ADOPTION OF COMPUTER ADAPTIVE TESTING IN EDUCATIONAL ASSESSMENT IN KENYA

BY

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2020

DECLARATION

This Research Project is my original work and has never been presented for any academic award in any other University.

Signature……………………………… Date……18·08·2020…………………

MUTISYA TITUS MUTIE

E58/78711/2015

This Research Project has been submitted for examination with my approval as the University of Nairobi Supervisor.

Signature…………………………………… Date…18/08/2020…………

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DEDICATION

I dedicate this work to my mother, Alice for instilling in me the value of hard work and for her support throughout my studies. Special dedication goes to my wife Faith Nzilani and my daughter Lynn Alisha who stood by me through it all. Your encouragement always kept me going and you never allowed me to give up. Thank you for being there for me when I needed your help most, I love you.

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Honor and glory be to the Almighty God for His sufficient provision and Grace that inspired me to endure to this end.

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LIST OF ACRONYMS

ASVAB   Armed Services Vocational Aptitude Battery

CAT   Computer Adaptive Testing

CBT   Computer Based Testing

CTTI   County Technical Training Institute

ECDE   Early Childhood Development Education

GMAT   Graduate Management Admission Test

GRE   Graduate Record Examination

ICT   Information Communication Technology

IRT   Item Response Theory

KNEC   Kenya National Examination Council

MCQs   Multiple choice Questions

MoE   Ministry of Education

PBT   Paper Based Testing

PPT   Paper-and- Pencil Test

ABSTRACT

The purpose of this study was to establish whether Computer Adaptive Testing can be successfully adopted in educational assessment in Kenya by focusing on factors likely to affect its adoption. The study objectives were to determine a) the extent to which adoption of CAT is affected by students and teachers perceptions b) the extent to which adoption of CAT is affected by the existing technological infrastructure; and c) the extent to which adoption of CAT is affected by levels of computer literacy.

The study used a sample selected from public secondary schools in Makueni County through simple random sampling technique. Questionnaires with both open and closed questions were used to collect primary data from the respondents while secondary data was obtained from the Ministry of Education, Makueni County Office. The data was analyzed using the Statistical Package for Social Sciences (SPSS) where Descriptive statistics such as frequency distributions, percentages, means and standard deviations as well as inferential statistics such as Pearson Correlation and ANOVA tests were utilized.

The findings of the study indicate that teachers and students perceptions are positively related with adoption of CAT (0.085) although the relationship is weak; there is significant relationship between ICT infrastructure and adoption of CAT (0.336) and the relationship between teachers and students level of computer literacy and adoption of CAT is negligible (0.049).

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Computer Adaptive Testing (CAT) has been defined by Chuesathuchon (2008) as a type of Computer Based Testing (CBT) where a student takes a "customized" or tailored test where after each item is administered, a student's competence is assessed and the next question is chosen based on the examinees estimated competency level. Weiss & Kingsbury (1984) argue that in Computer Adaptive Testing questions are chosen and delivered to the student via the computer depending on the answers supplied to earlier delivered questions.

Computer Adaptive Testing is now a common mode of test administration and it is slowly becoming a mainstay in the large scale examination in modern society (Tian et.al, 2007). According to Embreston & Reise (2000) &Weiss (2004) Computer Adaptive Testing consists of a set of test items given to an examinee which give optimal information about his/her abilities. In Computer Adaptive Testing, test takers do not have to see exactly the same questions as any other examinee and they don't have to answer equal number of test items (Weiss & Kingsbury, 1984). The objective of a Computer Adaptive Test is to choose for every student only those questions that most effectively and efficiently measure an examinees capability (Van der Linden et al., 2000).

The widespread adoption of Computer Adaptive Testing in educational assessment has been made practical by two major developments: the use of computers in testing (with improved processing abilities and speed) and Item Response Theory (IRT) procedures and this has led to the increased movement towards Computerized Testing in general and specifically towards the use of Computer Adaptive Testing.

Adaptive Testing is not completely a new idea because its principle can be traced from the work of Alfred Binet in the development of Binet IQ test used in psychological measurement (Davey & Stone, 2011; Weiss, 2004). In a Computer Adaptive Test, a test question is chosen, delivered, the answers scored and the test takers ability determined and the next question is chosen based on the determine ability level of the test taker. If the student gets the question right his/her competence level is increased and it is assumed that the examinee is also able to answer a more difficult question. If the item is wrongly answered, the examinee ability is decreased and an easier question is then chosen and presented (Gathitu, 2010).

Computer Adaptive Testing is seen as a more reliable mode of test administration than the usual Paper and Pencil Testing because it's only those questions whose level of difficult matches the ability of the student are delivered to the student (Chuesathuchon, 2008). Computer Adaptive Testing aims at assessing the capabilities of every student accurately while at the same time solving the problems encountered under the paper and pencil tests because it is only those questions considered appropriate are selected and administered to the test takers (Da Silva et al., 2017).

Research conducted in the area of Computer Adaptive Testing has been limited, however, those that have been done have stressed that compared to Paper Based Testing, Computer Adaptive Testing is more effective because the test items are adapted to the test takers ability level. Besides its general accessibility and basic statistical analysis of data, the advantages of Computer Adaptive Testing include reliability, validity, fairness and feasibility (Chuesathuchon, 2008). According to Karnjanawasri (2002), Computerized Adaptive Testing improves test reliability, improves test security, it greatly minimizes and controls cases of cheating in tests and greatly cuts on the cost of printing and shipping tests. CAT is also known to be convenient and flexible in scheduling the test, testing can be done anytime, it offers immediate scoring and reporting of test results, reduces test supervision and fewer test items can be used to arrive at a more accurate estimate of test-taker proficiency levels.

According to Ndume *et al.,* (2014), the use of computers in assessment has continued to provide a powerful tool that can be used to design assessment that are able to measure student capabilities that goes beyond the possibilities offered by the traditional assessment methods. The adoption of Information and Communication Technologies has therefore called for the reconsideration, rethinking and remodification of traditional examinations and out of this call; the idea of adopting Computer Adaptive Testing in assessment was born. The widespread use of computers in educational assessment has led to massive improvement in test administration and with the invention of the internet examination bodies and organizations can comfortably administer examinations worldwide with least problems. With the availability of computers in all schools,

Computer Adaptive Testing would present better methods of assessment and solve the problems associated with paper and pencil examinations (Al A'ali, 2007).

1.2 Statement of the Problem

The aim of this study was to establish whether Computer Adaptive Testing can be successfully adopted in educational assessment in Kenya by focusing on factors likely to affect its adoption.

The Government of Kenya has an ICT policy that aims at improving the lives of her citizens by making sure that ICT services across the country are accessible, efficient, reliable and affordable. Although technology has penetrated many sectors of the economy such as banks, transport and communication and in the medical field, the Kenyan education sector has not kept the same pace in adopting technology and has therefore lagged behind. According to a study conducted by Kandiri (2012), the use of computers is still an idea that is new and has not fully permeated in Kenyan schools and the study found that the perceptions and experiences of teachers and administrators plays a critical role in the use of computers and general applications of technology in Kenyan classrooms.

Although Kenya has an ICT policy for basic education, nothing much has been done to adopt ICT as an important tool in learning, teaching and assessment. According to UNDP (2015) use of ICT has a positive mark in fostering the goals of education if and only if it is effectively employed. ICT remains the greatest driver for development in both the

economic and technological fronts in the 21st Century, although despite this knowledge, a great deal of Kenyan school curriculum and assessment are delivered manually.

The problem facing the education sector in Kenya is how best the curriculum, instruction and assessment can be transformed to meet the ever rising call to employ ICT to teach and assess learners in the 21st century. In Kenya, the adoption of ICT in the education system is far from getting to the optimal required level and there is no empirical study that has fully addressed the level of integration of ICT required.

1.3 Research Questions

The study focused on the following questions:

i)   To what extent is adoption of Computer Adaptive Testing in educational assessment affected by students and teachers perceptions?

ii)   To what extent is adoption of Computer Adaptive Testing in educational assessment affected by the existing technological infrastructure?

iii)   To what extent is adoption of Computer Adaptive Testing in educational assessment affected by the existing computer literacy?

1.4 Objectives of the Study

The objectives of the study were to determine:

i)   The extent to which adoption of Computer Adaptive Testing is affected by students' and teachers' perception.

ii)   The extent to which adoption of Computer Adaptive Testing is affected by the existing technological infrastructure.

iii)   The extent to which adoption of Computer Adaptive Testing is affected by computer literacy.

1.5 Research Hypotheses

The study hypotheses were:

i)   Adoption of Computer Adaptive Testing in educational assessment is not affected by students and teachers perceptions.

ii)   Adoption of Computer Adaptive Testing in educational assessment is not affected by the existing technological infrastructure.

iii)   Adoption of Computer Adaptive Testing in educational assessment is not affected by the level of computer literacy.

All hypotheses were tested at α 0.05 (95% confidence level)

1.6 Justification of the Study

Research on Computer Adaptive Testing in Kenya has been limited and therefore, this study hopes to provide awareness on the potentials of using computers in educational assessment. The findings of this study, it is hoped, they will provide feedback to

educational policy-makers, particularly the Ministry of Education regarding Computer Adaptive Testing policy regulation, formulations and implementation in educational assessment.

The study will also be useful to the Kenya National Examination Council and students in preparing them to keep abreast with emerging trends in educational assessment. Future scholars and researchers who might be interested to pursue this area further, it is hoped, that they will find this study important.

1.7 Scope and Limitation

This research project aimed at assessing the possibility of shifting the mode of test administration from Paper Based Testing to Computer Adaptive Testing. The study did not attempt to develop a Computer Adaptive Test but it purely relied on responses concerning the perception of students' and teachers' on the adoption of CAT. Since students have never been tested using CAT before, the findings of the study were based purely on how the students and teachers would feel if CAT was to be adopted in educational assessment.

This study was conducted only in those schools that offer Computer Studies as an examinable subject in Makueni County. Makueni County was chosen because the inhabitants are not only known to be very receptive to new ideas but also their willingness to retain those new ideas.

1.8 Operational Definitions

Computer Adaptive Test: an exam administered on a computer that adapts the difficult of each   item to the competency level of the student. The next question selected depends on the response to the previous item.

Adaptive Testing: the process of test administration where the selection of the test items for administration depends on the examinees responses to earlier administered items (Weiss & Kingsbury, 1984).

E-Assessment: an electronic assessment process where technology is employed to administer, score, record and report assessment activities.

Computer Based Testing: method of test administration in which the questions are delivered via the computer.

Educational Assessment: the process of measuring and documenting what students have learnt.

Assessment: an educational process of gathering, analyzing and interpreting information related to students' performance. (Ghaicha, 2016)

Perception: the way in which something is regarded, understood or interpreted. How students and teachers view adoption of Computer Adaptive Testing in educational assessments

Adoption: the readiness to use computers in educational assessment. The readiness to adopt Computer Adaptive Testing in educational assessment was established by determining the coefficient scores for variables such as the ratio of students to operational computers, power reliability, speed of the internet, ICT Infrastructure and students ease of use of computers.

CHAPTER TWO

2.0 LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter focused on scholarly work conducted by other researchers on the area of adoption of computer adaptive testing and technology in general in educational assessment with a view to understand the topic of study better, provide context for the research and justify why the study was conducted and help identify and fill the gap identified in the topic of study. It specifically covers related studies in computer adaptive testing, relevant literature in the adoption of CAT in educational assessment, the concept of Computer Adaptive Testing and the study's theoretical and conceptual frameworks.

2.2 The Review

2.2.1 Theoretical Literature

2.2.1.1 Adaptive Testing

Adaptive testing refers to sequential Computer Based Testing where questions are chosen for administration depending on how examinees perform on previously presented questions (Phelan, 2011). In adaptive testing, the length of the test varies from one test taker to another because the test items chosen and presented for administration depends on the examinees response to earlier questions and this reduces the testing period thus reducing the pressure that comes with having to sit for long periods in an examination room among students. In adaptive testing therefore, the order of questions administered to every test taker will vary because the questions are based on answers to earlier responded to questions and therefore a student who takes the same examination twice in succession

will see and respond to different test items altogether. Adaptive testing is able to accurately measure the abilities of examinees using fewer test items than it would have been in a paper-and-pencil test. Among the many advantages of the adaptive testing, the examination process is quicker although the tests are not timed and the examinees do not have to struggle with questions which are below or beyond their potential (too hard or too easy). Since the examinations are not timed, students do not have to compete against time to accomplish standard number of question within strict timelines rather, each examinee works at his/her own pace. As the use of computers became more popular in organizations in the early 1970s, adaptive testing became computerized adaptive testing (CAT), where questions were administered by interactive computers and the students responded to the test items on the terminal keyboard where the computer was used as a medium of selecting the next question to be administered
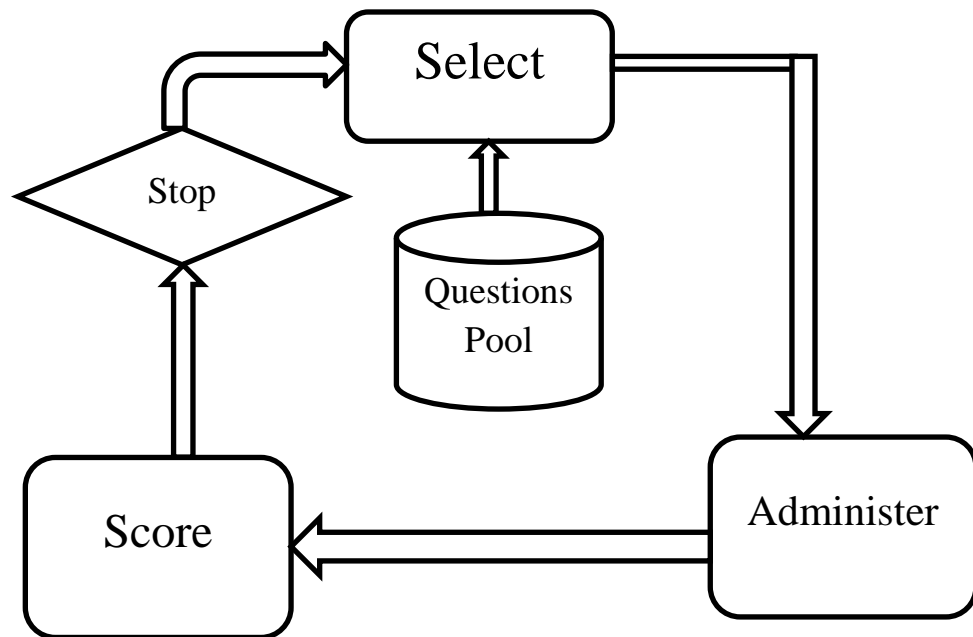
Figure 2.1: Adaptive Testing Cycle (source: Davey, 2011)

Weiss & Davey (2011) identified five main components of a Computer Adaptive Testing; a) a calibrated item bank, b) starting point, c) item selection algorithm, d) scoring algorithm and e) termination criteria. They noted that a CAT works by going through the first two components and then the process keeps on recycling through the third, fourth and fifth components until a termination criterion is determined. Once the termination criterion has been satisfied then the CAT stops.

2.2.1.2 Types of Adaptive Testing

Adaptive Testing is categorized into two types on the basis of the item selection strategies (Chuesathuchon, 2008); two-stage strategies and multi-stage strategies. In two-stage strategies adaptive testing involves two stages where the first stage consists of 10 questions adjusted to the ability of the student are provided. In the second step of adaptive testing, a main test that consists of many sub tests each containing 20-30 items ranging from easy to difficulty is provided. A student who scores high results from stage one takes more difficult questions in the second step. Consequently, an examinee who is average takes an average sub test in the second test.

In Multi-stage adaptive testing items are selected based on the response of earlier administered questions (Thissen & Mislevys, 1990). The first question is usually average in terms of its difficulty level, not too hard or too easy. If a question is scored correctly, the next question chosen will be harder and when the question is wrongly scored, the next question chosen will be easier. The process continues and the testing process is terminated once the students' ability has been precisely determined.

Between these two types of adaptive testing, the most suited for this study and for the education system in Kenya would be the multi-stage adaptive testing since the idea is would be to select for each student those set of question that would give the maximum information about a student as opposed to giving students whose abilities are different the same standard examination whose results may not tell much concerning the students' abilities.

2.2.1.3 Definition of Computer Adaptive Testing

Computer Adaptive Testing here in referred to as CAT has been defined by different scholars Wainer(1990), Chuesathuchon(2008), Cisar(2010), Kimura(2017) & Eggen(2018) as a type of Computer Based Testing (CBT) where a student takes a test whose level of difficulty matches his/her ability. Computer Based Testing refers to any form of assessment which is administered via the computer and the form of the assessment depends on the degree of adaptability of the test items (Papanastasiou, 2003). Some CBTs, also known as computerized fixed tests, are purely linear and are similar to the conventional paper and pencil tests because their format and length are fixed and the questions are organized in a predetermined manner unlike in Computer Adaptive Testing where the test takers ability level is determine after every test item has been delivered and the next question is chosen based on the immediate estimated proficiency level. CAT is also defined by Birdsall (2011) as an examination administered on a computer that adapts the difficulty level of every test item to the ability of the test taker where a student takes an examination which is appropriate to his/her ability.

According to Lilley *et al.,* (2004), the first item selected is of average difficulty. If the student scores the question correctly, his/her proficiency level is increased and a more difficult question is presented but if the student incorrectly scores the question, his/her proficiency level is decreased and an easier question is presented.

According to Weiss (2004), CAT consists of those set of items which give the maximum information about a student. The students do not answer exactly similar questions neither do they answer equal number of questions but the questions that a student answers depends on his/ her ability (Kamjanawasri, 2002).

2.2.1.4 Global Perception of Computer Adaptive Testing

Online assessments in many developed countries are now becoming common and are being used for both formative and summative purposes (Byrnes & Ellis, 2006).

The United States implemented a high stakes CAT, the Armed Services Vocational Aptitude Battery (ASVAB) which was a conventional paper and pencil test that was converted to a computer adaptive test. According to Pommerich *et al.,* (2009), the test was administered to more than a million candidates annually and tested on both vocational and academic skills. The test has since been administered over the internet since 2009.

Graduate Management Admission Test (GMAT) is another CAT that has been administered world-wide to more than 200,000 candidates annually in more than 400 testing centres (Rudner, 2007). Successful computer adaptive testing programs have been adopted in different countries in the world. Israel have implemented the Psychometric Entrance Test, Australia has administered the Multiple Choice Exam (MCQ) to candidates hoping to attend medical school and the Medical Council of Canada's Qualifying Examination Part 1 (MCCQE Part 1) which is administered in Canada. China has also developed an electronic assessment to establish the levels of proficiency in language and mathematics among her pupils in primary schools.

2.2.1.5 Implementation of e-Assessment in Institutions

2.2.1.5.1 University of Central Florida, USA

The University of Central Florida, United States of America introduced e-assessment to deal with the challenges brought up by the administration and grading of paper-based exams. The University shifted to the use of an e-assessment tool and majority of those who participated to give their opinions on the introduction of such an e-assessment reported that the electronic mode of assessment significantly cut down the cost of test administration compared to the paper-based exams and the manner in which the assessments where conducted using e-assessment was satisfactory.

2.2.1.5.2 University of Ilorin, Nigeria

The University of Ilorin is regarded as the pioneer of e-assessment (Adegbija, 2003) as it shifted its mode of test administration from paper and pencil method to computer based

assessment in the administration of assessments for programs with large number of examinees exceeding 500. The shift to e-assessment came with numerous advantages such as elimination of cases of examination malpractices, immediate feedback of results, minimal cases of missing and manipulation of results. The decision to shift to electronic assessment was informed by the need by the university to upgrade its educational programmes through integration of technology in examination administration. Oladimeji *et.al* (2017) however, noted that the implementation of e-assessment has not been without issues which called for urgent attention among them how students perceive technology, the cost of installing, running and maintaining the technology and quality of the assessments.

2.2.1.5.3 Aga Khan Academy, Mombasa, Kenya

This academy in Mombasa has not been left behind as far as adoption of e-assessment in education is concerned. The Academy adopted e-assessment platform in the year 2016 which has completely transformed the sitting and evaluation of the institutions examinations. The e-assessment mode of test delivery has been able to reduce the courier cost of examination materials as well as minimized cases of examination leakages.

2.2.1.6 Advantages of Computerized Adaptive Testing

Research in the area of CAT has been limited though in the literature available about CAT, the researchers stress that in terms of efficiency, CAT is better than PPT because the questions are matched to the test takers proficiency level. Computerized Adaptive Testing also offers improved test reliability, it is more secure because it presents a better

opportunity to control examination cheating, it offers faster data collection and in terms of printing and shipping, it is more cost effective. Kamjanawasri et al., (2002) argue that CAT is more convenient in the sense that it allows flexibility in scheduling of the tests making it possible for examinees to take the test anytime. In addition, CAT is able to offer immediate scoring and reporting of test scores, shorter tests with reduced supervision and the mode can use fewer test items to accurately measure test takers ability levels.

Psychologically, Computer Adaptive Testing greatly helps to lower stress levels of the test taker because students do not have to take the same examination. The low ability examinees do not have to take a test that is too difficult for them because every examinee is challenged at his/her own ability (Karnjanawasri et al., 2002).

CAT has been able to combine the advantages of computer innovations and recent advances of Item Response Theory to deliver tests which are more effective and fair to the examinees. This is due to the fact that it is only those items deemed appropriate which are administered to the examinees. CAT therefore lowers the measurement error while ensuring that test reliability is achieved using fewer items without loss of precision (Weiss & Kingsbury, 1984).

Computer Adaptive Tests have also been able to deliver fair tests. When the questions are delivered through the computer where there is no interference by man about which item should be selected next, all the test takers are given equal opportunity to demonstrate

their abilities and this enhances fairness in test administration. The current improvements that have been made on electronic test formats ensures that item banks can be easily screened to remove any test item likely to compromise the fairness of the test (Gershon, 2005).

Computer Adaptive Testing is however not without its own limitations despite its many celebrated benefits. Some of the cautions of CAT as identified by Rudner (1998) include:

a) The model (IRT) under which CAT is based may not be applicable to test all skills and test items.

b) The types of items that can be administered through CAT are limited. For example, detailed art work and graphs may be very difficult to present.

c) The success of CAT greatly depends on the availability of enough computers for large number of students and some level of computer literacy.

d) Once an examinee has keyed in the responses in a CAT, he/she may not be permitted to go back and change his /her responses.

2.2.1.7 Why Migrate to Computer Adaptive Testing?

The conventional Paper-Based Test (PBT) is gradually being replaced with e-assessment in most parts of the world due to its limitations which allows widespread irregularities during the testing process. Some of the limitations of PPT that have informed the shift according to Alabi et al. (2012) are:

i. The entire examination process is very tedious as the tests are administered in different centres at the same time and marking of the examination is manual.

ii.   Examination officials and students are exposed to high risks of accidents as they travel to the examination centres.

iii.   Paper based tests are susceptible to possible manipulation of examination results and marking is always subjective disadvantaging examinees.

iv.   The problem of late release of results and incidences of missing grades leads to anxiety among the students.

v.   PPT is an expensive mode of test administration on the part of examination bodies in terms of payment of allowances to examination officials.

The above steps are very much open to manipulation at any stage and also involve heavy resources in terms of manpower and funding. In the light of the above shortcomings, Fluck et al., (2009), therefore opines that educators must consider an assessment technique that permits learners to enjoy the benefits of technology in assessment.

E-assessment provides a platform to assess higher order thinking skills and reasoning that is not possible to measure using the traditional assessment method. Abubakar & Adebayo (2014) observes that e-assessments can be used to measure both the cognitive and practical abilities unlike PPTs which can only measure cognitive abilities. According to Obioma et al. (2013), if carefully designed, electronic assessments can reliably and effectively assess students' abilities in the three domains (cognitive, psychomotor and affective) of learning.

Table 2.1: Differences between Paper and Pencil Tests and Computer Adaptive Tests

	Paper and Pencil Test	Computer Adaptive Test
Nature	Examinees write a standard examination	Examinees write quite different examination
Level of Difficulty	Targets examinees whose ability level is average	Targets specific examinees.
duration	Standard for all examinees and the examination takes longer time to complete	Examinees take different examinations and the testing process takes a shorter time
Testing period	All the examinees are tested at the same time	Examinees can take examinations at different times
Test construction	Its time consuming	Not time consuming
Results	No immediate feedback	Has immediate feedback

Source: Tian, 2007

A study was conducted by Bulut and Kan in 2012 to investigate the suitability of adopting a Computer Adaptive Test format to choose students for university courses in Turkey. The study used actual responses from the student and the standard error of measurement was used as the criterion to stop the testing process once the students' abilities were precisely measured. The results of the study showed that smaller number of questions could be used to accurately measure the students' abilities compared to paper based testing and the duration of the testing process could as well be reduced by up to 70%.

Another study was conducted by Kenyon and Malabonga (2001) to examine the attitude of graduate and undergraduate students to taking foreign languages; Spanish, Arabic and Chinese in Thailand. The study used participants sampled from different universities taking different language programs. The results of the study showed that e-assessment helped to lessen the difficulty level of the test by matching difficulty level of the test to the ability level of the examinee.

Another study was conducted in Maryland, USA by Baghi, Gabrys and Ferrara in 1990 to determine the attitude of students towards Computer Adaptive Testing in Mathematics and Reading. The study was conducted between 1985 and 1990 and used students in grade eight and nine across schools from 24 school districts. The results of the study indicated that the students had positive attitude to taking an electronic format of a test in the form of CAT Math and CAT- Reading.

Results of these studies have indicated that CAT is more preferable to traditional tests. The results of these studies were all in agreement that the examinees preferred taking a computerized test over the paper and pencil test. The students reported that Computer Adaptive Testing offered a better testing experience compare to the paper based testing reading on the screen was no longer a problem to them. Students were more interested in doing electronic examinations that they were in doing paper based examinations.

2.2.2 Empirical Literature

2.2.2.1 The Concept of Assessment

According to Akhter & Fatima (1999), assessment is closely related to evaluation, sometimes measurement and testing and these terms are occasionally used one in the place of the other to refer to those means used to collect information on student learning. Mundrake (2000) argues that these terms can be used to refer to those means used to arrive at the end product from an educational process. However, Brown (2004) defines assessment as the process of gathering students' information using various methods such as administering a class quiz or use of interviews and interpreting the information related to students' performances. Assessment is an important tool of passing information to students and teachers as well as other stake holders to inform them about the learning-teaching process.

2.2.2.2 Types of Assessment

Formative Assessment also known as Assessment *for* Learning is a form of assessment which is continuous and therefore it is carried out throughout a course. It helps to provide

information to both teachers and learners on areas where improvement is needed (Garrison & Ehringhaus, 2007). Black and William (1998) points that formative assessment should clearly point at the areas where students should improve for learning to be successful.

Summative Assessment also known as Assessment *of* Learning is a form of assessment which takes place at the end of the teaching-learning process. It provides information as to whether curricula goals have been achieved or not.

Table 2.2: Comparison between Formative and Summative Assessment

Formative Assessment (Assessment *for* Learning)	Summative Assessment (Assessment *of* Learning)
It provides information on where improvement is needed	Provides information about the extent to which learning has taken place.
Provides information to both teachers and learners to improve the learning process.	Provides information to stakeholders about the success of the teaching-learning process.
Takes place continuously	Takes place periodically.
Feedback cannot be used to make selection or placement decisions	Feedback is used to make section and placement decisions.
It is student centered.	It is not student centered.

Source: Alexander (2008)

2.2.2.3 Current Trends in Assessment

PPTs have been strongly criticized for a number of reasons but despite the many challenges associated with them, they still offer some distinct advantages compared to other forms of assessments. These traditional tests tend to be reliable in that they require less time to administer, they are less expensive in terms of costs and their scores are

easier to interpret by educators. However, changes in assessment which are more expansive and complex have continued to emerge. These current trends in assessment are designed to mound a student who is holistic - a critical thinker, creative and a problem solver.-educated. Akhter and Fatima (1999) points that, the desire to change the current practice in assessment has been pushed by a number of factors:

a) Need to find a better method of assessment.

b) Greater emphasis on quality assurance.

c) Great emphasis on understanding of concepts rather than superficial learning.

d) Desire to incorporate the affordances of new technologies in teaching-learning process.

e) Need to cut on costs in test administrations.

f) Need to reduce the testing time for both the examinees and examination officials.

2.2.2.4 Computers and Assessment

The invention of the computer has been the greatest invention of the 20th Century and to great extent it has revolutionalised the education sector and how assessments are done. The use of computers has continued to plays a vital role in the education sector at all levels (Fadeyi, et al., 2010) and this has changed the way educational testing is carried out in many parts of the world. According to Mulvany (2011), the adoption of computers in education has brought in a new dimension in testing and now organizations are shifting from conventional methods of testing to e-assessment in order to be able to release information about students' performance within a short time and also offer a cheaper and speedier mode of test delivery. The use of computers in assessment has continued to

expand testing experience in ways that transcends above challenges encountered under Paper and Pencil Tests.

Modern technologies in computers have been applied widely in all areas of life allowing tasks that were previously time consuming to be undertaken while providing a tool that has extended the intellectual powers possessed by humans(Akhter & Fatima, 2017). The widespread use of word processing packages, spreadsheets and presentation packages have altered the way teaching, learning and assessment can be conducted and these new computer technologies in education have continued to offer exciting possibilities.
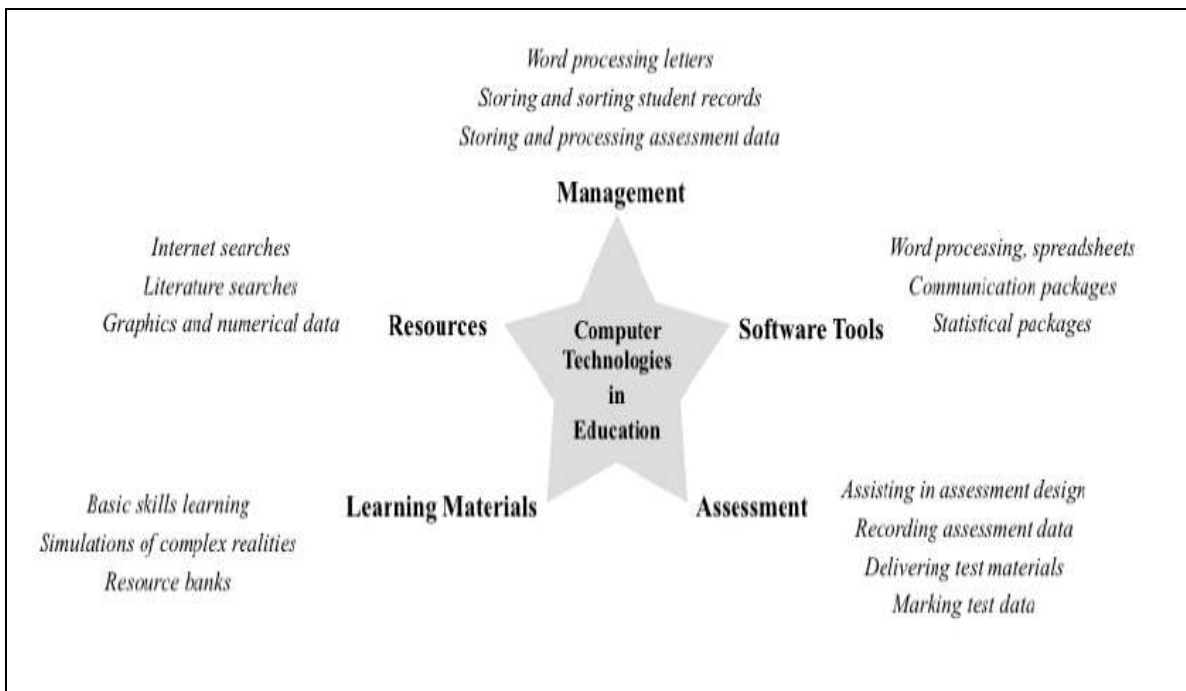
Figure 2.2: Computer Technologies in Education: (Source Akhter & Fatima, 2017)

For the use of computer technologies in education to be successful, Akhter and Fatima (2017) identified three major conditions that must be fulfilled. First, the right equipment must be readily available when needed and must be reliable. Secondly, the learner and the teacher must be competent and confident in using the equipment and software and

thirdly, the software must be able to carry out the tasks required in an educational setting with speed and reliability while it is essential that it be user friendly.

2.2.2.5 Computer Adaptive Testing Item Selection Algorithm

According to Birdsall (2011), the algorithm used for selecting items is often a balance between two contrasting objectives: the need to select the item that will give the most information about a candidate and the need to ensure that a specific item is not seen so often that candidates are familiar with it before taking the exam. The first objective is based on maximizing item information where an exam may be administered with fewer questions, if the item selection algorithm always chooses the items with the maximum information. The second objective is based on a common security concern that candidates will post questions online thus giving their peers undue advantage in the test.

2.2.2.5.1 Determining the Starting Ability

It is possible, in adaptive testing, to start with different items at different levels for different examinees. However, in determining an examinees starting ability level on a computer adaptive testing, Birdsall (2011) identifies three basic strategies. First, the candidate can start off in the middle of the difficulty level of the item pool with equal number of items between either extreme of the item difficulty level. This enables determination of an examinees reliable score before all the items at his/her ability level are exhausted. Secondly, the candidate can start off with an ability level based on a measure of class performance such as grade point average (GPA). Thirdly, a student's

starting ability can be based on the result of the previous CAT administration from previous modules.

2.2.2.5.2 Determining the Termination Criteria

Weiss & Kingsbury (1984) argues that, in CAT, testing continues as long as necessary until the ability of every student is determined accurately. The most important element in CAT is when to stop the testing process (Tian et al., 2007). A too short test may render the ability estimate of a test inaccurate. A too long test may lead to wastage of time and resources and unnecessarily exposure of test items. In addition, a too long test may expose the test taker to fatigue which may consequently affect his/her performance negatively. According to Tian, Miao et al., (2007), a CAT terminates when:

a) All the items in the item bank have been administered to the examinee.

b) The estimated length of the test has been reached.

c) The examinees ability has been estimated with precision.

d) The examinees ability is way above the pass-fail criterion.

e) The examinee starts showing off-test behavior such as choosing irrelevant response options and answering test items too fast or too slowly.

However, a CAT process is not terminated until a given number of questions have been administered, the content has been sufficiently tested and enough questions have been tested.

```
┌─────────────────────┐
│ Develop item bank and│
│      CAT system      │
└─────────────────────┘
          ↓
┌─────────────────────┐
│ Specify starting point│
│   and start test     │
└─────────────────────┘
          ↓
┌─────────────────────┐
│ Select item and deliver│        ┌──────────────┐
│    to examinee       │ ←────────│ Not satisfied │
└─────────────────────┘          └──────────────┘
          ↓                              ↑
┌─────────────────────┐                  │
│ Score item, update   │                 │
│  examinee score      │                 │
│    estimate          │                 │
└─────────────────────┘                  │
          ↓                              │
┌─────────────────────┐          ┌──────────────┐
│ Evaluate termination │          │  Satisfied   │
│      criteria        │          └──────────────┘
└─────────────────────┘
          ↓
┌─────────────────────┐
│    Conclude test     │
└─────────────────────┘
```
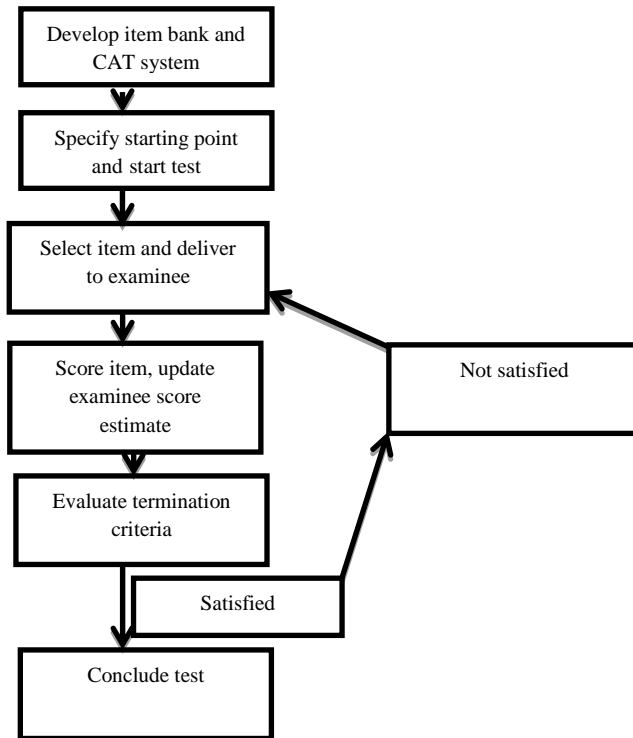
Figure 2.3: Flowchart of CAT algorithm (source: Thompson & Weiss, 2011)

2.2.2.6 Information and Communication Technology in the Kenyan Education System

Information Communication and Technology and its use in Kenya plays a great widen the access of education so long as it is appropriately used (Nchunge, 2013). The use of ICT in Kenyan system of education can bring to the classroom, teaching and learning many advantages such as providing an opportunity for more student-centered teaching, improving communication and collaboration between students-to-students and teacher-to-teacher and offers opportunities to wider access of various courses thus increasing learning enthusiasm to both the teachers and learners. Adoption of ICT in education, it is believed, has the potential to make the teaching-learning more efficient while at the same time increasing the access to education (GOK, 2005).

However, the main challenge inhibiting the successful adoption of ICT to Kenyan schools is poor connectivity and network infrastructure. The country has only a few schools that are connected to high speed internet. Penetration of the telecommunication services has been low mainly in remote areas and even where there is internet connectivity, high costs remains a challenge to its access. Gathitu (2010) notes that Computer Adaptive Testing is a new and untapped area in the Kenyan education system and it is yet to be realized and appreciated among the Kenyan testing systems.

2.2.2.7 Potentials of ICTs in Kenyan Education System

According to Gathitu (2010), ICTs are considered by many to have greater potential to enhance the teaching and learning process. The possibilities offered by ICT have the potential of transforming the organization and structure of schooling and may promote the development of cognitive processes.

2.3 Theoretical Framework

Various theories have been explained to support the implementation of Computer Adaptive Testing.

2.3.1 The Theory of Computerized Adaptive Testing

The theory of Computer Adaptive Testing is rooted in the principle of Computer Based Testing (Chuesathuchon, 2008). Computerized Adaptive Testing (Gathitu, 2010) is a new model of student modeling in educational assessment whose origin in psychometric theories of measurement. Computer Adaptive Testing is marked by its ability to measure an examinees proficiency level accurately using the least number of questions possible. An examinee is given test items whose level of difficulty is appropriate to his/her ability and this greatly reduces test anxiety while at the same time keeping the examinee motivated during the testing process.

The aim of Computer Adaptive Testing (CAT) is to determine an examinees level of competency by adjusting the difficulty level of each test item to his/her ability. If an examinee answers a question correctly, a harder question is chosen and administered and if the student scores the question wrong, a simpler question is chosen and presented. The aim is to match the difficulty level of test items to the ability level of the student until a consistent level of performance is achieved. Adaptive Testing technology can determine an examinees competency level more quickly than conventional examination techniques (Thomson, 2004).

In Computer Adaptive Testing, the test takers estimated competency level is used to determine the chances of getting a question correct. Examinees with low ability and those with high ability can be administered with totally different set of questions by taking into account how each of them responds to previous test items. Using this concept, a low ability examinee sees simpler items while a high ability examinee will see harder items. Although the same percentage of test items may be answered by both the low achievers and the high achievers, the high achievers will get a higher score because he/she answers more difficult questions correctly compared to the low achievers (Gathitu, 2010).

2.3.2 Item Response Theory (IRT)

The development and application of IRT in educational assessment is greatly credited to the work of F.M Lord (Natarajan, 2009). Hambleton and Jodoin (2003) argue that this theory was developed to assist in evaluation of respondents without depending on the same items included in the test. This model conceptualizes that the probability of a test taker correctly answering any particular test item depends on his/her ability. According to Baker (2001), the primary interest in IRT is in whether a test taker scored each test item correctly or not rather than in the general test scores because the basic principle of the model lies on the individual items of a test rather than on the aggregate test score.

Carlson and Davier (2013) assert that among other models, IRT is the commonly applied in education under large-scale testing in many countries. IRT models have been used to address two major measurement challenges faced in the digital world today. These challenges are one, the complex nature of the knowledge, capabilities and skills to be

assessed and two, and the increased use of e- assessments and IRT was developed to solve these challenges by offering an innovative approach to the development, delivery and scoring of tests. According to Natarajan (2009), IRT has become more popular in the field of psychological and educational testing due to its ability to offer a more adaptable and effective method of test construction, analysis and scoring than those derived from other models. This study is therefore based on the Item Response Theory (IRT).

2.4 Conceptual Framework

Mode of Testing	Why Migrate to CAT?	Independent Variables	Dependent Variable	Outcomes

Computer Adaptive Testing

-Takes shorter time to administer

-Immediate feedback of results

-Level of difficulty target specific examinees

-Examinees can take a test at different times

Paper & Pencil Testing

-Takes longer time to administer

-No immediate feedback of results

-Targets examinees whose ability level is average

-Examinees must take a test at the same time

-Tedious examination process

-High risks of accidents as officials travel to examination centres

-Possible manipulation of results

-Late release of examination results and incidences of missing grades causing anxiety among students

-Expensive mode of test administration in terms of payment of allowances and honoraria to examination officials

-Teachers' and Students' Perceptions

-Existing Technological Infrastructure

-Level of Computer Literacy

Adoption of CAT in Educational Assessment

Easier Management of Examinations

Speedier Delivery of Tests

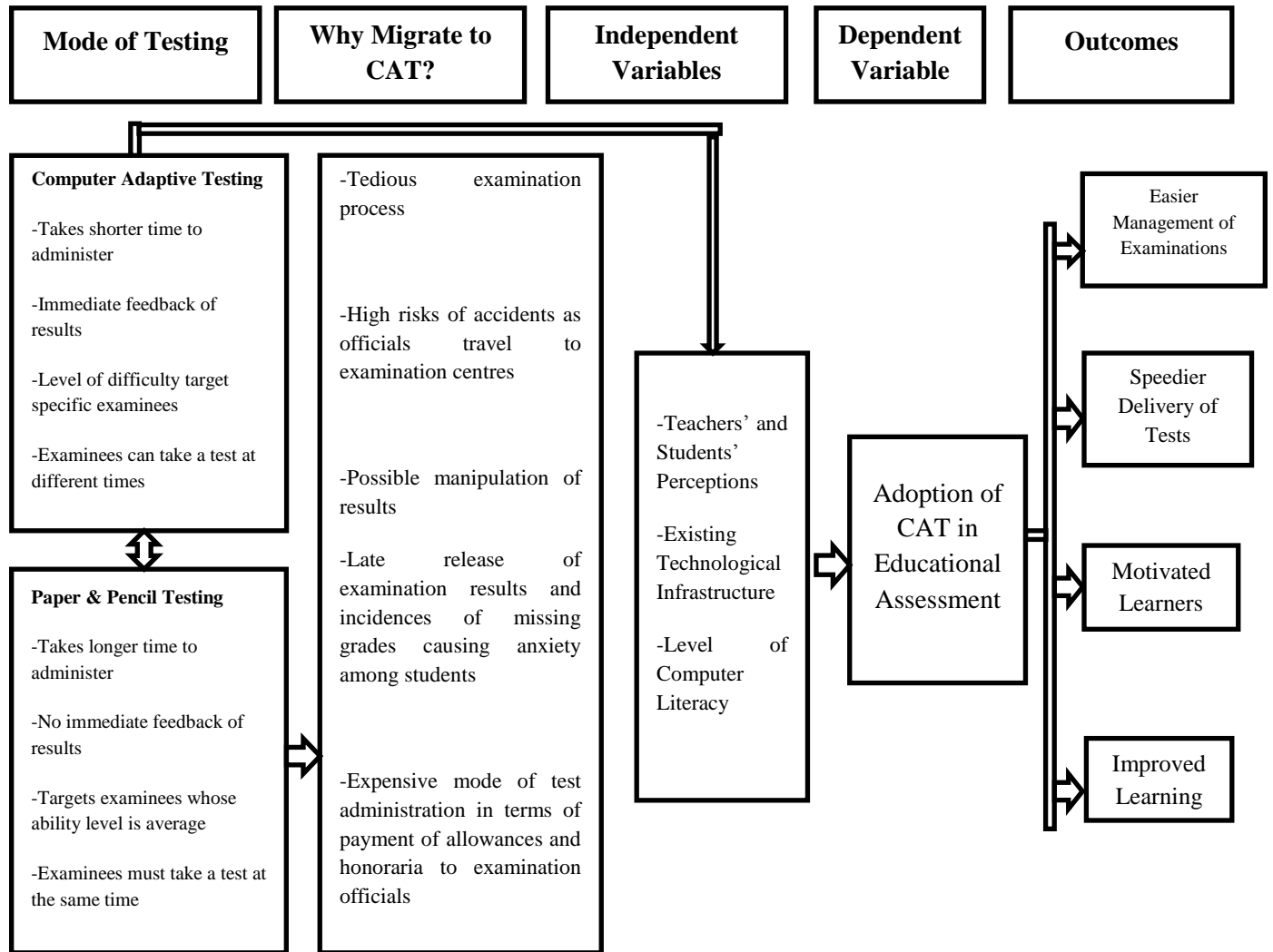Motivated Learners

Improved Learning

Figure 2.4: Conceptual Framework (source: Author, 2020)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Research Design

This study used a multi stage sample survey research design. The survey design was employed because of its ability to obtain information about the status of the topic under study as it currently exists and compared to other methods of data collection, it is a faster method, it is able to collect data from a large group of respondents, it is cheaper and the data collected is very accurate. According to Kerlinger (1973), survey research aims at collecting data based on perceptions, attitudes and beliefs of people and the data collected was used to make conclusions on whether Computer Adaptive Testing can be successfully adopted in educational assessment in Kenya.

The target population that participated in this study was identified using systematic and stratified sampling techniques. The schools that were chosen to participate in this study were only those that offered computer studies at the examination level in form four. To ensure that all the subgroups were well represented in the study, stratified sampling was used to select the schools where in this study the identified strata were Boys' Schools, Girls' Schools and Mixed Schools. Computer studies students and computer studies teachers in form three were the target population for this study where the students were sampled in a first come first participate basis in computer classes with a student population of more than 10 students while those classes with a student population of exactly 10 students, all of them were selected to participate. The computer teacher teaching the form three classes was selected to participate and where there were more than one computer teacher, the first one who volunteered to participate was selected.

3.2 Data Types and Sources

This study sought to use various variables to address the research problem and meet the objectives of the study which was to determine how students' and teachers' perception affect the adoption of Computer Adaptive Testing, how the existing technological infrastructure affect the adoption of Computer Adaptive Testing and the extent to which computer literacy affect the adoption of Computer Adaptive Testing.

The study used primary data collected from the field where students and teachers were directly involved. This was done by the use of self-administered questionnaires for a period of about three weeks where the respondents (both students and teachers) were requested to answer the given questions. The study used only the primary data that was collected from the sampled students and teachers in the sampled schools. Information about the schools (Secondary data) was obtained from the County Education Office, Makueni and this information assisted the researcher to identify the target population for the study by zeroing in to only those schools which offered computer studies at the examination level in form four.

3.3 Data Collection

3.3.1 Pilot Survey

A preliminary survey was conducted mainly to identify the target population and determine the appropriate sample size. The preliminary survey assisted to identify the target population for schools by focusing only on those schools which offered computer studies as an examination subject in form four, whose computer classes had more than 10 students and schools which were conveniently accessible.

The pilot survey was also important in identification of the students who would give their honest opinion in relation to the adoption of computer adaptive testing in educational assessment and this therefore targeted the form three. Form three computer students were chosen because they were the most stable class having chosen the subject as one of their elective subjects examinable at form four.

The pilot study also helped to identify challenges likely to be encountered and short-comings in the data collection instruments. Those unclear or ambiguous items identified in the research instruments were cleared out or adjusted to ensure that the data collection instruments were valid and reliable.

3.3.2 Target Population and Sample Size

The population for this study comprised of all the public secondary schools in Makueni County, all the form three students and the teachers. From this population, it was only those public secondary schools that offer computer studies at the examination level in form four, form three students taking computer studies and the computer studies teachers teaching the form three computer studies class that were included in the study and therefore constituted the target population. The study focused only on the public secondary schools because most secondary school students are in Public schools and these schools gave a good representation which was needed for the study. From the total of 390 secondary schools in the county, it was only 63 secondary schools that offered computer studies as an examinable subject in form four. A sample of 23 secondary schools offering computer studies was chosen arbitrary. Because it was not logically possible to consider all the computer studies students, the study used only 10 students

in form three taking computer studies and only 1 computer studies teacher teaching the computer class in form three from each of the sampled schools. Simple random sampling was used to choose those to participate in the study.

A total of 253 questionnaires (230 for students and 23 for teachers) were distributed targeting both the teachers and students from the sampled schools. An equal representation of 10 students and 1 teacher was drawn from each of the 23 sampled schools giving a total of the 253 questionnaires. Out these questionnaires, 243 (220 for students and 23 for teachers) questionnaires were responded to while 10 questionnaires were returned unanswered and this represented a return rate of 96.04%. The unanswered questionnaires were received from those sampled schools which had a population of less than 10 students in their form three computer studies classes and therefore the four schools which had less than 10 students and had participated in the study were dropped from this study.

3.3.3 Data Collection Instruments

The study used questionnaire for students and teachers with open-ended and closed questions to collect primary data. Use of questionnaires as a data collection instrument was chosen because of its ability to gather large amounts of data from a large sample cheaply, quickly and efficiently and the researcher does not have to be present for the questionnaires to be completed. The questionnaires were grouped into two: Teachers' Questionnaire and Students' Questionnaire.

The teachers' questionnaire had four sections:

Section A: This section captured the general background information including name of the school, type of the school (Boys, Girls or Mixed), gender of the teacher, number of students in the computer class, number of operational computer machines available for use, how the computer machines were acquired, internet connectivity and accessibility of the computer by teachers.

Section B: This section captured information intended to meet the first objective by gathering information about teachers' perceptions toward adoption of Computer Adaptive Testing.

Section C: This section highlighted on the second objective by gathering information on the general technological infrastructure like reliability of power supply, the speed of internet connectivity and the criterion for placing the ICT infrastructure.

Section D: This section was intended to collect information on how the teacher rated the level of computer literacy among his/her students.

The Students' Questionnaire had only three sections:

Section A: This section captured the background information in relation to the name of school, type of school, gender, number in the computer class, internet connectivity and computer access outside the school.

Section B: This section collected information to meet objective one of the study. It contained questions on whether they believed they could do examination via the computer confidently and whether taking an examination using a computer would be interesting.

Section C: This section contained questions that were intended to meet the third objective by asking the students to rate their computer literacy.

Table 3.1: Summary of Data Collection Instruments

Objective	Information Required	Data Collection Instrument
Determine the extent to which adoption of Computer Adaptive Testing is affected by students' and teachers' perception.	Extent to which CAT is affected by Students' and Teachers' perceptions.	Teachers' Questionnaire Students' Questionnaire
Determine the extent to which adoption of Computer Adaptive Testing is affected by the existing technological infrastructure.	Extent to which CAT is affected by technological infrastructure	Teachers' Questionnaire
Determine the extent to which adoption of Computer Adaptive Testing is affected by computer literacy.	Extent to which CAT is affected by levels of computer literacy	Teachers' Questionnaire Students' Questionnaire

3.3.4 Sampling Procedure

The representative sample size for this study was selected using stratified and systematic sampling for the schools and simple random sampling for the students. The simple random sampling was used because it offered the respondents equal chances of participating in the study while the stratified sampling was used to ensure that all the subgroups (Boys', Girls' and Mixed schools) were well represented in the study.

The study used 23 secondary schools in Makueni County offering computer studies as an examinable subject in form four and the information on the population for this study was received from the county education offices from where the schools offering computer studies were identified. The sampled schools were chosen based on a number of conditions: the school had to be offering computer studies as an examinable subject in form four, the minimum number of students in the computer studies class had to be 10 and the school had to be easily accessible to allow the researcher ample time to collect data because the County is vast and accessing schools remotely located would be a challenge. In each of the sampled schools, 10 students were selected randomly and 1 teacher in the form three Computer Studies class were selected to participate in the study.

The researcher visited each of the sampled schools and administered the questionnaires to the respondents. However, in three schools, the questionnaires could not be responded to immediately due to the nature of their school programs. In those schools, instructions on how to answer the questionnaires were given to the computer studies teacher and the students responded to the questionnaires at a time when their program was convenient to them.

3.4 Data Processing and Analysis

3.4.1 Data Processing

The questionnaires received from the field were grouped into two categories, one for the students and another one for the teachers. After the questionnaires were verified, the data was tabulated, coded and keyed into a computer. The data from the students' questionnaires was used to create the students data file while the data from the teachers' questionnaires was used to create the teachers data file. To achieve the objectives of this study which was to determine the extent to which adoption of computer adaptive testing is affected by teachers and students perceptions, technological infrastructure and computer literacy, additional variables which were not initially captured by the data collection instrument were created and included into their respective data files. These additional variables created were; the students-computer balance (to denote the deficit or surplus in the number of computers against the number of students) students' computer ratio and grouped data for the number of computer studies students in the class. The teachers' data file and the students' data file were then merged into one data file using the name of the school as the common variable.

3.4.2 Data Analysis Techniques

This study used exploratory technique of analyzing the data collected from the field to allow the researcher to accurately give the descriptions of the sampled data using frequencies. Qualitative techniques were used to analyze the data by computing descriptive statistics such as percentages, frequencies, bar charts, means and standard deviations. Quantitative techniques on the other hand were used to generate inferential statistics like ANOVA tests for the variables ICT infrastructure and students' and teachers' perceptions and correlations which were used to establish the

relationship between the variables used in this study. Step wise regression analysis was employed to determine the extent to which adoption of CAT is affected by the teachers and students perceptions, ICT infrastructure and the level of computer literacy on the adoption of Computer Adaptive Testing in educational assessment. The step wise regression analysis was important because it assisted in measuring the extent to which one or more of the independent variables affected the dependent variable.

The regression analysis equation used to test the relationship between the independent variables (ICT infrastructure, students and teachers perceptions and computer literacy) and the dependent variable (Adoption of Computer Adaptive Testing) was in the following form:

$$y=\beta_0+\beta_1\chi_1+\beta_2\chi_2+\beta_3\chi_3+\varepsilon$$

Where; $y=$ Adoption of Computer Adaptive Testing

$\chi_1=$students' and teachers' perception

$\chi_2=$ICT infrastructure

$\chi_3=$computer literacy

β_1, β_2 and $\beta_3 =$coefficients of determination

$\varepsilon=$error

From the SPSS generated table, the above equation became:

$y =1.9 +3.742 \chi_1 +2.107 \chi_2-1.086 \chi_3$

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 The concept of Adoption

Adoption hereby refers to the readiness to use computers in educational assessment. In this study, adoption was measured against some parameters which included the availability of operational computers for use by both the students and teachers vis-à-vis the number of students in the class, internet availability, reliability of power supply and presence of computer competent students.

4.2 Background Information

Table 4.1: Category of School, Type of School, Gender of Student and Gender of Teacher

		No.	%
Category of School	**Public**	19	100
Type of School	**Boys**	10	52.6
	Girls	5	26.3
Total	**Mixed**	4	21.1
		19	*100*
Gender of Student	**Female**	63	33.2
Total	**Male**	127	66.8
		190	*100*
Gender of Teacher	**Female**	4	21.1
Total	**Male**	15	78.9
		19	*100*

Boys' secondary schools comprised of 52.6% while girls schools comprised of 26.3% and mixed secondary schools 21.1%. This is attributed to the fact that boys' schools are more than girls' schools in the county. The number of mixed secondary schools used in the study was few because installing computers and related software and infrastructure is an expensive affair which most of these mixed schools cannot afford.

In terms of gender, 66.8% comprised of male students and 33.2% female students. The high number of male students who participated in the study could be due to the fact that boys' secondary schools were more than girls' secondary schools and the student population taking computer studies in form three was higher in boys' schools compared to girls' schools and in mixed schools, boys taking computer studies were more than the girls.

The study shows that 78.9% of the teachers teaching computer studies who participated in this study were male and 21.1% were female. This may be attributed to the fear of technology and its related complexity by the female gender that tends to see technology as a male dominated field.

4.3 Computer Adaptive Testing and Teachers' and Students' Perception

Objective one of the study sought to determine the extent to which adoption of Computer Adaptive Testing is affected by Teachers' and Students' perceptions. The respondents gave their views on ten variables discussed below.

4.3.1 I can use a computer confidently

On whether they could use a computer confidently, 53.2% of the respondents strongly agreed that they could confidently use a computer, 34.5% agreed and 12.3% were not sure whether they could be confident in using the computer. The reason as to why majority of the respondents agreed that they could use a computer confidently could be due to the fact that computers have permeated many sectors of our economy and therefore students have greater access to computers both at home or in school.
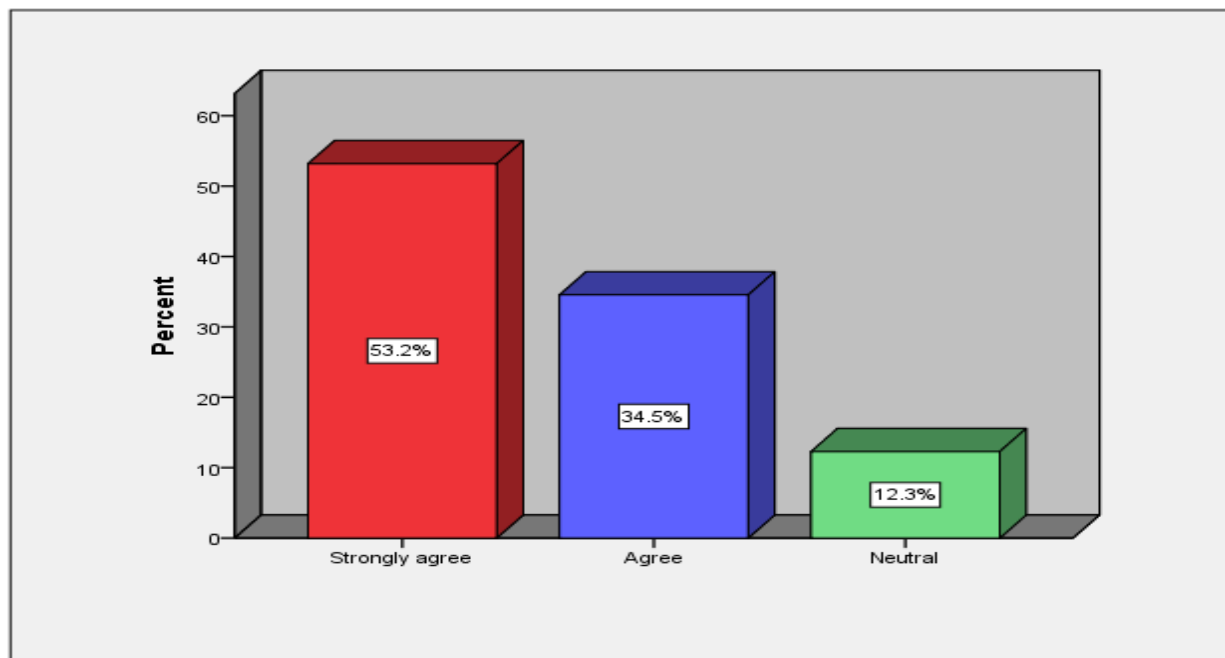

Figure 4.1: I can use a computer confidently

4.3.2 I believe I can do a Computer Adaptive Test well

When asked on their belief to do a computer adaptive test, 45% of the respondents said that they strongly agreed that they could do a CAT well, 42.7% agreed they could do a CAT, 11.4% were neutral concerning their ability to do a CAT while 0.5% disagreed and strongly disagreed they could do a CAT well. This could be due to the fact that students are always fascinated by the use of computers or technology in general in carrying out their education activities.
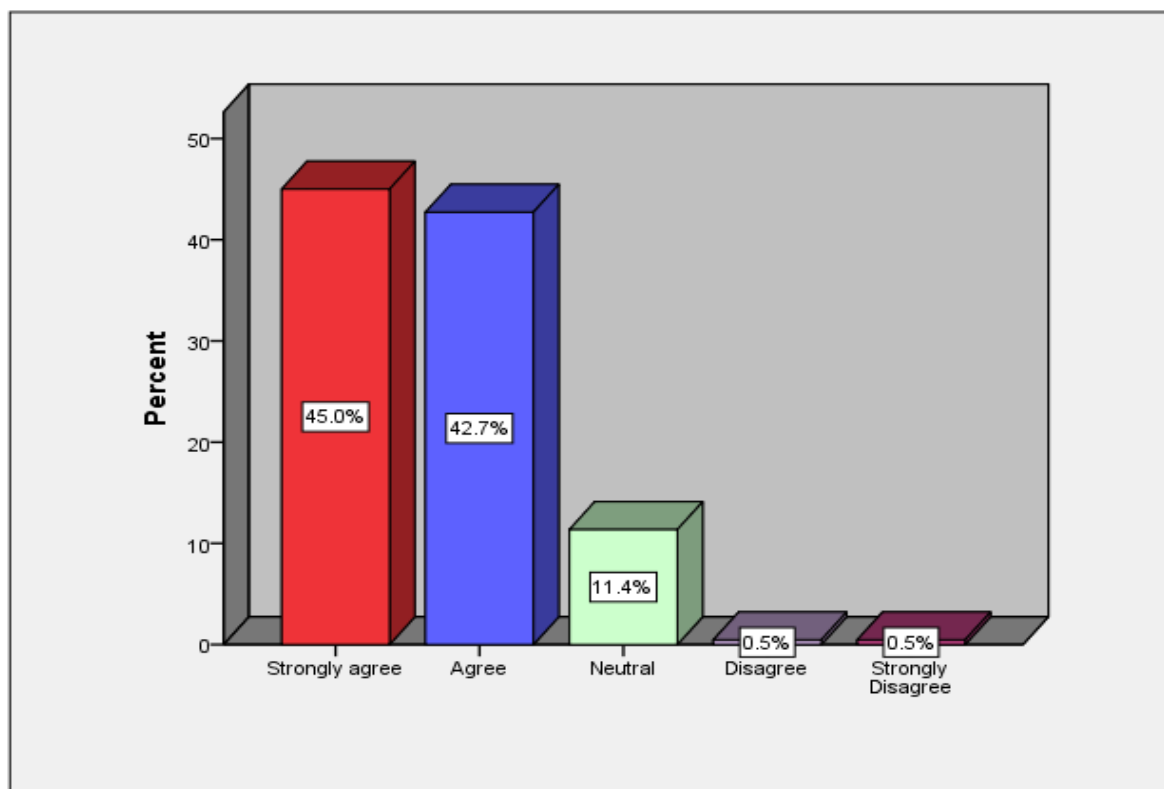

Figure 4.2: I believe I can do a Computer Adaptive Test well

4.3.3 Computer Adaptive Tests can be fair to all students

When asked on whether Computer Adaptive Test could be fair to all the students, 27% of the respondents strongly agreed, 43% agreed, 23% were neutral, 6% disagreed while 1% strongly disagreed.
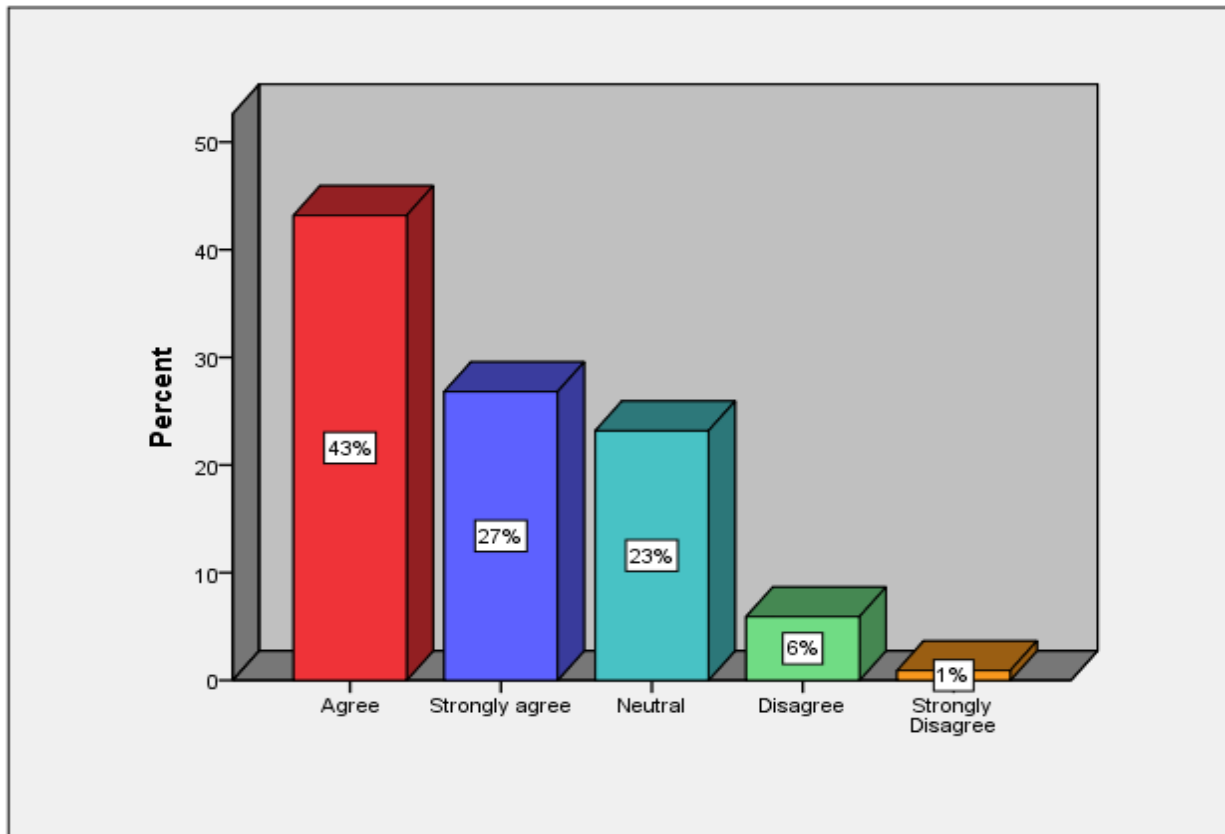

Figure 4.3: Computer Adaptive Tests can be fair to all students

4.3.4 I can take a test using a computer with confidence

On whether they can take a test using a computer with confidence, results showed that 48.2% of the respondents strongly agreed that they could take a test using a computer with confidence, 40.9% agreed, 10.5% were not sure while 0.5% disagreed. This could again be due to excitement that comes with the use of technology that majority of the students felt that they could take such an examination confidently.
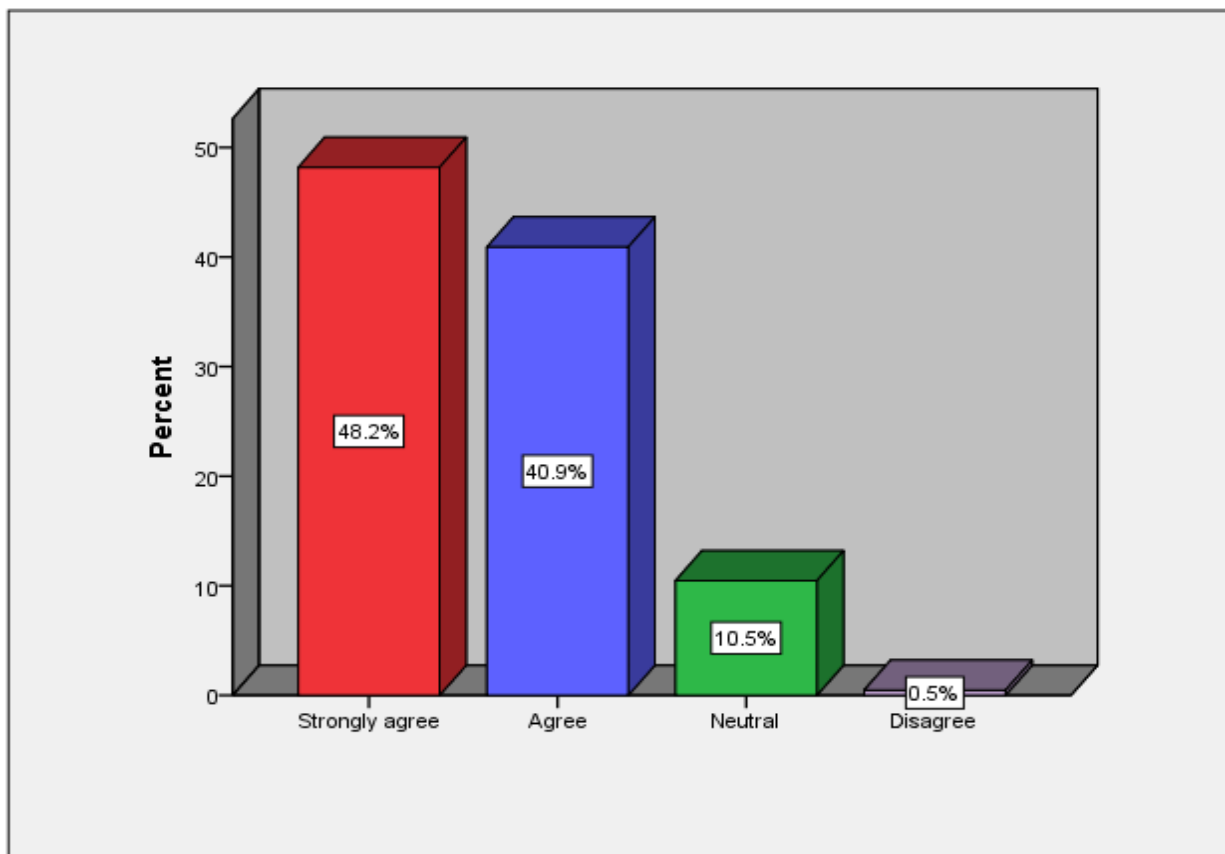

Figure 4.4: I can take a test using a computer with confidence

4.3.5 I would like to take a test that gives immediate results

When asked on whether they would like to take a test that gives immediate results, an overwhelming 93% of the respondents strongly agreed and agreed, 6% were not sure while 1% said they would not like to take a test that gives immediate results. The reason why majority of the students said they would like to take an examination that gives immediate results was probably because the anxiety that comes with waiting for results would be reduced.
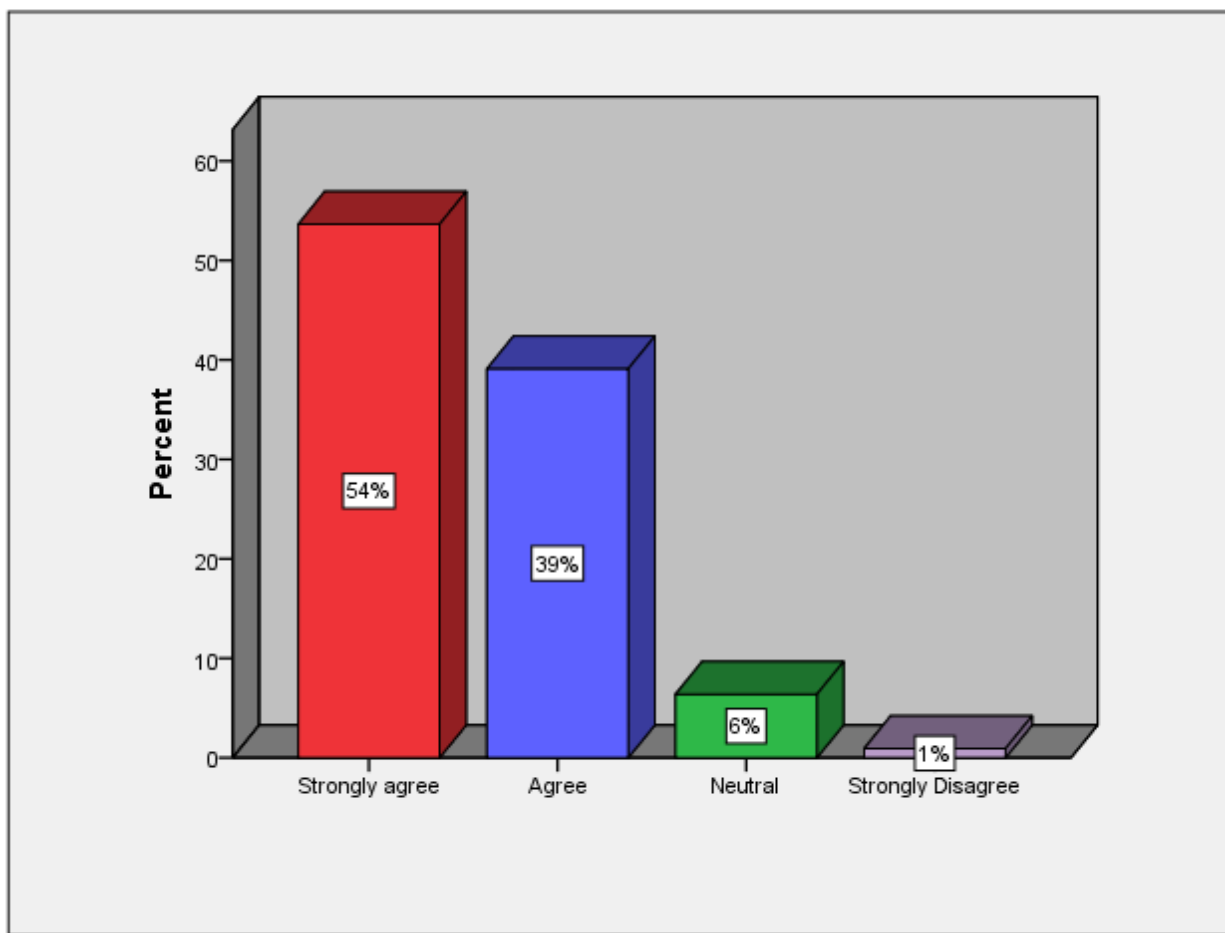
Figure 4.5: I would like to take a test that gives immediate results

4.3.6 Taking an examination using a computer can be very interesting

On whether the students would find taking an examination using a computer interesting, an overwhelming majority at 70% strongly agreed, 25% agreed, 3.6% of the students neither agreed nor disagreed and 0.9% and 05% strongly disagreed and disagreed respectively. The overwhelming support could mainly be due to the fact that most of the students are fascinated by the use of new technology in education.

Figure 4.6: Taking an examination using a computer can be very interesting

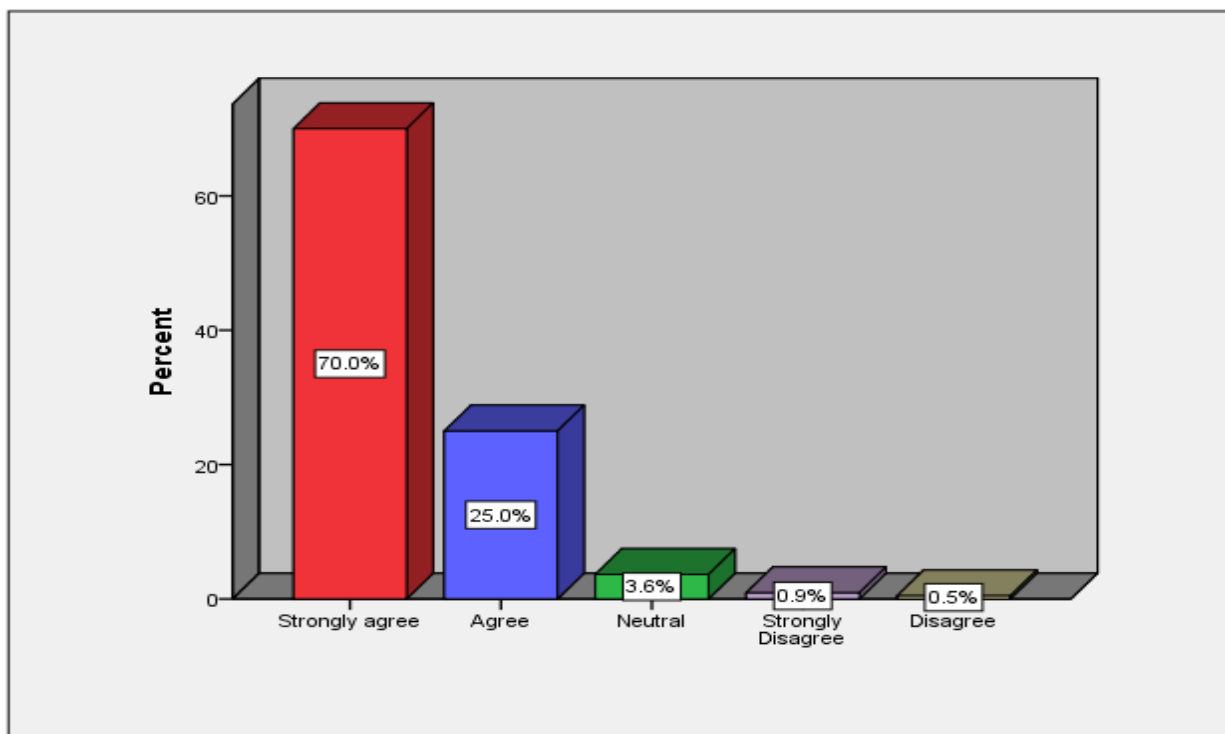**4.3.7 How do you rate your ability to use computers?**

When asked to rate their ability to use the computer, 48% of the respondents said that their ability was very high, 35% said their ability was high and 17% said that their ability to use the computer was moderate.
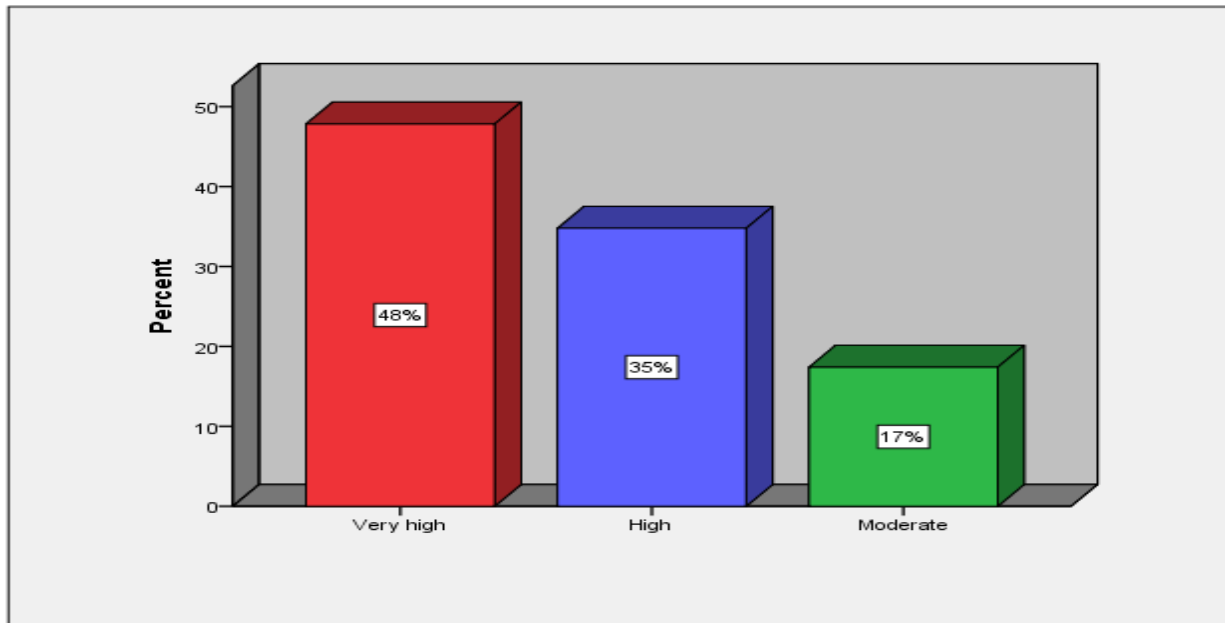
Figure 4.7: How do you rate your ability to use computers?

4.3.8 Do you think your students are capable of doing an examination via the computer?

When asked about the capability of their students to do an examination through the computer, 26.1% of the respondents felt that the students were very able, 69.9% were able while 4.3% felt that the students were unable to do an examination via the computer. This shows that there were still a minority number of students who were completely unable to do an examination via the computer and this could be due to factors such as family background or socio-economic factors among the students.
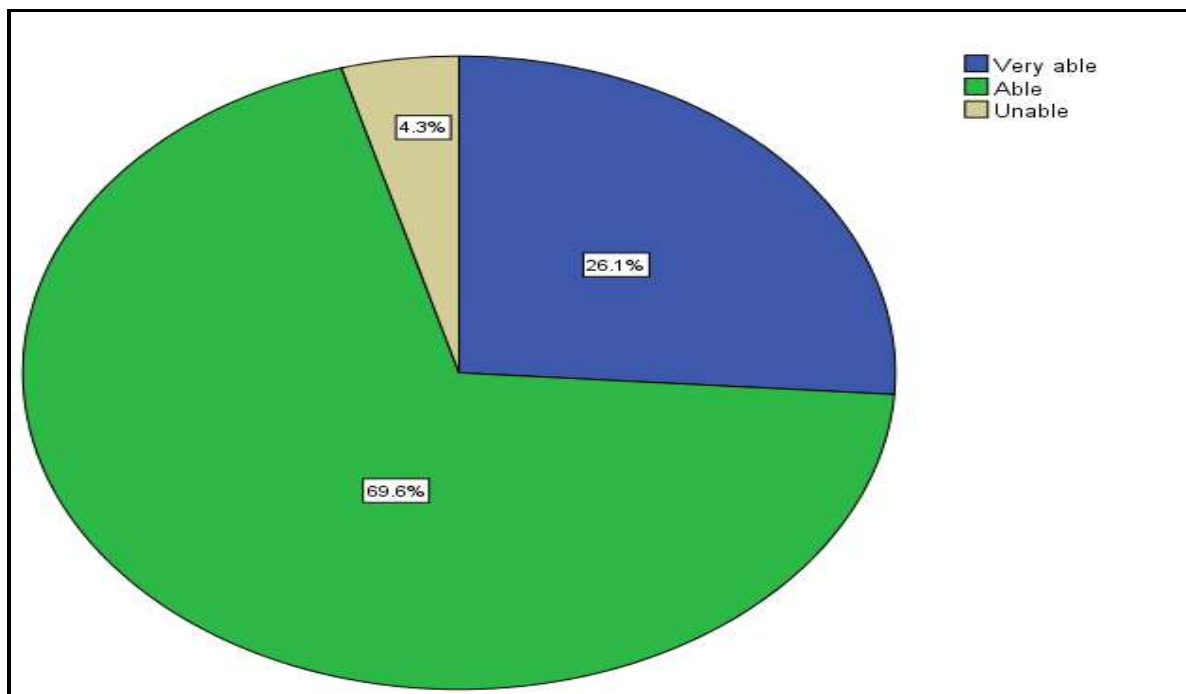
Figure 4.8: Do you think your students are capable of doing an examination via the computer?

4.3.9 Do you think the use of Computer Adaptive Testing in assessment can offer a better testing experience than current Paper and Pencil Test?

When asked on whether CAT could offer a better testing experience than the paper and pencil testing, 56.5% of the respondents strongly agreed, 39.1% agreed while 4.3% felt that the was no difference in terms of the testing experience between Computer Adaptive Testing and Paper and Pencil Testing.
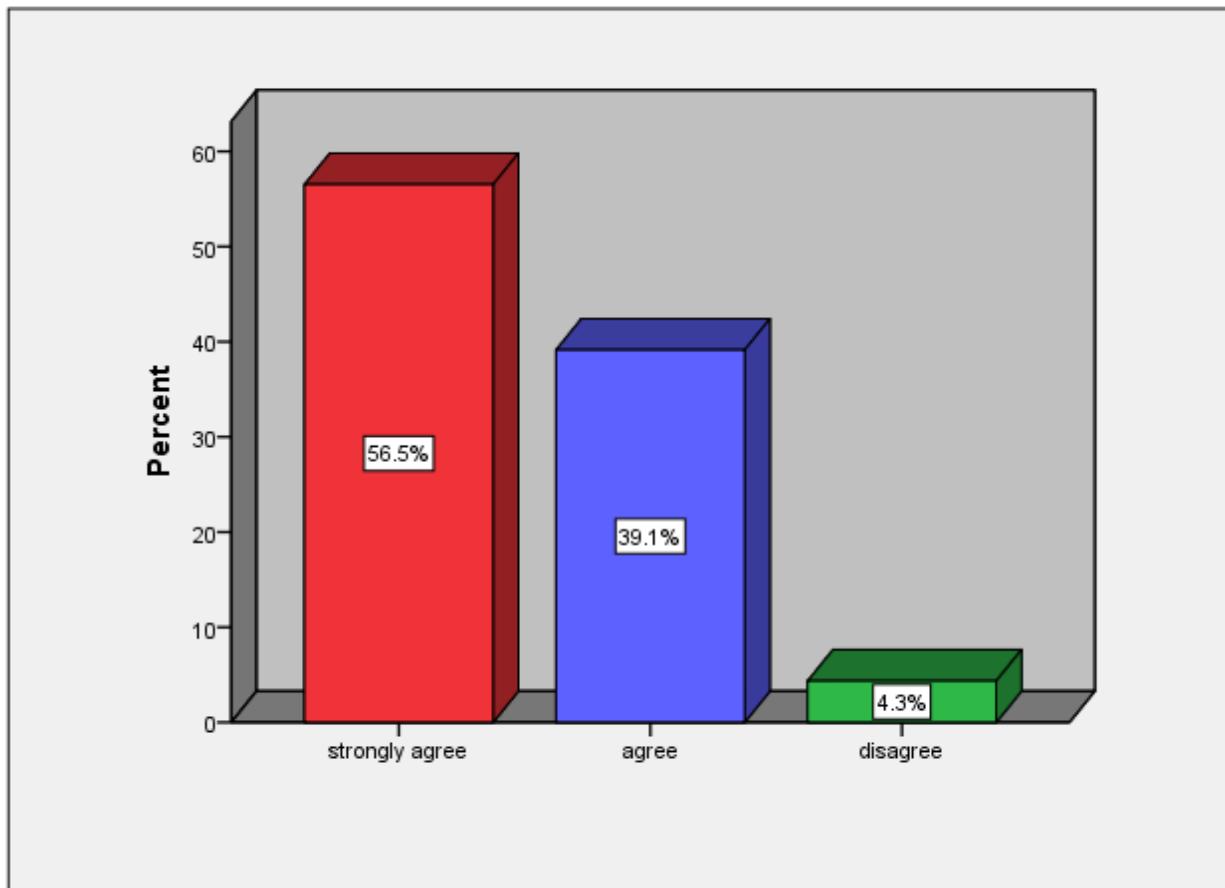
Figure 4.9: Do you think the use of Computer Adaptive Testing in assessment can offer a better testing experience than current Paper and Pencil Test?

4.3.10 Do you think your students can enjoy taking a Computer Adaptive Test examination?

When asked on whether students could enjoy taking a computer adaptive test examination, 30% of the teachers felt hat the students were very likely to enjoy computer adaptive testing while 70% said that the students were likely to enjoy it. Surprisingly, no respondent felt that the students could face nightmares in taking such an examination and this underlines the need to transform the mode of test delivery from the current paper and pencil to computer adaptive testing.

Figure 4.10: Do you think your students can enjoy taking a Computer Adaptive Test examination?

4.4 Computer Adaptive Testing and Technological Infrastructure

Objective two of the study sought to determine the extent to which adoption of Computer Adaptive Testing is affected by the existing technological infrastructure. The respondents were required to respond to several statements stating the exten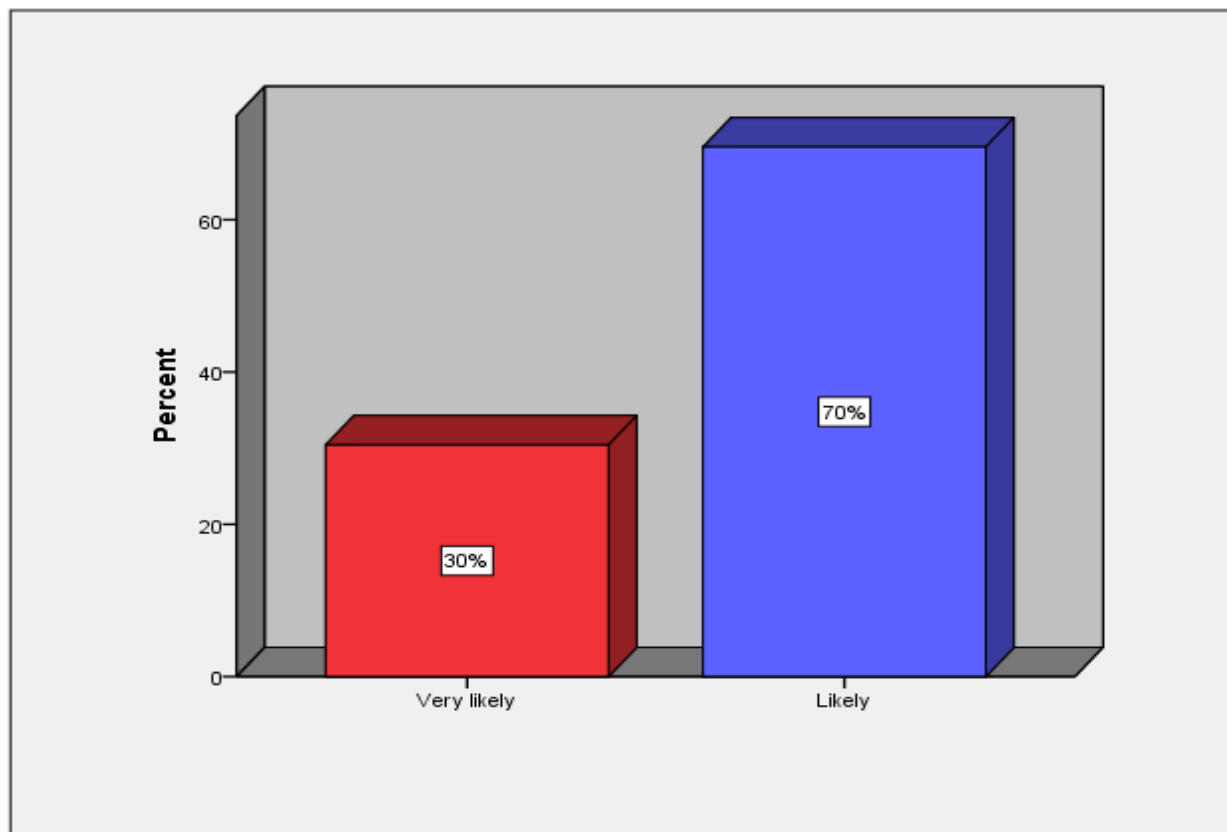t to which they agreed or disagreed with the given statements in relation to adoption of ICT to support learning in educational institutions. The findings are discussed below.

4.4.1 Lack of reliable educational support software has contributed to slow rate of ICT integration in this school

When asked about the impact of reliable educational support software on ICT integration, 83% of the respondents agreed that lack of reliable educational support software in school contributed to the slow rate of ICT integration in schools. 4% could not tell the impact of educational support software on ICT integration while 13% disagreed that lack of reliable educational support software contributed to the slow rate of ICT integration in schools.
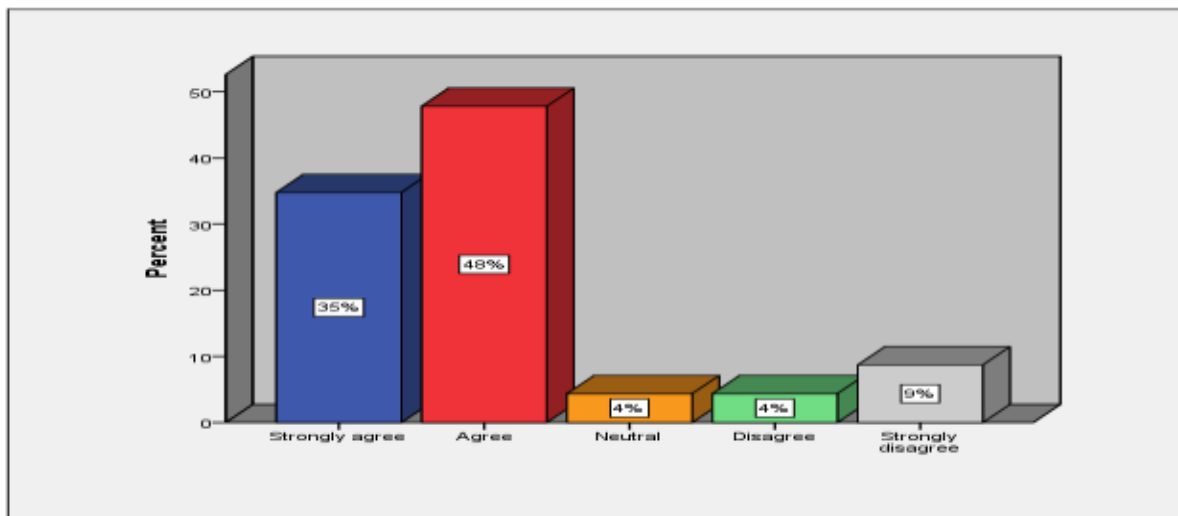
Figure 4.11: Lack of reliable educational support software has contributed to slow rate of ICT integration in this school

4.4.2 The poor state of ICT interconnectivity affects its adoption rate in schools

When asked about the impact of ICT interconnectivity on adoption of ICT in schools, 48% of the respondents strongly agreed that the poor state of ICT interconnectivity affects its adoption in schools while 39% agreed, 9% were neutral and 4% disagreed. This shows that most of the schools are ill equipped with the necessary ICT infrastructure and therefore the need for school managements together with the government to collaborate to ensure the necessary infrastructure is put in place to allow smooth adoption of technology in learning-teaching process.
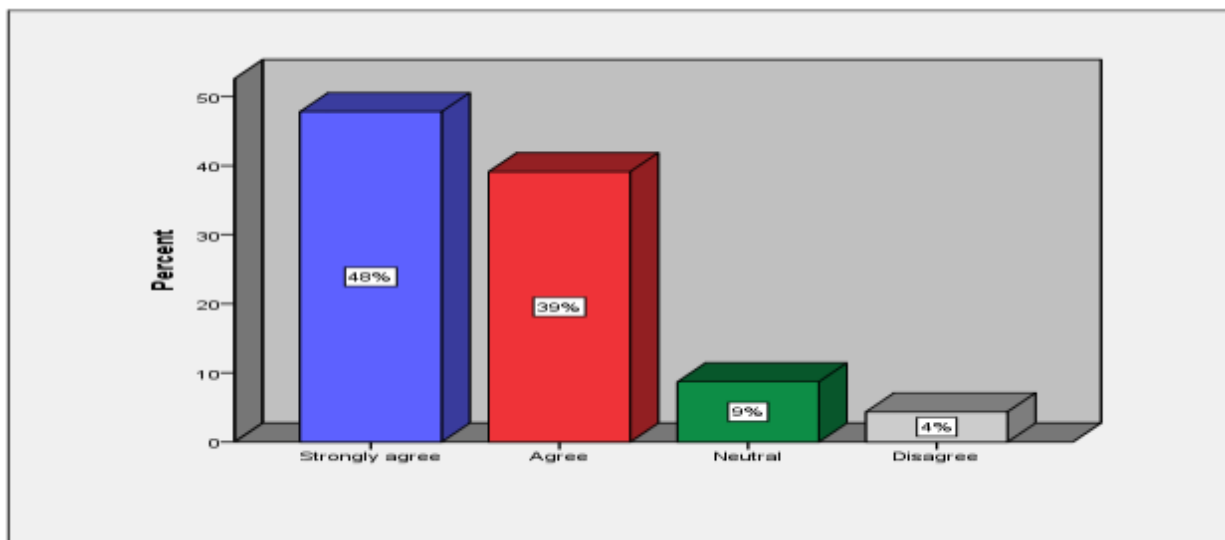
Figure 4.12: The poor state of ICT interconnectivity affects its adoption rate in schools

4.4.3 Low connectivity speed has contributed to slow rate of ICT adoption in this school

On the impact of connectivity speed on ICT adoption, 39% of the respondents strongly agreed that low connectivity speed contributed to slow rate of adoption in schools, 48% agreed, 4% were neutral, 4% disagreed and 4% strongly disagreed. This show how important the connectivity speed affects the rate of ICT adoption in schools hence the need for school managements to adopt internet connectivity in schools by establishing standard Local Area Networks (LAN) to improve on the access to online resources including assessments.
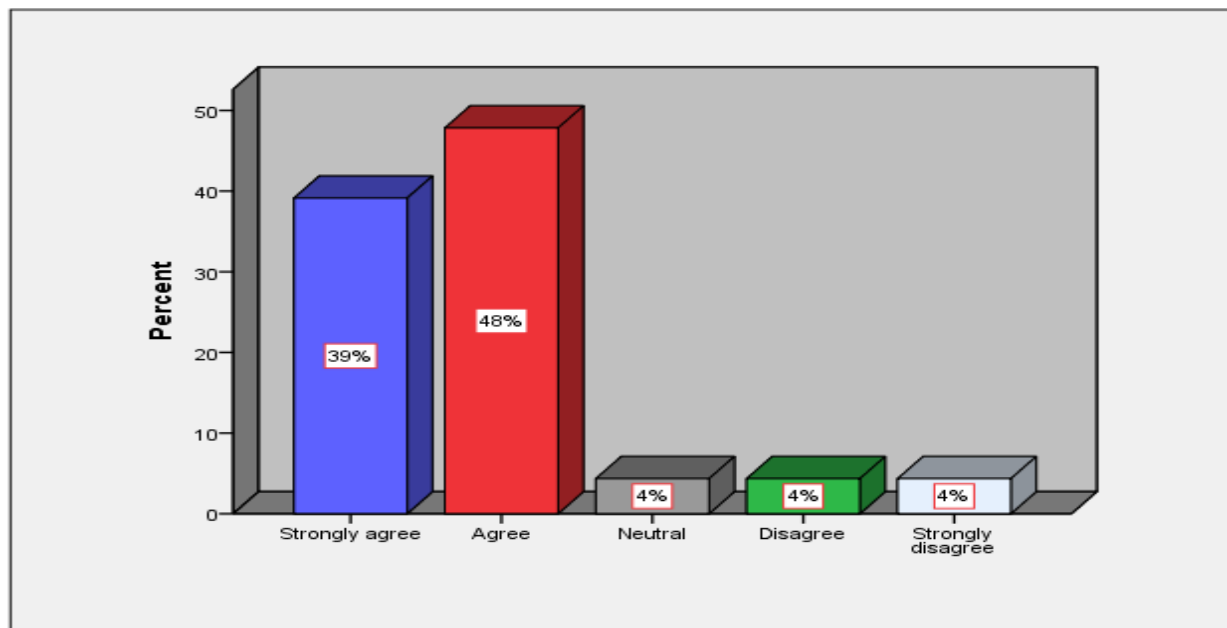
Figure 4.13: Low connectivity speed has contributed to slow rate of ICT adoption in this school

4.4.4 Low internet access has contributed to slow rate of ICT adoption in this school

On the impact of internet access on ICT adoption, 74% of the respondents agreed that low internet access has contributed to the slow rate of ICT adoption in schools, 13% were neutral, 9% disagreed and 4% strongly disagreed. This means that schools should invest on internet services in order to increase the pace of ICT adoption in these schools.
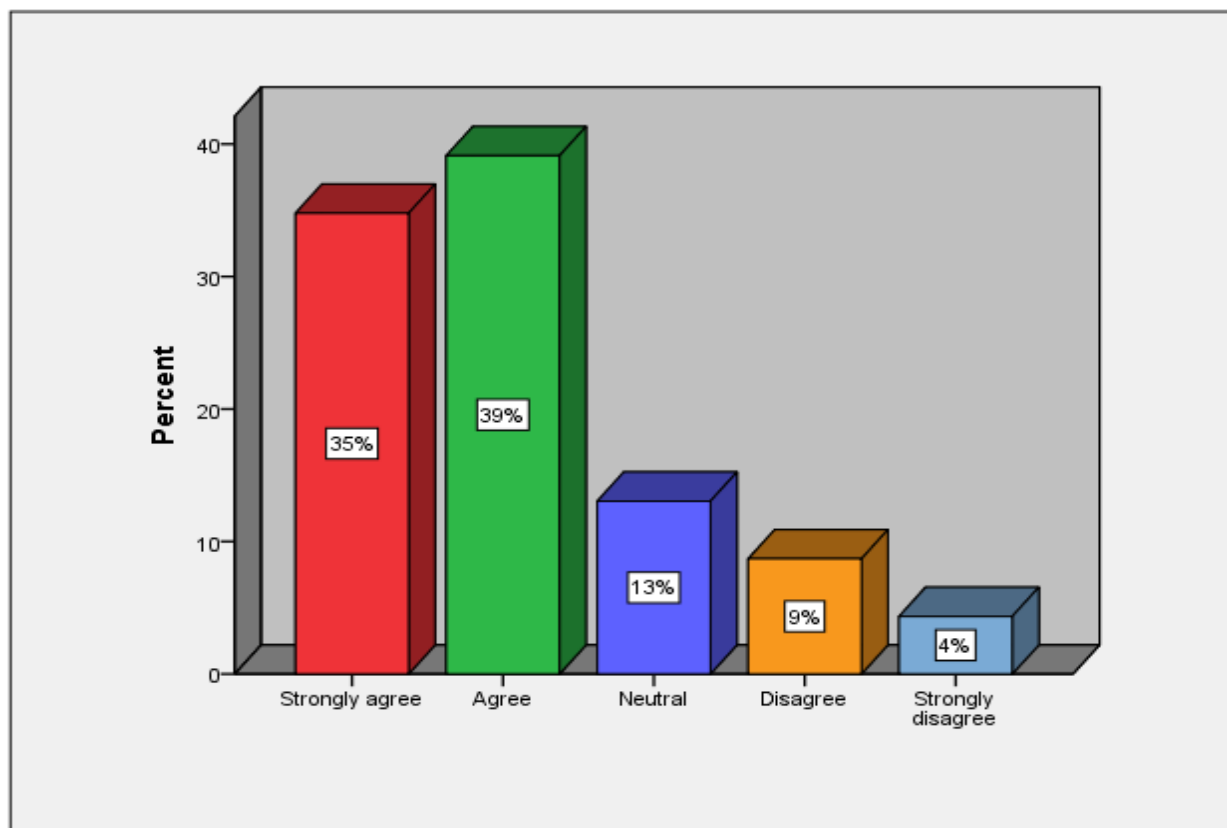
Figure 4.14: Low internet access has contributed to slow rate of ICT adoption in this school

4.4.5 How reliable is electrical power for educational support in this school

On the reliability of electrical power, 52% said it was very reliable, 39% said it was reliable and 9% said it was unreliable. Majority of the schools had reliable electrical power supply and this could be due to the government's initiative to connect all the schools to the national power grid.
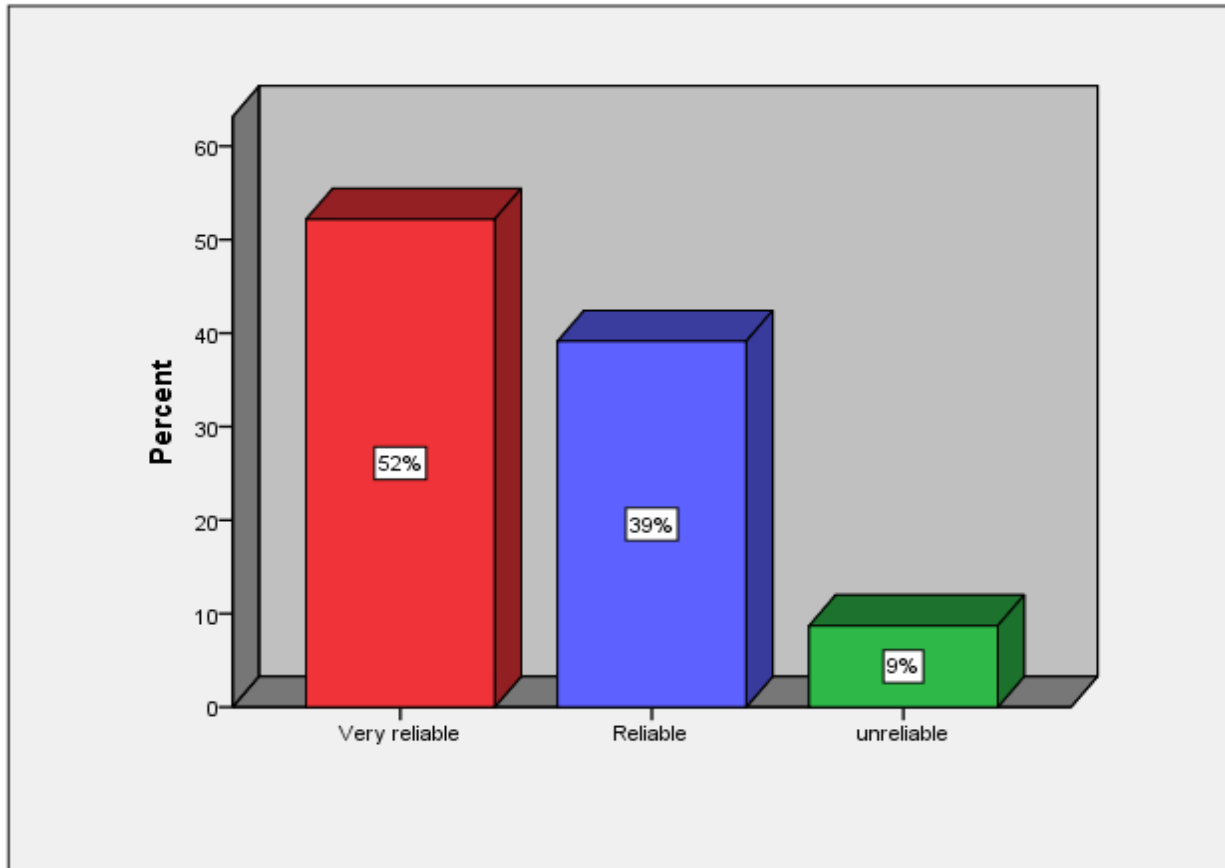
Figure 4.15: How reliable is electrical power for educational support in this school

4.4.6 How do you rate the speed of internet connectivity in meeting the teaching learning needs for educational purposes in this school?

On the rate of the internet speed in majority of the schools, it was low (48%) with only 26% reported to have a high internet speed and 9% very low speed. 17.4% of the sampled schools had no internet connectively altogether. This shows that the government should step up effort to ensure primary and secondary schools have affordable internet access through the use of strong and effective servers that are able to transfer data at high speed to promote online sharing of resources such as online examinations.
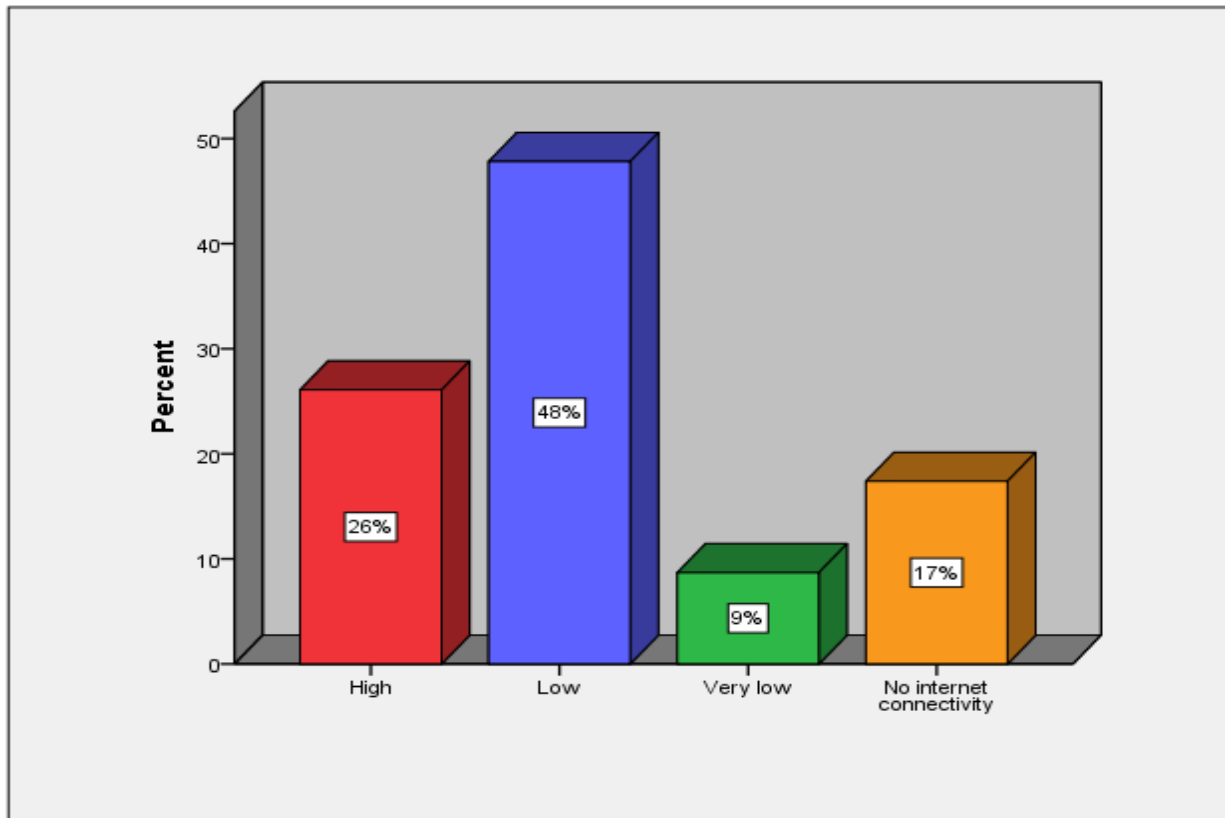
Figure 4.16: How do you rate the speed of internet connectivity in meeting the teaching learning needs for educational purposes in this school?

4.4.7 Criteria used for placing ICT Infrastructure for Educational Activities

On the criteria used for placing ICT infrastructure for educational activities in the schools 41.3% of the respondents said school management support was the leading factor, ICT literate teachers 30.4%, electricity supply 15.2%, adequate 8.7%, government support in financing 2.2% and positives attitudes by teachers 2.2%. This means that all schools had equal chances of putting in place the necessary infrastructure since this depended majorly on the school management support.
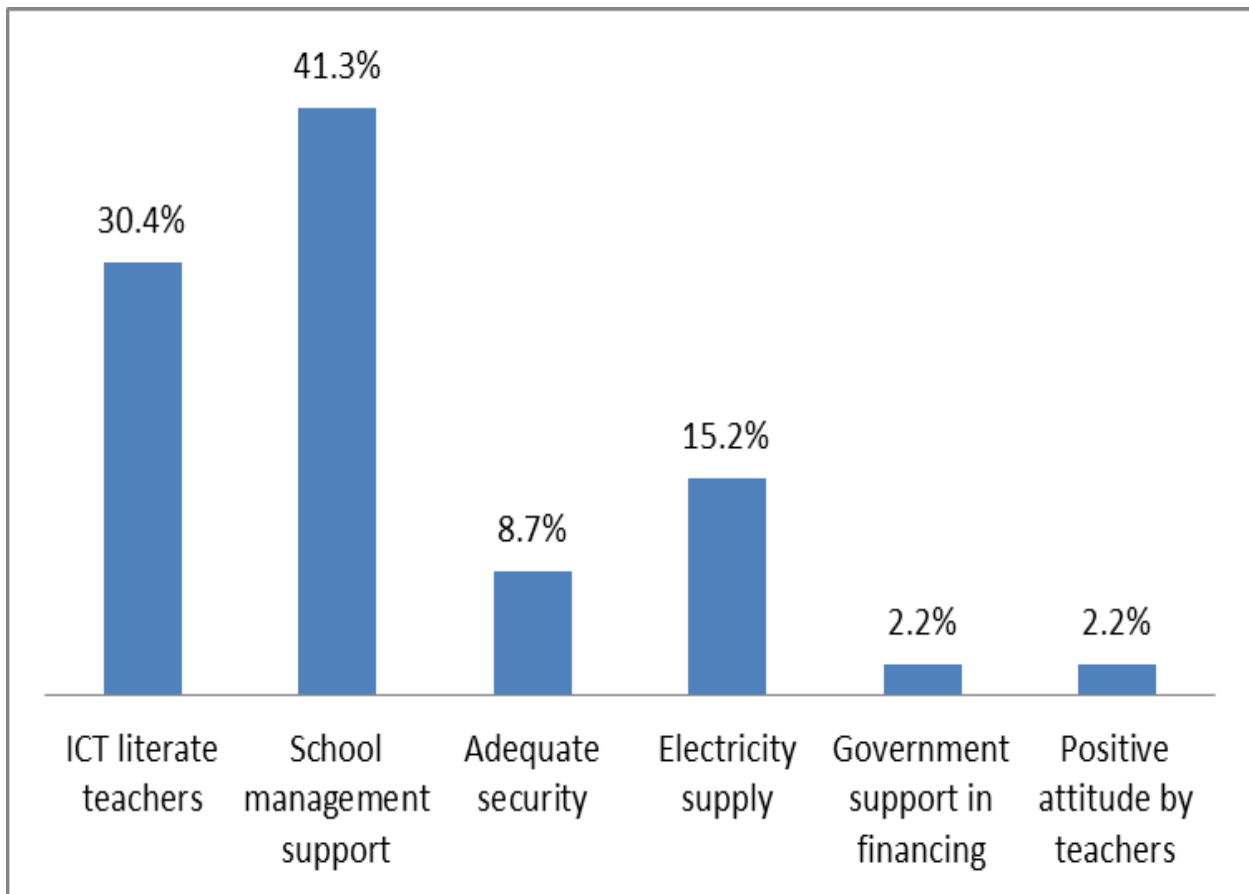
Figure 4.17: Criteria used for placing ICT Infrastructure for Educational Activities

4.5 Computer Adaptive Testing and Computer Literacy

The third objective of the study sought to determine the extent to which adoption of Computer Adaptive Testing is affected by computer literacy. To determine the levels of computer competency, the study used seven variables and the findings on the views of the respondents are discussed below.

4.5.1 How would you rate your own computer literacy?

On computer literacy, 51.4% of the students said that they had good computer literacy skills, 38.2% had very good computer literacy skills and 10% had adequate computer literacy skills while 0.5% had poor computer literacy. This can be attributed to the fact that students have greater access to computers in and outside the school and this gives them confidence when using computer.
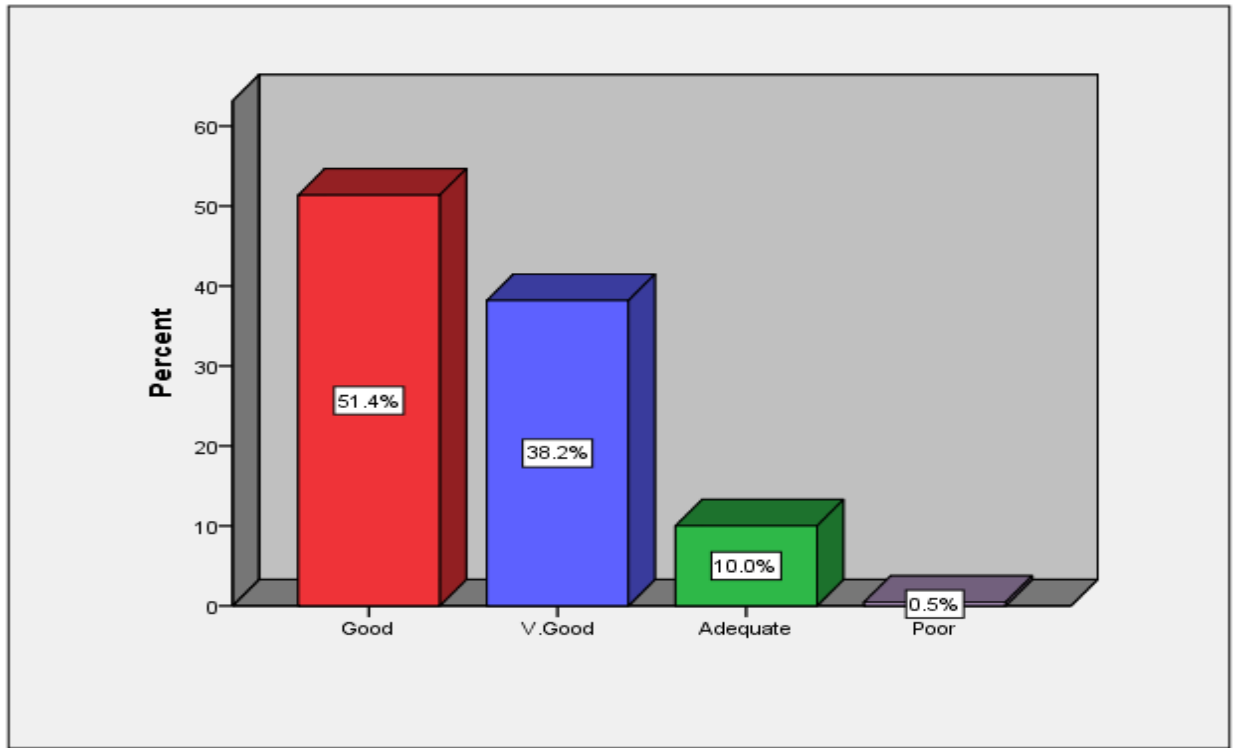
Figure 4.18: How would you rate your own computer literacy?

4.6 How would you rate your own Internet literacy?

When asked to rate their own internet literacy, 52% of the respondents said they were good, 34% were very good, 13% had adequate internet literacy and 1% was poor at the internet. This is probably due the greater penetration of internet even up to the remotest of the areas. There is need though to bridge the gap between those who are very good and good at computer literacy and those who are poor or are have moderate levels of computer literacy.
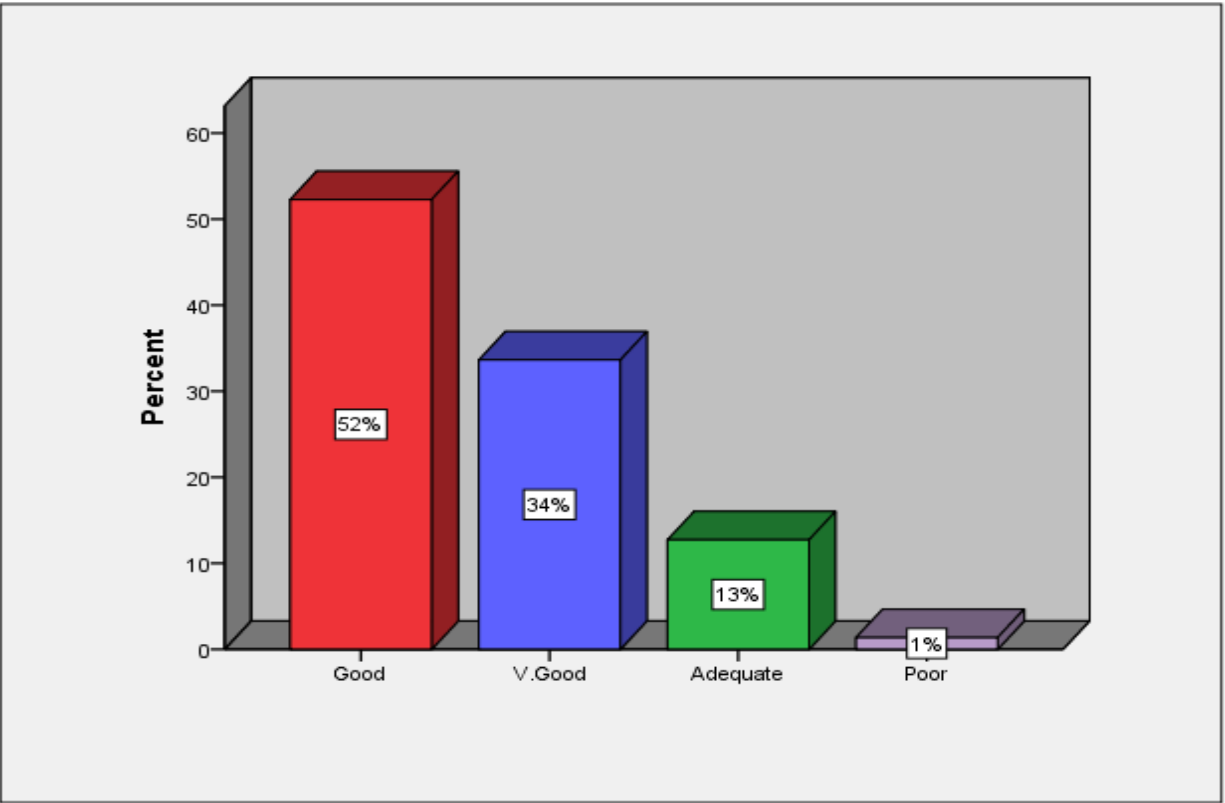
Figure 4.19: How would you rate your own Internet literacy?

4.6.1 How would you rate your current typing skills?

On their typing skills, 54% of the respondents said that they were good at typing, 30% were very good, 15% said had adequate typing skills while 1% was poor at typing. The reason for the overwhelming majority being very good at typing could be due to greater accessibility of computers in schools or at home.
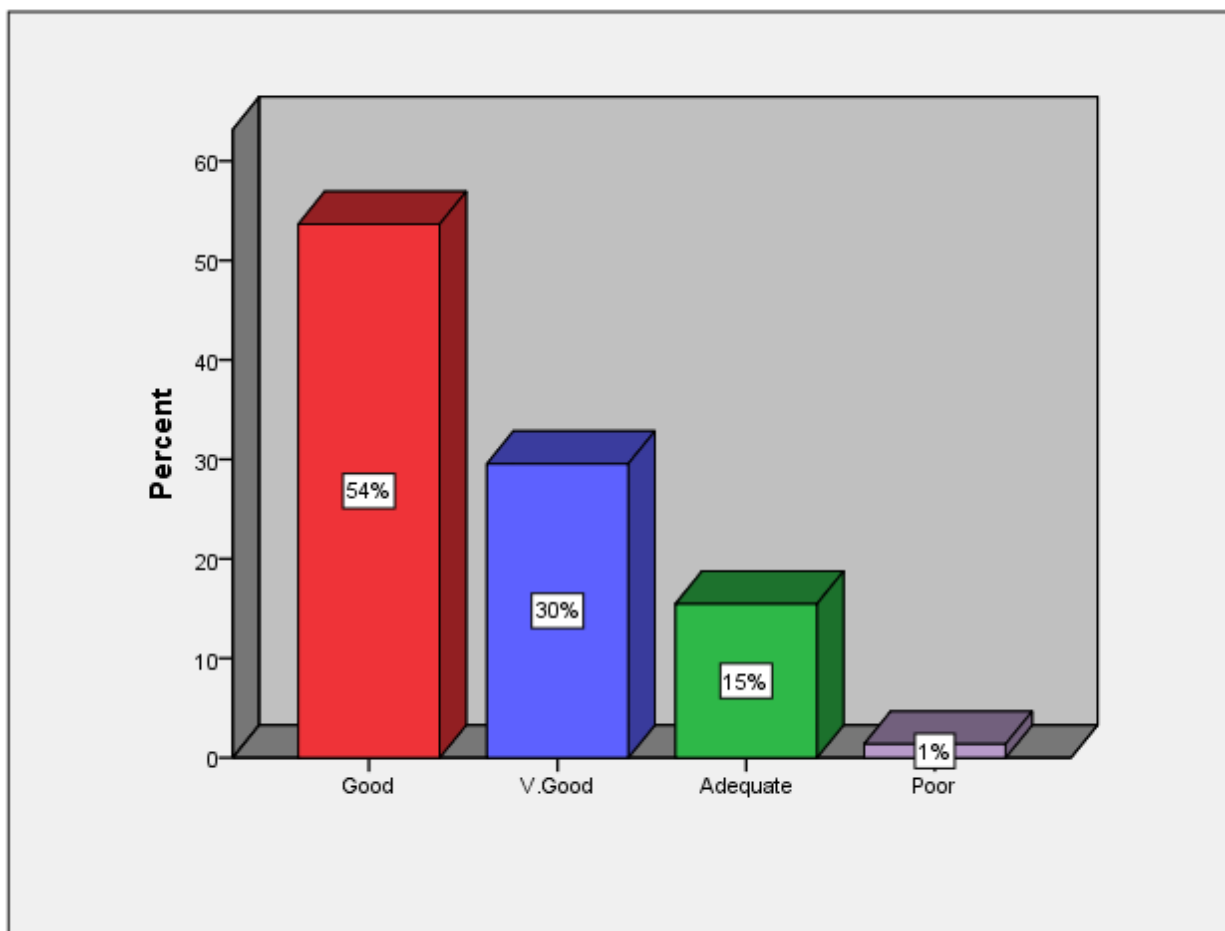
Figure 4.20: How would you rate your current typing skills?

4.6.2 How do you rate the ability of your students to use a computer?

When asked to rate their students' ability to use a computer, 33.3% of the teachers felt that the students had very high ability, 23.8% felt that students ability was high while 42.9% felt that the students had moderate ability.
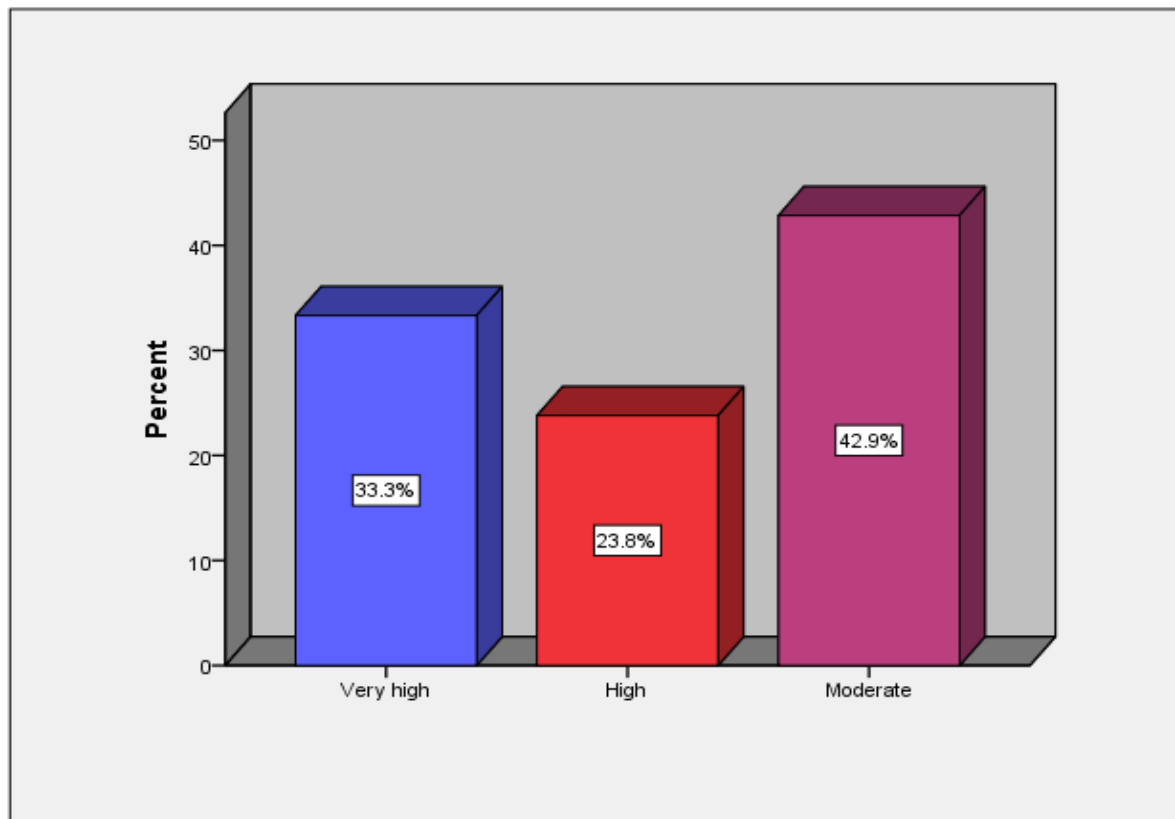
Figure 4.21: How do you rate the ability of your students to use a computer?

4.6.3 How Easy or Complex is use of Computer Applications among your students

On how easy or complex is the use of computer applications among students 19% of the respondents said that the students found it very easy to use the computer applications, 66.7% said that the students found the computer applications easy while 14.3% said that the computer applications were of moderate difficult for use by the students. This could be attributed to the fact that students are always fascinated by technology hence the reason why majority of the teachers felt that the students would find the computer applications easy to use.
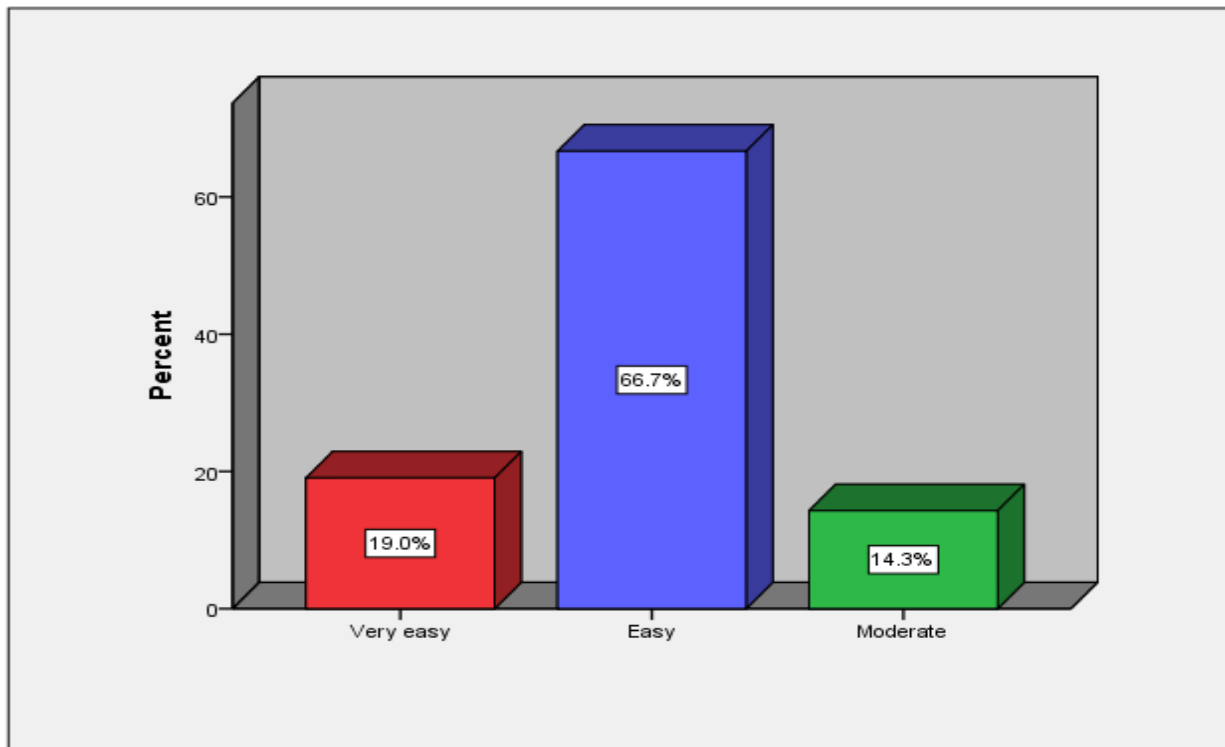
Figure 4.22: How Easy or Complex is use of Computer Applications among your students

4.6.4 How would you rate the adequacy of computer literacy for your students in

supporting their learning activities?

When asked about the adequacy of computer literacy 28.6% of the respondents said that the students had very adequate computer literacy, 66.7% said that the students computer literacy was adequate while 4.8% said that the students computer literacy was inadequate and therefore they could not use computers to support their learning activities.
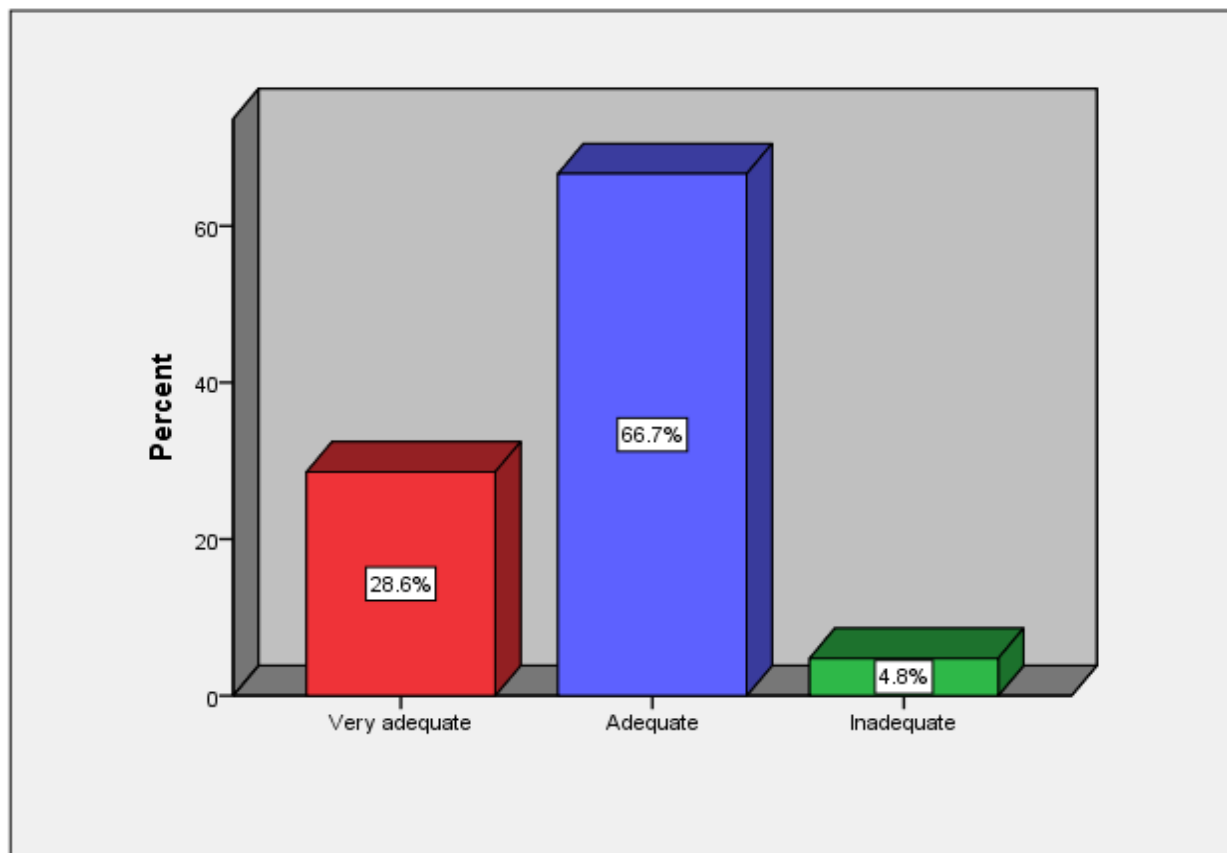
Figure 4.23: How would you rate the adequacy of computer literacy for your students in supporting their learning activities?

4.7 Pace of CAT Adoption

Measuring adoption in this study was quite challenging and therefore adoption was not measured directly, rather the study used the readiness of schools to use computers in assessment. The study used seven variables to determine the extent to which schools were ready to adopt CAT in educational assessment. The variables used were; The number operational computer machines, Power reliability, Speed of the internet, ICT infrastructure, Students' ability to use computers, Ease of use of computers and Computer literacy.

Each of these variables had five options which were rated 1-5 in the data collection instrument and the respondents were required to state how strongly they agreed or disagreed with the given statements in the questionnaire. The most desirable response (Strongly Agree) was assigned a value of 5 while the least desirable response (Strongly Disagree) was assigned a value of 1. For each of these variables, a coefficient score was computed by dividing the total observed score by the total expected score. The individual coefficient scores for each of the variables were then summed up and their mean determined to establish the adoption coefficient score.

Table 4.2: Pace of CAT Adoption

Measure of Adoption	Co-efficient Score
Number of Operational Computer Machines	0.5
Power Reliability	0.905
Speed of the Internet	0.558
ICT Infrastructure	0.574
Students ability to use computers	0.765
Ease of Use of Computers	0.8
Computer Literacy	0.824
Mean Adoption Score	0.704

Students attitude score was computed by summing up the individual scores for the variables; students computer use confidence, belief that CAT can be fair to all the students, belief that a student can take a test using a computer with confidence, belief that a student would like to take a test that gives immediate results and belief that taking an examination using a computer would be very interesting. A total coefficient score for each variable was computed by dividing the total observed score by the total expected score.

The teachers attitude score was computed by summing up the individual scores for the variables; ability to use computers, belief that students are capable of doing an adaptive test well via the computer, belief that CAT can offer better testing experience, belief that students can enjoy taking CAT, lack of reliable educational support software, poor state of ICT connectivity, low connectivity speed, low internet speed and absence of appropriate electronic educational content.

Teachers' attitude co-efficient score was established by dividing the total observed score by the total expected score. The students and teachers attitude co-efficient were used to determine the mean attitude score.

Infrastructure score was computed using the individual scores for the criteria used to place the infrastructure in the schools i.e. school management support, ICT literate teachers, electricity supply, adequate security, government support in financing and positive attitude by teachers. To obtain the infrastructure coefficient, the total observed score was divided by the total expected score.

Table 4.3: Relationship between Adoption of Computer Adaptive Testing and Computer Literacy, ICT Infrastructure and Perception

Correlations

		Pace of Adoption	Students' & Teachers' level of Computer Literacy	ICT Infrastructure	Teachers' and Students Perception'
Pearson Correlation	Pace of Adoption	1.000	.049	.366	.085
	Students' & Teachers' level of Computer Literacy	.049	1.000	.026	.451
	ICT Infrastructure	.366	.026	1.000	-.289
	Teachers' and Students' Perceptions	.085	.451	-.289	1.000
Sig. (1-tailed)	Pace of Adoption	.	.266	.000	.137
	Students' & Teachers' level of Computer Literacy	.266	.	.369	.000
	ICT Infrastructure	.000	.369	.	.000
	Teachers' and Students' Perceptions	.137	.000	.000	.

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From the findings, it is shown that the relationship between students' and teachers' level of computer literacy and Adoption of CAT is negligible (0.049); ICT Infrastructure is positively related with the Adoption of CAT (0.366) while Teachers' and Students' Perceptions are positively related with adoption of CAT (0.085) although the relationship is weak. The statistical insignificance of computer literacy on the adoption of CAT explains why the independent variable was excluded from the step wise regression analysis. This indicates that ICT Infrastructure is the most important factor likely to affect the Adoption of Computer Adaptive Testing into the educational assessment in Kenya.

Table 4.4: Model Summary of Adoption of Computer Adaptive Testing

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
ICT Infrastructure	.366[a]	.134	.129	1.08942
Teachers and Students Perceptions	.417[b]	.174	.164	1.06742

The findings in the table 4.3 above indicate the extent of the variations on the Adoption of Computer Adaptive Testing which are explained by the independent variables. The combined R Square value of 0.308 means that ICT Infrastructure and Teachers' and Students' perceptions only explains 30.8% of the variations in the dependent variable and that the remaining 69.2% is explained by other factors. From this Model Summary Table 4.3 given above it shows that the larger the multiple Correlation Coefficient R, the stronger the relationship between the dependent and the independent variables would be and the smaller the multiple correlation coefficient the weaker the relationship. The squared multiple correlation coefficients for the Infrastructure and

Teachers' and Students' Perceptions indicated that 13.4% and 17.4% of the respondents felt that these variables affect Adoption of Computer Adaptive Testing in educational assessment respectively.

At a combined Adjusted R Square of 29.3% indicated that the relationship between these variables and Adoption of CAT was weak and therefore the variables do not strongly affect the Adoption of CAT in to the educational assessment but rather Adoption of CAT is likely to be influenced by other underlying factors such as the government policy in relation to the use of computers in assessment

Table 4.5: Analysis of Variance (ANOVA)

Model		Sum of Squares	Df	Mean Square	F	Sig.
ICT Infrastructure	Regression	30.484	1	30.484	25.685	.000[b]
	Residual	197.014	166	1.187		
	Total	227.497	167			
Teachers' and Students' Perceptions	Regression	39.497	2	19.749	17.333	.000[c]
	Residual	188.000	165	1.139		
	Total	227.497	167			

Dependent Variable: Adoption of CAT

Predictors: (Constant), ICT infrastructure, teachers and students perceptions.

The findings indicate a significance value of 0.00 which is less than 0.05 for the two independent variables thus showing that there is significant relationship between adoption of CAT and ICT Infrastructure and Teachers' and Students' Perceptions.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The position taken by the Adoption of Computer Adaptive Testing in educational assessment is critical for enhancing 21st C assessment and has the potential to demolish the challenges caused by time and distance. However, despite the recognition of this role, the pace of its adoption in educational assessment has been very slow. This study therefore sought to establish whether CAT could successfully be adopted in educational assessment by focusing on factors likely to affect its adoption.

The study was carried out only in Public Secondary Schools offering Computer Studies as an examinable subject at form four in Makueni County. Questionnaires were administered to 23 Public Secondary Schools to collect primary data from form three Computer Studies students and teachers. Data collected was analyzed using Statistical Package for Social Sciences (SPSS) where Descriptive statistics such as frequency distributions, percentages, means and standard deviations as well as inferential statistics such as Pearson Correlation and ANOVA tests were utilized.

On the first objective of the study, findings show that Teachers' and Students' perceptions are positively related with Adoption of Computer Adaptive Testing (0.085) although the relationship is weak. The weak relationship though strongly indicates the slow pace of Adoption of Computer Adaptive Testing in educational assessment which may be as a result of gaps in the implementation process of policies where teachers' psychological preparedness when the

government is introducing new technologies is not considered. Such attitude where teachers always feels left out on matters directly affecting them can be changed through appropriate policy measures.

On the second objective of the study, Earl (1989) defines ICT infrastructure as the technological foundation of computer, communication, internet, data and a framework that guides users in efficiently satisfying organizational needs. A continuous flow of capable human capital with appropriate skills in dynamic IT systems is key for the growth of knowledge economy both in first and third world countries. In contrast, teachers and school managements have continued to remain adamant on traditional instructional methods due to inadequate ICT connectivity, low connectivity speed and limited internet speed coupled with absence of an enabling policy framework that is characterized by lack of relevant educational support software and electronic content. Although most of the schools are connected to electrical power, the ICT infrastructure remained poor and underutilized. Most of the schools had internet connection though the low connectivity speed has limited access of resources in the internet. The findings show that the availability of technological infrastructure in educational institutions depended majorly on the school management support and ICT literate teachers and this means that all the secondary schools, all factors held constant, have equal chances of putting in place basic ICT Infrastructure to support learning and teaching programmes.

The significant relationship between ICT infrastructure and CAT Adoption in educational assessment (0.366) implies that with better ICT Infrastructure, the pace of adoption of CAT would be higher and this would in turn enhance delivery of tests in real-time.

Thorough knowledge in computer technology and internet use in education is an important aspect for the 21st C that schools cannot afford to ignore but despite this knowledge of the potentials that computers bring into the learning-teaching process, schools are yet to adopt the affordances of technology in their educational activities. Findings from the study show that computers are mainly used in educational institutions for office related work, in preparation and processing of examinations, timetabling and data storage for teachers, students and other staff. Findings show that the relationship between Students' and Teachers' level of Computer Literacy and the Adoption of CAT is negligible (0.049). The statistical insignificance of computer literacy on the adoption of CAT explains why the independent variable was excluded from the step-wise regression analysis.

5.2 Conclusion

From the findings of the study, the researcher concludes that the pace of Adoption of CAT in educational assessment in Kenya is likely to be slow due to inadequate Infrastructure such as low internet speed connectivity, lack of reliable educational support software and low internet access all of which have been found to affect the pace at which CAT can be adopted in educational assessment. In terms of the major factors affecting the Adoption of CAT, the study found that Teachers' and Students' Perception and Technological Infrastructure had a significant relationship with the Adoption of CAT while Computer Literacy showed negligible relationship with Adoption of CAT. The statements below therefore respond to the research questions that guided this study.

1. Teachers and students perceptions affect the extent to which Computer Adaptive Testing is adopted in educational assessment in Kenya.

2. The existing technological infrastructure affects the extent to which Computer Adaptive Testing is adopted in educational assessment in Kenya.

3. The level of computer literacy of the teachers and students does not affect the extent to which Computer Adaptive Testing is adopted in educational assessment in Kenya.

5.3 Recommendations

5.3.1 Policy Recommendations

1. The study recommends that the government constantly keeps on retraining teachers especially those in the IT courses because the pace at which new technology is adopted into the education sector and mainly in the basic learning institutions is highly dependent on their perception on its ease of use.

2. The study recommends that the government develops an ICT funds kitty alongside the budgetary allocation to the Ministry of Education to cater for the placement of the ICT infrastructure in Kenyan schools. Since the study found that technological infrastructure is main factor likely to affect Adoption of CAT, this fund would go a long way in assisting schools to put up the necessary infrastructure and help in the maintenance of the equipment to enhance ICT teaching-learning and assessment in Kenyan schools.

To ensure that all the schools have basic ICT infrastructure, the study also proposes that the government and parents through the school managements to collaborate and partner to ensure that such infrastructure is put in place within set timelines.

3. The study recommends that the government through the Ministry of Education, Science and Technology to adopt internet connectivity in schools by establishing standard Local Area Networks (LAN) to improve on the access to online resources including assessments. All

primary and secondary schools should have affordable internet access through the use of strong and effective servers that are able to transfer data at high speed to promote online sharing of resources such as online examinations.

To promote computer literacy in schools, the study also proposes that school managements and the government should work hand in hand in organizing ICT workshops and seminars for teachers to ensure that they keep pace with the ever changing technological world.

5.3.2 Research Recommendations

4. The study recommends further research to Assess Whether the Factors affecting Adoption of Computer Adaptive Testing are Similar in all Institutions.

5. The study also recommends further research on Adoption of Technology to Assess Students with Special Needs.

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APPENDIX I: LETTER OF INTRODUCTION TO THE RESPONDENTS

Mutisya Titus Mutie,

University of Nairobi,

Department of psychology,

Nairobi.

To the respondent,

Re: Adoption of Computer Adaptive Testing in Educational Assessment.

I am a post graduate student at the University of Nairobi pursuing a Master's Degree in Education (Measurement and Evaluation) conducting research on the above topic.

The questionnaires are designed to assist me in determining whether Computer Adaptive Testing can be successfully implemented in educational assessment in Kenya.

The questionnaire is meant for research purposes only and the responses given will be treated with utmost confidentiality. Any cooperation given will be highly appreciated. I look forward to your honest responses and participation.

Thank you.

Yours faithfully,

Titus Mutisya

Contacts: 0729159778

Email: mutisyatitus14@gmail.com

APPENDIX II: STUDENTS' QUESTIONNAIRE

This questionnaire is anonymous. Please don't write your name or any identification on it.

The questionnaire is designed to determine how teachers' and students' perception and the extent to which technological infrastructure and computer literacy affect adoption of Computer Adaptive Testing in educational assessment. It is meant to provide the researcher with different opinions and comments directed to the research study.

A **COMPUTER ADAPTIVE TEST** is an examination administered on a computer where each student is given a set of questions that are appropriate to his/her ability. If a student answers a question correctly, the computer selects a more difficult question for the student and if a student answers a question wrongly, the computer selects an easier question for the student.

DIRECTION: please read all the following item wordings and answer by putting a tick (√) on the item which best describes how strongly you agree or disagree with each wording. Remember to tick (√) only one place for each item.

You are kindly requested to complete the questionnaire honestly.

SECTION A: Background Information

1. Name of the school: ……………………………

2. Type of the school: Boys' ☐   Girls' ☐   Mixed ☐

3. Category of the school: Public ☐   Private ☐

4. Gender of the student: Male ☐   Female ☐

5. How many are you in the Computer Studies class? ☐

6. Does the school have internet connectivity? Yes ☐   No ☐

   If yes, how often does the school provide internet?

   i)   Every day ☐   iii)   Once per week ☐

   ii) More than once per week ☐   iv)   Not regular ☐

7. How often do you attend computer lessons in the school?

   i) Every day ☐   iii)   Once per week ☐

   ii) More than once per week ☐   iv) Not regular ☐

8. Do you have access to computers outside the school? Yes ☐ No ☐

SECTION B: Perception towards Computer Adaptive Testing

1. I can use a computer confidently.

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) Disagree ☐

2. I believe I can do a computer adaptive test well.

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) Disagree ☐

3. Computer adaptive tests can be fair to all students.

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) Disagree ☐

4. I can take a test using a computer with confidence.

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) Disagree ☐

5. I would like to take a test that gives immediate results

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) Disagree ☐

6. Taking an examination using a computer can be very interesting.

   i) Strongly Agree ☐ iii) Neutral ☐ v) Strongly Disagree ☐

   ii) Agree ☐ iv) disagree ☐

SECTION C: COMPUTER LITERACY

1. How would you rate your own computer literacy?

    i)   V. Good ☐   iii) Adequate ☐ v) V. Poor

    ii)   Good ☐   iv) Poor ☐

2. How would you rate your own Internet literacy?

    i)   V. Good ☐   iii) Adequate ☐ v) V. Poor

    ii)   Good ☐   iv) Poor ☐

3. How would you rate your current typing skills?

    i)   V. Good ☐ iii) Adequate ☐ v) V. Poor

    ii)   Good ☐ iv) Poor ☐

Thank you for your participation.

APPENDIX III: TEACHERS' QUESTIONNAIRE

The following is an anonymous questionnaire to be given to teachers.

The questionnaire is designed to determine how teachers' perception and the extent to which technological infrastructure and computer literacy affect adoption of Computer Adaptive Testing in educational assessment. It is meant to provide the researcher with different opinions and comments directed to the research study.

A **COMPUTER ADAPTIVE TEST** is an examination administered on a computer where each student is given a set of questions that are appropriate to his/her ability. If a student answers a question correctly, the computer selects a more difficult question for the student and if a student answers a question wrongly, the computer selects an easier question for the student.

SECTION A: Background Information

1. Name of the school: ………………………….

2. Type of school: Boys ☐   Girls ☐   Mixed ☐

3. Category of the school: Public ☐   Private ☐

4. Gender of teacher: Male ☐ Female ☐

5. How many computer students do you have in the class? ☐

6. How many operational computer machines are available for use by the students in the school? ☐

7. How did the school acquire the computers?

    i)   Bought by the government through CDF   ☐

    ii) School fees paid by the parents   ☐

    iii) Donation by NGOs   ☐

    iv) Others please specify……………………………………..

8. Does the school have internet connectivity? Yes ☐   No ☐

9. Do the teachers have direct access to the school computers? Yes ☐ No ☐

SECTION B: Teachers' Perception towards Computer Adaptive Testing.

1. How do you rate your ability to use computers?

    i) Very High ☐   iii) High ☐   v) Moderate ☐

    ii) Low ☐   iv) very low ☐

2. Do you think your students are capable of doing an examination via the computer?

    i) Very able ☐   iii) Able ☐   v) Not sure ☐

    ii) Somehow able ☐   iv) Unable ☐

3. Do you think the use of Computer Adaptive Testing in assessment can offer a better testing experience than current Paper and Pencil Testing?

    i) Strongly agree ☐   iii) Agree ☐   v) Neither agree nor disagree ☐

    ii) Disagree ☐   iv) Strongly disagree ☐

4. Do you think your students can enjoy taking a Computer Adaptive Test examination?

    i) Very likely ☐   iii) likely ☐   v) Not sure ☐

    ii) Not likely ☐   iv)Very unlikely ☐

SECTION C: TECHNOLOGICAL INFRASTRUCTURE

1. Indicate to what extent you agree or disagree with the following statements in relation to adoption of ICT for educational assessment in schools.

    (1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree, 5=Strongly Disagree)

	Statement	1	2	3	4	5
a)	Lack of reliable educational support software has contributed to slow rate of ICT integration in this school.					
b)	The poor state of ICT interconnectivity affect its adoption rate					
c)	Low connectivity speed has contributed to slow rate of ICT adoption in this school.					
d)	Low internet access has contributed to slow rate of ICT adoption					
e)	Absence of appropriate electronic educational content has contributed to slow rate of ICT in this school					

2. How reliable is electrical power for educational support in this school?

    i) Very reliable ☐   ii) Reliable ☐ iii) Unreliable ☐

    iv) Very Unreliable ☐   v) No electrical power at all. ☐

3. How do you rate the speed of internet connectivity in meeting the teaching-learning needs for educational purposes in this school?

    i) Very High Speed ☐   ii) High Speed ☐ iii) Low Speed ☐

    iv) Very Low Speed ☐   v) No Internet Connectivity ☐

4. Which is the criterion for placing ICT infrastructure for educational activities in school? (Kindly tick all applicable.)

    i)   ICT literate teachers ☐

    ii) School management support ☐

    iii) Adequate security ☐

    iv) Electricity supply ☐

    v)   Others (specify)**...**

SECTION D: COMPUTER LITERACY

1. How do you rate the ability of your students to use a computer?

    i) Very High ☐   ii) High ☐   iii) Moderate ☐

    iv) Low ☐   v) Very Low ☐

2. How easy/complex is use of computer applications among your students?

    i)   Very Easy ☐   ii) Easy ☐   iii) Complex ☐

    iv) Very Complex ☐   v) Not Applicable ☐

3. How would you rate the adequacy of computer literacy for your students in supporting their learning activities?

    i) Very Adequate ☐   ii) Adequate ☐   iii) Not Sure ☐

    iv) Inadequate ☐   v) Very Inadequate ☐

4. Are the following educational activities computer aided in this school?

    a) Time Tabling   Yes ☐ No ☐

    b) Examination result analysis   Yes ☐ No ☐

    c) Teachers and students information storage Yes ☐ No ☐

    d) Production of examinations and office letters Yes ☐ No ☐

Thank you for your participation.

APPENDIX IV: INTRODUCTION LETTER FROM THE UNIVERSITY

UNIVERSITY OF NAIROBI
FACULTY OF ARTS
PSYCHOLOGY DEPARTMENT

Telegrams: VarsityNairobi
Telephone: 318262
Fax: 3245566
Telex: 22095 varsity Ke Nairobi

NACOSTI
P.O Box 30623-00100
NAIROBI

Dear Sir/ Madam,   20th August 2019

RE: REQUEST FOR PERMISSION TO CARRY OUT RESEARCH

The student whose name is given below is duly registered in the Masters of Education(M.Ed)_ Measurement and Evaluation programme at the University of Nairobi(UON), in the Department of Psychology. The student intends to carry out field work after defending her Thesis. They are seeking a research permit to complete her Thesis research.

Please accord them all the assistance they need.

MUTISYA TITUS MUTIE
E58/787111/2015
TOPIC: Adoption of Computer Adaptive Testing in Education Assessment in Kenya

Yours Sincerely,

Dr. Karen T. Odhiambo
Coordinator _ MEd Measurement and Evaluation Program
Department of Psychology

Cc_ Dean, School of Education

APPENDIX V:PERMISSION TO COLLECT DATA

REPUBLIC OF KENYA

MINISTRY OF EDUCATION

STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telephone: ....
Fax: ....
Email:cdemakueni@gmail.com
When replying please quote

COUNTY DIRECTOR OF EDUCATION
MAKUENI COUNTY
P.O. BOX 41 - 90300
MAKUENI

7th October ,2019

Ref No. MKN/C/ED/S/33/VOL.2/10

Mutisya Titus Mutie
University of Nairobi
P.O BOX 30197
NAIROBI.

RE: RESEARCH AUTHORIZATION FOR MUTISYA TITUS MUTIE

This office is in receipt of a letter from the Director General, National Commission for Science, Technology and Innovation (NACOSTI) authorizing you to carry out research on **"Adoption of Computer Adaptive Testing in Educational Assessment"** for the period ending 04th October, 2020.

Following this authorization, you are allowed to proceed with your research as requested.

Gladys Malonza
For County Director of Education
MAKUENI COUNTY
CC:
Director General/ CEO, NACOSTI

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THE PRESIDENCY

MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegram:
Telephone:
Fax:
Email: _makuenicc@yahoo.com_

COUNTY COMMISSIONER
MAKUENI COUNTY
P.O. Box 1-90300
MAKUENI

Ref: MKN/CC/ADM.6/1 VOL.III/249

Date: 7th October, 2019

Mr. Titus Mutisya
University of Nairobi
P.O Box 30623-00100
NAIROBI

RE: RESEARCH AUTHORIZATION

Reference is made to Director General National Commission for science Technology and Innovation letter Ref. NACOSTI/P/19/1894 dated 4th October, 2019 on the above subject matter.

You are hereby authorized to undertake research on "*Adoption of Computer Adaptive testing in Educational Assessment in Kenya*" for a period ending 4th October, 2020.

By a copy of this letter the Deputy County Commissioners are requested to give you the necessary assistance.

B.K. NICHOLAS
FOR: COUNTY COMMISSIONER
MAKUENI

Cc
County Director of Education
MAKUENI COUNTY

Deputy County Commissioners
MAKUENI COUNTY

APPENDIX VI: RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 477469

Date of Issue: 04/October/2019

RESEARCH LICENSE

This is to Certify that Mr., titus mutisya of University of Nairobi, has been licensed to conduct research in Makueni on the topic: ADOPTION OF COMPUTER ADAPTIVE TESTING IN EDUCATIONAL ASSESSMENT IN KENYA for the period ending : 04/October/2020.

License No: NACOSTI/P/19/1894

477469

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION

Verification QR Code

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