exams are meant to reduce costs of administration, and improve quality and speed of the correction process, unbiased test administration and scoring efficiency, reduced costs of the testing lifecycle, improve test security resulting from electronic transmission and encryption, consistency and reliability, controlled test revision process with shorter response time, faster decision-making as the result of immediate scoring and reporting, and many others.

Due to the scarcity of empirical research concerning Computer based assessment and use of technology in Kenya and majority of the developing world this study hopes to raise awareness on the use of computers in learning and assessment in Kenya. It is hoped that this study will be a step on the road for a brighter future for e-assessment, in Kenya.

1.6.   Study Matrix

1.6.1 Location and Size

The study was carried out in two counties of Kenya, Nairobi County and Machakos County. The schools in the category of urban area were to be sampled from the schools in the Nairobi County, while those falling in the category of rural area were to be sampled from schools in rural Machakos County.

Figure 1: Nairobi County
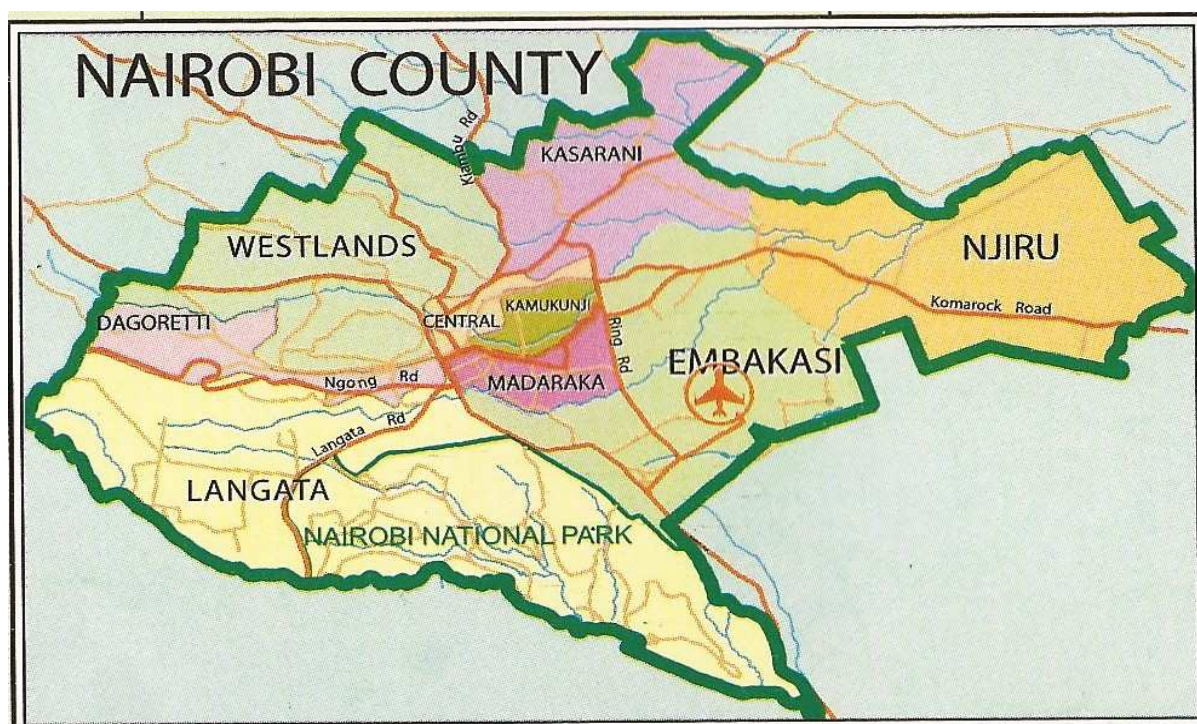
1.6.2 Strategic Geographical Location

Nairobi is the largest and most populous city and the national capital of Kenya. The city is located at the Nairobi River in the Highlands, in the south-central part of the country. It lies on the central Kenyan plateau at an altitude of 1,680m (5,500 feet) above sea level. The city is situated at 1.28° South latitude and 36.82° East longitude.

Nairobi city and its metropolitan region is striving to be a regional and global service hub, and it is struggling to find its place within the competing global cities and metropolitan regions.

The city acts as the natural gateway to the rest of Africa. The Great North Road corridor from Cape Town (South Africa) to Cairo (Egypt) passes through Nairobi. Jomo Kenyatta International airport is 5.5 hours away from major cities in Africa. Nairobi provides the main access route for various markets in Africa, the Indian Ocean and South Asia (Kenya National Bureau of Statistics (2007).

Figure 2: Nairobi Population Pyramid
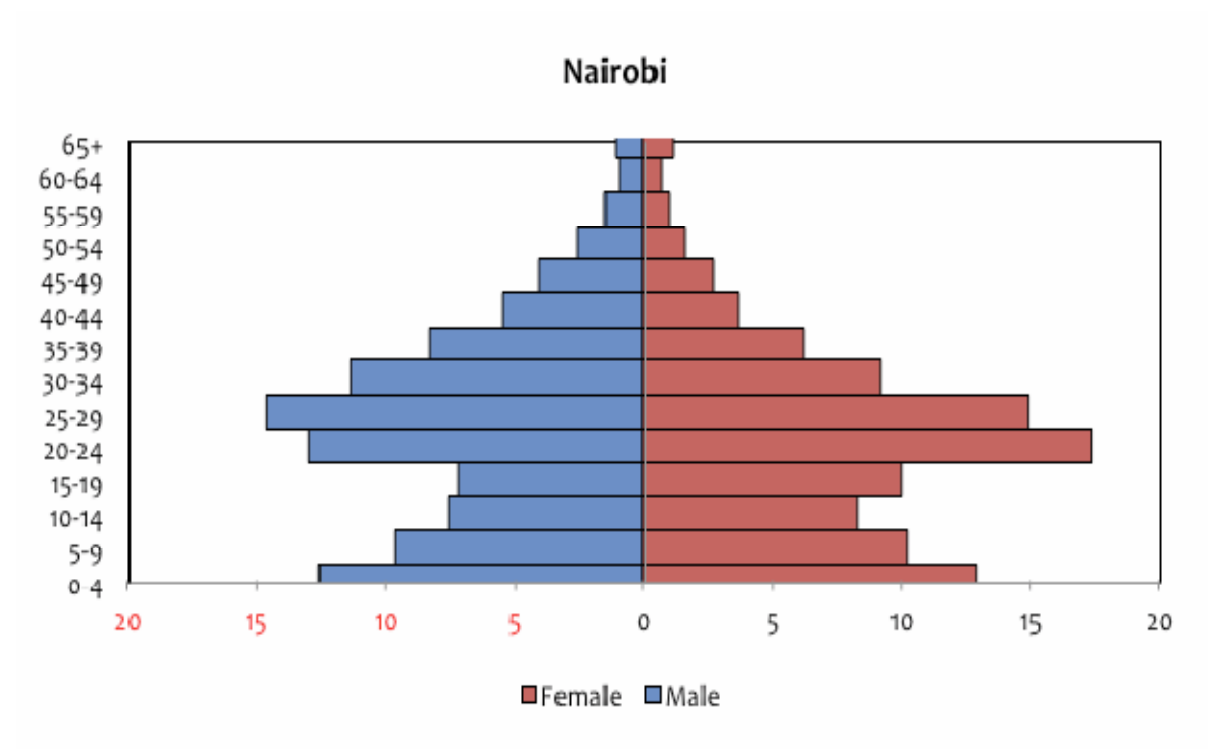
Source: Kenya National Bureau of Statistics(2009)

The county also has a high youthful population where 15-34 year olds constitute 49% of the total population. labour migration from the rural areas in search for jobs is the main reason why the county has a very high proportion of the working age population of those aged between 15-64 years old who form 68% of the total population.

Figure 3: Nairobi Metro and Boundaries

Area	County	Area (km²)	Population Census 2009	Cities/Towns/Municipalities in the Counties
Core Nairobi	Nairobi City County	694.9	3,138,369	Nairobi
Northern Metro	Kiambu County	2,449.2	1,623,282	Kiambu, Thika, Limuru, Ruiru, Karuri, Kikuyu
Southern Metro	Kajiado County	21,292.7	687,312	Kajiado, Olkejuado, Bissil, Ngong, Kitengela, Kiserian, Ongata Rongai
Eastern Metro	Machakos County	5,952.9	1,098,584	Kangundo-Tala, Machakos, Athi River
Totals	Nairobi Metro	30,389.7	6,547,547	

Source: Kenya National Bureau of Statistics(2009)

1.6.3 Education Scenario in Nairobi County

There are 556 Public and Private secondary schools in Nairobi County as per the KNEC data for registered schools in 2014. While in Machakos County, the Public and Private secondary schools totaled to 216 in number. Over 2,715 schools across Nairobi County are set to benefit from free internet connectivity following a move by Wananchi Group, Kenya Education Network (KENET) and the County Government of Nairobi to embark on a long term corporation in relation to this commitment.

Figure 4: Machakos County

1.6.4 Machakos County Profile

Machakos County is an administrative County in the eastern part of Kenya. The County has 8 constituencies which are; Machakos Town, Masinga, Yatta, Kangundo, Matungulu, Kathiani, Mavokoand Mwala. The County covers 6,208 square kms and has a population of 1,098,584 as per 2009 census(Male –49 %,Female – 51 %); with an age distribution of 0 to 14 years at 39%, 15 to 64 years 56% and 5% above 65 years-break down this age distribution more (0-14, 15-29, 30-64 and over 64). Its population annual Growth Rate is 1.7 % with a current estimate of 264,500 households of which only 17% accessing electricity. Its capital town Machakos is cosmopolitan and is located 64 kilometres southeast of Nairobi. The prevailing local climate is semi-arid and the landscape is hilly, rising from an altitude of 1,000 to 1,600 metres above sea level. The counties Road Network of Bitumen Surface covers only 88.5 Km, and Gravel Surface 440.4Km.

1.6.5 Educational Scenario

Machakos County has close to 850 primary schools and 216 secondary schools. The primary school enrolment rate is 81% for both boys and girls of school going age. School dropout was reported to be 5.5%. The Primary school going population (6-13 years) makes up to 20.3% of the County total population. The secondary schools enrolment rate is 32% for both boys and girls. The secondary school dropout rate is estimated to be 4.7%. Many children drop out of primary and secondary school mainly due to inability to afford cost of education and the limited number of schools; other factors contributing to the low transition rate from primary to secondary and Low education enrollment include pregnancy cases, children taking care of sick parents, and inadequate infrastructure. Taking measures against the aforementioned issues should be able to increase the percentage of population with primary and secondary education in the County which currently (in 2012) stands at 67.7% and 14.6% respectively, while the Literacy levels (those who can read and write) is estimated at 88%.

Machakos is also one of the towns known to cater for the physically handicapped and impaired. Schools like the APDK for the physically handicapped, school for the deaf, school for the blind

and the special unit for the mentally handicapped (in TMPS) have gone a long way in providing education for these special children.

Figure 5: The 2012 Student enrolment in Machakos County
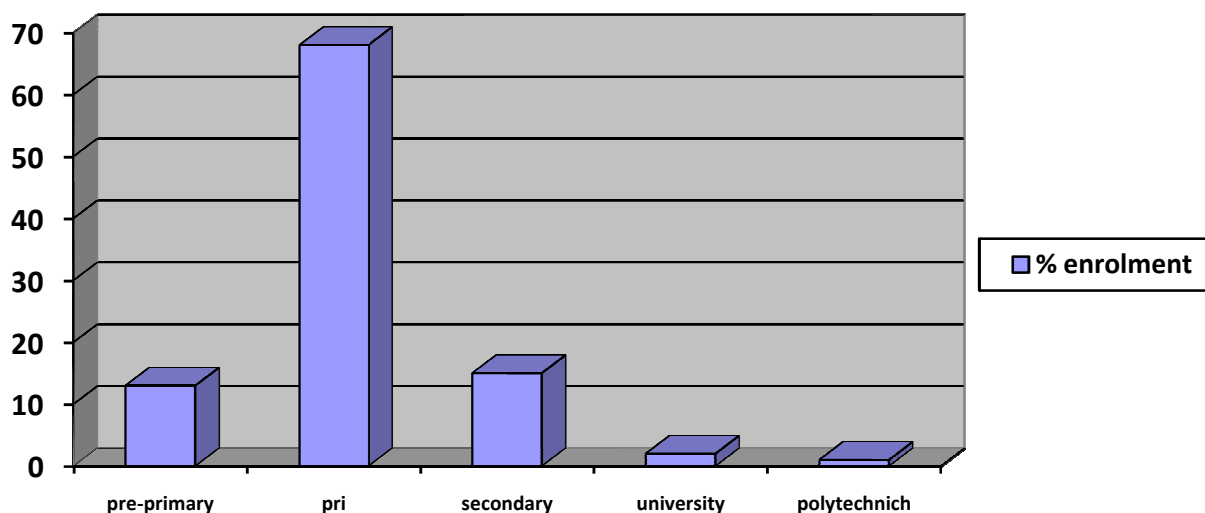
1.6.6: Challenges of ICT the Counties

Since the 1980s implementation of ICT in schools has been compulsory in the developed nations. This is not so in developing nations such as Kenya, where implementation is considerably more recent, small-scale and experimental. It is however, universally acknowledged that implementation of ICT in schools has progressed in nearly identical pattern, from formulation of policies, attainment of basic computer skills, computer aided teaching and learning, communications and research, to usage in every subject.

Despite the importance of ICT in schools and the strategies developed by the government and other stakeholders, as formulated in sessional paper no. 1 of 2005, research has revealed that many schools have not efficiently implemented ICT to support teaching, learning and management in school. Manduku et al (2010) observed that despite the benefits of ICT, most school management have not fully implemented the policies developed by the Ministry of Education. Laaria (2013) asserts that some schools had developed guidelines on how to implement ICT but no attempt was made to implement them.

The government of Kenya recognizes implementation of ICT in secondary schools would contribute to knowledge production, information and communication sharing among the school community. This view stems from assertions in the literature regarding the importance of ICT in schools (Manduku, Kosgey & Sang, 2010). The government through Sessional paper no. 1 of 2005 noted that ICT has a direct role to play in schools and if used properly, it can bring many benefits to school as well as to the community. It was noted that ICT will present new opportunities for teaching and learning by providing opportunities for teacher-to-learners, teacher-to-teacher and learner-to-learner communication and cooperation, enhanced opportunities for several technologies delivered by teachers, creating superior keenness for learning among students and presenting access to a wider variety of courses (GOK, 2005).

To successfully implement ICT in schools in these counties, access to good quality electricity is vital. Equipping school with relevant infrastructure like building, physical facilities, purchases of hardware and software must be considered. Thirdly, professional development of teachers through in-service courses should be well planned. Lastly, school leaders should have interest, committed and champion the implementation. To achieve this, the government would have to partner with private sector and other stakeholders in order to implement ICT in Kenyan schools.

1.6.7 Education Sructure in Kenya.

The Kenya Institute of Curriculum Development (KICD), a semi-autonomous governmental agency, is responsible for educational research and development of the curriculum. KICD is focused on providing quality, relevant and affordable educational and training programs in response to a changing social, economic and technological environment. The initiatives are met through continual research, evaluation, assessment and the monitoring processes (Kenya Institute of Education, 2009). KICD works closely with the Kenya National Examination Council (KNEC), The Teachers Service Commission (TSC) is responsible for teacherrecruitment, human resources services, and place of government employed teachers (Ministry of Education, 2008).

Figure 6: Education system
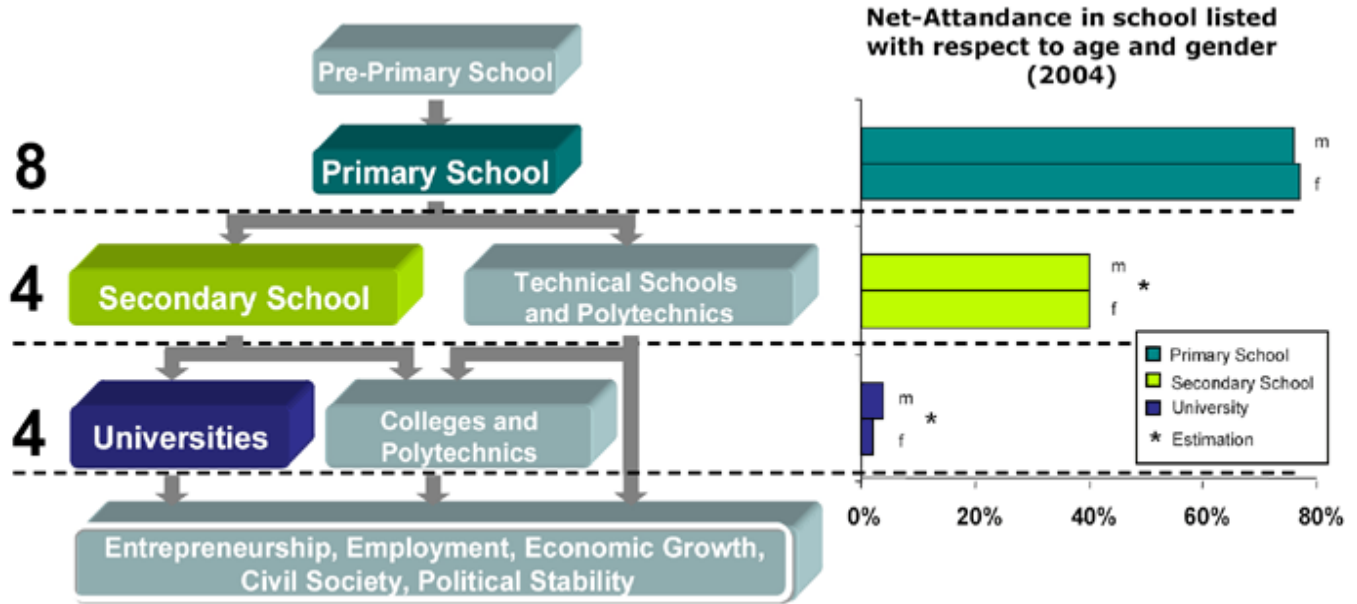
Source: Original image on Aideducational International web page on Kenya education system. Original image link

Table . 1: The Current Education Structure

Level	No. Of Years	Age
ECDE	Not formally intergrated	-
Primary	8 Years	6 – 13+
Secondary	4 Years	14 – 17+
Tertiary/TIVET	Not formally intergrated	Flexible and Variable
Adult Basic Education and Training (ABET) /NFE	6 Years	18+
University	4 Years	18 – 21+

8 -4-4 structure was adopted by the government based on a recommendation made by the MacKay report of 1983 .

1.7. Operational Definitions

Computer Based Assessment - It is the use of information technology for any assessment-related activity. It describes the use of computers within the assessment process. The defining factor is that the computer marks or assesses the responses provided from candidates. It can be performed on an equivalent electronic device such as a cell phone or PDA. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams.

Information and Communication Technology - is often used as an extended synonym for information technology (IT), but is a more specific term that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information..

Universal Primary Education is one of goals to be achieved under the United Nations Millennium Development Goal, to "ensure that by 2015, children everywhere, boys and girls alike will be able to complete a full course of primary schooling".

Computers for Schools Kenya is a non-governmental organization that was formally registered in October 2002 with a vision to establishment an information-rich Kenyan Society actively participating in sustainable development.

Summative Assessment means to *evaluate students learning* at the end of an instructional unit by comparing it against some standard or benchmark. These are often high stakes, which means that they have a high point value.

Formative Assessment is used to *monitor students learning* in order to provide ongoing feedback that can be used by instructors to improve their teaching and by students, to improve their learning.

Validity – This refers to whether the item set actually measures what it purports to measure. It relates to the appropriateness of the inferences made on the basis of the test scores and it is often divided into content, construct, criterion, concurrent and predictive validity.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. Introduction

This chapter analyses literature concerning the adoption of information technology and communication and important role played by in the assessment process in learning institutions. It looks into the efforts by numerous scholars and educators who have tried to demystify technology and in cooperate it in the education systems, with the intentions of taking educational needs into the 21st century. The review is organized in terms of theoretical work and empirical work on a topical basis. The objectives of this review included:

- To provide a context for the research and offer justification for the study.
- Help to critic the existing material on the study.
- Provide evidence that research has not been done before.
- Enable the researcher to learn from the previous theories on the subject and
- Show that the work done is adding to the understanding and knowledge in this field.
- Helps identify gaps in the study topic
- Provide a better understanding of the study topic

2.2 The Review

2.2.1. Theoretical Literature

2.2.1.1 Definition of Computer Based Assessment

Computer-Based Assessment (CBA) also known as Computer-Based Testing (CBT), e-assessment, computerized testing and computer-administered testing, is a method of administering tests in which the responses are electronically recorded, assessed, or both. As the name implies, Computer-Based Assessment makes use of a computer or an equivalent electronic device such as a cell phone or PDA. CBA systems enable educators and trainers to author, schedule, deliver, and report on surveys, quizzes, tests and exams. Computer- Based Assessment

may be a stand-alone system or a part of a virtual learning environment, possibly accessed via the World Wide Web (Bull et, al. 1999).

2.2.1.2. Tests and Measurements in CBA

In order for information and communication technology (ICT) to produce educational transformation, educators must consider assessment techniques which permit students to utilize the affordances of new technology (Downes, et, el. 2001,Russell, Jamieson-Proctor and Russell, 2007), Without a suitable, computer based way of conducting examinations (as an example of rigorous or standardized assessment), curriculum transformation may be unlikely to occur because assessment is a major determinant in teaching (Ainley and Searle, 2007). This can only be achieved adequately, especially in African countries when governments step in and embrace technology as a critical segment of education and the assessment process, and this will translate in channeling of resources towards putting in place the right infrastructure to allow this to succeed.

According to Kleimann (2006) the implementation of electronic examinations comes along with a significant change of the whole academic examination culture. A sustainable success in implementing electronic tests depends upon the overcoming of infrastructural, technical, methodological, and juridical barriers (furnishing adequate PC pools, procurement of adequate software, successful integration into curricula, adaptation of examination regulations, etc.

Online assessment is now common place in many developed countries, i.e. in Australian universities; this is largely superficial for both formative and summative purposes (Byrnes and Ellis (2006). In many cases online assessment is conducted using an institutional learning management system (LMS) such as *BlackBoard, WebCT,* or an in house product (Pullen and Cusack, 2007; 2008). Online assessments however, offer several advantages for the institution and the learner.

One reason for supporting a change to e-Examinations is the linkage between tertiary and secondary assessment methods. These are only loosely linked systems, yet it is likely methods used in one sector will be noticed and appropriately adopted in the other. Secondary sector assessments may be impeded from adopting computer mediated methods whilst tertiary systems rely heavily on high stakes written examinations (Fluck, 2007).

In a 1988 article, Messick states: "Over the next decade or two, computer and audiovisual technology will dramatically change the way individuals learn as well as the way they work. Technology will also have a profound impact on the ways in which knowledge, aptitudes, competencies, and personal qualities are assessed and even conceptualized. There will also come a heightened emphasis on individuality in assessment with a premium on the adaptive measurement, perhaps even dynamic measurement, of knowledge structures, skill competencies, personal strategies and styles as they develop with instruction and experience. But although the modes and methods of measurement may change, the basic maxims of measurement, and especially of validity, will retain their essential character. The key validity issues are the interpretability, relevance, and utility of scores, value implications of scores as a basis for action, and the functional worth of scores in terms of social consequences of their use" (Messick, 1988)

In light of this argument, examinations should not lose the fundamental measurement standards for testing fairness, rights and responsibilities of learners, testing individuals with diverse linguistic backgrounds, and testing individuals with disabilities and special needs.

Computer-based examinations therefore should be designed to retain the fundamental standards identified in the six technical areas:

1) Test construction, evaluation, and documentation;

2) Reliability and errors of measurement;

3) Test development, and revision;

4) Scales, norms, and score comparability;

5) Test administration, scoring, and reporting; and

6) Supporting documentation for tests or in other words, certification.

2.2.1.3 Key Indicators of Growth of CBA

The area of CBA and assessment is emerging as a significant professional field in educational measurement. There have been three major reference editions for educational measurement in 1951, 1971, and 1989, according to Bartram (1997). The proportion of reference pages devoted

to computer-based or machine-based testing in each of those three editions was 3 percent in 1951, 8 percent in 1971, and 14 percent in 1989. By the turn of the millennium, the number of computerized tests that had been administered in professional testing and assessment centers reached at least 4.5 million. It is estimated that Internet-based testing programs have administered at least several hundred thousand additional computer-based tests.

In German, the Bologna University has software systems that are used to support examination processes, i.e. campus management systems (examination administration and course management systems) as well as learning management systems and e-learning testing solutions. While the IT-based administration of examination processes is widespread and well-established at many German universities, the switch from paper-based to computer-based examination environments is still in its early stages. Nevertheless, the IT-based rearrangement of examinations is currently becoming more and more popular due to increasing numbers of exams (Parshall et, al. 2001).

 Bartram (1997) commented on the fact that, despite the potential offered by technology for new forms of assessment, the literature on computer-based assessment (CBA) within occupational assessment settings has been largely confined to a small number of issues. These have been dominated by the issues relating to the parallel use of computer-based and paper-based versions of the same tests and use of computers to generate descriptive and interpretative reports of test results (for reviews, see Bartram and Bayliss, 1984; Bartram, 1987b, 1989, 1993, 1994, 2005). CBT is seen as a catalyst for change, bringing transformation of learning, pedagogy and curricula in educational institutions (Scheuermann & Pereira, 2008).

2.2.1.4 Modes of Test Administration

Four modes of test administration have been defined by Bartram, (2001c). These modes form the basis for the guidelines on computer-based testing and the Internet developed by the ITC.

Open mode. These are conditions where there is no means of identifying the test taker and there is no human supervision. Examples of this include tests that can be accessed openly on the Internet without any requirement for test taker registration.

Controlled mode. This is similar to the open mode in that no human supervision of the test session is assumed. However, the test is only made available to known test takers. For the Internet this is controlled through the requirement for the test taker to be provided with a logon username and password.

Supervised mode. For this mode, a level of human supervision is assumed, whereby the identity of the test taker can be authenticated and test-taking conditions validated. This mode also provides a better level of control over dealing with unexpected problems or issues. For Internet testing, this mode is achieved by requiring the test administrator or proctor to log-in the candidate and to confirm that the testing was completed correctly at the end of the session.

Managed mode. This is a mode where a high level of human supervision is assumed and there is also control over the test-taking environment. For computer-based testing this is achieved through the use of dedicated testing centres. The organization managing the testing process can define and assure the performance and specification of equipment in test centres. They can also generally exercise more control over the competence of the staff. In addition to standard 'thin-client' Internet applications, managed mode also provides the opportunity for delivering 'thick-client' applications under highly controlled conditions.

Amongst these modes provided by Bartram, the most suited for the Kenyan examination scenario would be the **Managed mode**, since supervision is a key aspect in the examination process and it cannot be eliminated due to security purposes and this allows the administrator, in this case the Kenya National Examinations council to be in full control.

2.2.1.5 Test Session and Supervision Functions

Irvine and Kyllonen (2002) outline the main six functions of supervision:

- Authenticating the identity of the test taker (i.e. establishing who is actually taking the test).
- Establishing a positive rapport with the test taker (i.e. making sure that an appropriate climate is created for the test taking session and that the test taker is not unduly anxious).

- Ensuring that instructions regarding standardized conditions are followed (e.g. making sure that timing conditions are adhered to, that calculators or other aids are used or not as instructed).

- Dealing with unexpected conditions or problems that arise prior to or during the administration process (managing problems with equipment, hardware, disruptions during the test session, test taker disabilities etc).

- Validating the test results (i.e. ensuring that the results obtained are what they appear to be, and were the product of the authenticated test taker operating unaided).

- Ensuring that test materials are kept secure for example, making sure that no copies of test booklets or items are removed by the test takers.

Kyllonen (2002) emphasis on the importance of supervision and on the degree to which administration of an instrument requires the presence of a human supervisor for each of the above functions. This in turn depends on the nature and format of the test and the reasons why testing is taking place: for example, the type of test being administered (maximum versus typical performance); the format of the test (physical versus virtual); and the consequences of assessments (high versus low stakes).

One of the main reasons for requiring human supervision of testing is to manage the level of exposure that the item content has. Item generation techniques, according to (Irvine and Kyllonen, 2002) provide us with the opportunity of developing a whole new range of tests for which this aspect of test security become less of a problem. This is a particular issue for high-stake tests where the item content needs to be re-used or where it might otherwise become known before the test session occurs. It is generally not an issue where tests of typical performance are concerned.

Baron (2001) on the other hand cites that the management of test-taker honesty within a high-stakes assessment process is not just a matter of supervision. It is also a matter of the design of the whole process and the extent to which cheating or dishonest behavior is likely to be detected. The assessment processes for job selection can be backed by an explicit 'honesty policy' to which candidates are asked to sign up. This is supported by the process of re-assessing the final stages of the selection process, any key competencies which formed the basis for the shift. While such contracts are not legally binding or able to guarantee that the applicant has actually abided

by them, they do help provide a clear set of expectations and explain that failure to abide by these conditions could have undesirable consequences.

At present, there is very little hard data to show the impact of such approaches on test taking strategies. What is known, however, is that the use of an unsupervised randomly generated numerical reasoning test during the sift stage of a recruitment procedure can dramatically improve the quality of the candidates who pass that sift (Baron et al. 2001).

2.2.1.6 Feedback and Reporting

Irvine and Kyllonen (2002) continue to argue that, just as it is necessary to ensure that there is a human test administrator present to ensure that high-stake assessments are carried out properly, so there will also be conditions where it is important to ensure that feedback is provided to a test taker by a qualified person rather than over the Internet. The question of when this is necessary is a matter of professional judgment. Generally, one can argue that in any situation where the feedback is complex and needs careful explanation face-to-face feedback should be given. An in-between option is to provide simple feedback online with a phone-in 'help-line' for people to get more in-depth feedback.

Most computer-generated test reports are designed for the test user rather than the test taker (Bartram, 1995a). Considerable care and attention needs to be given to reports that are intended to provide the sole source of feedback for the test taker.

In practice, the situations where feedback needs to be provided on a face to face basis will tend to be the same ones as where the assessment itself needs to be supervised. As such, providing for this is no more of a problem than it would be for traditional paper-and-pencil testing. With well designed Internet testing process-management software, the logistics of arranging for test sessions and feedback appointments are much simpler than for traditional assessment.

2.2.1.7 Test Quality

The effect on a test's psychometric properties of delivering it over the Internet must be considered. Drasgow (1993) is of the opinion that when people take timed and supervised, paper-and-pencil tests and put them onto the Internet as un-timed and unsupervised, the Internet version clearly cannot be regarded as the 'same' test as the original.

In general, when a test is presented in some medium other than the one in which it was developed, it is necessary to check the equivalence of the new form. In practice this is most likely to be an issue for timed ability and aptitude tests. Most research suggests that the data obtained from un-timed self-report inventories are not affected by whether the test is administered on paper or on computer (Bartram, 1994; Bartram and Brown, 2004; Mead and Drasgow, 1993; Salgado and Moscoso, 2003).

In summary, the main concern over the use of unsupervised modes of test administration is that such administration will adversely affect validity and, therefore, utility. In addition, lack of supervision can result in the compromising of test security. This may be a critical issue for traditional ability tests, which have a fixed set of items. Once these become widely known, the test will be of little value. However, this is far less of an issue for self-report personality measures or for tests where item content is continually modified.

2.2.1.8 The Need to Transform Assessment

Current assessments reflect typical pedagogical and assessment practices found in classrooms but they are also a key determiner of what students learn in classrooms and how that is taught (Pelgrum and Plomp, 2008). Consequently, assessment reform is key to the transformation of the educational system as a whole. It is a "determiner" of learning in two senses. Nitko (1994) defines assessment as, the means by which society determines what students have learned and what they can do next.. These student assessments are often "high stakes"; test scores certify student achievement, permit advancement or graduation, and determine competitive advantage in further study. High stakes assessments include the SAT, KCSE, the O-Level (or GCSE) and A-Level exams in most Commonwealth countries, Advanced Placement exams in the U.S. the *Matura* in much of Eastern Europe, and the *Abitur* in Germany, Austria, and Finland (Pellegrino et. Al. 2004). National assessments are used to determine the effectiveness of teachers, schools, and entire educational systems. These assessments are often also "high stakes"; student performance on tests scores is connected to rewards and punishments for schools and teachers. International assessments are often high stakes for policymakers interested in how their school systems compare with those of other countries. Students, parents, teachers, administrators, and entire schools systems respond accordingly to these high-stakes assessments and it is in this second sense that they have also come to determine what is learned. Whatever the formal

curriculum says, whatever teachers are taught to do in their training, whatever it is that students want to learn, the paramount determiner of what is taught, how it is taught, and what is learned is what is assessed, particularly on high-stakes exams. These summative, high-stakes assessments that determine students' futures, establish rewards and punishments for schools and teachers, and shape classroom and instructional practices of classrooms are the focus of this call to action.

Unfortunately, these traditional assessments, (Pencil-and-Paper) do not measure all the competencies and skills that are needed by the 21st century workplace and society (Pellegrino, et, al., 2004). There is a significant gap for assessments, and for the rest of the education system, between what happens in schools and what happens outside of schools (as summarized in **Table 2. below**).

While people in contemporary business work with others and use subject knowledge and a variety of technological tools and resources to analyze and solve complex, ill-structured problems or to create products for authentic audiences, students taking traditional exams do so without access to other people or resources and are, in the main, required to recall facts or apply simple procedures to pre-structured problems within a single school subject.

Standardized Student Assessments	Tasks in the Outside World
Assessments are designed primarily to measure knowledge of school subjects and these are divided by disciplinary boundaries.	Subject knowledge is applied within and across disciplinary boundaries along with other skills to solve real world problems, create cultural artifacts, and generate new knowledge.
Students are assessed on their ability to recall facts and apply simple procedures in response to well-defined, pre-structured problems.	People respond to complex, ill-structured problems in the real world contexts.
Students take the exam individually.	People work individually and in groups of others with complementary skills to accomplish a shared goal.
Students take a "closed-book" exam, without access to their notes or to other sources of information, and use only paper and pencil during the assessment.	People use a wide range of technological tools and have access to a vast array of information resources and the challenge is to sort through all of it to find relevant information and use it to analyze problems, formulate solutions, and create products.

Students respond to the needs and requirements of the teacher or school system.	People respond to official standards and requirements and to the needs and requirements of an audience, a customer, or a group of users or collaborators.

Table 2: Gap between student Assessment and Society expectations

This gap between school assessments and the world outside of school fails to prepare students for the demands of the 21st century. As Stanford Hammond (2005) points out, when high-stakes assessments are emphasized in schools, the use of pedagogical methods focused on the teaching of complex reasoning and problem solving decreases. Teachers report that with such assessments, they have little time to teach anything that is not on the test and that they have to change their teaching methods in ways that are not beneficial to students (Pedulla, et al., 2003). For example, when writing is assessed with paper and pencil, teachers are less likely to use computers when they teach writing (Russell and Abrams, 2004).

Traditional assessments also fail to measure all the skills that are believed to be enabled and acquired by the regular use of new, technology-based learning environments. A great deal has been learned about how teachers can integrate the use of ICT into everyday classroom practices and how students can use them to work in teams and to apply their deep understanding of school subjects and ICT tools to solve complex real world problems (Bransford, et al, 2001).

(Schwartz, Bransford and Sears, 2005) show that new approaches to assessments reveal the strengths of innovative pedagogical approaches. A key goal for this project is to examine these classroom innovations and find ways to take ICT-based learning environments and assessments out of laboratories and classrooms, scale them up, and derive implications for international and national high-stakes assessments of 21st century skills and for classroom practices that support assessment reform.

This clearly illustrates that in order to be on an equal footing with the rest of the world where education is concerned and the ability to produce learners who can tackle 21st century issues, it is inevitable that our systems of learning and evaluation should also be at par with the global market. This brings out the objective of transitioning our assessment from the current PPT to the CBA system.

2.2.1.9 The Transition Process

The recommended process for a good transition of paper and pencil test to computer-based testing as proposed by Schwartz, Bransford and Sears, (2005) first assumes that the principles of universally designed assessments have been followed. Then, these five steps are recommended:

Step 1. Assemble a group of experts to guide the transformation.

Step 2. Decide how each accommodation will be incorporated into the computer-based test.

Step 3. Consider each accommodation or assessment feature in light of the constructs being tested.

Step 4. Consider the feasibility of incorporating the accommodation into the computer-based test.

Step 5. Consider training implications for staff and students.

This would be the most recommended format to be applied if The Kenya National Examination Council decided to transform its assessment and evaluation systems.

2.2.1.10 Technological and Methodological Challenges

Despite the potential advantages offered by computer-based testing, there remain numerous challenges, especially in the transition from paper/pencil assessments.

a) Technological Aspects

Computers and the Internet do not always work the way they expected to. The word "crash" has taken on a whole new meaning in our technology-oriented world. Burk (1999) points out how "testing sessions can be interrupted, or proceed so slowly as to interfere with student performance, or encounter difficulties in machine operation or telecommunications that cause data to be lost entirely. Unlike a paper-and-pencil testing system, keeping a computerized system functioning requires significant technical expertise, which many schools lack". Burk further argued, "Computerized testing for students with disabilities is viable but only with appropriate equipment, staff preparation, and student preparation" (p. 6). This is the reality in majority of developing and underdeveloped nations. Kessy, et al, (2006) and Ford (2007) discuss on reasons for under use of ICT in education in the African context, identified cost of adopting ICT including acquiring hardware and software, setting up telecommunication networks, and the

maintenance and repair of facilities is often prohibitive for developing nations as a major setback. African countries have poor infrastructure including unreliable transportation, limited electricity supply, and broadcast and telecommunication facilities. This makes it difficult for institutions to maintain Internet connections and in the case of Kenya electricity is not government subsidized making it relatively expensive at an average cost US$ 0.08/KWh compared to US$0.02/KWh.

Some researchers, like Hamilton, Klein, and Lorie (2001), question whether an infrastructure currently exists that can support the use of computers by large numbers of students. They also question the quality of the hardware, especially with the constant evolution of technology, and whether there is sufficient training for staff that must help with administration and technological difficulties that may be encountered. The test program may be device-dependent; for example, there may be a difference in contrast between monitors and speed of the computer. A test presented online may default to the computer's font, print size, and background color. Graphics may become distorted on small screens, reducing standardization of the assessment presentation. According to a report by the National Governors Association (2002).

Haaf and Duncan et, al (1900) have stated that a constant challenge is the ongoing entry of new Web browsers and new versions of existing browsers. In addition, HTML and document converters are constantly being developed and modified. Unfortunately, several features may not be universally accessible and advancements in assistive technology are usually several steps behind new Internet components and tools. For example, using an eye pointing device may increase the time needed to position each eye pointing frame, leading to increased fatigue, boredom, and inattention by the test-taker (Haaf, et, al, 1999). As computer-based testing becomes a reality globally, it is important to ensure that the new technology either improves accessibility or is compatible with existing assistive computer technology.

The use of technology cannot take the place of content mastery. No matter how well a test is designed, or what media are used for administration, students who have not had an opportunity to learn the material tested will perform poorly. Students need access to the information tested in order to have a fair chance at performing well. Other challenges that must be overcome in order for computer-based testing to be effective include: issues of equity and skill in computer use,

added challenges for some students, technological challenges, security of online data, lack of expertise in designing accessible Web pages, and prohibitive development cost.

b) Methodological Aspects

Significant methodological challenges brought up by Kozma(2003) include:

- The need to determine the extent to which ICT-based items that measure subject knowledge should be equivalent to legacy paper and pencil-based results.

- The need to detail the wider range of skills that can only be assessed by ICT.

- The need to determine the age-level appropriateness of various 21st century skills.

- Need to design complex, compound tasks in a way such that failure on one task component does not cascade through the remaining components of the task or result in student termination.

- The need to integrate foundation ideas of subject knowledge along with 21st century skills in the assessment. At the same time, there is a need to determine the extent to which subject knowledge should be distinguish from 21st century skills in assessment results.

- The need to develop new theories and models of scoring the students' processes and strategies during assessment, as well as outcomes.

Schuemer et, al (2001) have also cited several crucial challenges faced by students when presented with Computer based tests and assessment mode:

- It places more demands on certain skills such as typing, using multiple screens to recall a passage, mouse navigation, and the use of key combinations (Bennett, 1999; Ommerborn and Schuemer, 2001).

- Some students become more fatigued when reading text on a computer screen than on paper (Allan et al, 2001; Mourant, et, al, 1981).

- Long passages may be more difficult to read on computer screen (Haas and Hayes, 1986).

- The inability to see an entire problem on screen at one time is challenging because some items require scrolling horizontally and vertically to get an entire graphic on the page (Hollenbeck, Tindal, et, al, 1999).

- Few teachers use computers in math instruction, or spreadsheets, so students do not know how to "think on the monitor" (Trotter, 2001).

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- Graphic user surfaces present considerable obstacles to students with visual impairments (Ommerborn and Schuemer, 2001).

Hollenbeck, et, al (1999) strongly caution that the use of a computer, in and of itself, does not improve the overall quality of student writing. They, and other researchers, continue to find significantly lower mean test scores for students with disabilities than for their peers without disabilities.

Many other critical challenges also arise: the tremendous efforts that are necessary for the development of electronic exams or for the initial creation of a pool of questions through the test developers, as stated by Quellmalz and Kozma, (2003) insufficient familiarity of users with the new procedures, malfunctioning hardware components or operating systems or a failure in Internet access, legal security requirements that had to be met, insufficient flexibility of examination regulations or attempts at manipulation and fraud. Therefore, the development of a methodologically sound and juridical stable electronic exam scenario demanded overcoming many barriers.

The National Governors Association (2002) in its report, further points out additional challenges as follows:

- Significant start-up costs for assessment systems that have previously implemented only paper and pencil assessments. These costs would include hardware, software, and network purchases; software development related to localization; and technical support and maintenance.
- The need to handle a wide variety of languages, orthographies, and symbol systems for both the delivery of the task material and for collection and scoring of open-ended responses.
- The need to keep up with rapidly changing technologies and maintaining comparability of results, over time.
- The lack of knowledge of technological innovators about assessment, and the corresponding scarcity of examples of educational software that incorporates with high-quality assessments.

- The need to incorporate qualities of high-level professional judgments about student performances into ICT assessments, as well as support the efficiency and reliability of these judgments.

- The need to develop new theories and models of scoring the students' processes and strategies during assessments, as well as outcomes.

- The need to establish the predictive ability of these judgments on the quality of subsequent performance in advanced study and work.

- Security of on-line data and maintenance of confidentiality of test items and student data.

In many African nations, the list goes further to include lack of ICT policies, poor ICT project management, and high levels of corruption which leads to ineffective implementation, adoption of different systems and standards, duplication of effort, and waste of technology resources. Efforts are often uncoordinated and initiatives are often in competition with each other rather than complementing each other. In addition there are many unsustainable ICT programs where schools have computers that do not work as resources that are often redirected and misuse (Ford, 2007; Kessy et al., 2006).

2.2.1.11 PPT verses CBA Examination Process

Bartram (2001) has prescribed various steps involved in administrating and executing of a computer based assessment process. He states that the Speed and quality of processing the examination data depend upon a frictionless cooperation of administrative staff (student office and IT administration) and lecturers. Batram(2001) outlines the various process of the examination as shown below:

1. CBA Examination Administration Process

Preparation phase of the examination including:

• step 1: general examination planning

• step 2: recording of course and examination data

• step 3: carrying out time and room planning.

Enrolment and admission for the examination include

• step 4: student enrolment for examinations

• step 5: generation of registers for the exam registration

• step 6: verification of prerequisites for admission to examination.

The core part of the examination process chain is the examination itself (step 7).

Processing the examination results comprises

• step 8: assessment and recording of the examination results

• step 9: storage of data in the database.

Announcing the results means

• step 10: automated generation of mark information

• step 11: supplying additional information for examinees through administrators

• step 12: creating reports, lists and certificates.

Finally, there are several permanent tasks such as

• step 13: coordinating examination tasks between the examination administrator and the
  schools.

• step 14: maintenance of relevant software systems.

Figure 7: Computer Based Assessment - flow of examinations

Source: Batram(2001)

2. The PPT Examination Process

All the activities are conducted manually up to the process of online registration of candidates, which until recently was also done manually as Figure2.1 below illustrates. The study will thus emphasis on the importance of reevaluating the examination process with the application of Information Technology to reduce these procedures to a great minimum in terms of time utilized, personnel involved and resouces used.

Figure 8: Paper and Pencil Examination Process
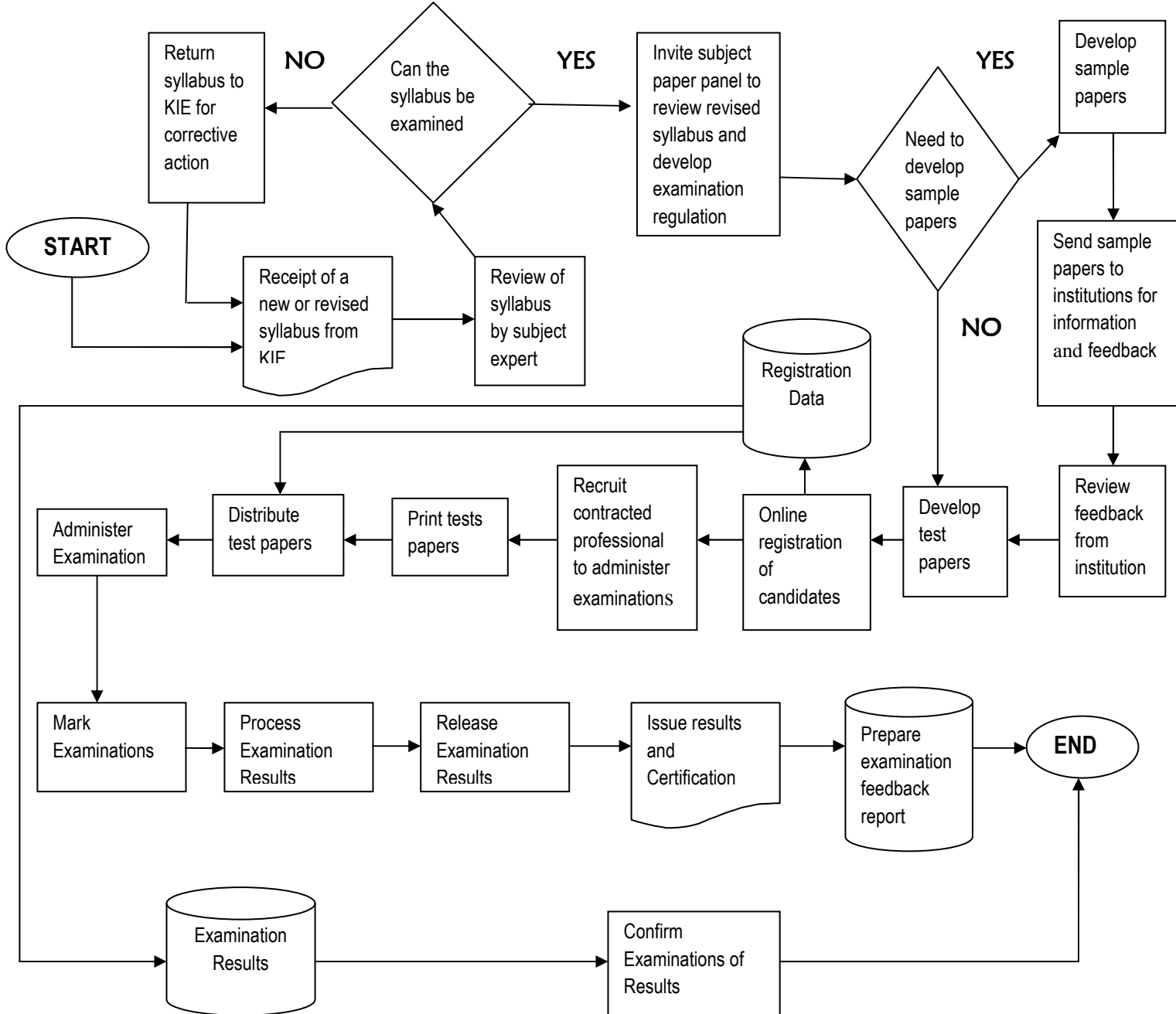
Source: KNEC, 2012: Examinations Report

2.2.1.12 Beneficial Aspects of CBA

Computer-based tests offer numerous advantages over paper-based tests. These would include: paperless test distribution and data collection, greater standardization of test administrations, monitoring of student motivation, obtaining machine-scorable responses for writing and

speaking, providing standardized tools for examinees (e.g., calculators and dictionaries), and the opportunity for more interactive question types.

While not all assessment reforms require the use of ICT, technology provides some significant advantages when introduced into assessment. The incorporation of ICT into large-scale assessments promises a number of other significant advantages.

These include:

- Reduced costs of data entry, collection, aggregation, verification, and analysis.
- The ability to adapt tests to individual students, so that the level of difficulty can be adjusted as the student progresses through the assessment and a more-refined profile of skill can be obtained for each student.
- The ability to efficiently collect and score responses, including the collection and automated or semi-automated scoring of more-sophisticated responses, such as extended, open-ended text responses.
- The ability to collect data on students' intermediate products, strategies and indicators of thought processes during an assessment task, in addition to the student's final answer.
- The ability to take advantage of ICT tools that are now integral to the practice and understanding of subject domains, such as the use of idea organizers for writing, data analysis tools in social science, and visualization and modeling tools in natural science.
- The ability to provide curriculum developers, researchers, teachers, and even students with detailed information that can be used to improve future learning.

2.2.1.12 ICT in Schools

There exists a clear need and rationale for the incorporation of ICT into the educational system. Three of the reasons for integrating ICT into education are:

- *The risk of being marginalised in the new development dispensation due to information and knowledge poverty:* In order to be part of international economic processes that would benefit local people, it is imperative to be part of the international information exchange. To remain apart from it would mean poor prices for national agricultural and

non-agricultural produce, unfavourable economic relationships, and an inability to influence or be involved to the best advantage in international events.

- *The risk of producing redundant human capacity in a globalised job market that envisions unfettered movement of knowledge, labour and skills:* Globalisation has brought new opportunities as well as demands on educational systems the world over. The competition is not restricted to learners seeking the best schools and training; it is also between countries seeking to offer the best training opportunities to woo students along with their money in fees on one hand, and, among locations and localities as better managers or sources of knowledge and information, on the other. Winning countries, localities, and locations using ICTs get higher student numbers as well as the money these students bring and offer superior knowledge and information products. In the worst case scenario, Kenyan graduates could be unemployable outside or possibly even inside the country on account of poor training.

- *Limited resources as an ever-present risk in most education systems, including Kenya:* Human resources for the educational system, in the main, teachers, are hugely insufficient especially when the decimating influence of HIV/AIDS in Africa is factored into the teacher supply equation. Non-human resources such as teaching and learning materials are evidently insufficient to support the growing needs of the educational system in Kenya. ICTs can come to the rescue as they can tremendously expand the reach.

2.2.2. Empirical Literature

2.2.2.1. Computer Based Assessment

Despite the benefits of computer-based testing over the past four decades, there has been incremental growth in computer-based testing (CBT) as a viable alternative to paper-and-pencil testing. However, the transition to CBT is neither easy nor inexpensive. European countries are currently facing the challenge to shift from traditional testing to computer-based assessment approaches and to organize a smooth process of transitioning.

Online assessment is now commonplace in many **Australian universities** for both formative and summative purposes. Outside Australia, there appears to be a greater uptake of e-Assessment in

schools, with 38% of awarding bodies surveyed in England using some form of e-Assessment to deliver up to 60% of their assessment program (Chapman, 2006).

The Educational Testing Institute, in **Reykjavik, Iceland** is in charge of carrying out national school assessment and has had on its agenda now for some time the transition of conventional paper and pencil based tests over to computerized adaptive testing. The Institute is also responsible for carrying out the Icelandic parts of a number of international surveys, among others the PISA study and that experience has further strengthened the CBT plans. This plan for going over to computer based testing is partly a response to requests from the school system where more and more emphasis is being put on individualized learning and teaching and an adaptive electronic approach to testing, fits that approach very well. There have been in recent years growing concerns about the conventional national paper and pencil tests and all stakeholders are presently very enthusiastic about utilizing the new methods of electronic testing (Harrison et al., 2003; Ravitz et al., 2002). The Republic of **Chile** has addressed computer literacy as a significant national priority. Like the U.S. E-Rate program, Chile has begun an ambitious effort to invest $100 million in a computer and social network called Enlaces a Spanish Word meaning "links", enabling thousands of schools to connect to the Internet (Chapman, 2006). However, Enlaces goes even further beyond ensuring access. The project provides extensive training to help teachers integrate technology into the school curriculum and design collaborative learning projects that involve children all over the world (Claro et, al. 2012).

2.2.2.2 ICT in Education in Africa

The process of adoption and diffusion of ICT in education in Africa is in transition. As cited by Casely-Hayford, et,al (2003,) there appears to be the beginnings of a marked shift from a decade of experimentation in the form of donor-supported, NGO-led, small-scale, pilot projects towards a new phase of systemic integration informed by national government policies and multi-stakeholder-led implementation processes. One of the primary features of this new phase is the priority that governments are giving to policy development. Casey further states that all but a handful of countries surveyed already have a national ICT policy in place or under development. While some of these national policies define goals and implementation strategies for ICT in the education sector, nearly half the countries have chosen to develop an ICT policy that is specific to the education sector. The new phase of ICT for education in Africa is occurring within

national, and emerging regional, policy frameworks that are providing the basis for partnerships and donor participation. While most countries have embraced policy development, there is a notable stratification in terms of their ability to implement. A country like South Africa, with its extant infrastructure and more mature economy, is clearly an outlier in terms of being able to implement its ICT in education agenda.

Many of the countries of North Africa constitute another stratum that has made excellent progress because of their resources and the high bandwidth connectivity they enjoy with Europe. Another group is made up of those countries that are moving steadily toward stable economies and that are placing a high priority on ICT applications. Cameroon, Ghana, Mauritius, and Botswana are examples. The largest group is made up of those countries that are emerging from a period of conflict and authoritarian rule. They look to ICTs to assist them in their efforts to improve capacity for social and economic development. And, unfortunately, there remains a group of countries that are plagued with internal conflict and political instability that make progress on ICT for education impossible.

2.2.2.3 Public-Private Partnerships and ICT Initiative In Education in Africa

There are multi-partnerships that involve private companies (usually ICT based), government ministries, educational institutions, donors, development agencies, and civil society organisations by working together to garner resources and set priorities for ICT in education projects. According to Mwololo (2005), the Kenya ICT Trust Fund and the Egyptian Education Initiative are good examples, as is the Information Society Partnership for Africa's Development (ISPAD) put together by NEPAD through the e-Africa Commission and five major ICT companies to implement the NEPAD e-Schools Demonstration project. Mwololo Waema (2005).

There has been a remarkably increase in the number of bilateral partnerships between ICT organisations (e.g., Microsoft, Cisco, Intel, Hewlett Packard) and national ministries of education in Africa to enable the use of specific ICT products. In Rwandan, two universities (the National University, the Kigali Institute for Education, and the Kigali Institute for Science and Technology) and the University of Nairobi in Kenya, have partnered with Google to improve access to Web-based communications for staff and students which allows free access to Google applications (Gillwald, 2005).

International partnerships , particularly in higher education, exist for a variety of reasons, including the development of ICT capacity. Mwololo(2005) pointed out that the two organisations that are particularly active are the Agence Universitaire de la Francophonie (AUF) and the Partnership for Higher Education in Africa that is sponsored by seven American foundations.

There has been myriad of initiatives that demonstrate the rapid changes in the developement of ICT in Africa, based on the *Survey of ICT and Education in Africa*:

- The availability of mobile phone technology is increasing at a remarkable rate.
- Wireless networks are becoming increasingly common.
- Undersea cable projects such as the EASSy project are being planned to provide global connectivity for countries that currently lack such access.
- A variety of public-private partnerships are emerging, particularly in the form of ICT trusts designed to encourage investment and stakeholder participation in ICT infrastructure development in education. (See the country reports for Kenya, Namibia, and Sudan for examples.)
- In the national ICT policies of several countries (notably Rwanda, Mauritius, Algeria, and Botswana), there is a declared intention to become a regional ICT service hub.

It is only through partnering with National and International bodies specialised in ICT initiavies and developement , that countries in Africa can adopt ICT integration in the learning process. It is only after enabling schools access ICT at the grassroot level, that the posibility of ttransitioning from PPT to CBA can be realised.

2.2.2.4 ICT Equipments and Connectivity In Schools of Africa

In a survey carried out by Steiner and Karanja(2006), it was cited that the formal schools sector has led the way on ICTs in education in most African countries, often before the adoption of national policies. South Africa, Namibia, Senegal, Mali, Cameroon, Nigeria, Ghana, Kenya, and Uganda are a few examples. In these cases, the initiation of ICT access in schools has been supported by large programmes like the World Bank's World Links for Development, which worked mainly in partnership with ministries of education, SchoolNet Africa, and the IDRC's Acacia programme. These initial small-scale projects have been taken to the next level by

national programmes that are promoting ICT access to all schools. Much of the emphasis is on secondary school access in almost all countries.

All African countries with national policies on ICTs in education have made detailed and specific reference to issues of universal ICT access and use in all formal schools. Botswana, Ghana, Kenya, Namibia, South Africa, and Zambia are examples. These programmes have been given further impetus by high-level pan-African programmes such as the New Partnership for Africa's Development (NEPAD) e-Schools Initiative, which is concluding its first phase Demonstration Project involving 16 African countries. Steiner and Karanja(2006).

Table 3: Access and Connectivity Models

Technology/Connectivity	Project and Country
Radio	OLSET (South Africa), KIE (Kenya)
Television broadcast	Mindset (South Africa), Learning Channel (South Africa Talk Back TV (Botswana), Ethiopian Ministry of Education Centre for Technology Development and Decisionmaking Support (Egypt)
Video	Discovery Channel Global Education Fund (Angola, Tanzania, Uganda, Zimbabwe)
DVDs and CDs	Learnthings Africa, CurriculumNet Uganda, Mindset (South Africa)
Second-hand PCs	Schoolnets in Cameroon, Mali, Mozambique, Namibia, Nigeria, Senegal, Swaziland, Zambia Zimbabwe
PC refurbishment centres	SchoolNet Africa and GEEP(Senegal), World Links (Zimbabwe) Computers for Schools Kenya, SchoolNet Uganda, Computer Education Trust (Swaziland), SchoolNet Namibia
Dial-up Internet	SchoolNet Cameroon,
Satellite datacast	Mindset (South Africa)
Broadband Internet	Mauritius Ministry of Education and Ministry of IT
VSAT connectivity	SchoolNet Uganda, NEPAD e-Schools (Mali, Uganda, Rwanda)
Mobile phones	Teacher SMS Project (Kenya), Math on MXit, Meraka Institute (South Africa); M-Girls, Mindset (South Africa)
Open source software	OpenLab (SchoolNet Namibia); SchoolNet Mozambique

Source: World Bank, 2006.

The table illustrates the range of technologies being used to provide connectivity in some form.

This shows that many African countries are connected on a very basic level and the need to enhance the connectivity is urgent.

Table 4: Computer Penetration Ratios at Schools in Selected African Countries, 2006

Country	Number of schools	Schools with computers	% of schools with computers
Egypt	26,000	26,000	100%
Ghana	32,000	800	2.5%
Mozambique	7,000	80	1.1%
Namibia	1,519	350	22.1%
South Africa	25,582	6,651	22.6%
Kenya	7,000	2,000	28.6%

Source: Government of Egypt, 2006.

Table 2.3. above provides some estimates of numbers of schools reached with computers in a sample selection of African countries. Notably, the NEPAD e-Schools project has targeted the reach of Africa's full complement of formal schools estimated at 600,000 which has been factored into its recently developed business plan

2.2.2.5 Under-Utilization of ICT in Education in Africa

In their discussions, Kessy, et, al, (2006) and Ford (2007) cited several reasons for the under utilization of Information Communication and Technology in education in the African context. The cost of adopting ICT including acquiring hardware and software, setting up setting up telecommunication networks, and the maintenance and repair of facilities is often prohibitive for developing nations. Kessy et al. recommend privatization as a means to enhance competition and reduce cost. In general, African countries have poor infrastructure including unreliable transportation, limited electricity supply, and broadcast and telecommunication facilities. This makes it difficult for institutions to maintain Internet connections. To be effectively adopted, ICT requires good governance and appropriation of allocated government funds and foreign aid.

In many developing nations lack of ICT policy, poor ICT project management, and corruption has led to ineffective implementation, adoption of different systems and standards, duplication of

effort, and waste of technology resources. Efforts are often uncoordinated and initiatives are often in competition with each other rather than complementing each other. In addition there are many unsustainable ICT programs where schools have computers that do not work as resources that are often redirected and misuse (Ford, 2007; Kessy et al., 2006).

The policy framework and implementation plans of ICT in majority of African countries focus predominantly on the development of ICT operational skills rather than on its integration in pedagogical practice.

The cultural context of ICT adoption, language barriers, and attitudes toward ICT affect the rate at which it is adopted. Perceived difficulty in the integration of ICT in education is based on the belief that technology use is challenging, its implementation requires extra time, technology skills are difficult to learn, and the cost of attaining and maintain resources is prohibitive (Fourie and Alt, 2002). For instance, as Ford (2007) notes humanities teachers are the most resistant to computers. Limited skilled human resources and students' limited computer knowledge which is precipitated by the reluctance or inability for schools to introduce ICT often result in limited use of resources, creating a vicious cycle (Kessy et al. 2006). Further, Ford (2007) states that in many instances teachers believe that using computers deprives students of the time needed to study for their national examinations and that computers disrupt the traditional structure of the classroom.

2.2.2.6 Factors Enabling and Constraining ICT use In Education in Africa

The factors enabling and constraining ICT applications are essentially the same in both developed and developing economies, although they obviously differ in terms of importance, depending on which side of the digital divide they are viewed from. What differentiates the rate of adoption and diffusion of ICT in education is not the factors at play, but rather the degree to which they have been developed or are present in a given country. Table 2.4 (Appendix iv) provides a general picture based on the country reports (Gakio Karanja 2006).

The most common factors accounting for the constraint are:

1. Policy framework and implementation plans
2. Advocacy leadership
3. Gender equity

4. Infrastructure and access
5. Collaborating mechanisms
6. Human resource capacity
7. Fiscal resources
8. Learning content
9. Sustainability
10. Attitudes
11. Procurement
12. Regulations

2.2.2.7 CBA in East Africa

The five countries forming the East African Community have formulated national ICT policies and most of them have drawn out plans for ICT integration in schools. These policies were all formed at the turn of the millennium (about the year 2000) against a backdrop of haphazard and uncoordinated ICT developments; with a national ICT policy preceding the education-sector-specific ICT policy formulation. Although the reasons for the formation of these policies varied from one country to another, the bottom line was the eradication of poverty through the training of skilled human resources and provision of education in line with the Education for All (EFA)agenda. The formulation processes were led by the respective government ministries with evident donor support.

In their ICT for education policies, all the East African countries express the need for integrating ICT in both formal and informal education. There is a stated commitment to invest in ICT infrastructure in schools with deliberate plans to ensure that the digital divide between rural (poor) and urban (rich) schools does not escalate and that children with special needs are catered for as well. The policies point to a desire for a nationally coordinated effort in the creation, dissemination and sharing of e-learning content to improve the quality of teaching and learning in schools (Ang'ondi, Susan Namalefeet.el)

East African countries are experiencing rising primary and secondary school student populations, yet they have static or shrinking resources for training and upgrading teachers. As major stakeholder in the education process, there is need for greater involvement of teachers in solving

educational problems. One way of doing this is through the use of ICT in teaching, learning and assessment, an area with great potential for growth and impact. While most institutions in East Africa avail courses in ICT, use of this knowledge has not been well applied within the same setting (Gunga and Ricketts, 2007).

A teacher-led process of creating, selecting, adapting technologies, and subsequent reflections facilitates the teachers' professional growth, and helps improve quality of instruction. It is important therefore to look at current technologies for assessment and how these can be adapted and configured for use in our education system.

Primary summative examinations in East African countries, KCPE/ PSLEE/ depend heavily on objective test items. Though these items are administered using the traditional paper and pencil format, scoring is done electronically. The technology used for this purpose is known as the **Optical Mark Reader** (Speedwell, 2007). Great potential exists for the use of ICT in the administration of objective test items in education systems in the East African region.

Feedback on Computer Based Assessment can be disseminated quickly, analyzed, archived and retrieved with convenience. The main drawback here has of course got to do with the poor internet connectivity in rural areas in **East Africa**, and online security issues. Nevertheless, this mode of communicating feedback is gaining acceptance locally. For example, national examinations bodies in East Africa have adopted online means of communicating feedback, as a supplement to the traditional paper-based reports, the **short messages system**(sms) which give instant feedback.(KNEC, 2007; NECTA, 2007; UNEB, 2007).

Assessment using ICT presents new frontiers in the testing and mentoring aspects of teacher development as well. Expertise in both pedagogy and content is distributed over wide geographical areas. ICT will enable the establishment and maintenance of mentoring relationships between these experts and remote students. For example, Uganda may have experts in HIV/AIDS Curricular Integration, who may provide support for pre-service trainees and teacher trainers in Tanzanian and Kenyan institutions. This initiative will also present an opportunity for a unified teacher registration and certification service, leading to a strengthening of the profession in the region.

2.2.2.8. ICT Policies for the Kenyan Education System

The Ministry of Education, Science and Technology (MoEST) is responsible for providing education to its citizens (Ministry of Education, 2008). The ministry's tasks include employment of teachers for government schools, distribution of learning resources, and implementation of education policies. The education sector takes up about 30% of the government's annual expenditure accounting for the largest share of the annual budget. However, much of the expenditure goes toward higher education and teacher training. University education falls under the Ministry of Education, Science, and Technology. The ministry's mandates are: 1) Science Technology Innovation (STI) Policy; 2) Research development, research authorization; and 3) Coordinating Technical Education (TE). Among other roles, the higher education ministry is responsible for improving the quality, relevance, equity and access to higher education and technical training and to enhance the capacity of the national STI system towards demand driven STI, quality higher education and technical education services (Ministry of Higher Education, Science, and Technology, 2009).

The vision of the Ministry is to provide "quality education for development," while its mission is "to provide, promote and co-ordinate lifelong education, training and research for Kenya's sustainable development." MoEST focuses on certain priority areas, notably attaining Universal Primary Education (UPE) by 2105 within the context of the wider objective of the UNESCO/World Bank initiative Education for All (EFA) (Ministry of Education, 2008; UNESCO, 2006).

Computers for Schools Kenya (CFSK) is a non-governmental organization that was formally registered in October 2002. Their vision is the establishment of an information-rich Kenyan Society actively participating in sustainable development. In the nine years that they have been in existence, CFSK has sourced over 50,000 personal computers that we have deployed in over 3,000 public secondary and primary schools, technical training institutes, teacher training colleges, medical training centers and several universities.

The Kenya Institute of Development of Curriculum (KIDC) formerly known as (KIE), a semi-autonomous governmental agency, is responsible for educational research and development of the curriculum. It is focused on providing quality, relevant and affordable educational and

training programs in response to a changing social, economic and technological environment. The initiatives are met through continual research, evaluation, assessment and the monitoring processes (Kenya Institute of Education, 2009). KIDC works closely with the Kenya National Examination Council (KNEC), the examining body responsible for developing and assessing national exams at various levels of learning including the Kenya Certificate of Primary Education (KCPE) and Kenya Certificate of Secondary Education (KCSE) (Kenya National Examination Council, 2008). The Teachers Service Commission (TSC) is responsible for teacher recruitment, human resources services, and place of government employed teachers (Ministry of Education, 2008).

In January 2006, Kenya promulgated a National ICT Policy and sector policy in Sessional Paper No. 1 of 2005, in line with the E-Government Strategy of 2004 and the wider Economic recovery Strategy Paper for Wealth and Employment Creation (ERSWEC), with the aim of improving the livelihood of Kenyans by ensuring the availability of accessible, efficient, reliable and affordable ICT services (Mwololo, 2005). The Ministry of Education developed a Kenya Education Sector Support program (KESSP) in 2005 that featured ICT as one of the priority areas with the aim of main streaming ICTs into learning and teaching process. The National ICT policy embedded this intent as a national priority and provided the impetus for the ministry to develop its sector policy on ICT in Education (Government of Kenya, 2005)

By June 2006, the National ICT Strategy for Education and Training was introduced, the document referred to as the ICT policy for education sector consisted of the following components:

- ICT in education Policy
- Integration of ICTs in Education
- Digital equipment
- Connectivity and network infrastructure
- Access and equity
- Technical support and maintenance
- Harnessing emerging technologies
- Digital content

- Training-capacity building and professional development
- Research and development

The ministry was given the mandate to lead the monitoring and evaluation of the strategy's implementation, guided by overall government policies on education and ICT, specific strategy documents for implementing its mandate, the global goals such as the Education for All (EFA) and the Millennium Development Goal (Mwololo, 2005)

According to Sessional Paper No. 1 of 2005, entitled "A Policy Framework For Education, Training and Research", the overall goal of education is to achieve EFA by 2015 in tandem with national and international commitments. The short-term goal is to attain UPE by 2010 and to increase the transition rate, from primary to secondary schools, from 47% to 70%. In addition, the policy envisages expansion of capacity for universities to enroll an average of 5,000 students annually. In addition, the policy provides commitment for enhancement of access, quality and equity in delivery of education services at all levels. Equally important, the policy provides commitment to ensure that learning needs for all are met through appropriate learning and life long skills by 2015. In order to realize these policy objectives, commitment is made to integrate ICTs in the delivery of the education curricula, to strengthen Open and Distance Education (ODE) and topromote effective and efficient administration at all levels of education. (Government of Kenya, (2005:80)

2.2.2.9 Educational Growth and Reforms
Education in Kenya is directly influenced by government policies and is therefore constantly changing according to socioeconomic and political trends. After gaining independence, the country set up a commission to make changes in the formal education system, (Oketch and Rolleston, 2007).The focus of the commission was to build a national identity and to unify the different ethnicities through subjects in school such as history and civics, and civic education for the masses.

1. The 7-4-2-3 Education system
Between 1964 and 1985, the 7-4-2-3 education structure was modeled after the British education system. It was designed to provide seven years of primary education, four years of lower secondary education, two years of upper secondary education, and three years of university

(Buchmann, 1999). The country was in dire and immediate need for skilled workers to hold positions previously held by the British. Hence, the government set out to quickly expand educational opportunities to its citizen.(Ntarangwi, 2003).

2. The 8-4-4 System of Education

In 1981, a Presidential Working Party was commissioned to examine curriculum reform of the entire education system in the country. The committee submitted a recommendation to change the 7-4-2-3 education system to the current 8-4-4 system of education, whose overall structure was similar to the U.S. education system. The 8-4-4 system was launched in January 1985, and the name was also changed from **Certificate of Primary Education (CPE)** to adopt the current **Kenya Certificate of Secondary Education (KCPE**) at the same time (**KCE)** became (**KCSE)**. It was designed to provide eight years of primary education, four years of secondary, and four years of university education. Emphasis was placed on Mathematics, English, and vocational subjects. The focus on vocational education was aimed at preparing students who would not continue on with secondary education, those who would be self-employed, and those who would be seeking employment in the non-formal sector ("Ministry of Education," n.d.).

3. Free Primary Education

Free Primary Education (FPE) was first introduced in Kenya in the late 1970s, however, the programme was later abolished in 1988 under the Structural Adjustment Programs (SAPs) to ease financial burden on the public education system . These meant that parents had to contribute more towards education of their children through a cost-sharing programme. Parents were responsible for buying school uniforms, textbooks and other instructional materials for their children, as well as constructing buildings and other equipment to schools. The government retained the role of recruiting and paying teachers for their services.

The cost-sharing system led to high wastage within in the primary education system in the form of low enrolment, high dropouts, grade repetition, low completion and poor transition rates (Bedi et al., 2002 and Kimalu et al., 2001).

To reverse this poor trends in educational achievements, the government again initiated free primary education programme (FPE) beginning January 2003. This policy was congruent to the 2001Student's Act that calls for affordability and equitable access to education in Kenya. The

Act states that the government should provide free and compulsory primary education and the world leaders also made the achievement of universal primary education by the year 2015 one of the key Millennium Development Goals (Oketch and Rolleston, 2007; Onyango, 2003).

2.2.2.10 CBA Initiative at the Kenya National Examinations Council

The Kenya National Examinations Council (KNEC) has recently established several panels to present viable solutions for the adaptation and implementation of item banking on a web-based platform, where test items are submitted without the logistic of setting up an item writer workshop, a proposal that is being rolled out in phases.(KNEC, 2010).

A panel was also set up to pursue the adoption of Computer Based Assessment in Post Schools examinations, that is Business and Technical examinations. These examinations offer the best structural support for CBA in Kenya. The reasoning being:

These colleges offer manageable number of candidature Institutions already offer significant infrastructure Learners and instructors already have the requisite ICT skills.

1. Existing platforms for CBA in Post Schools Examinations

Availability of the required hardware capacity to undertake the exercise has been put in place at the Kenya National Examination Council, though not yet implemented. Countrywide internet connectivity covering majority of the colleges makes the implementation viable, since majority of colleges in the country are on a power-grid. The future of CBA in the entire educational forum in Kenya is almost assured as the country is going digital and there is a desire to formulate both policy and legal frame work to support digitalization of the Education sector.

2. The One-Laptop-per-Child Initiative

The recently sworn in Government in Kenya seems to have spurred things toward digitalization in education with the laptop per child initiative. The curriculum developers KICD (initially KIE) already have digital content to be loaded onto theses laptops. (GoK, 2013). This in itself is leap towards achieving a future digitalized education system.

3. Candidature Growth in Kenyan schools

As the number of candidature continue to rise with every year's examination registration, so will the need to transform our assessment systems in order to adequately and efficiently accommodate them.

Examination candidature trends for KCPE and KCSE within the last 7 years in the Kenya National Examination for both boys and girls.

Table 5: KCPE Trends 2006- 2012 for both boys and girls

KCPE Year	Total Registered	Increase/ Decrease (%)	MALE		FEMALE	
			Total (%)	+/- (%)	Total (%)	+/- (%)
2012		142.85%	415,620		396,310	
2011	776,214	4.04%	400,814	3.24%	375,400	4.90%
2010	746,080	4.24%	388,221	3.46%	357,859	3.26%
2009	727,054	4.50%	381,600	3.94%	345,454	5.11%
2008	695,732	-1.30%	367,085	-1.39%	328,647	-1.20%
2007	704,918	5.77%	372,265	5.52%	332,653	6.05%
2006	666,451	-0.76%	352,782	-0.01%	313,669	-1.59%

Source: KNEC, 2012 KCPE Examinations Report

There are currently over 4000 public secondary schools in Kenya and the recently Increase in primary school enrolment is putting pressure on the demand for and access to secondary schools (GoK, 2007). The Ministry of Education Science and Technology remains concerned with the quality of education which is characterized by poor performance in core subjects. There are obvious benefits for integrating ICT in schools as students at this age need to focus on subject-specific content, greater critical thinking skills, scientific inquiry. Students will benefit greatly with the analytical, creative and collaborative power of computers to map out and analyze assumptions, present ideas and participate in projects with peers from around the country and around the world.

Table 6: KCSE Trends 2006-2012

KCSE Year	No. of Centres	TOTAL	Increase/ Decrease (%)	BOYS			GIRLS
				Total	+/-		Total
2012	6,968	436,349	24,566 (5.97%)	241,139	11,968		195,210
2011	6,448	411,783	54,295 (15.19%)	229,171	31,071		182,612
2010	6,004	357,488	20,084 (5.95%)	198,100	13,537		159,388
2009	5,600	337,404	32,389 (10.62%)	184,563	18,972		152,841
2008	5,183	305,015	32,786 (13.47%)	165,591	15,464		139,424
2007	4,833	276,239	17,212 (6.60%)	150,127	21,056		126,112
2006	4,506	243,453	37,989 (17.06%)	129,071	12,185		114,382

Source: KNEC – 2012 KCSE Examinations Report

The yearly increases in candidature for both KCPE and KCSE as depicted above, is a clear indication that the transition from PPT to CBA will benefit the examination system in the country greatly. There is a clear indication of the seriousness of the issue under discussion and the need to embrace technology wholly in our education system. We can no longer continue hiding behind poverty and inadequacy as a country. More learners from an early age are increasingly becoming techno-savvy with the advent of smart phones and computer games and will expect to see a system that embraces this, both in curriculum content, implementation and assessment.

Higgs (1997) states that most reforms in schools fail because of flawed implementation. Teachers and administrators see minimal gains and much loss in changes that are proposed. The difficulty associated with facilitating change in people's values, attitudes, and behavior is grossly under played and often ignored.

Siegel (1999) states two reasons why people would want to bring ICTs into schools:

- the intention to use schools as modern to the world of tomorrow, Higgs (1997) details how each new development in the popularization of information and entertainment

technology (radio, film, television, computers) in society at large brought with it a corresponding insistence that the deployment of this revolutionary machine into schools would, finally, bring the classroom out of the dark ages and unto the modern world. This has not been the case.

- the second impetus has been standardization by modeling schools with the expectation of uniformity of outcome. The weakest link has been found to be the instructional delivery vehicle'' the teacher who once in the confines of a classroom issues of standardization of curricula, of facilities mean very little. This has been the rationale for educational technologists to produce solutions designed not to aid the teacher but to review, or replace the teacher through the introduction of machines or his/her management style.
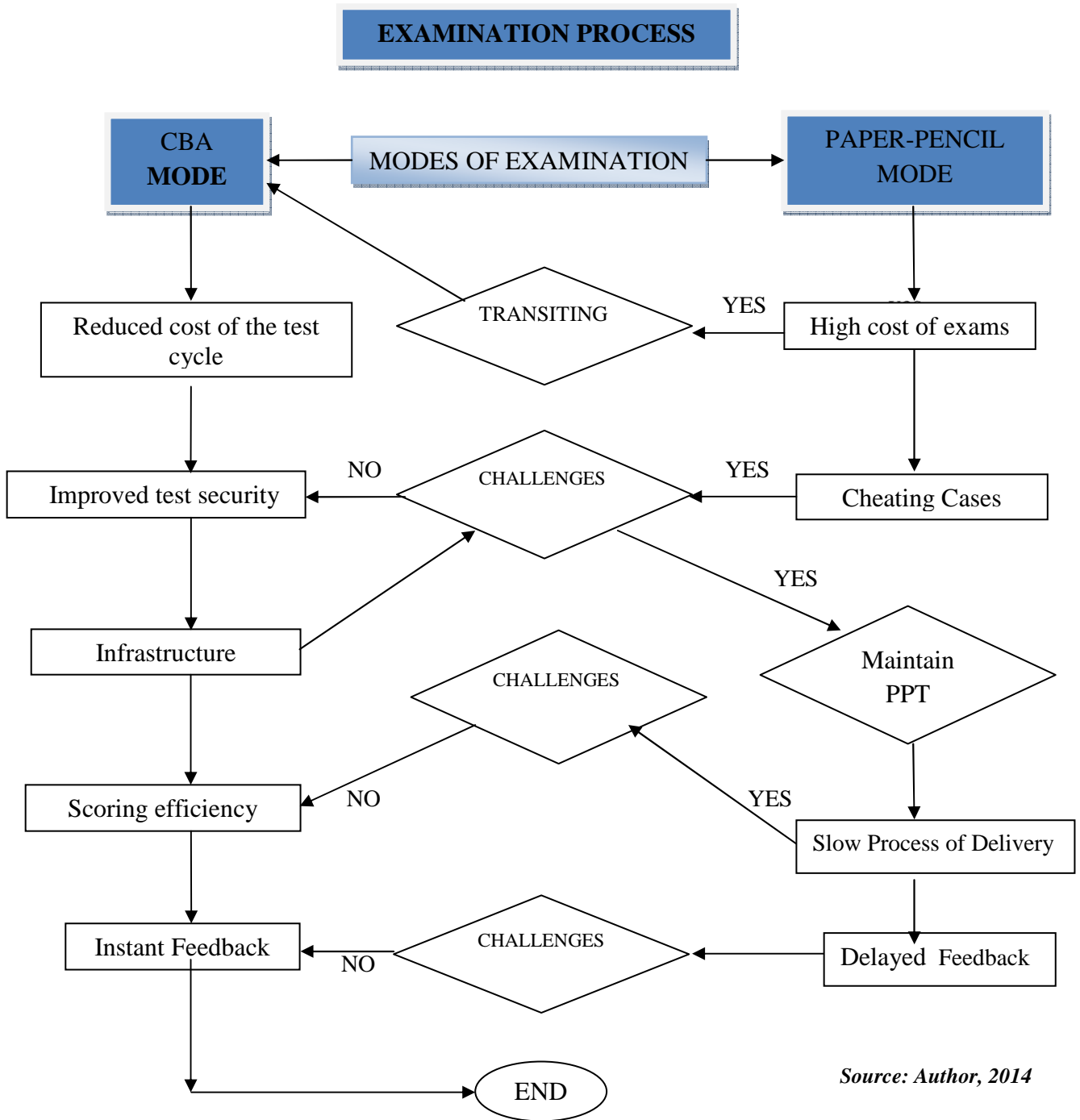
2.2.2.11 CBA Initiative at Aga Khan University-Tanzania

Based in **Dar es Salaam**, **Tanzania,** the Aga Khan Institute for Educational Development, Eastern Africa (AKU-IED,EA) is charged with the responsibility of contributing to the betterment of educational quality in East Africa through teaching, research, and policy analysis. (AKU, 2005). Since starting operations in 2006, it has offered professional enrichment courses, mostly in Educational Leadership, for practicing teachers in the region (AKU, 2007a). The Institute seeks to achieve a high level of impact multiplication, where its graduates become change agents upon returning to their workplaces. The use of ICT in teaching and learning is considered as one of the means of adding value to the quality of instruction in this university. In line with its general ICT strategy (AKU, 2007b), the university is in the process of developing a virtual learning environment based on an open-source software known as Moodle.

Moodle is an acronym for modular object oriented dynamic learning environment, an educational electronic platform (IMS Global Consortium, 2007; Robb, 2004). With Moodle, teachers with only basic computing skills can publish and update course materials on the internet or the institution's local area network. These course materials include syllabi, course objectives, lecture notes, assignments and quizzes This virtual learning environment (VLE) allows for student-teacher interaction through discussion forums, assignment feedback and message boards. This innovation is useful for it frees up a good proportion of face to face interaction to allow for more tutorials rather than lectures.

2.3. Conceptual Framework

Figure 9: The Examinations Process

EXAMINATION PROCESS

CBA MODE — MODES OF EXAMINATION → PAPER-PENCIL MODE

Reduced cost of the test cycle — TRANSITING — YES — High cost of exams

Improved test security — NO — CHALLENGES — YES — Cheating Cases

Infrastructure — CHALLENGES — YES — Maintain PPT

Scoring efficiency — NO — CHALLENGES — YES — Slow Process of Delivery

Instant Feedback — NO — CHALLENGES — Delayed Feedback

END

Source: Author, 2014

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CHAPTER THREE

3.0. METHODOLOGY

3.1 Research Design

The Research design that was used in the study was a survey technique in Nairobi and Machakos County to derive information on the aspect of adoption of computer based testing and assessment in the National examinations. The survey was designed to capture both primary and secondary level from the perspective of the interviewees. The resulting data was used to make general statement about the adoption of computer based testing and assessment. The reason why the survey techniques was used was because this technique allowed the researcher to use only a small portion of the population, to collect a large amount of data in a relatively short period of time and also allowed the researcher to include a wide range of variables including personal facts, attitudes and opinions.

The Primary data was collected from the field through the interviews from Nairobi and Machakos over a period of three (3) weeks. The secondary data pertaining to the student population and the number of the schools in both counties was retrieved from the Kenya National Examination Council. While the data pertaining to the location of the schools and those that were undertaking holiday sessions, was collected from the county education offices in Nairobi and Machakos County.

Under the survey method, the sampling technique was used to identify the target population that was to participate in the study. The two counties that were selected in the study, were Nairobi and Machakos counties, to represent both the urban and rural perspective of the study. The schools included in the sample were identified on the basis of schools that were conducting holiday classes for the form four students. Students and teachers in this category of schools were selected as the target population for the study. This sample group participated in answering the questionnaires used in the data collection and provided most of the information that helped answer the objectives of this research. The sample group of students was selected based on first come basis. The first 10 students who raised their hands were the ones identified to participate,

while the first five teachers who volunteered to respond to the questionnaires were selected to participate.

Descriptive and Inferential statistical Techniques were used to provide accurate description of the sample data and to generalize about the larger population on adoption of Computer Based Testing and Assessment.

3.2. Data type and Sources

The study used various variables in addressing the problems and meeting the objectives of the study which were, to measure the respondents' attitude toward transition from Paper and Pencil Testing to Computer Based Testing and Assessment, their attitude towards the appropriate transition mode and their opinion as to whether computer based testing and assessment would eliminate cheating cases in National examinations.

Data was collected from both primary source where the researcher collected data from the field surveys at the student level and teacher level. The secondary data was information about the schools in the county, this was sourced from the Kenya National Examinations Council and from the County Education offices in different counties. This assisted in narrowing down the research population to a sample of Nairobi and Machakos county. The primary data was collected from selected 10 schools in Machakos county and 10 schools from Nairobi county.

3.3 Data Collection

3.3.1. Pilot Survey

A preliminary survey was conducted to help in the selection of the target population for the study. The researcher visited various counties before zeroing in on Nairobi and Machakos County where the County Education offices for these two counties were visited to access information about the secondary schools in the regions. The information helped to identify the target population by helping the researcher zero in on the schools in these two counties which met the following requirements:

- Schools where Form Four students were available.
- Schools which were opened during holiday for holiday classes.
- Schools which had easy accessibility from the main road.

It was therefore considered useful to target schools in this category because at this time other students were not in school and there was least interference from other school activities. It was also important to identify students who were most likely to interface with National examinations within a given time limit and these were targeted to be Four Four students. A pre-testing of the instruments to be used was carried out to 5 students in Nairobi School in Nairobi county and 5 students in Alim Secondary school in Machakos County. This was to help test the viability and reliability of the instruments.

3.3.2. Target Population and Sample Size

The target population of this study comprised of all secondary schools in Nairobi and Machakos County as well as all students in Form Fours in these schools and the teachers teaching the form Fours in those school. From a population of 772 secondary schools, 556 in Nairobi and 216 in Machakos County, only those schools that were conducting holiday sessions were included in the study and therefore these are the once that constituted the target population of secondary schools.

The students in the schools that were conducting holiday classes and were in Form Four constituted the target population for the students in the study. The entire student population of the two Counties was 25,462, of which 20,962 were from Nairobi and 4,500 were from Machakos County, only those students who were in form four in that schools that conducting holiday sessions constituted the target population for the students in the study. All teachers who were in session during the holiday constituted the teachers target population, from the target population. From which a sample of 20 schools were drawn with a candidature of 2352 students in Nairobi and Machakos, 1277 were from Nairobi and 1075 were from Machakos County respectively. An equal representation of 10 schools each were, drawn from both the counties for the study.

Table 8: Distribution of the Target Population

	Counties	Actual student population in Form Four (2013)	Target population per county	Students in the target population
1.	Nairobi	20,962	150	1,277
2.	Machakos	4,500	150	1,075
	Total	**25,462**	**300**	**2,352**

Nairobi County provided the urban environment and Machakos County provided the rural environment in order to capture the varying aspect of education in Kenya.

Table 9: Secondary Schools of the Sample population and Actual Candidature for 2013

Name of the school	Candidature 2013
Schools in Nairobi county	
St. Teresas Boys	120
St. Teresas Girls	113
Buruburu Girls	106
Lenana School	249
Kasarani Private	101
Nairobi School	284
Wamy High School	94
Light Academy	26
Nairobi Muslim Academy	58
Hospital Hill High	126
Total	1277
Schools in Machakos county	
Masii Boys High	153
Tala Boys	119
Tala Girls	132
Katethiya High Sch	72
Kithioko Sec	102
Alim Boys Sec	23
Nyayo AIC Girls	113
Mumbuni High Sch	213
Katoloni Sec Sch	117
St. Luke Sec	31
Total	1075

Source: Knec and Author (2014)

The reason for these timing was because the researcher needed to select a period when the students had more time to respond to the questionnaires with the least interference from regular school activities. The total sample size of 300 respondents was selected for the study. The number of secondary schools in Nairobi County is 556, while the total number of secondary schools in Machakos County is 216 respectively. It also targeted the class teachers and the form

four students in these schools. A total number of 300 questionnaires distributed to 20 schools. 10 schools from each county and the study targeted 10 students and 5 teachers in each school. The total population of students in the Nairobi schools is 1277, while the population in the Machakos schools is 1075. Only 10 students were selected per school since it was not logically possible to select all the students. The sample size was arrived at arbitrary.

3.3.3. Data Collection Instruments

The study utilized two data collection instruments, Observation checklists and Questionnaires. The Questionnaires had both structured and unstructured questions. The Questionnaires were preferred because they were easy to administer to the respondents and convenient for collecting information and the language was easily understandable.

The Questionnaires were divided into the following categories:

1. Teachers' Questionnaire
2. Students' Questionnaire
3. Observation Checklist

1. The Teachers' Questionnaires consisted of three (3) sections.

Section A: This section was intended to capture information about the category of the school, whether Private or Public, the location of the school, whether urban or rural. The gender of the teachers, the computer facilities in the schools in terms of number, connectivity, accessibility by students and staff.

Section B: This section the information about teachers' knowledge and attitude towards ICT. It highlighted the objectives of the study by asking questions about the transitioning of computer based testing and assessment, elimination of cheating cases, stress level during examinations.

Section C: Highlighted the challenges to be faced in Adopting ICT (Transiting).

2. The Student's Questionnaires consisted of two sections.

Section A: This section captured background information of the school and student. The name, gender, age, competency where computers were concerned, lessons in computers in the school timetable and accessibility.

Section B: This section focused more on the objectives of the study. It highlighted questions on students' attitude towards ICT, the mode of transition, its impact on cheating and effects on stress.

3. The Observation Checklist to the schools;

Section A dealt with the information about the school and the computer facilities available in the school. The numbers, laboratories, space adequacy, connectivity, safety measures on the ground, resource areas and power availability.

Section B was mainly targeting the Administrative information like Timetables for student computer classes, security access codes and passwords, internet facilities, updated software and anti viruses, a conducive environment for the students, precaution against fire hazards.

3.3.4. Sampling Procedure

The study sampled 20 secondary schools located in Nairobi County and Machakos County offering the local 8-4-4 curriculum and these represented Public schools and Private schools.

The research divided the schools into two categories, the urban schools and the rural schools.

The two of which were expected to vary in terms of amenities, infrastructure and accessibility

The study identified four steps to follow in doing the sampling which was done in the research. These include:

  i)   Identifying the population. The study population was obtained from the county examination officers in Nairobi and Machakos counties. This acted as the sampling frame. This helped identify (20) schools that were undertaking holiday learning sessions for the form four students, these were narrowed down to (10) schools from each county based on the proximity to accessible main roads. This was because the researcher had to use public transportation and therefore accessibility to the main road network was very crucial.

  ii)   In the research the study population was stratified into urban and rural schools since they have different characteristics in terms of infrastructure and amenities.

  iii) The teachers were selected based on the first (5) who volunteered to participate and who were not busy with the students when the study was being undertaken.

  iv)   The students were selected based on the first (10) students who raised their hands to volunteer for the exercise.

3.3.5. Ethical issues

Permission to collect data from the respondents was sought from the relevant institution. Letters requesting respondents to participate in the research were sent to the respondents early enough. The respondents were given the questionnaires, filled them and returned to the designated person.   The letter assured the respondents that the information they gave would be treated with strict confidentiality and that the information will be solely used for academic purposes. Vayana (2006) and Trochim (2006) identified the following ethical issues to be considered in a research.

    (i)   Avoided question which could embarrass the respondents.

    (ii)   Assured confidentiality to the respondents.

    (iii)   Avoided leading questions

    (iv)   Made sure the respondent could relax and not feel intimidated by the questions.

    (v)   Quoted and acknowledged all sources of the information.

By observing the ethical issues, the research collected valid and reliable information.

3.4. Data Processing and Analysis Techniques

3.4.1 Data Processing

The returned and duly filled questionnaires were verified by coding and tallied per the counties and the number of students and teachers according to the objectives and thereafter they were arranged two groups of Teachers and Students for comparative analyses. The findings of the survey were then analyzed.

3.4.2. Data Analysis Techniques

The exploratory Data analysis technique is used in this case to allow accurate description of the sample data using frequency analysis method as a measure of number of occurrence of a variable (event) in an observation distribution. All variables in the students' database were included in the frequency analysis to produce frequency tables and associated bar charts (values were percentages). From the frequency results (by type of school and its location), further analysis were carried out using cross tabulation to create contingency tables from which a chi-square could be computed to test for differences between school types and locations.

Frequencies

Chi-Square Test

Chi-square is a statistical test used to compare observed data with data we would expect to obtain according to a specific hypothesis. If the deviations (differences between observed and expected) the result of chance, or were they due to other factors. How much deviation can occur before, the investigator, must conclude that something other than chance is at work, causing the observed to differ from the expected. The chi-square test is always testing the **null hypothesis,** which states that there is no significant difference between the expected and observed result.

Chi-Square Formula

$$X^2 = \sum \frac{(\text{Observed Value} - \text{Expected Value})^2}{(\text{Expected Value})}$$

Chi-square is the sum of the squared difference between observed (*o*) and the expected (*e*) data (or the deviation, *d*), divided by the expected data in all possible categories.

Degrees of freedom (df) = n-1 where n is the number of classes

Degrees of freedom can be calculated as the number of categories in the problem minus 1.

The analysis was done usong the objectives of the study as stated below;

- Determining attitudes of stakeholders toward the transition of CBA;
- Determining the extent of eliminating cheating in National Examinations.
- Determining appropriate transition mode.

Proportion measure was done by use of Pie charts. Frequency analysis was done through graphical representation. Quantitative analysis was done and results presented in tables and figures. This analysis was based on the responses obtained from the respondents. The findings formed the basis of the study.

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The Data was eventually analyzed by using frequency distribution techniques which allowed clear observation of specific values and the percentages of the variables. This was achieved with

the aid of bar graphs, tables and pie charts which helped interpret and present the data collected and Inferential statistical analyses were used.

3.6. Scope and Limitations

The research in the study looked at the challenges of computer based assessment and testing before implementation, it was based mainly on perceived outcome and not the actual scenario. The research was limited to only 20 secondary schools from two counties in the country and the entire secondary schools population in Kenya and therefore the statements were limited only to the samples data.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSIONS

4.1. Concept of Attitude as used in the Study

An Attitude is an expression of favor or disfavor towards a person, place, thing, or event. The way a person views something or tends to behave towards it, often in an evaluative way. The definition of attitude allows for one's evaluation of an object to vary from extremely negative to extremely positive, but also admits that people can also be conflicted or ambivalent toward an object meaning that they might at different times express both positive and negative attitude toward the same object.

The term 'Attitude' as used in this study denotes the perception and view of the students and teachers towards the adoption of Computer Based Assessment and Testing in National examinations, in relation to attempting the National examinations by use of ICT as opposed to Paper and Pencil mode that is currently in place. The students and teachers' attitude towards adoption of CBA in the marking exercise, receiving of examinations results and general feedback. The extent to which cheating can be reduced or eliminated entirely and possibility of eliminating stress if examinations are taken through CBA.

Measuring Attitude in this study was a challenge in the sense that, students have never been assessed using CBA or ICT in National examinations before, and therefore the findings were based on how they would feel about the system if it were ever adopted. Therefore, there was no formal attempt to evaluate the students' experience of online computer based assessment. The exercise was geared to assess their attitude and responses in an event that these systems were to be implemented the examination process in schools. The research targeted schools in Nairobi County which represented the urban schools and Machakos County which represented rural school, from both public and private. The findings also found that the Attitude of students from the two settings varied, where students from urban private school had a more positive attitude towards the adoption if CBA than their counterparts in rural public schools.

The following were the findings that were derived from the study.

4.2 Student Attitude on Computer-based examinations

Table 10: Distribution of Students Schools, Location, Gender and Computers availability

|		No.	%
The category of the school	**Private**	*7*	*29.2*
	Public	*17*	*70.8*
The location of the school	**Rural**	*14*	*58.3*
	Urban	*10*	*41.7*
Gender of the Student	**Male**	*14*	*58.3*
	Female	*10*	*41.7*
Are there computers in the school	**Yes**	*14*	*58.3*
	No	*10*	*41.7*

Source: Author, 2014

Figure 10: Distribution of students' schools, location, Gender and Computers availability
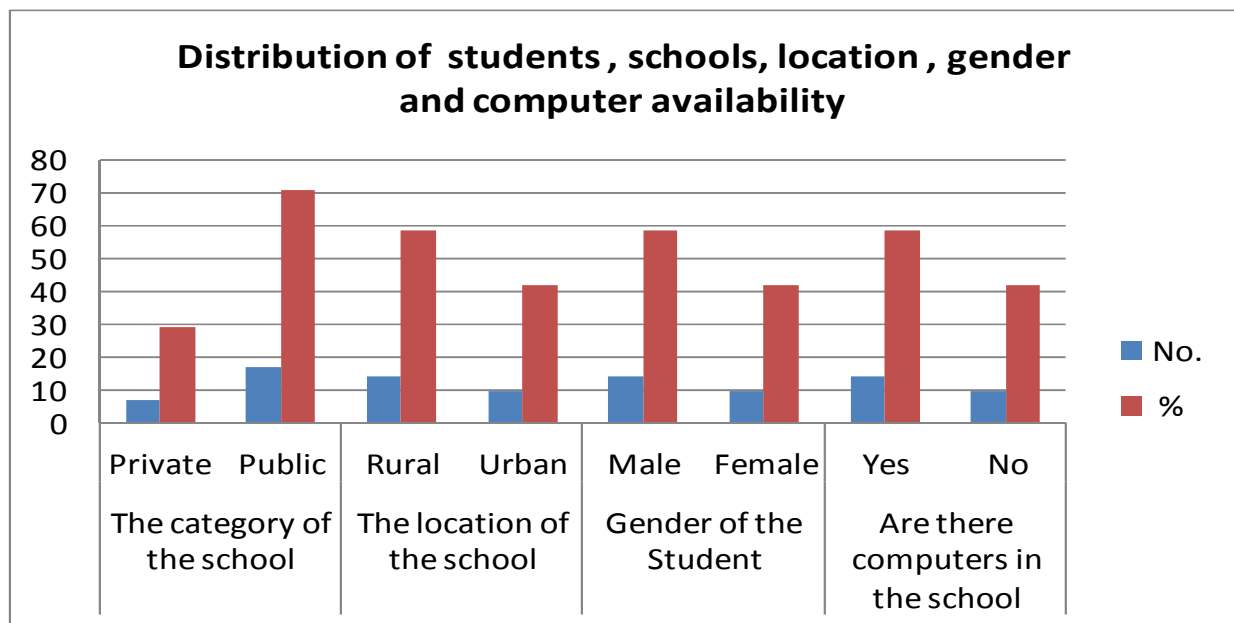
Source: Author, 2014

This study reached out to both Public and Private schools in rural and urban location. Most of the schools reached were public schools (70.8%) and the privates schools that participated in the study were 29.2%, this could be due to the fact that private investment is secondary schools in the country is not as much as much as that in primary schools.

Figure 11: The Location Of The School

Location of sampled schools

Urban 42%

Rural 58%
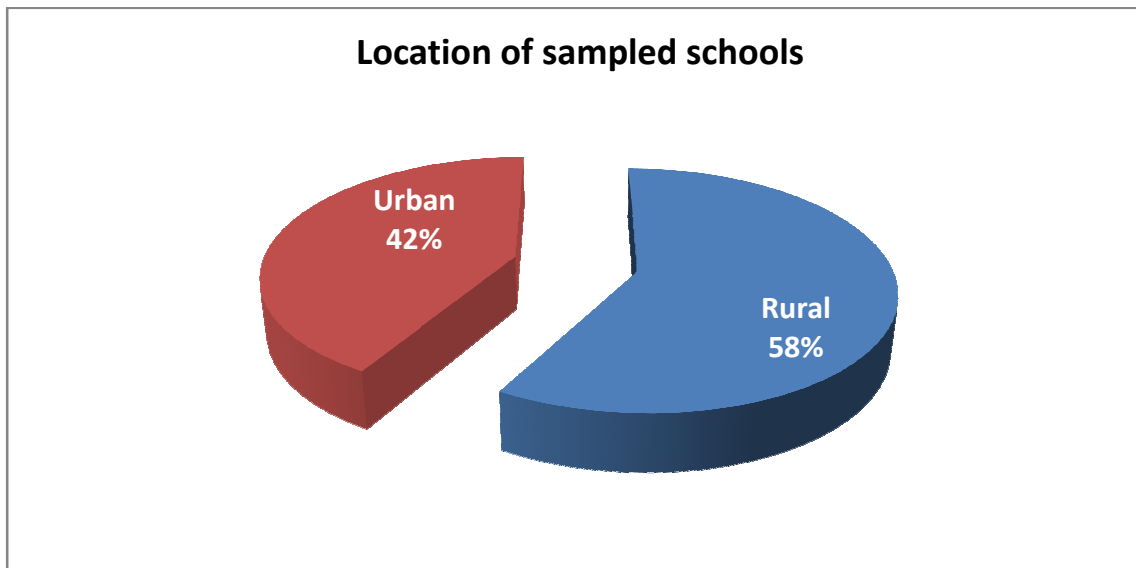
Both the public and private schools were located in both rural and urban settings. Most secondary schools (58.3%) were in the rural setting, while (41.7%) were in urban setting. This was significant because urban schools are thought to have more access to computer facilities therefore the necessity to have schools located in both urban and rural setting, and the percentages in the figure11 above are very representative of both the settings.
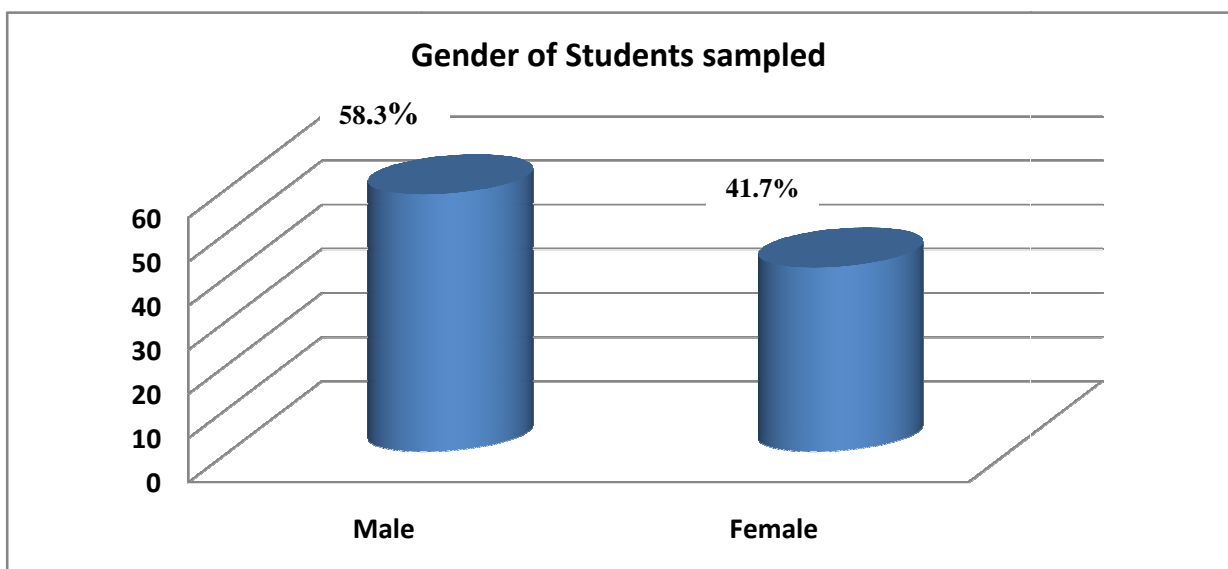
Figure 12: The Category of the School
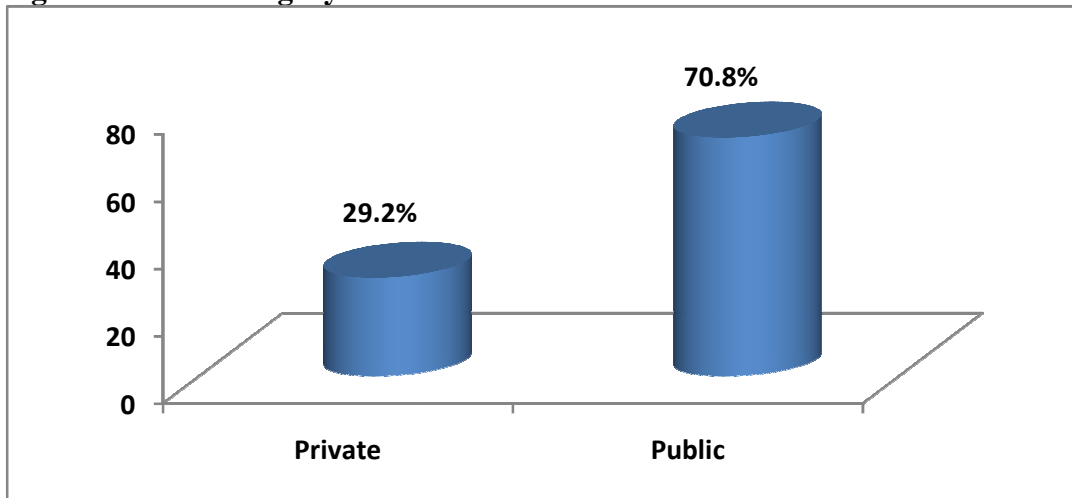
The schools were selected in from the category of Private and Public schools. This was deliberately done in order to bring out the issue of inequity in the spread of ICT facilities and infrastructure between Privates schools and Public schools in Kenya

.**Figure 13: Gender of Students**

In regards to gender, the study reached out to both male students (58.3%) and female students (41.7%) in rural –urban and private-public schools.

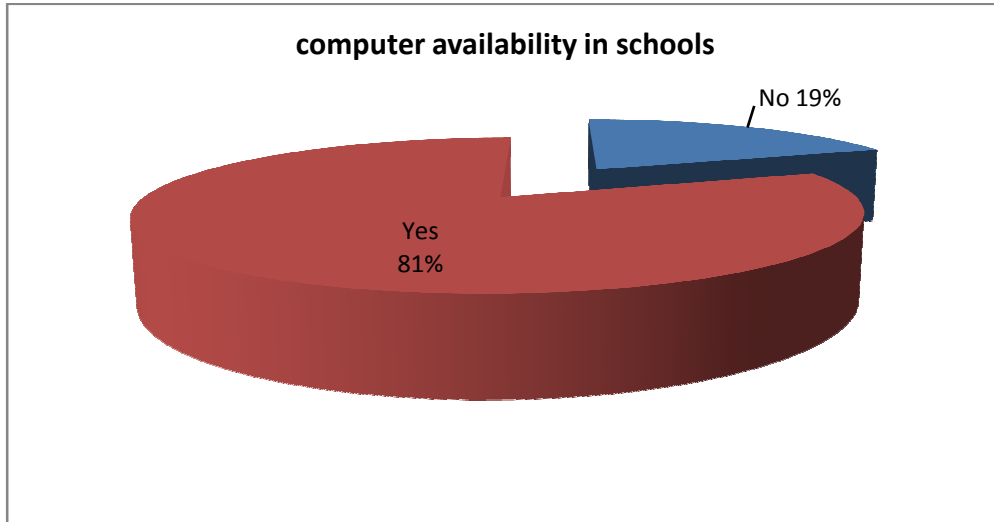Figure 14: Availability of Computers for student's use in school.
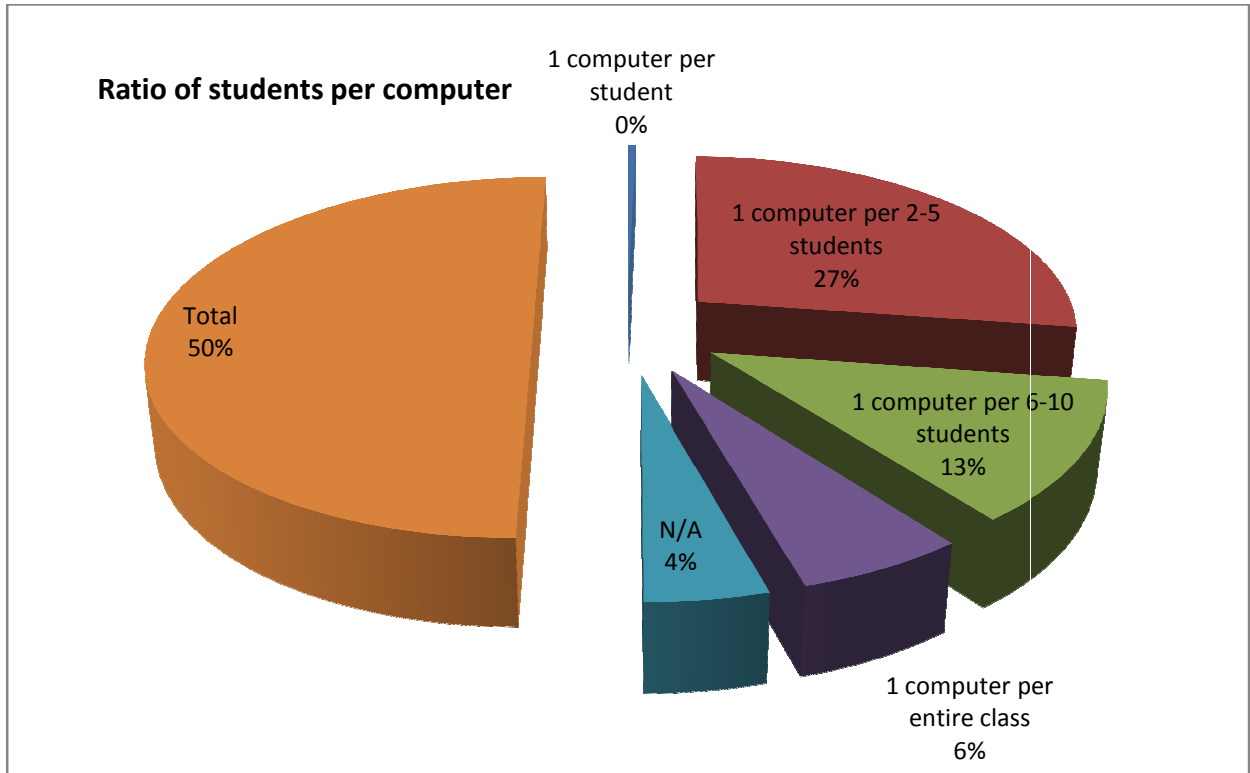

computer availability in schools

No 19%

Yes
81%

Table 11: Computer Availability and Usage in Schools.

Summary of Computer Availability and Usage		No	%
Are there computers for student use in the school	**Yes**	*137*	*91.3*
	No	*13*	*8.7*
	Total	*150*	*100.0*
If yes, what is the ratio of students per computer in the school laboratory	**1 computer per student**	*1*	*.7*
	1 computer per 2-5 students	*81*	*54.0*
	1 computer per 6-10 students	*37*	*24.7*
	1 computer per entire class	*18*	*12.0*
	N/A	*13*	*8.7*
	Total	*150*	*100.0*
How many computer lessons do you have in a week	**Every day of the week**	*0*	*.0*
	More than once a week	*26*	*17.3*
	Once a week	*109*	*72.7*
	Not regular	*15*	*10.0*
	Total	*150*	*100.0*

Are the computers always connected to the internet	Yes always	0	.0
	Sometimes	53	35.3
	Never	97	64.7
	Total	150	100.0
The school source of power is	Electricity alone	51	34.0
	Electricity and Generator	99	66.0
	None of the above	0	.0
	Total	150	100.0
How often do you use computers to do schoolwork	I use a computer often, both at home and at school	52	34.7
	I use a computer sometimes, mostly at home	56	37.3
	I use a computer sometimes, mostly at school	28	18.7
	I never or almost never use a computer	14	9.3
	Total	150	100.0

Table 9: Shows that majority of the schools had computers (93.3%) while the student-computer ratio in most schools was between 2-5 (54.0%) and 6-10 (34.7%). 72.7% of the students have a computer lesson once per week and they though only 35.3% sometimes have internet connection while 64.7% don't have access to the internet. Regarding their homework, most of the student (90.7%) said they either use computer at home or at school to do their homework while 9.3% never.

Figure 15: Ratio of Computers to Students

Ratio of students per computer

- 1 computer per student 0%
- 1 computer per 2-5 students 27%
- 1 computer per 6-10 students 13%
- 1 computer per entire class 6%
- N/A 4%
- Total 50%

From the findings on the Ratio of students per Computer, none of the schools reported to have a 1:1 ratio of computer to student. This is worrying given that in order to achieve the adoption of computer based assessment and testing in national examinations, the ratio of computers per student ought to be 1:1. The study indicated that highest ratio of 1:2-5 (27%), where 1 computer is shared among 2 to 5 students in majority of the schools.

**Figure 16: Frequency of Computer usage in Schools**
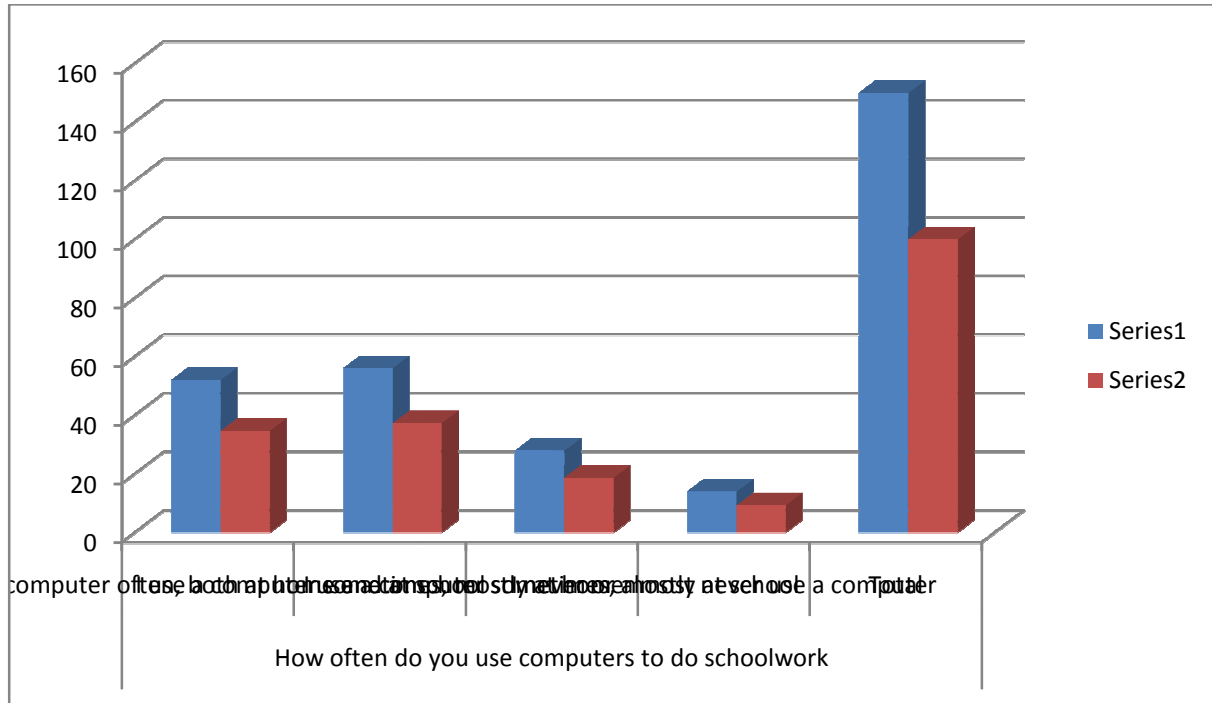
The study shows that majority of the students had accessibility to computers in one way or another, 34.7% cited that they used computers both in school and at home to do their school work, 37.3% reported that they sometimes use computers at their homes, 18.7% of them only access computers at home while a small percentage of 9.3% almost never use them.

Table 12: Students' Attitude toward Computers

Statement	No.	%
I feel I do my best work on a computer	44	29.3
I am comfortable using a computer	94	62.7
Using computers does not appeal to me	7	4.7
I am frequently frustrated when I use a computer	5	3.3
Total	150	100.0

Figure 17: Students' Attitude toward Computers
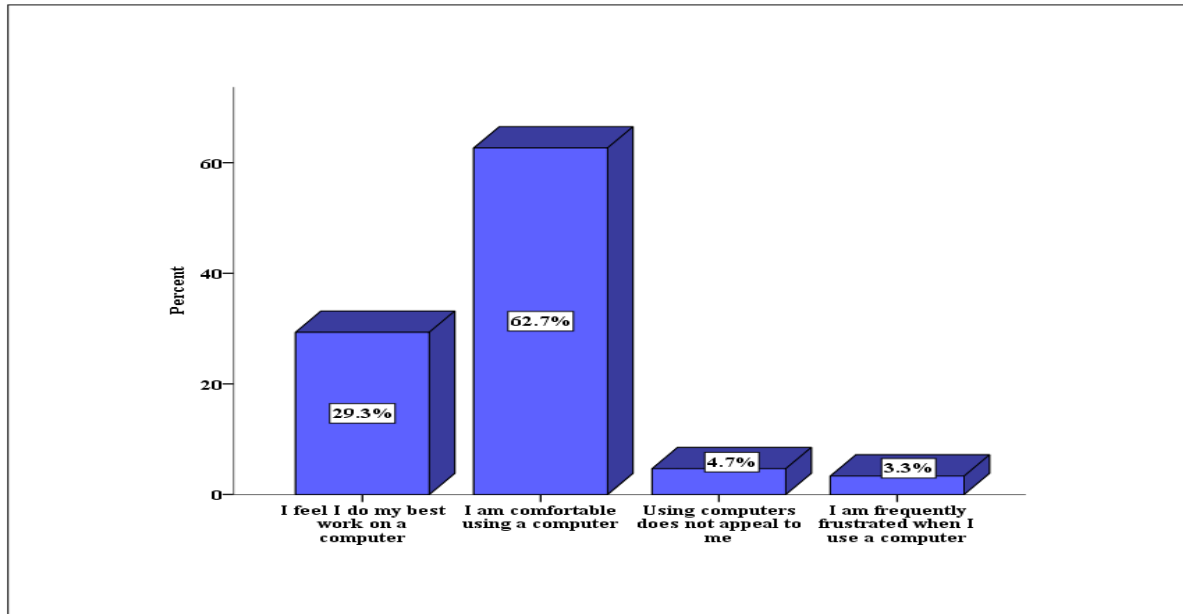
When asked about their attitude toward computers in National examinations, majority (62.7%) indicated they would be comfortable using a computer as opposed to the current Paper and Pencil format, 29.3% felt best working on a computer while the lest (8.0%) felt computer does not appeal to them or get frustrated using a computer as shown in table and graph above.

The findings in this study indicate that there is a positive attitude among the students towards the transition from Paper and Pencil to computer based assessment format of examination.

**Figure 18: How conversant are the students in using ICT in the classroom**

Legend:
- Highly Conversant
- Conversant
- Moderately Conversant
- Poor

1.7% 16.7% 23.3% 58.3%
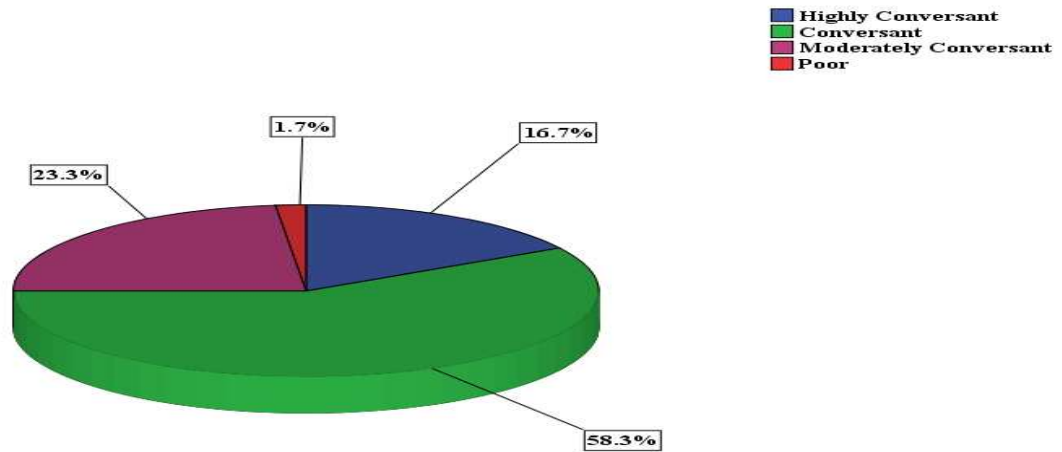
Regarding how conversant the students were in using ICT in the classroom, 16.7% were highly conversant while 58.3% were moderately conversant. 23.3%. A small percentage of 1.7% were quite poor in respect of computer use. The findings are a good indicator that majority of students are already conversant and this would eventually make it less challenging in transiting to the proposed system of assessment by simply improving on the usability skills.

Table 13: Students Attitude towards taking National Examinations on Computers

Opinions	No.	%
It would be easier and more enjoyable than paper and pencil test	72	48.0
It would be about the same as taking a paper and pencil test	54	36.0
It would be harder than taking a paper and pencil examination	9	6.0
It would be more difficulty at first, but would become easier as i get used to it	15	10.0
Total	150	100.0

Figure 19: Students Attitude towards taking National Examinations on Computers
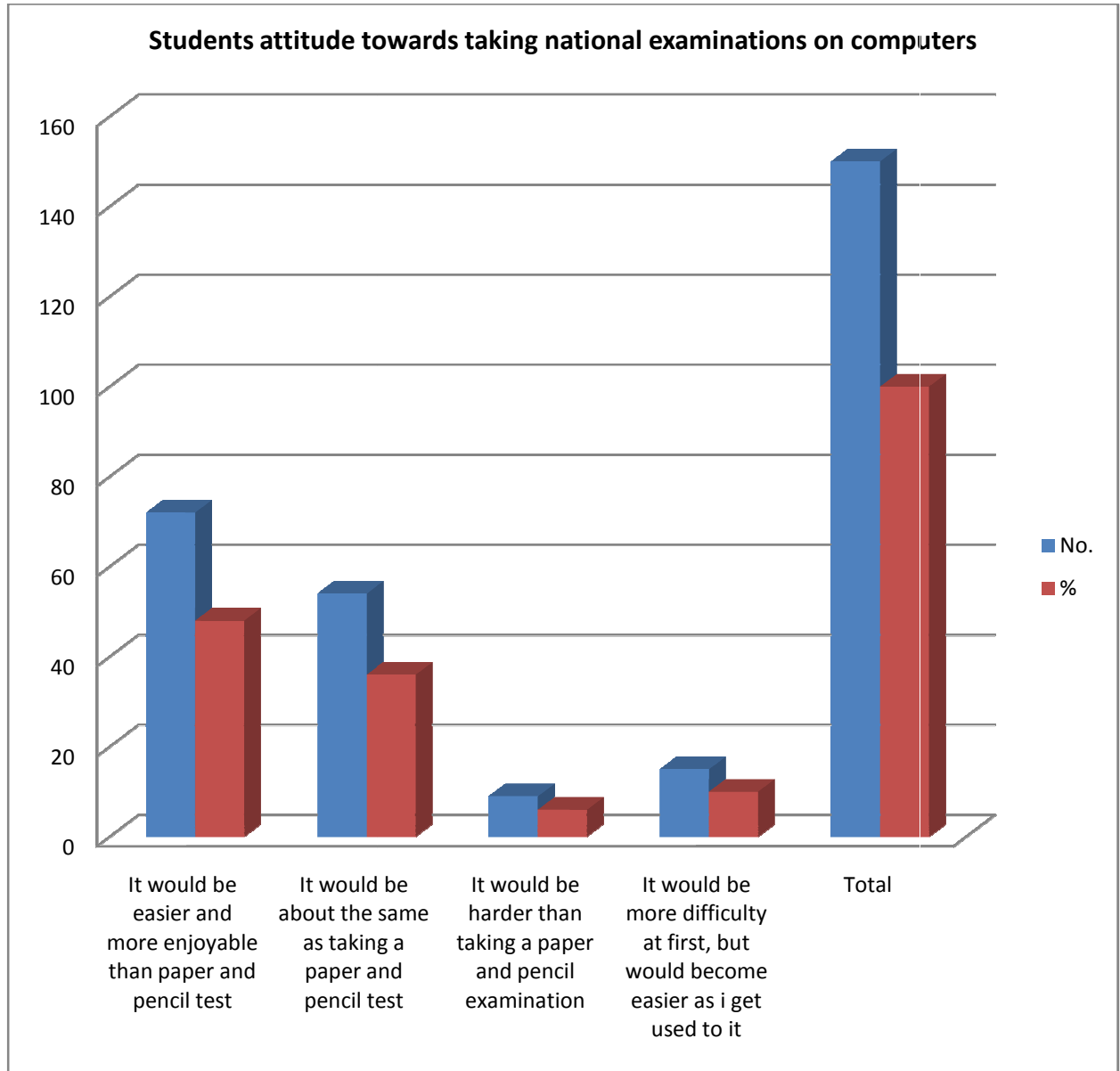
Most students (48.0%) felt it would be easier and easier and enjoyable to use computer while taking National Examinations than using Paper and Pencil mode. However, 10% felt that it would be difficult at first but that would change with more exposure and familiarity. The findings clearly show that the attitude of the students is encouragingly positive towards the

transition from the current examination format to the adoption of the proposed system of Computer based assessment and testing in national examinations.

Table 14: Preferred format for reading the Examination Questions

Choice	Number	Percentage %
Paper and pencil	31	20.7
Computer	91	60.7
No difference	28	18.7
Total	150	100.0

Source: Author, 2014

Figure 20: Preferred format for reading the Examination Questions
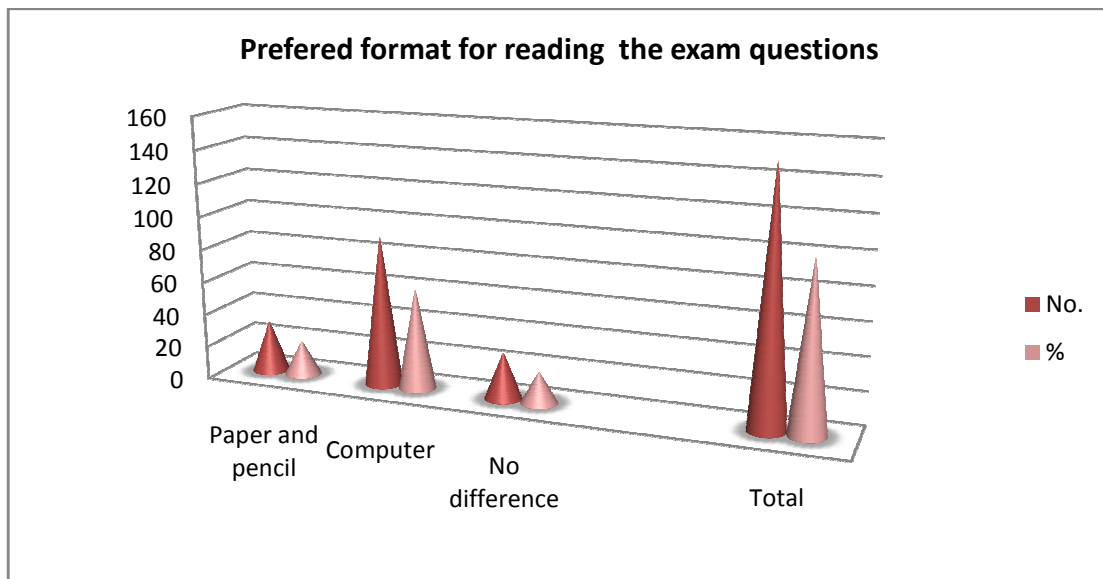
From the figure above, 60.7% of students in the study would prefer to computer format in reading examination questions while 20.7% would prefer the Paper and Pencil format. The remaining 18.7% were of the opinion that whichever format is used, it would not make a difference. This is a continuous indicator of the preference for Computer based assessment and testing to Paper and Pencil format by the students.

72

Figure 21: Examination format where cheating is less likely to occur

Format where Cheating is less likely to occur

Paper and pencil 10%

Total 50%

Computer 33%

No difference 7%
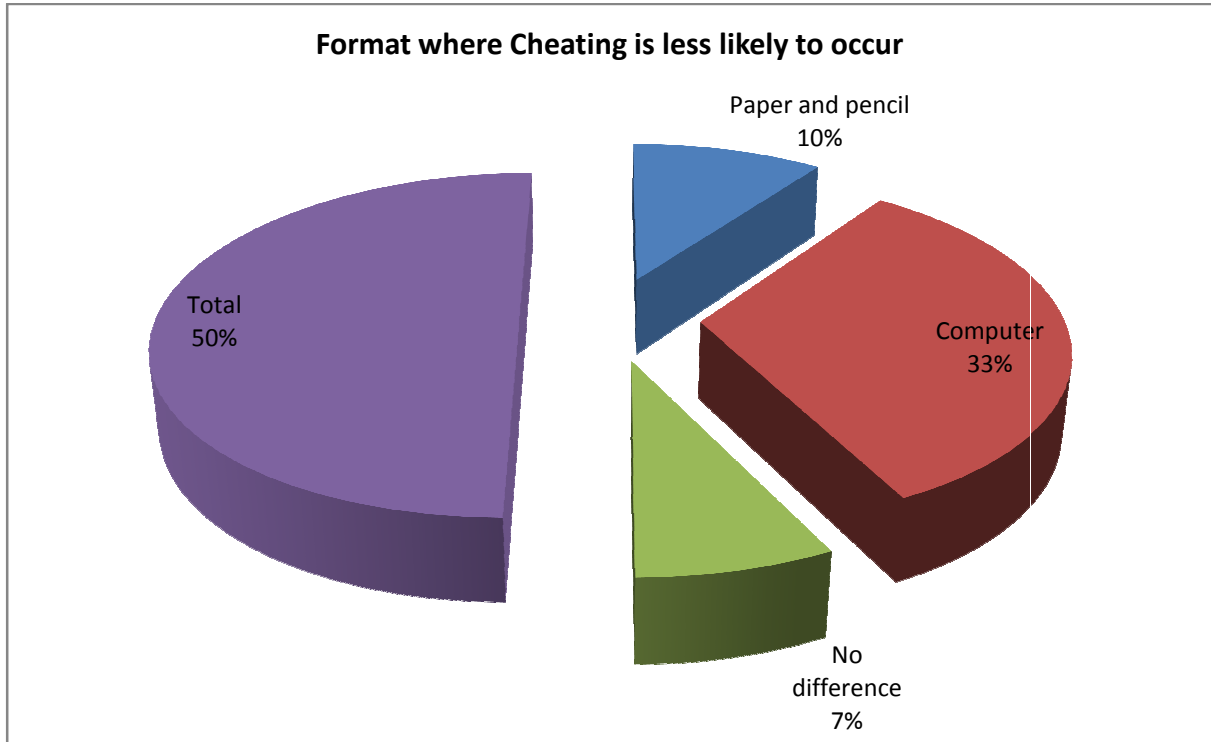
It was the opinion of the students that cheating is less likely to occur when national examinations are administered in the Computer based format (33.0%). However, 10% of the respondents felt tha cheating is less likely to occur when examinations are in the format of Paper and Pencil. A mere 7.0% felt that it would bring no change in cheating cases in national examinations regardless of what system is in place. The finding indicates that examination malpractices could be managed more effectively if Computer based assessment and testing format is used in the administering of National examinations.

Table 15: Format which is more preferred for obtaining Examination Results

Choice		Number	Percentage %
	Paper and pencil	32	21.3
	Computer	95	63.3
	No difference	23	15.3
	Total	150	100.0

Figure 22: Format which is more preferred for obtaining Examination Results
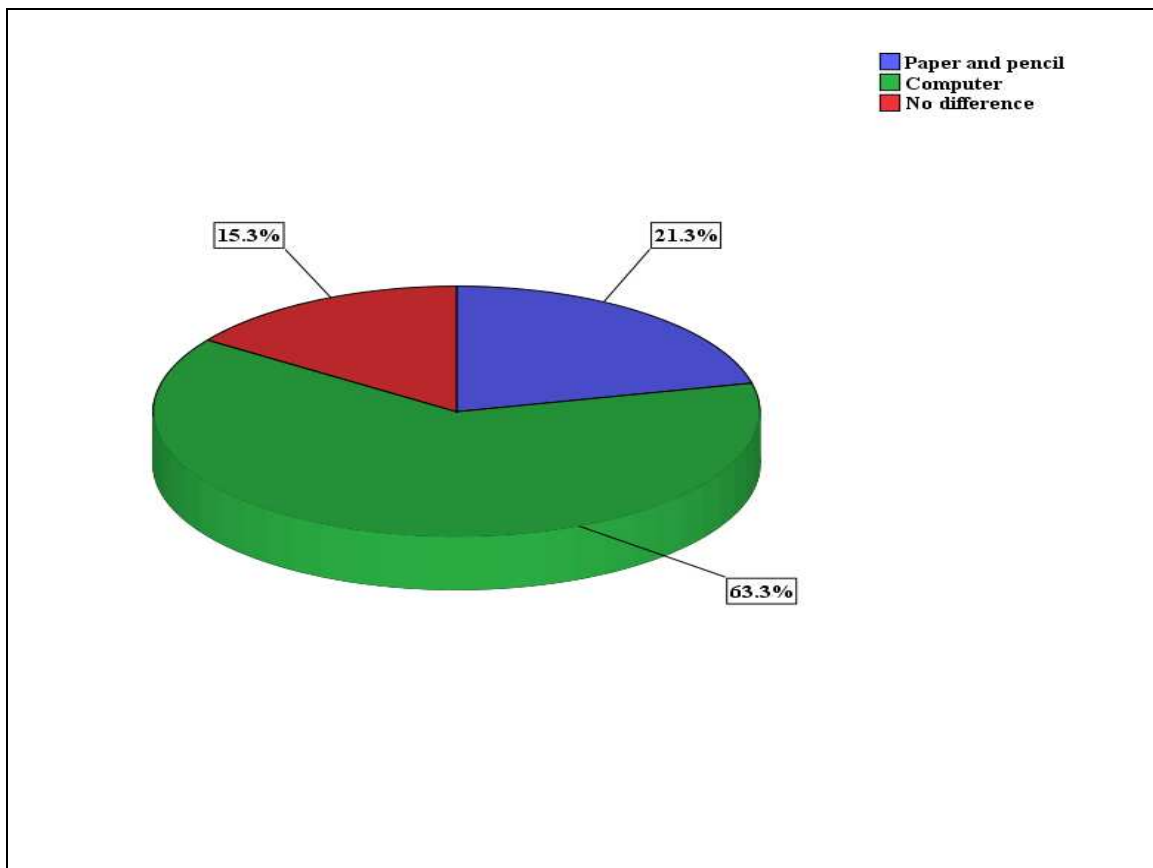
Figure 18 indicate that 63.3% of the respondents preferred computers for obtaining exam results, 21.3% paper and pencil and 15.3% thought it would make no difference.

The idea of Computer-Based-Assessment was generally acceptable to many of the respondents who appreciate the speed of marking and feedback that the system can provide, as opposed to the

Paper-and-pencil based system which delays results and feedback for months, thus causing a lot of anxiety among students and parents alike. The benefits of Computer-Based-Assessment, both for staff and students is well documented. These include rapid formative feedback to students and reduced marking load for examiners.

Table 16: Format likely to cause more stress during examination

Choice of Exams format	Number	Percentage %
Paper and pencil	40	26.7
Computer	79	52.7
No difference	31	20.7
Total	150	100.0

Source: Author, 2014

Figure 23: Format likely to cause more stress during examination
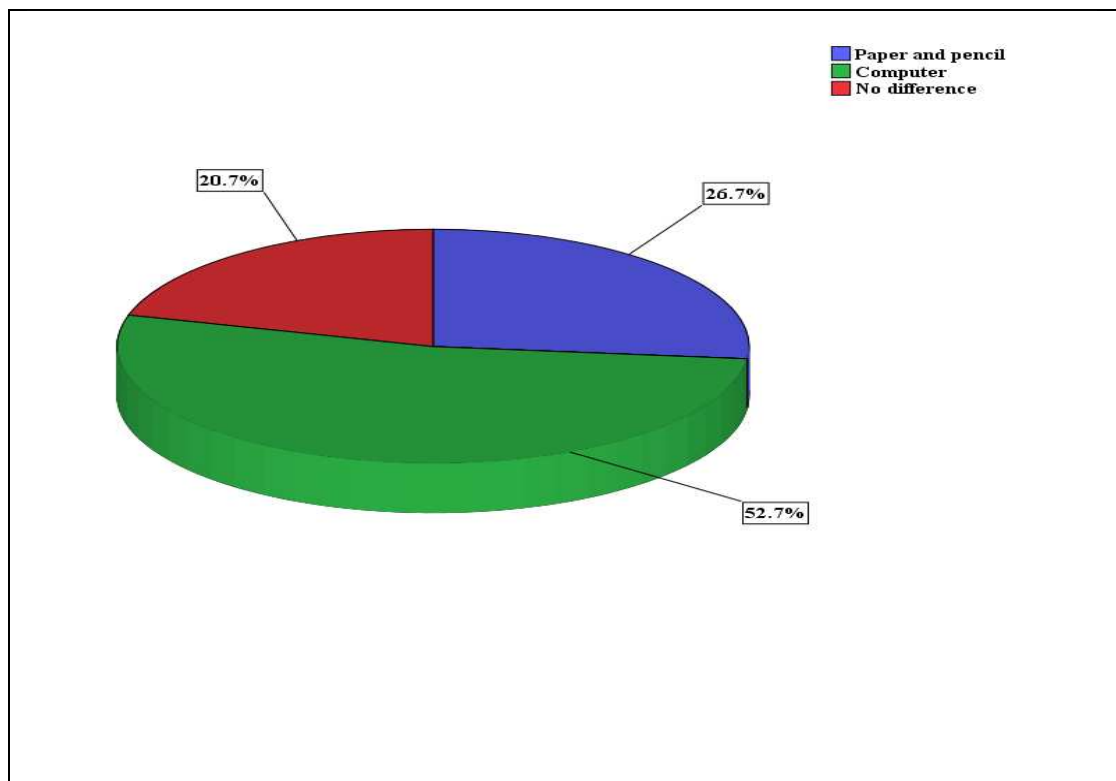
Source: Author, 2014

When students were asked which format would cause more stress during exam, surprisingly 52.7% said computers. This fact may be contributed to their knowledge and ability in using computers. Pencil and paper was 26.7% while those who had no preference were 20.7%.

Majority of respondents especially from rural-public schools felt that online examination would be more stressful or would have a disadvantage for them because they were not very conversant with computer operations. This is in line with the comments of Bosnan (1999) about computer anxiety affecting performance based on familiarity. However those students in the urban- private schools remarked that this format would be less stressful than the other paper and pencil format due to the fact that they were very comfortable using computers and they had constant accessibility both at school and in their homes.

4.3 Teachers' Responses

Table 17: Summary of Gender, Qualifications and Computer Availability

		No	%
Gender of teacher	**Male**	36	60.0
	Female	24	40.0
	Total	60	100.0
Highest academic qualifications	**P1**	14	23.3
	Diploma	3	5.0
	Bachelors	42	70.0
	Masters	0	.0
	Others	1	1.7
	Total	60	100.0
Are there computers in your school	**Yes**	60	100.0
	No	0	.0

	Total	60	100.0
How were the computers acquired	**Donations by the Private Institution**	*10*	*16.7*
	Bought by the School	*50*	*83.3*
	Donated by the Government	*0*	*.0*
	Total	*60*	*100.0*
Do you have internet connectivity in the School	**Yes**	*58*	*96.7*
	No	*2*	*3.3*
	Total	*60*	*100.0*
Does the school have a computer lab technician in school	**Yes**	*29*	*48.3*
	No	*31*	*51.7*
	Total	*60*	*100.0*

Source: Author, 2014

Figure 24: Teachers Gender, Qualifications and Computer Availability
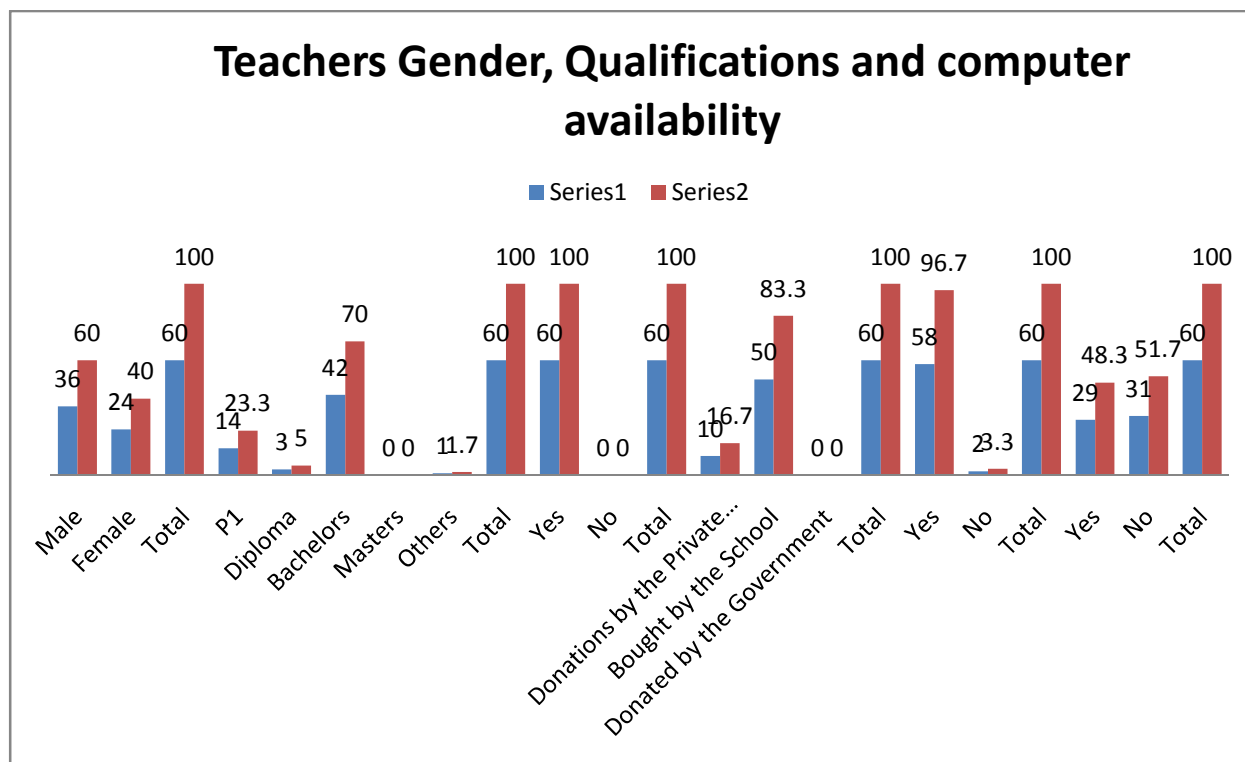
Source: Author, 2014

The figure 18 above is a summary of the teachers' gender, academic qualifications, availability of computers, access to the internet and maintenance in schools that participated in the study.

Table 18: Rating of Teachers knowledge and ability to use computers

Opinion		Number	Percentage %
	Very High	*3*	*5.0*
	High	*26*	*43.3*
	Moderate	*26*	*43.3*
	Low	*5*	*8.3*
	Very Low	*0*	*.0*
	Total	*60*	*100.0*
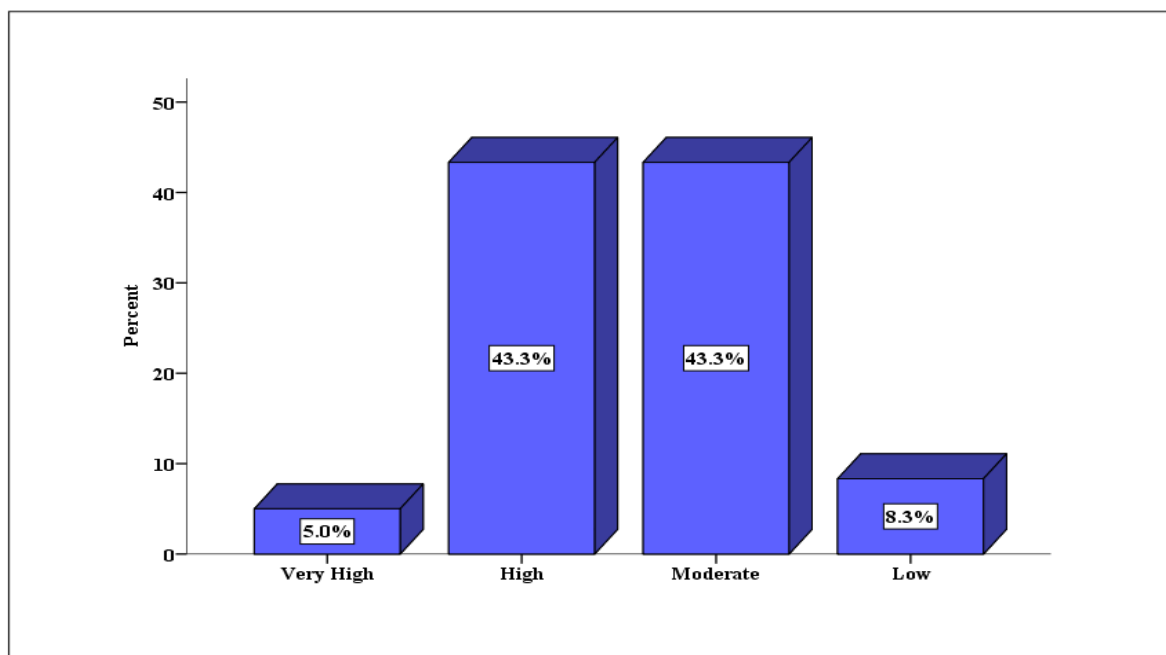
Source: Author, 2014

As table and graph above shows, 5.0% of the teachers indicated very high 43.3% of the teachers had and high knowledge and ability to use computer, 43.3% moderate while 8.3% have low knowledge and ability in using computers. This shows they can use computers comfortably.

Figure 25: Use of ICT in assessment and improvement in Marking
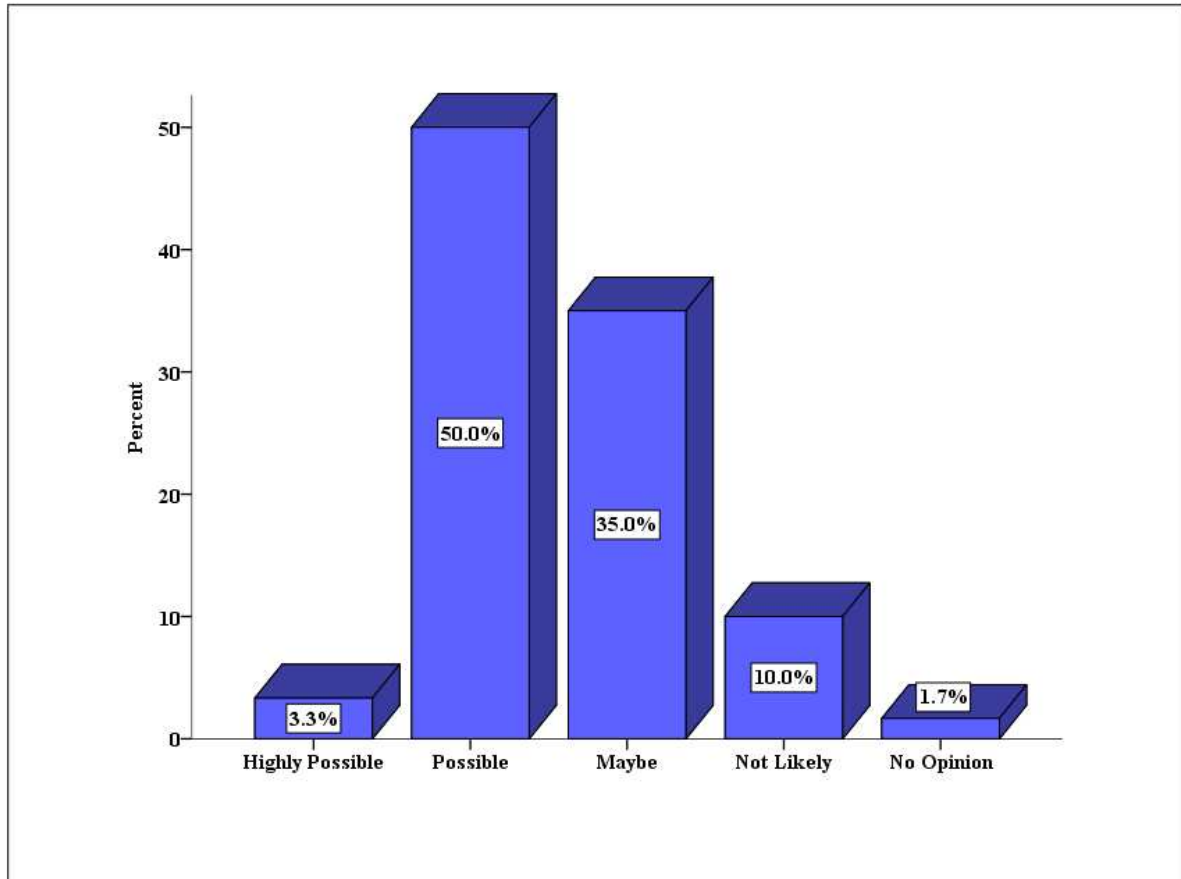
Figure 18 clearly shows that 50 % of the teachers who participated in the study were of the opinion that use of ICT in assessment would greatly improve the process of marking and issuance of results to the candidates.

Since both the marking and results issuance will be delivered and controlled by the computer, it makes both the exercises faster and feedback would be instant to the students. This would be a great improvement from the Paper and Pencil system of marking and issuance of results.

Only 10% of the respondent did not feel that this was an unlikely result, while a minute percentage of 1.7% did not know what the outcome would be.

Figure 26: ICT in relation to reduction of cheating in National examinations
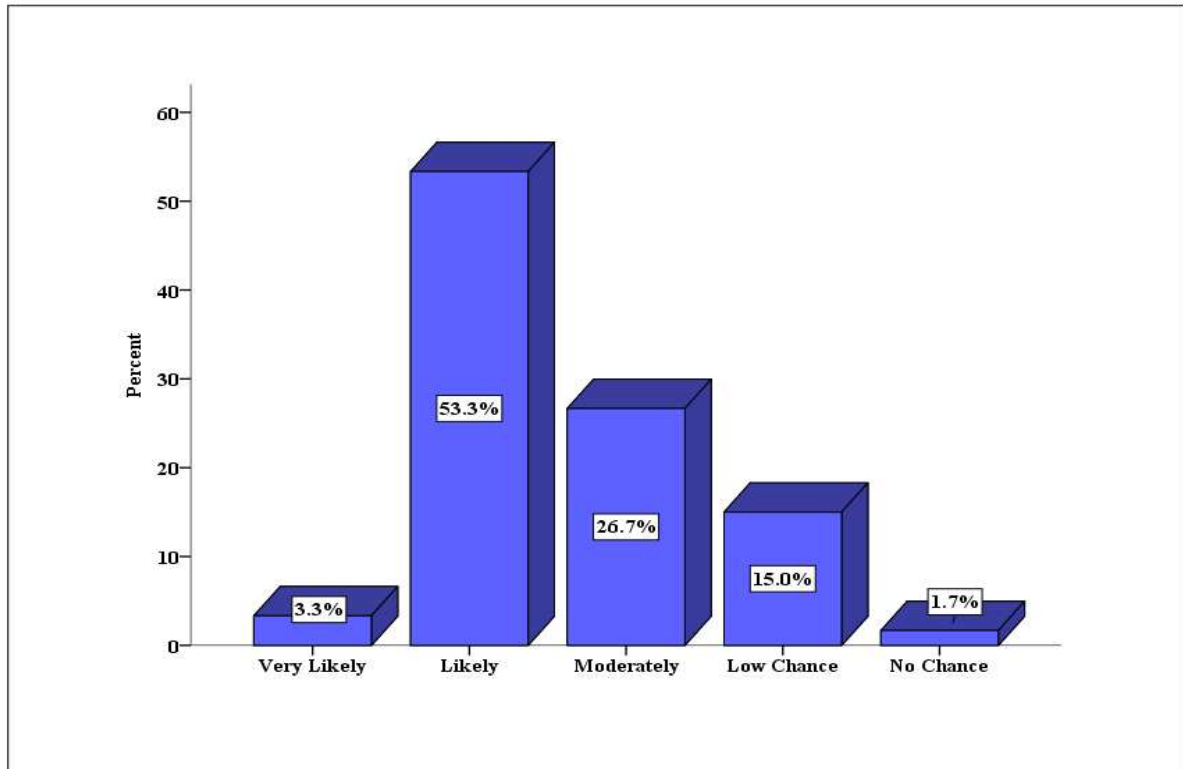
On whether the use of ICT in assessment would eliminate cheating in national examinations, majority of the teachers 56.6% indicated that it was highly likely, while 26.7% were of the opinion that the reduction of cheating cases will not be that substantial in magnitude. 15.% and 1.7% of teachers thought it had a low or no chance of reduction respectively, as shown in the figure above.

Figure 27: Adequacy of infrastructure in adapting ICT in schools

Adequate infrastructure for adoption of CBA

- 34% Yes
- 16% No
- 50% Total
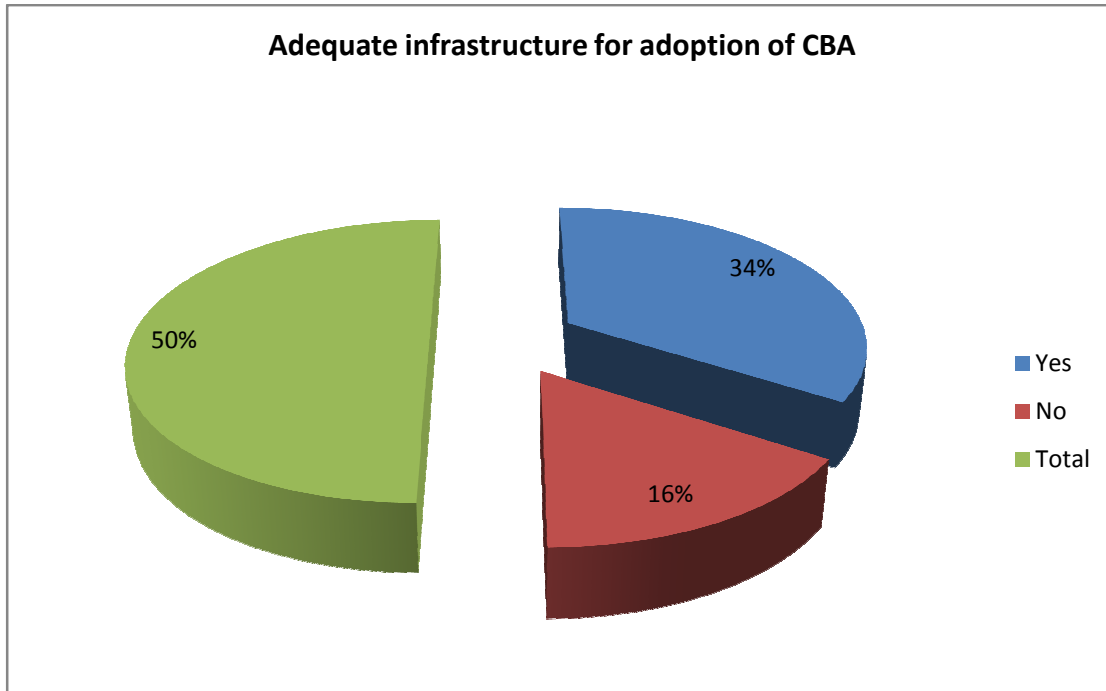
Most of the schools that were interviewed acknowledge that infrastructure was not a hindrance in adopting CBA. 68.3% had adequate infrastructure to adapt ICT based program while only 31.7% did not have the required infrastructure in place, as shown above.

This goes to show that government has been very active in ensuring that there is availability of electricity in many urban and rural schools. With the NEPAD e-Schools computer project for African schools, many schools that benefited are able to utilize these facilities adequately and would be up to task if CBA would be in co-operated in National assessment in these two counties, Nairobi and Machakos county.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary Findings

The study concluded that the attitude of the Teachers and Students towards adoption Computer Based Testing and Assessment in National examinations was generally more positive than towards the pencil and paper testing. In terms of the attitude, all stakeholders geared towards the transition from Paper and Pencil assessment to Computer Based Testing and Assessment. Majority of the respondents among the students indicated they were comfortable using a computer, and they welcomed the idea of transitioning to a computer based system of examinations, while a small number of the students indicated that they were just comfortable while working on a computer but were skeptical about CBA being used in National examinations. A small percentage stated that computers do not appeal to them and they get frustrated using a computer and therefore they would be very uncomfortable if they had to undertake their National examinations using CBA as opposed to PPT.

The response on the second objective of the most appropriate transition mode from Paper and Pencil assessment to Computer Based Testing and Assessment mode had varying responses from the respondents. When students were asked which would be the most appropriate mode of transiting to computer based assessment from the regular Paper and Pencil mode of examinations, majority were of the opinion that the transition should be implemented in phases and through piloting while less than half of the respondents were confident that they could handle an immediate overhaul and jump right in with the computer based assessment. The remaining number of respondents were not so confident and they opted for a parallel program allowing them the option to choose either the Paper and Pencil assessment or the Computer Based Testing and Assessment.

The study showed that incidents of examinations malpractices and cheating are likely to reduce if the adoption of Computer Based Testing and Assessment is implemented as indicated by the

response from a large number of respondents, who felt that cheating cases would be less likely to occur if examinations were administered using the Computer Based Testing and Assessment system as opposed to the Paper and Pencil assessment system. Only a small percentage of respondents felt that it would not make a difference in curbing cheating cases. This was the response for the third objective.

5.2 Conclusion

More than an average number of the respondents prefered Computer Based Testing and Assessment to paper and pencil test. Respondents also demonstrate a strong perception of increase in their learning performance if they were to undertake National examination using Computer Based Testing and Assessment. On the other hand, problems such as shortage of computers, lack of skills, loss of data in the process of writing Computer Based Testing and Assessment, slow network and hazard of reading on the screen were identified.

There is need to radically review the conception of assessment as a process and to reconsider the relationships between the various stakeholders in the assessment process: Test developers. Test publishers. Test takers, consumers of test results, proffectional bodies and law makers. While the essential principles of best practice will not change, as they are independent of assessment technologies, actual standards do not need to be reviewed and re-concideed interms of relationships between vitual tests and roles in cyber-space, rather than material tests and people in real geographical space. In the next few decades the country will see the availability of internet technology with which one can create fully immersive virtual realities (sound, touch, vision and smell) for single and multi-person assessment. The opportunity this would provide to assessment is almost without limit. However, with each new step advance in technology come associated new issues for best practices.

The key advantage, as the medium matures, would lie in test producers and publishers being able to assume the viability and accessibilityof an infrastructure through which to deliver new products and services. Test users and test takers will have access to a wider range of services, better matched to their needs and better supported. Test designers would be able to consider new possibilities for assessment design: real-time interactive virtual group exercises using emails or videophones conferencing; realistic in-tray tasks and so on. The presence of International

networks, globalization of industries and communication means that testing is now an international activity, and individual nations need to be prepared to work as open systems within agreed international standard frameworks.

Efforts to transform assessment from Paper-and Pencil to Computer Based Assessment and Testing have been hindered by a number of methodological, technological, political and economical factors. These barriers must be addressed, by issuing a call for action to political, educational and business leaders on a global scale.

5.3 Recommendations

The Kenya National Examinations Council needs to consider the use of Computer Based Assessment and Testing in National examination for both Primary and Secondary education and the Ministry of Science and Technology on its part, should consider increasing the ration of computers per students in public schools in kenya in order to promote computer literacy ain schools.   While the Kenya Institute of Curriculum Developement should be preempt the introduction of computer related curriculum activities for both teachers and students, early in the learning process inorder to dymystify technology in edication and promote confidence in the use of computers at the National Examination level.

Schools should be willing to initiate Formative Assessment using Computer Based Assessment and Testing in schools to help familiarise the students and teachers with this mode of examinations.

5.3.1 Factors to be put into consideration

1. Mobilize the international educational, political andbusiness communities around the need and opportunity to transform educational assessment, and hence, instructional practice and make doing so a global priority.

2. Specify high-priority skills, competencies and types of understanding that are needed to be productive and creative workers and citizens of the 21st century and turn these specificatons into measureable standards and an assessment framework.

3. Examine inovative ICT-enabled classroom based learning enviroment and formative assessment that addresses the 21st century skill and draw implications for ICT- based international and national summative assessment and for reformed classroom pratices aligned with assessment reforms.

4. Identify methodological and technological barriers to ICT-based assessment, suppor the specification of breakthrough solutions that are needed to measure 21st century skills, and derive implication for the scaling up of ICT- eabled classroom learning environmrnt.

5. Support the implementation of these standards and breakthrough methodologies, pilot test them in selected countries, and make recommendation for broader educational assessment reforms.

5.4 Recommended Topics for Further Research

1. Assessing students with Special Educational Needs by use of Computer Based Testing and Assessment.
2. Analyses of Test Item Banking through the use of ICT.

APPENDIX I: LETTER OF INTRODUCTION TO THE RESPONDENTS

Farida Mukambe Bandari

University of Nairobi

Department of Psychology

Nairobi.

To the Respondent,

Re: Adoption of Computer Based Testing and Assessment in National Examinations.

I am a Post Graduate student at the University of Nairobi, pursuing a Masters' Programme in Measurement and Evaluation. I am conducting a research on the above topic.

These questionnaires are designed to assist me in establishing the attitude of students and teachers towards adoption of Computer based testing and assessment as compared to traditional method of Paper and Pencil mode of assessment.

The questionnaire is meant for research purposes only and the responses given will be treated with utmost confidentiality. I will greatly appreciate any cooperation offered.

I look forward to your honest participation.

Thank you.

Yours faithfully,

Farida Bandari.

Contact No. 0722898296

Email address : mkambebandari2@yahoo.ca

APPENDIX II: TEACHERS' QUESTIONNAIRE

The following is an anonymous questionnaire given to teachers.

The questionnaire is designed to determine the practicability and feasibility of Computer based Testing in school: It is trying to compare the Pencil and Paper based assessment vs. Computer Based assessment in the national examinations. It is geared to provide the researcher with different opinions and comments directed to the research study.

Tick appropriately (√)

Section A : School Profile

1. Name of the school...

2. Category of School : Private ☐ Public ☐ (tick appropriately)

3. Location of school ; Rural ☐ Urban ☐

4. Gender of teacher: Male ☐ Female ☐

5. Are there computers in your school? Yes ☐ No ☐

6. How many computer machines are there in the school? ☐

7. How were the computer acquired? Donations by the private institution ☐
    Bought by the school ☐ Donated by the Government ☐

8. How many teachers have direct access to school computer? ....

9. Do you have Internet connectivity in the school? Yes ☐ No ☐

10. Does the school have a computer lab technician in school? Yes ☐ No ☐

SECTION B: TEACHER'S KNOWLEDGE AND ATTITUDE TOWARDS ICT

The statements given below relate to the teachers' use and attitude of ICT. Please indicate by ticking (√) whether you: Strongly Agree, Agree, Disagree, Strongly Disagree or Not Sure against each statement.

Tick appropriately (√)

1. **Kindly indicate your highest academic qualifications:** P1 ☐ Diploma ☐
   Bachelors ☐ Masters ☐ Others, ☐ (specify)_____

2. **What is your accessibility to computers?**
   a. Personal computers yes/no
   b. Friends' computer
   c. Faculty internet facilities
   d. Library
   e. Cyber cafe
   f. Explain …………………………………………………………………

3. **How will you rate your knowledge and ability to use computers?**
   a. Very high
   b. High
   c. Moderate
   d. Low
   e. Very low
   f. Explain …………………………………………………………………

4. **Do you think the use of ICT in assessment would improve marking and the results issue in examinations**
   a. Highly possible
   b. Possible
   c. Maybe
   d. Not likely
   e. Explain …………………………………………………………………

5. **Do you think use of ICT in assessment would eliminate cheating in national examinations?**
   a. Very likely
   b. Likely
   c. Moderately

d. Low chance

e. No chance

f.   Explain ………………………………………………………………………

6. Would the use of ICT in assessment improve stress levels in students during examinations?

a. Highly possible

b. Possible

c. Maybe

d. Not likely

e. Explain ………………………………………………………………………

SECTION C: CHALLENGES LIKELY TO BE FACED IN ADOPTING ICT IN TESTING

1. Do you think ICT can be employed in assessment successfully?

a. Highly possible

b. Possible

c. Maybe

d. Not likely

e. Explain ………………………………………………………………………

2. How would you rate the school's infrastructure in terms of adapting ICT in assessment?

a. Very high.

b. High.

c. Moderate.

d. Low.

e. Very Low

f. Explain ………………………………………………………………… ……………..

3.   What the school's source of power?

a. Electricity alone

b. Electricity and Generator

c. Solar panels

c. None of the above

4. What's the level of literacy of the students in using ICT in the classroom?

a.   Very high.

b.   High.

c.   Moderate.

d. Low.

e. Very Low

f. Explain …………………………………………………………………

5. **Does the school's have the power capacity to facility use of computers for examinations**
   a. Highly possible
   b. Possible
   c. Maybe
   d. Not likely
   e. Explain ……………………………………………………………

6. **Do you think ICT testing can ensure examinations security adequately**
   a. Highly possible
   b. Possible
   c. Maybe
   d. Not likely
   e. Explain ……………………………………………………………

7. **Which would be the most successful mode of transition from PPT to CBA?**
   a. All at once
   b. In Phases
   c. Parallel Programme – (both at once, but sampling schools or subjects)
   d. Pilot Programme i.e. in Mocks
   e. Am not sure
   f. Explain…………………………………………………………………………

Thank you for taking the time to fill in the questionnaire.

APPENDIX III: STUDENTS QUESTIONNAIRE

The questionnaire is designed to determine the practicability and feasibility of Computer based Testing in school: It is trying to compare the Pencil and Paper based assessment *vs.* Computer Based assessment in the national examinations. It is geared to provide the researcher with different opinions and comments directed to the research study.

You are kindly requested to complete it with your honest response.

Please circle the most appropriate response to each question.

SECTION A: Background Information

1. Name of the school: _____

2. Category of the school: Girls   ☐   Boys   ☐   Mixed   ☐

3. Gender of the student: Male   ☐   Female   ☐

4. Indicate your age range: 14 -16 ☐   17 -18 ☐   19 -20 ☐   Above 20 ☐

5. Are there computers for student use in the school?   Yes   ☐   No   ☐

   6. If Yes, What is the ratio of students per computer in the school laboratory?

   a. 1 computer per student
   b. 1 computer per 2-5 students
   c. 1 computer per 6-10 students
   d. 1 computer per entire class

   7. How many computer lessons do you have in a week?

   a. Every day of the week
   b. More than once a week
   c. Once a week
   d. Not regular

   8. Does the school provide Internet facilities?

   a. Yes always
   b. Sometimes
   c. Never

   9. Do you have accsee to computers outside the school? If Yes, where?

a. At home, personal computer
b. Parents' computer/s
c. Cyber cafe
d. Friends' computer
e. Others. Explain...

SECTION B: Attitude towards ICT

1. **How often do you use computers to do schoolwork?**
   a. I use a computer often, both at home and at school.
   b. I use a computer sometimes, mostly at home.
   c. I use a computer sometimes, mostly at school.
   d. I never or almost never use a computer.

2. **How do you rate your knowledge and ability in using computers?**
   a. Very high.
   b. High.
   c. Moderate.
   d. Low.
   e. Very Low

3. **Which choice below best describes your attitude toward computers?**
   a. I feel I do my best work on a computer.
   b. I am comfortable using a computer.
   c. Using computers does not appeal to me.
   d. I am frequently frustrated when I use a computer.

4. **How would you feel about taking the National Examinations on a computer?**
   a. It would be easier and more enjoyable than a paper and pencil test.
   b. It would be about the same as taking a paper and pencil test.
   c. It would be harder than taking a paper and pencil examination.
   d. It would be more difficult at first, but would become easier as I get used to it.

5. **Which format makes it easier to read the exam questions?**
   a. Paper and Pencil
   b. Computer
   c. No difference

6. **Which format is easier to enter your answer choices?**
   a. Paper and Pencil
   b. Computer

c. No difference

7. Which format allows a <u>review</u> of exam questions more easily (i.e., to move back and forth among questions)?
   a. Paper and Pencil
   b. Computer
   c. No difference

8. Which format requires the least amount of time to complete the exam?
   a. Paper and Pencil
   b. Computer
   c. No difference

9. For which exam format is cheating <u>less</u> likely to occur?
   a. Paper and Pencil
   b. Computer
   c. No difference

10. Which format is preferred for obtaining exam results?
    a. Paper and Pencil
    b. Computer
    c. No difference

11. Which format would cause more stress during the exam?
    a. Paper and Pencil
    b. Computer
    c. No difference

Thank you for your participation in the exercise

APPENDIX IV: OBSERVATION CHECKLIST

NAME OF SCHOOL:	YES	NO
- Does the school have a computer lab/s	☐	☐
– Does the school have a computer instructor?	☐	☐
– Were the computers a donation to the school?	☐	☐
Facilities		
– Is there adequate work space in the labs for all the students?	☐	☐
– Are the computers connected to the internet? – Does the school have adequate Data back- up system?	☐	☐
– Are there emergency exits, first aid facilities in case of accidents?	☐	☐
– Is there adequate spacing in the lab for the computers and students?	☐	☐
	☐	☐
– Are there resource areas, printer / fax / photocopier	☐	☐
– Does the school have generators in case power shortages?	☐	☐
Administrative information		
– Is there a Time table or schedule for the use of the computers for staff and students?	☐	☐
- Is there a security access: keys, security codes, ID badge for users?	☐	☐
- Are the pupils' allowed the use of the Internet and e-mail systems in the labs	☐	☐
- Does the school send information to parents regarding ICT use in schools?	☐	☐
- Does the school have filtering systems in place to prevent pupils from accessing inappropriate materials?	☐	☐
- Are there procedures in place for pupils to report accidental access to inappropriate material?	☐	☐
	☐	☐

NAME OF SCHOOL:	YES	NO
- Does the school provide appropriate opportunities within a range of curriculum areas to teach computers ?	☐	☐
- Does the school ensure that software and its windows operating are updated?	☐	☐
- Are the pupils' allowed the use of the Internet and e-mail systems in the labs	☐	☐
- Does the school send information to parents regarding ICT use in schools?	☐	☐
- Does the school have filtering systems in place to prevent pupils from accessing inappropriate materials?	☐	☐
- Are there procedures in place for pupils to report accidental access to inappropriate material?	☐	☐
- Does the school provide appropriate opportunities within a range of curriculum areas to teach computers ?	☐	☐
- Does the school ensure that this software and its windows operating systems are regularly updated?	☐	☐
- Has the school deployed an appropriate level of security on its networks to ensure their reliability and prevent unauthorized access to systems and data?	☐	☐
	☐	☐

APPENDIX V: Table 2.4: Enabling and Constraining features affecting ICT implementation in Africa

FACTORS	ENABLING FEATURES	CONSTRAINING FEATURE
Policy framework and implementation plans	Most countries have developed, or are in the process of developing, a road map for the incorporation of ICT in their education systems. some have detailed implementation plans with priorities and timetables and measurable indicators in place.	The predominant focus is more on the development of ICT operational skills than on the integration of ICT in pedagogical practice.
Advocacy leadership	Progress in the development of policies and implementation plans has typically had champions for ICT in education from various sources: the office of the president, line ministers and senior staff, and from civil society such as women's and country-based school-net organizations.	Advocacy needs to be both visionary and practical in the sense of not raising expectations beyond what is possible in the near term.
Gender equity	A few policies promote gender equity in terms access to ICT and the development of ICT competencies.	A larger number of policies do not consider gender equity issues at all and many implementation strategies have not considered the promotion of gender equity
Infrastructure and access	Cyber cafés in urban areas provide public access for those who can afford to pay. access for secondary and tertiary education institutions is growing rapidly in urban areas through wireless networks. Growth in mobile phone technology is also growing rapidly.	The major constraints are inconsistent or unavailable supply of electricity, lack of ICT equipment, overcrowding of computer labs, and lack of affordable access to connectivity with acceptable bandwidth.
Collaborating mechanisms	Collaboration models are emerging at national levels to involve stakeholders in policy development and implementation, to encourage investment in ICT development, and to share access to, and cost of, network accessing.	The notion of international collaboration on matters of content development, training, support services, etc. is not yet being explored aggressively.
Human resource capacity	The need to train teachers in the use of ICT, to develop ICT user skills among education administrators, and a capacity to provide local support for ICT users is recognized in the policies	The shortage of skills limits the implementation process.

		and plans.	
Fiscal resources		Governments are starting to recognize the need for investment and many now have ICT-related line items in their annual budgets.	The lack of resources is a serious limitation in all countries. There is a general dependence on donors for the implementation of policy.
Learning content		Initiatives to develop on-line content repositories of freely available learning materials are becoming commonplace in the global world of education. These are likely to be adopted on a regional basis in Africa	The lack of local digital content is a general problem. There is currently substantial reliance on content from the private sector. There is a need to develop materials in indigenous languages. The predominant use of English on the Internet is also constraining.
Sustainability		There are many examples of schools with ICT equipment and connectivity to the Internet developing services for the wider community on a cost-plus basis in order to generate revenue.	Meeting the ongoing costs of maintaining equipment, staff training, connectivity, content materials acquisition, and development and consumables is a major challenge. some governments are allowing an ICT surcharge to be levied on students, but that is discriminatory. Planners need to improve their analysis of the true cost of ownership of the ICT models they adopt.
Attitudes		Unlike many parts of the developed world, staff and teachers appear to be more welcoming of the prospect of ICT in education.	Governments can encounter inter-ministerial jurisdiction issues regarding the control and management of ICT applications.
Procurement regulations			While a few countries have modified their policies to eliminate or reduce import duties on ICT equipment and software, this has yet to be adopted as widespread practice. i.e. Kenya has recently(2014) imposed duty on computer software.

African Tertiary Institutions Connectivity Survey (ATICS) 2006 Report.

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