USE OF MODERN ASSISTIVE TECHNOLOGY AND ITS EFFECTS ON EDUCATIONAL ACHIEVEMENT OF STUDENTS WITH VISUAL IMPAIRMENT AT KIBOS SPECIAL SECONDARY SCHOOL KISUMU COUNTY, KENYA

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A RESEARCH THESIS SUBMITTED TO THE SCHOOL OF EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF EDUCATION (SPECIAL NEEDS EDUCATION) AT KENYATTA UNIVERSITY

OCTOBER, 2016
DECLARATION

This thesis is my original work and has not been presented for a degree in any other university. The thesis has been complemented by referenced sources duly acknowledged. Where text data, graphics, pictures or tables have been borrowed from other works including the Internet, the sources are specifically accredited through referencing in accordance with anti-plagiarism regulations.

Signature _________________________ Date: ___________________

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To my parents Raphael and Salome, my wife Vane, our children Davy, Teresa, Sospeter, Margaret and brother Dominic. They have been supportive throughout the trying periods of doing this study, materially, spiritually and emotionally. I have been inspired by their noble intention. Let their worthy reward come from our maker.
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TABLE OF CONTENTS

DECLARATION .................................................................................................................. ii
DEDICATION .................................................................................................................. iii
ACKNOWLEDGEMENT ................................................................................................. iv
LIST OF TABLES .............................................................................................................. ix
LIST OF FIGURES ........................................................................................................... x
ABBREVIATIONS ........................................................................................................... xi
ABSTRACT ..................................................................................................................... xiii

CHAPTER ONE: INTRODUCTION .................................................................................. 1
  1.1 Background to the Study ......................................................................................... 1
  1.2 Statement of the Problem ....................................................................................... 8
  1.3 Purpose of the Study ............................................................................................... 9
  1.4 Objectives of the Study .......................................................................................... 9
  1.5 Research Questions ............................................................................................... 10
  1.6 Significance of the Study ...................................................................................... 10
  1.7 Assumptions of the Study ..................................................................................... 11
  1.8 Limitations of the Study ....................................................................................... 11
  1.9 Delimitation ........................................................................................................... 11
  1.10 Theoretical Framework ....................................................................................... 12
  1.11 Conceptual Framework ....................................................................................... 14
  1.12 Operational Definition of Terms ......................................................................... 16

CHAPTER TWO: LITERATURE REVIEW .................................................................... 18
  2.0 Introduction .......................................................................................................... 18
  2.1 Assistive Technology Used at Secondary Level of Education ......................... 18
  2.2 Assistive Technology Used by Students with Visual Impairment in Secondary
      Schools .................................................................................................................. 20
  2.3 Best Modern Technology for Students with Visual Impairment ...................... 22
  2.4 Coping with Modern Assistive Technology ....................................................... 24
  2.5 The Impact of Modern Assistive Technology on the Education Achievement for
      Students with Visual Impairment .......................................................................... 27
2.6 Challenges Faced By Teachers and Students with Visual Impairment Using Modern Assistive Technology

2.6.1 Teacher Preparedness

2.6.2 Location of Computers

2.6.3 Goals and Objectives Addressed by Classroom Teachers

2.6.4 Maintenance

2.6.5 Number of Computers

2.7 Summary

CHAPTER THREE: METHODOLOGY

3.0 Introduction

3.1 The Research Design

3.2 Locale of the Study

3.3 Variables of the Study

3.4 Target Population

3.5 Sampling Techniques

3.5.1 Purposive Sampling

3.6 Sample Size

3.7 Research Instruments

3.7.1 Questionnaires

3.7.2 Interview Schedule

3.7.3 Observation Checklist

3.8 Piloting

3.9 Validity and Reliability of Instruments

3.10 Data Collection Procedure

3.11 Data Analysis and Presentation

3.12 Logical and Ethical Consideration

CHAPTER FOUR: RESULT PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

4.1 Demographic Information of the Respondents

4.2.1 Learners Respondents

4.2.1.1 Learners Age Distribution

4.2.1.2 Learners Class and Age Distribution
4.2.1.3 Learners Visual Disability Distribution ..........................................................45
4.2.2 Teacher Respondents ..................................................................................46
4.2.2.1 Teachers Age Distribution ......................................................................47
4.2.2.2 Teachers Qualification Distribution ..........................................................47
4.2.2.3 Teachers Training Distribution ..................................................................48
4.3 Assistive Technology Engaged in the Teaching of Students with Visual
Impairment ........................................................................................................50
4.3.1 Use of assistive Technology ........................................................................51
4.3.2 Items Used in Writing and Reading .............................................................51
4.3.3 Modern Assistive Technology Media Available in Classroom ..................54
4.4 The Kind of Assistive Technology Used in Kibos Special Secondary School ....56
4.4.1 Modern Assistive Technology Available in Kibos Special Secondary School .. 57
4.4.2 Frequency and level of Assistive Technology Used in School ........................58
4.4.3 Activities Done By Learners When on Computer ........................................59
4.5 Criteria Used to Select the Best Assistive technology that Suit Student’s
Individual Needs ..................................................................................................60
4.6 Challenges Faced by Teachers and Students with Visual Impairment while Using
Modern Assistive Technology ..............................................................................63
4.6.1 Challenges Faced by Teachers .....................................................................63
4.6.2 Challenges Faced by Students .....................................................................65
4.7 Ways Teachers and Students with Visual Impairments Cope with the Various
Types of Assistive Technology .............................................................................67
4.8 Impact of Assistive Technology on the Educational Achievement of Students with
Visual Impairment ...............................................................................................68
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS .... 72
5.0 Introduction ....................................................................................................72
5.1 Summary of the Findings ...............................................................................72
5.1.1 Assistive Technology Engaged in Teaching Students with Visual Impairments at
Secondary Level .................................................................................................72
5.1.2 Kind of Technology Used in Secondary Schools that Embrace Teaching and
Learning of the Visually Impaired Students .....................................................72
5.1.3 Criteria Used to Select the Best Assistive Technology that Suits Students with Visual Impairment ................................................................. 74
5.1.4 Problems/Challenges Facing Teachers and Students While Using Assistive Technology ............................................................................. 74
5.1.5 The Impact of Assistive Technology on Educational Achievement of Students with Visual Impairments .................................................. 75
5.2 Conclusion ........................................................................................................ 76
5.3 Recommendations ............................................................................................. 76
5.4 Suggestions for Further Research ................................................................. 77
REFERENCES ......................................................................................................... 78
Appendix A: Informed Consent .............................................................................. 84
Appendix B: Questionnaire for Teachers of Visually Impaired Learners ............... 87
Appendix C: Questionnaire for Learners who are Visually Impaired ...................... 96
Appendix D: Interview Schedule for Transriber and Librarian ............................... 101
Appendix E: Observation Schedule for the researcher ........................................... 104
Appendix F: Research Authorization Letter ......................................................... 106
Appendix G: Research Permit .............................................................................. 107
LIST OF TABLES

Table 3.1: School population ................................................................. 36
Table 3.2: Sampling frame ................................................................. 38
Table 4.1: Distribution of learners respondents age ................................ 44
Table 4.2: Learners class and age ....................................................... 45
Table 4.3: Disability distribution .......................................................... 45
Table 4.4: Distribution of teacher respondents age ................................ 47
Table 4.5: Teacher respondents professional qualification ..................... 48
Table 4.6: Training distribution ............................................................ 49
Table 4.7: Experience of the teachers .................................................. 49
Table 4.8: Items used in writing and reading ......................................... 52
Table 4.9: Instructional media available for learners with visual impairment .... 55
Table 4.10: Motivating aspects of computers ......................................... 58
Table 4.11: Computer activities ............................................................ 59
Table 4.12: Criteria used to select the appropriate assistive technology ....... 61
Table 4.13: Students responses on challenges facing ICT ....................... 65
Table 4.14: Teachers responses on impact of assistive technology .......... 69
LIST OF FIGURES

Fig 1.1: Conceptual framework ................................................................. 14
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFP</td>
<td>American Foundation for the Blind</td>
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<tr>
<td>AT</td>
<td>Assistive Technology</td>
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<tr>
<td>BoM</td>
<td>Board of Management</td>
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<td>CAK</td>
<td>Communication Authority of Kenya</td>
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<td>CAT</td>
<td>Centre for Adaptive Technology</td>
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<td>DAISY</td>
<td>Digital Accessible Information System Disabilities</td>
</tr>
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<td>GoK</td>
<td>Government of Kenya</td>
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<tr>
<td>HTML</td>
<td>Hypertext Markup Language</td>
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<td>ICEVI</td>
<td>International Council for the Visually Impaired children</td>
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<td>ICT</td>
<td>Information Communication Technology</td>
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<tr>
<td>IDEA</td>
<td>Individuals with Disabilities Education Act</td>
</tr>
<tr>
<td>ITU</td>
<td>Internationals Telecommunication Union</td>
</tr>
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<td>JAWS</td>
<td>Job Access with Speech</td>
</tr>
<tr>
<td>KSB</td>
<td>Kenya Society for the Blind</td>
</tr>
<tr>
<td>MoEST</td>
<td>Ministry of Education, Science and Technology</td>
</tr>
<tr>
<td>NCLB</td>
<td>No Child Left Behind</td>
</tr>
<tr>
<td>NCPWD</td>
<td>National Council for Persons With Disabilities.</td>
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<td>NLS</td>
<td>National Library Services</td>
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<tr>
<td>NVDA</td>
<td>Non-Visual Desktop Access</td>
</tr>
<tr>
<td>OCR</td>
<td>Optical Character Recognition</td>
</tr>
<tr>
<td>PDAs</td>
<td>Personal Digital Assistants</td>
</tr>
<tr>
<td>PWD</td>
<td>Persons with Disabilities</td>
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<tr>
<td>SCATP</td>
<td>South Carolina Assistive technology Program</td>
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TVIs - Teachers of Students with Visual Impairments
UDPK - United Disabled Persons of Kenya
UN - United Nations
UNCRPD - United Nations Convention on the Rights of Persons with Disabilities
VI - Visual Impairment/ Visually Impaired
WHO - World Health Organization
WSIS - World Summit of the Information Society
ABSTRACT

Modern assistive technology can move a long way in improving the quality of special education through making students with special needs more independent. Analogy assistive technology which is mainly used in Kenyan special school is slow, bulky, inefficient and dependent. Therefore, the purpose of this study was to analyze the potential of modern assistive technology in educational achievement for students with visual impairment at Kibos special secondary school. The study employed a case study research design where both quantitative and qualitative data of one special school were collected and analyzed. The target population of 133 students with visual impairments comprised of 73 boys and 60 girls. The study also targeted 10 teachers, a transcriber and a librarian. The study employed purposive sampling technique to select a sample of 40 students, 10 teachers, 1 librarian and 1 transcriber. Research instruments were questionnaires, interview schedule and observation checklist. Research findings were presented using frequency tables and percentages. The study revealed that in Kenya students with visual impairment use analogy technology which embraces manual brailers, slate and stylus, abacus, Taylor Frame, cubes and Cuberithms Board which are slower, inefficient and not matching digital age. The study also found that: use of modern assistive technology has enormous contribution on curriculum coverage and early completion of class work and assignments, assistive technology was in use at Kibos special secondary school in a computer laboratory where computer lessons were being conducted. Braille machines were the most frequently used types of assistive technology followed by computers, I pads and tablets. Functional vision was the most important factor considered when selecting any kind of assistive technology, and the limited number of computers was the greatest notable challenge because sharing of machines among the visually impaired is not beneficial possible due the sensory lose. The study recommended that the Ministry of Education should recognize the potential of assistive technology in supporting education for students with VI, schools for VI schools be equipped with modern assistive technology which is less bulky, quick, easier efficient, motivating and that encourage independent study/learning. Teacher empowerment is necessary to ensure adequate computer literacy skills to deliver adequately to students with visual impairment and teachers, parents, guardians and all stakeholders of institutions dealing with students having visual impairments be sensitized about the enormous benefits that come with modern assistive technology.
CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Modern assistive technologies are innovative technologies that modify or adapt the classroom for special learning needs (Shell, Cashman, Gunter & Gunter, 2006). This kind of technology assists in teaching students who have physical, sensory or cognitive disabilities. Such modern technology provides teachers with innovative tools to help students with special needs overcome the disability that block or impedes their learning process. According to American Foundation for the Blind (2012), assistive technology is any tool that helps students with disabilities to do things more quickly, easily or independently. The same sentiment about assistive technology is affirmed by Jonassen and colleagues (2008) who observe that assistive technology in education is a product system modified to increase maintain or improve the functional capabilities of children or students with special needs. Such technology for students with visual impairment entails large print access, speech access, braille access and scanned material access (Hasselbring & Glaser, 2012).

Modern assistive technology has proved to be an equalizer for students because it allows the Braille user to provide feedback to teachers by producing materials in braille for personal use and then in print for teachers, classmates and parents. It also provides students with visual impairment many options for accessing printed information and producing written material for communication sighted. This indicates that a computer system adapted by installation of jaws, NVDA, large screen and large raised keys for keyboard is an appropriate functional modern assistive technology is
an ideal tool for students with visual impairment. In addition, studies show that a computer with preferred applications enhances cognitive and multiple forms of thinking in students. Jackson (2009) affirms that in this era of educational inclusion, integration and globalization, students and teachers with disabilities at all levels need every kind of information on how technology can enhance their performance, facilitate participation in instructional activities and improve educational outcome.

Educational achievement for students with visual impairment concerns the whole concept of education, which are academic achievement, personal development and autonomy. The aim of special education is to narrow the gap between inability and ability, so that educational achievement can be measured through examining the output. Students with disability must like other students who attend regular schools can achieve well and competitively if their schools and teachers can adopt assistive technology (D’andrea & Presley, 2009).

Constructivists, on the other hand, believe that students do not learn from technology which supports students to learn. The assistive technology for learners with visual impairment include screen magnifier, screen reading software such as jaws, window eyes, virtual magnifying glass, ward talk, Non-Visual Desktop Access, Thunder, Web Anywhere, Zoom Text and Soretek among others. When a computer is fitted with any of these assistive technologies becomes accommodative to a student with visual impairment. He/she can use it for reading, writing, doing assignment, socializing with others on facebook or email and searching for any new knowledge or information on the internet. For example, screen enlargement software allows the students to easily read and see what is on the monitor, especially those with poor eyesight. The talking
software on the other hand reads the text appearing on the screen for the visually impaired student hence making access to information easier and education possible.

Computers and other technologies are powerful tools that support students with special educational needs. Those with visual impairments access written text through auditory devices or print magnification devices (Tomei, 2003). According to D’Andrea and Presley (2009), professionals and students with visual impairments function independently in other activities with the appropriate assistive technology. They further confirm that having a personal computer acts as a backbone in one’s life as it supports a visually impaired user to independently write, edit documents, send and receive e-mails. It creates efficiency and independence to a student with visual impairment who has skills to use it. D’andrea and Presley (2009) further affirm that Personal Digital Assistant (PDA) or note-taker allows a student with visual impairment to quickly and efficiently attend to his/her duties. Equipping a computer with assistive technology for learners serves as a backup for the learners’ brain since it has speech, a line of refreshable braille, and braille input keypad, calendar, work-related files and notes.

The United Nations Convention of the Rights of Person with Disabilities (UN CRPD, 2006) emphasizes on the significant duty of governments and concerned ministries to avail equal access to education and employment opportunities to persons with disabilities. The convention postulates a number of innovative and progressive concepts on the enjoyment of human rights by persons with disabilities. It also holds that accessibility of ICTs is equally important as the accessibility of other domains like the adaptive environment and transportation. Article 9 of the UN Convention
observes access to ICT as a key enabler for the enjoyment of rights to education, work and independency.

World Health Organization (2004) estimates states that there are estimated 180 million people worldwide with visual impairments. Blind persons and those with visual impairment use a variety of modern assistive technology to access information and other electronic content. In the Kenyan context, visual impairment could be one per cent of the total population of forty million people, giving a total of four hundred thousand people in general with visual impairment; this is a big number that should not be taken for granted (Web Aim, 2005).

The UN convention considers adapting the environment to provide access to persons with disabilities more superior to that of struggling to fit in society was passed to move towards a view to disability resulting from barriers within society, for example, steps at the entrance of a building for a wheelchair user and away from a view that disability results exclusively from a person’s medical condition. This kind of approach of moving from medical to social model of disability puts focus on giving persons with disability access to society and its structures. The other innovation within the UN convention is access to ICT for persons with disabilities which play a pivotal role in overcoming many of societal barriers (UN Convention, 2006). Today, technology provides access to curriculum and activities that in the past were not accessible to students with special needs.

The American public law 94-142 was passed in 1975 and the enactment of public law 101-476, the Individuals with the Disabilities Education Act (IDEA, 1997). Since that time, there has been greater focus on supporting students with disabilities in the
general education curriculum and proper assessment to meet individual needs (Taylor, 2000). It has been observed that use of technology by students with disabilities is not unique to special education classrooms. Assistive technology is beneficial whenever there is a disability that hinders a student from participating in educational, social and co-curricular activities compared to the demands of the environment and the skills as well as abilities of the student. For example, a student can lack the ability to talk about what has been learnt in the classroom. At any rate, but through the use of assistive technology, can enable students to communicate using an augmentative communication device effectively removing the barrier. The primary purpose of technology for students with disabilities is to remove or diminish the handicap and provide a means to by-pass the disability and offer access to curriculum and activities (Tomei, 2003).

A study conducted in USA by Johnstone, Altman, Timmons, and Laitusis (2009) on technology assisted reading assessment funded by US Department of Education office of Special Education programmes revealed that application of technology in education has increased. The study involved 27 teachers of students with visual impairment. These were teachers who worked in schools for the blind, itinerant teachers for low vision, those who taught students who were totally blind, teachers who taught braille and those who did not. It emerged from the study that all teachers who taught students with low vision used some form of magnification assistive technology and almost all teachers used some form of computer screen magnification. Those who taught students using braille applied various technologies including audio devices, and Braille note-takers. Finally, those who taught using Crossed Circuit Television (CCTV) reported specific names of products used in addition such as, Alpha Smart,
Book Port, Braille and speak, DAISY Readers, Extreme Readers, Free box, iPod, JAWS, Kurzweil, Open book, Outspoken, Pac mate and Zoom Text. It became apparent from the study and conversation with the participants that technology and reading go hand in hand.

In South Africa, Sensory Solutions Limited (2008) developed a handbook stipulating guidelines on how the visually impaired can use and benefit from assistive technology. The handbook portrays the reality in South Africa by stating that blind students have access to braille production and Braille note taking class and for study. Students have access to Screen reading, magnification, as well as Scan and Read facilities. On the same note, the South African National Council for the blind (2010) in support of assistive technology stated that in the year 2003, nine schools for the visually impaired received assistive technology materials. It also stated that by the end of 2004, 21 schools were to receive assistive materials adding the total of schools to 30 having a population of 10,000 students with visual impairment. This was an indication that in South Africa, students with visual impairment have been introduced to efficient technologies to learn independently while at school.

In 1999, the centre for adaptive technology through Kenya society for the Blind in response to train persons with visual impairment computer skills initiated training for persons with visual impairment. The first group of students received individualized attention in order to access electronic information for work and further their studies. Thirty-six students enrolled on JAWS screen reading software, orientation on computer hardware, braille display and embossers (KSB, 2012). Since then, no any organized training has trickled down to primary and secondary schools to prepare
students on the same rendering the case on the ground different because the that kind of technology has not been introduced to all schools as a compulsory subject or as part of the subjects taught. Further still teachers are not technology survey and the number of computers in schools is minimal and limited to computer laboratories where they are minimally accessed.

In 2012, Communication Authority of Kenya (CAK) facilitated a multi-stakeholder workshop on E-accessibility for persons with disabilities to address the barrier of accessibility among persons with special needs. During that workshop a web portal for persons with disability was launched by the name of the Kenya disabilities web portal in collaboration with other stakeholders. However, it has not been utilized. The study intends to bridge the gap of inefficiency created by such outdated technology which is part of the barrier to equitable access of education for students with visual impairment (KSB, 2012).

In Kenya, students with visual impairments largely use analogy kind of technology in their daily educational activities which basically comprise of Braille, slate and stylus accompanied with Braille papers. Majority are not exposed to modern technology their learning is majorly at the mercy of the sighted guide (Mugo, 2013). Mugo also noted that, students with visual impairments use braille and interact sparingly with JAWs, NVDA, Dolphin pen and other forms of assistive technology during computer lessons. The amount of time allocated, students cannot independently study and achieve education as per individual’s ability. Following this background the study sought to examine the use of modern assistive technology on education in education achievement for students with visual impairment.
1.2 Statement of the Problem

Education in developed countries is mandatory to all citizens and students in terms of design, environmental demands, economic empowerment, social demands and individual interest. It accommodates diversity whereby those living with disability are not left behind in every tier of education because the state has the sole role to provide quality education to every child, student and citizen. For instance, Singapore in 1970 to date recognized the potential of information technology as a key enabler in accelerating its economic development (Koh & Lee, 2008). United States of America, Canada, Australia and South Africa have fully embraced the potential of modern assistive technology as it supports students with visual impairment to learn independently, easily, quickly and efficiently. That is, they access quality education by utilizing information communication technology.

In Kenya, the situation is different because the students with visual impairment cannot access quality education due to lack of modern assistive technology which is efficient in obtaining educative information, experience online entertainment, communicate with others and be independent in daily operations. Assistive technology utilized is analog such as braille machines for writing, Braille books, abacus, cubes and cubarithm board, taylor frame and types, Low vision optical and non optical devices and CCTV. There is, however, limited studies on use of modern assistive technology and how it affects education achievement for learners with disability in Kenya. Ministry of Education in its Strategic Plan 2006-2011 intended to integrate information communication technology in education. If implemented, learners will benefit through acquiring ICT skills which are very fundamental in today’s all aspects of life (Ministry of Education, 2006). The strategic plan has however shown little
concern in implementing adoption of ICT for persons with disability. There is also little awareness on the potential of modern assistive technology in effective education for students with visual impairment. There is also a problem of technical expertise in the area of providing specialized ICT for the visually impaired through digitization of the curriculum. This study sought to examine the use of modern assistive technology on educational achievement of students with visual impairment.

1.3 Purpose of the Study

The purpose of this study was to examine the potential of modern assistive technology and its effects on educational achievement of students with visual impairment at Kibos Special Secondary School.

1.4 Objectives of the Study

The study sought to address the following objectives:

(i) Identify modern assistive technology used in Kibos special secondary school for the visually impaired.

(ii) To examine the criteria used to select the best modern assistive technology that suits students individual needs.

(iii) To find out the challenges facing teachers and students with visual impairment while using modern assistive technology.

(iv) To find out the effects of modern assistive technology on educational achievement for students with visual impairment.
1.5 Research Questions

The study was guided by the following research questions:

(i) What kind of modern assistive technology used in Kibos special secondary school?

(ii) What criteria are used in selecting modern assistive technology that suit individual education need?

(iii) What are the challenges faced by teachers and students while using modern assistive technology in learning?

(iv) What is the effect of modern assistive technology in education achievement of students with visual impairment?

1.6 Significance of the Study

The study is expected to be of great benefit to various stakeholders in special education. To the Ministry of Education science and technology, the study will be useful while formulating policies and developing curriculum regarding special education since it will highlight the need of adopting modern assistive technology in teaching students with special needs. To the teachers, the study will be useful since it will highlight the benefits of adopting modern assistive technology while teaching learners with special needs. To the students, the study will be of great help since it will reveal how they can develop themselves independently to achieve their educational goals. To the parents, the study will be of particular importance since it will highlight the importance and how modern assistive technology can be effectively used to the betterment of their children education. The study will also act as a good foundation for other researchers interested in conducting studies on the use of modern
assistive technology and its effects on educational achievement of students with visual impairment.

1.7 Assumptions of the Study

The researcher assumed that:

(i) Respondents involved could willingly provide reliable information to guide the study.

(ii) All students had equal chances of interacting with assistive technology to strengthen their learning.

(iii) Teachers had information communication technology skills in addition to area of specialization.

1.8 Limitations of the Study

The study faced various challenges, one of the challenge the researcher faced was time; putting in mind that the study was a case study, a lot of time was required in the distribution and collection of questionnaires. In addition, student with visual impairment require more time to fill the questionnaire. To overcome the challenges, the researcher worked under tight schedules and also sought the help of teachers in helping the students fill the questionnaire. The researcher had to prepare brailed script of the questionnaire so that the students can respond to the questionnaire independently. The students’ response was also in braille format.

1.9 Delimitation

The study was on the use of assistive technology and its effects on educational achievement of students with visual impairment. Therefore, other forms of impairments will not be included in the study. The study was also conducted in Kibos
special secondary school therefore; other special schools in the area of study were not included.

1.10 Theoretical Framework

The theoretical framework of the study was drawn from constructivists. The theory was founded by John Dewey in 1933 and he later expounded it in 1998. However, Jean Piaget is considered the chief theorist when he came up with cognitive constructivism in 1972. Dewey argued that school should not focus on repetitive and rote memorization. He proposed an approach of ‘directed living’ arguing that students should engage in real world activities or practical workshops in which they would demonstrate their knowledge through creativity and collaboration. He insisted that student should be provided with opportunity to think from themselves and articulate their thoughts. He proposed that education should be grounded in real experience. In one occasion, he cited that if people have doubt about how learning happens, they should engage in sustainable inquiry; study, ponder, consider alternative possibilities and arrive at one self-belief grounded in evidence.

On the other hand, Piaget rejected the idea that learning should be the passive assimilation of given knowledge and he instead proposed that learning is a dynamic process comprising stages of adaptation to reality. During this period, learners construct knowledge by creating and testing their own theories of the world. Piaget argument has inspired several education principles such as: Discovery learning, sensitivity to children’s readiness, acceptance of individual differences and learners don’t have knowledge forced on them; they create it for themselves.
Since constructivism is about observation and a scientific study on how people learn by experiencing things and reflecting on what they experience, this theory suits the visually impaired when looking at how they learn. When one meets something new, he/she has to reconcile with previous ideas and experiences. This is by changing what one believes in and bringing in new ideas. In the classroom, constructivists view learning as a practice that involves different teaching methods and approaches (Newby, Stepich, Lehman, Russell & Leftwich-Ottenbreit, 2011). In the general sense, constructivism is encouraging students to use active techniques like experimenting where most senses are used to create more knowledge and then reflect on it and change one’s understanding. That means assistive technology provides independence among the visually impaired in studying, interacting and doing the best in life (Spector, 2010 et al.). Newby (2011) further affirms that constructivism triggers the students’ innate curiosity about the world and how things work.

The introduction of modern assistive technology for accessing electronic information for the visually impaired will make learning more interactive and meaningful. That will involve use of computer options, PDAs, e-book readers, refreshable braille display, touch tablets, computers, talking word processing programmes, screen reading software, talking books, dictionaries and embossers among others (Presley & D’ Andrea, 2009).
1.11 Conceptual Framework

Conceptual framework on the usage of modern assistive technology and its effects on educational achievement of students with visual impairments

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<thead>
<tr>
<th>Independent Variables</th>
<th>Dependent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistive technology</td>
<td>Education achievement</td>
</tr>
<tr>
<td>• Computers</td>
<td></td>
</tr>
<tr>
<td>• Ipad/tablet/talkback</td>
<td></td>
</tr>
<tr>
<td>• Jaws</td>
<td></td>
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<tr>
<td>• NVDA</td>
<td></td>
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<tr>
<td>Teachers’ challenges</td>
<td></td>
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<tr>
<td>• Skills required for using assistive technology</td>
<td></td>
</tr>
<tr>
<td>• Infrastructure</td>
<td></td>
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<tr>
<td>Criteria for selecting assistive technology</td>
<td></td>
</tr>
<tr>
<td>• Available funds</td>
<td></td>
</tr>
<tr>
<td>• Remaining visions</td>
<td></td>
</tr>
</tbody>
</table>

Intervening Variable

- Independent study
- Full curriculum exploration
- Confidence
- Socialization
- Access to all educational resources

**Figure 1.1: Conceptual Framework**

The study viewed modern assistive technology, teachers challenges and criteria for choosing a modern assistive technology as the independent variables which ultimately affects educational achievement of learners with visual impairment which is the dependent variable. This is, however, influenced by other intervening variables such as: Independent study, full curriculum exploration, confidence, socialization and access to all educational resources.
Infrastructure includes electricity, good network system that can support and sustain computer functioning – Assistive technology makes computer adaptable and accommodative to visually impaired students like jaws, intellitalk, Non-Visual Desktop Access (NVDA), talking calculators, ipods and ipads, braille writers, dragon dictate, handheld magnifiers, kruzweil 1000 and 3000 among others. Skilled manpower includes; skilled teachers/instructors who teach students with visual impairment and students have to be ready to interact with all components in the school in order to learn and be skilled. Confidence is gained through acceptance and strong belief in oneself, gain independence in learning, fully explore the curriculum, socialize and finally access and enjoy educational resources.
1.12 Operational Definition of Terms

The following terms meant as follows in the study:

**Acuity:** Sharpness of vision; usually refers to central vision (Kruegle & Blumenthal, 1998).

**Adventitious:** Accidental or acquired not inherited. (Mastropieri Scruggs, 2007).

**Accessible Technology:** Assistive, adaptive and rehabilitative devices for people with disabilities and the process used in selecting, locating and using them.

**Assistive Technology:** Any item, piece of equipment; or product system modified or customized in order to increase, maintain or improve the functional capabilities of a child with disability.

**Blindness:** Ranges from being totally without sight to unreliable vision and primary reliance on other senses. Such a person usually uses braille as a reading and writing mechanism.

**Congenital:** Loss of vision present at birth.

**Legal Blindness:** Ranges from a visual acuity to 20/200 in the better eye after correction, to having no usable vision or a field of vision rescued to an angle of 20 degrees.

**Low Vision:** Is reduced central acuity of 20/70 or less in the better eye after correction.
**Visual Efficiency:** The degree to which visual tasks can be performed with ease, comfort or minimum time.

**Visual Field:** Area of physical space visible when one looks straight ahead/forward. The normal visual field ranges from 160° – 180°.

**Visual Exploration:** Careful inspection of visible things or the surrounding.

**Visual Impairment:** An umbrella term for any optically or medically diagnosable condition that affects the development and normal use of vision. Impairments may be minor, may be correctable or severe and uncorrectable (Mastropieri & Scruggs, 2007).
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction
The chapter reviews literature of assistive technology used in schools providing education to students with visual impairments, the criteria applied in selecting the best technology that suits individual needs, the challenges faced by teachers and students while using technology and the impact of the assistive technology on the academic achievement of students with visual impairments. The chapter will also identify gaps in literature and indicate how the study intends to fill them.

2.1 Assistive Technology Used at Secondary Level of Education
According to Koh and Lee (2008), Singapore recognized the potential of information communication technology (ICT), as a key enabler in accelerating its economic development as early as 1970. The kind of technology used by all students from preschool to university is similar. Investment in education had been a nation’s priority right from the start, students are provided with core knowledge, skills and the habits of learning that enable them to learn throughout their life. However, the above studies show how Singapore has heavily invested in ICT in its education system since 1997 but little has been indicated on how modern assistive technology has been used for educational achievement of students who are visually impaired.

American Foundation of the Blind (AFB) (2015) through Texas School for the Blind and Visually Impaired (TSBVI) which offer technology assessment, training materials, lesson plans and others technology related information, together with Perkins School for the Blind, have categorized assistive technology for the visually
impaired into four major groups: Large print access, speech access, braille access and scanned material access. Large print access includes screen magnification software such as zoom text which magnifies text and graphics, CCTV and magnification scanning systems. Speech access includes talking word processors such as intellitalk and SAnote, which is a talking word programme (South Africa National Council for the Blind, 2015). Another one is writeout loud, a software that allows the student to set the background and font colours. Speech synthesizers are hardware and software versions that can be internal or external serial devices that integrate speech output for the visually impaired. Screen review software includes the JAWs and window eyes designed to add voice access to windows.

Braille access is braille translation software which is the Braille 2000, an editing tool that handles all kinds of direct entry of braille tasks. Duxbury is editing and translation software which is easy to use and compatible with speech and braille output. Megadots are also a flexible and intuitive MS DOS word processor with software magic that liberates the user from the complexities of braille and printers. Braille embosser is a braille accessing facility which is a printer whose output is Braille. It can be used with any computer using Braille translation software. There is, however, limited study showing the types of modern assistive technology in Kenyan schools, this study therefore, identified various modern assistive technology at Kibos Special Secondary School.

Some literature show foundation for the blind donating the following assistive technology to secondary schools in Kenya: JAWs, Dolphin pen, Non-visual desktop access and embossers. These are assistive technology found in some schools but not
all (Kieti, 2008). That shows that students rely on the universal Braille kit, Braille machine, slate and stylus which are used at different tiers of education such as primary, secondary, colleges and universities as writing and major basic operation assistive technology. These technologies are, however, analog as compared to more advanced modern assistive technologies which are more effective in improving academic achievement of students with visual impairment.

2.2 Assistive Technology Used by Students with Visual Impairment in Secondary Schools

A research conducted in Texas by Mason involving 280 teachers of students with visual impairment and 368 students gave some insight on the use of assistive technology Mason (2014), on Transforming Teaching: Implementing mobile technology, learning strategies in serving students with visual impairment indicates that assistive technology is beneficial. The study was conducted in phases and the purpose of the study was to describe and explain the progression of teacher professional development around assistive technology in an online learning format for teachers of students with visual impairments. The learning comprised multimedia resources and comprehensive framework with steps towards ipad implementation. The research was defined as transforming teaching meaning teachers are progressing in their level and expertise in technology implementation. In the process, the transformative teacher redefines how technology is used with students who have visual impairment in their study programme. Respondents consisted of teachers who work with students with visual impairment.
The first phase of respondents was drawn from over 250 TVIs (n>250). The second phase of 30 TVIs (n=30) respondents was drawn the first phase through sampling. The analysis of the data indicated that vast majority of students with visual impairments who were 98.5% (n=362) felt that ipads were extremely important in their learning. Four participants felt ipads were neither important nor unimportant. On the question about accessing curriculum using the ipad 327 of the participants responded that is was extremely important. Coming to the question of implementation of assistive technology such as ipad with students, the TVIs were equally divided. They lacked the confidence to implement the assistive technology because those who were ready were 10% (n=37), confident 39% (141), somewhat confident 40% (142) and not confident 11% (n=38). The actual data showed that 98% of the TVIs highly valued technology and felt that it should be accessed by all students with visual impairments and only 50% were confident to implement assistive technology.

The study was conducted in Texas, the environment where technology and resource base is stable which is different from Kenya where most of the resources used are imported and not enough to sustain the needs of all visually impaired students. That analysis gives us what exactly is on the ground about teachers and students with visual impairment. The review provides the gap to be filled by the study because the Kenya case is different because of several factors starting with economic stability, level of technology and policy.

A comparative study by Mugo (2013) between Kenyatta University and Syracuse University on assistive technology used by university students in the university reflects what is at the secondary level of education. Mugo observes that students with
visual impairments struggle with Braille machines in studying as major tools of writing. They don’t willingly interact with computers due to little or no exposure. They need sighted guide to orient them before opening up. The general view is that students and teachers fear technology due to lack of exposure and skill, but with interaction and gaining of skill, assistive technology becomes a necessity of accessing knowledge and information conveniently. The above studies have portrayed the use of assistive technology in improving educational achievement of students with disability but none of it has given a conclusive report on the best assistive technology for the visually impaired. Therefore, this study was keen in giving a conclusive report on the best assistive technology for students with visual impairment.

2.3 Best Modern Technology for Students with Visual Impairment

Research shows that advances in technology extended communication options among the visually impaired through the use of touch, speech and residual vision (Alves, Monteiro, Rabello, Gasparetto & Carlvarho, 2009). There are various hardware and software for the blind and visually impaired students. They have been assessed and used in their education in the developed countries. They include the use of computer adapted to talk via synthesized speech; this is made possible through screen reading software available for use by the visually impaired. National Centre for Tactile Diagrams, (NCTD, 2011) states that there are varieties of computer software that students with visual impairment can use in education. They are the Duxbury Braille translator, graphic designers, and speech output software like the JAWs for Windows, dolphin pen, and non-visual desktop access among others. There exist other assistive technologies like screen readers which allow users to scan text into a computer then
read through a speech synthesizer. Other assistive technology equipment used include optacon a tactual system of reading print material.

Educational technology has been realized to offer many possibilities and advantages to students with visual impairment. It eases the problem of depending on the sighted guide in order to gain access to the curriculum (Mason, 2003). Selection of the appropriate access technology for learners with visual impairment must be driven by individual needs. The reason being students have a wide range of blindness and low vision levels (Kelly, 2008). To ensure the best access technology is availed to students, educational teams must carefully assess students’ needs considering current and future needs. They must also specify need and objectives of meeting students interests. On the individual education plan, intensify instruction and provide specific type of access to required technology required (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kaperman, Stikken & Heinze, 2003; Murphy, Halton & Erickson, 2008; Parker et al., 1990; Sahyi Zhou, Smith, Kelly, 2009; Smith, Kelly Maushak, Griffin-Shirley & Lan 2009).

According to Individuals with Disabilities Education Act (IDEA, 2004) and the No Child Left Behind Act (NCLB, 2001), school districts must ensure that all students have equitable access technology devices and instruction as documented by the individualized education programme. In the Kenyan context, the National government through the Ministry of Education starting from schools, education assessment centres, Sub-county and county education and quality and standards personnel, should be involved in planning and ensuring students with visual impairment get the best assistive technology for quality instruction and studies. Instruction in blindness and
low vision specify access technology, which is a fundamental component of the curriculum for students with visual impairments that must be tailored to individual needs through diagnostic and ongoing evaluation.

Kavagi (2010) states that the main drivers that justify the use of computer among students with visual impairment in Kenya are based on:

- **The social drive:** Anchored on the general perception of promoting computer literacy efficient learning since that is the direction society is shifting to.
- **The vocational drive:** Main purpose is to prepare the visually impaired students for career industry.
- **The catalytic drive:** Major aim is to trigger innovation and independence in education among the visually impaired.
- **The pedagogical drive:** The focus being using computer to improve the teachers output and students’ output through efficient methods of preparation and content delivery to students.

2.4 Coping with Modern Assistive Technology

Advances in technology never occur in a vacuum. They result from urgent needs and demands by segments of the population in society. Assistive technology for students with visual impairment is an example of change promoted by human need. Such technology includes low technology devices for mobility such as walking canes, or high academic tools like computers, ipad, or print magnification devices and screen readers (Cox & Dykes, 2001). Through such technology, students with visual impairments are better able to deal with demands of education while in schools. The findings of research clearly show that with assistive technology at their disposal, they
can read books at any time, gather material for their assignments, share ideas with colleague and get in touch with current affairs at the same base and time with other peers.

A study conducted by Johnstone, Altman, Timmons, Thurlow and Laitusis (2008) sought to establish the use of assistive technology in instruction and assessment of students with visual impairment. The aim of the study was to gather information meant to address reading as an activity that involves use of assistive technology. To determine the role and use of assistive technology adequately, they interviewed and observed students. The study targeted students with visual impairments in grade 6-10. Students were interviewed in five states. Among these states, two were from Northeast, one in the Southwest, one in the upper Midwest and one in the South to ensure geographical representation. In the study, students were sampled from both general education system (n=9) and state schools for the blind (n=5). Four additional students were getting their education at state schools through general education classes in nearby public school system. In total, eighteen students were interviewed for this study. In this total sample, 13 students had low vision and 5 students were totally blind. Two participants with low vision also had hearing loss and four additional students had one other documented disability.

Students participated in “observational interviews” facilitated by three researchers on the project. Observational interviews were a hybrid between verbal interview, where respondents described phenomenon (Bogdan & Biklen, 1998) and cognitive interviews where interviewees participated in an activity and described their thoughts and actions. During the interviews, students were asked several questions about their
use of reading access technology in the classroom and home. Each interview lasted between 30 and 60 minutes. Interviewers worked alone or when possible in groups. Students interview and observation produced a wealth of information about students’ use of access technology. After examining students characteristics, learning and access technology used, it was found that 17% of the participants (n=3) were able to read regular print, large print and two of them in addition used audio books. Eight additional students read large print only making the number of print readers among participants 11. The next 7 students all read Braille. The final student read using audio only. Many students who read large print also read in Braille. In the sample population of 18 students in the study, 56% read Braille (n=10). Many of the students also read audio books to access regular print regardless of their primary method 72% (n=13). Ten students used JAWS in the past year for audio needs. Zoom Text with audio was also used by 8 students. In general, the study found that students used a variety of assistive technologies from handheld magnifiers to computer-based products.

Whereas the above study used students representing the entire region of five and interviewing students of grade six to ten where assistive technology is available for use, this study was conducted in one region of Kisumu County representing the entire country. The students involved were from form two and three. This being a developing Country assistive technology is not readily available because education for such students depends on donors, organizations for special needs persons and other charity organizations. That brings a challenge in the study. However, the study is related in the sense that it deals with assistive technology and its contribution to attaining quality education among students with visual impairment.
2.5 The Impact of Modern Assistive Technology on the Education Achievement for Students with Visual Impairment

According to South Carolina assistive Technology programme (2015), assistive technology benefits students in many levels. It helps them accomplish tasks including mastering grade level content by presenting it in different forms such as visual, auditory and tactile. Technology aids and improves writing and organizational skills, note taking skills and observation ability. Such experiences are shared by (D’andrea & Presley, 2009) when they say that listening is an important part of the classroom experience; some students need assistive facilities for hearing whereby special systems help in hearing loss. Those who rely on vision as a primary mode of learning technology can help students by increasing contrast, enlarging stimuli, making use of tactile and auditory modes. Assistive technology allow students to access educational material through their strongest learning mode enhancing equal access to education as it removes barriers to access. Computer-based technologies play significant roles, not only in facilitating a broader range of educational activities to meet diverse needs of students with visual impairment but also those with severe disabilities to become active learners in the classroom (AFB, 2015). Through the use of assistive technology for word processing, students with visual impairment independently access, gather and organize information, communicate and share ideas. Computerized technologies have broken down much information and communication barriers (D’andrea & Presley, 2009).

Assistive technology has the potential to act as an equalizer by freeing many students from disabilities (AFB, 2015). A positional paper by Smith, Kelly, and Kapperman (2011) states that with access technology, appropriate instruction, and provision of
specialized skills based upon diagnostic evaluation, students will develop ability to navigate computer using word processing software or any other possible applied software programme. These skills will enable visually impaired students to effectively use the internet to search for specific information, send mails, and participate in online learning.

To attain such high level operation, they require systematic and consistent instruction from teachers accompanied with patience and practice. Practical skills bring about mastery of keyboarding skills, use of word processing programme to proofread, check spelling, compose and revise documents. The appropriate use of assistive technology translates to academic autonomy leading to educational attainment.

In Australia, students who are blind or visually impaired attend all types of education systems (Jolly, Steer, Gale & Gentle, 2001). Academic success of such students depends on their ability to access the classroom curriculum provided with the same books and resource material as those of sighted students. The format of the material is appropriate to cater for the learner needs like Braille, large print, e-text and audio. It is found at the same place, level and same book edition (Kelly & Gale, 1998; Mason & McCall, 1997; Mosen 1996; Royal National Institute for the Blind, 1998) have also suggested that educational goals for students who are blind or visually impaired should be the same as those without disability but some modifications and adaptations should be made to fit individual needs without interfering with content.

Through assistive technology, research has proved that students with visual impairment are comfortably realizing tremendous change in their education and general life. Change is always inevitable. Human beings are living through a period of
A revolutionary change induced by what is called information communication technology (Carlow, 2005). The ICT revolutionary refers to the economic, social-political transformation centred on the electronic media and internet. These are technological tools and resources used to create, communicate, disseminate, store and manage information. The visually impaired students were first fully introduced to academic and education discourse through technology. The first technology was embossed letters, later an experiment of the Charles Barbie Braille code which was using twelve dots and finally the current Braille by Louis Braille, whose Braille cell consists of six dots (Icevi, 2009).

The major benefit of information communication technology, according to the Ministry of Education is the ability to powerfully support learners to achieve the nationally stated goals of the curriculum. Technology is expected to encourage student-centred learning, inquiry-based learning, collaborative work among teachers and learners, creativity, analytical skills, critical thinking and informed decision-making. Finally, achieve the ministry’s envisaged mission of facilitating effective use of information technology to improve access, learning, monitoring, evaluation and administration, (MoEST, 2006).

2.6 Challenges Faced By Teachers and Students with Visual Impairment Using Modern Assistive Technology

This section discusses challenges faced by teachers and students with visual impairment while, using modern assistive technology. This was viewed in terms of teacher preparedness, location of computers, the goals and objectives addressed by teachers, maintenance, cataloging and shelving software and the number of computer.
2.6.1 Teacher Preparedness

Many teachers in Kenya have not acquired computer skills (Mugo, 2013) without appropriate skills modern assistive technology cannot realize its full potential of improving the educational achievement of students with disability. The challenge can only be averted by providing technical skill in addition to Braille, orientation and mobility, guidance and counseling for better curriculum delivery. That implies that effective use of assistive technology of curriculum delivery is a big issue both to teachers and students.

2.6.2 Location of Computers

Many schools in Kenya have a few computers in their laboratories (Kavagi, 2010). Computers in laboratory centres make access impossible for regular class routines. Therefore, such computers will not be used frequently in lessons by all students. From the interview it was realized that many of the students visit the computer room/laboratory twice a week for lessons which is not enough for quality education.

2.6.3 Goals and Objectives Addressed by Classroom Teachers

According to South Carolina Assistive Technology Program (2015), talking software help a student hear the words while seeing them on the page in the process of reading. On the same context, word processing and word prediction help a student with limited vocabulary and students whose use of keyboard is limited due to disability to express one in writing with less frustration. On the other hand, teachers benefit from effective use of assistive technology as they are provided with more options in addressing different learning approaches for individual students. This implies therefore that, the needs of the teacher for instruction and the needs of the student for access must be
balanced with available equipment and the list of priorities for instruction should be met for effective delivery. The environments for quality teaching of any subject and student participation constructively require enough teaching and learning facilities (Koh & Lee, 2008). This study was, therefore, keen in addressing how modern assistive technology can be used in a classroom in a way that students with visual impairment can be able to effectively learn in a more independent way through self-learning.

2.6.4 Maintenance

Proper care for the equipment and software is essential (Kavagi, 2010). This demands employment of trained personnel to make cleaning and repairs in order for computers to be functional. The gap that should be filled is training instructors who can service the assistive technology as they make use it. Currently, teachers and students using the assistive technology are only consumers. Maintenance is basic for sustainability of an active computer facility for the visually impaired who depend on large print, speech access and tactile.

2.6.5 Number of Computers

According to American Foundation for the Blind (AFB, 2015), effective teaching of individual students requires personal laptop or desktop. Due to impairments, students use other senses to obtain information from the environment such as audio, tactile and magnification. Therefore, there are good reasons for individual computers to suit individual requirement for effective independent functioning.
2.7 Summary

The literature review has highlighted the potential of assistive technology in general and how technology can bridge the gap in quality learning among students. In developed countries, technology has taken education at a higher level whereby quality learning and education is a requirement for all children and adults. That is best observed in Singapore, Canada, the United States of America, Australia and South Africa. In those countries assistive technology has been employed in the education sector to address the needs of students with visual impairments. This indicates that those with disabilities are regarded as any other person in the education development agenda. There is no discrimination in the education system because individual differences and needs are catered for adequately. However, the study reviewed seemed to focus on use of assistive technology on students with disability and therefore could not bring out conclusive findings of students with visual impairment.

This study breached this gap by focusing on usage of assistive technology and its effects on educational achievement of students with visual impairment. Most of the study reviewed was conducted in developed countries therefore, other factors such as environment and socio-economic factors can make the findings of such studies not applicable to developing countries hence a need to conduct on usage of modern technology and its effects in educational achievement of persons with disability in a developing country such as Kenya. The minimal study that has been conducted in Kenya shows that, students with visual impairments use the old kind of technology which is slow, inefficient, bulky, manual, time wasting and disturbing when used makes irritating sound. This technology depends heavily on sighted guide where one
student reads while others listen. This study was however keen in establishing whether these have changed by identifying the type of assistive technology used in special schools at present. Considering the findings of majority of studies reviewed are from developed countries where technology advancement is at optimum, the researcher was motivated to conduct a study in a developing country due to the fact that as other students in regular schools change with the technological change, students in special schools may be left behind therefore, denying them the basic right in life.
CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section focuses on research design, study locale, target population, sampling procedures and sample size. The instruments used in the study, how they were used, their validity and reliability are discussed finally data collection and analysis procedures and the description of study variables are presented accordingly.

3.1 The Research Design

The study employed a case study research design. McBurney and White (2007) state that case studies involve observation and archival methodologies. Stakes (2008) stated that a case study is a situation where the researcher is investigating a single case. He also noted that case study is particularly effective when investigating phenomenon in real life situation. Creswell (2008) noted that case study when one is interested in conducting an in-depth exploration of a bounded system for example activity, events, process or individual based on extensive data collection. The choice of this design was driven as noted by Creswell, the unique characteristic of the response to this study. A case study can be quantitative or/and qualitative (Creswell, 2008). This suited our study since the study collected both qualitative and quantitative data. A case study can also enable the researcher to get an in-depth understanding of an entity, issue or theme (Stake, 2008). These were appropriate in this study since it sought to examine use of modern assistive technology and its effects on educational achievement for students with visual impairment.
3.2 Locale of the Study
The study was carried out in Salvation Army Kibos Secondary School for the visually impaired. The institution is situated in Nyangetta zone, Winam division, Kisumu East District, Muhoroni sub-county, Kisumu County, Kenya. It lies at the attitude of 1173 metres above sea level, 8 km East of Kisumu City. It is in the neighbourhoods of agricultural processing industries such as Kibos Sugar Company and Lake Basin Development Authority. Other institutions around it are Kibos Prison Rehabilitation Centre, Kibos Prison Primary, Kibos Agricultural Research Centre, Kenya Bureau of Standards and Kibos Centre of Excellence. The geographical coordinates of Kisumu centre are O’ 60’ 0” South, 34° 45’ 0” East of the equator, it is 347 km from Nairobi. It is 4 to 5 hours drive from Nairobi or 29-35 minutes flight.

The school was ideal for the study since it provided the type of respondents required by the study. It had enough students with visual impairment who helped the study to succeed. The institution provided an adequate sample for the study in the area of concern.

3.3 Variables of the Study
An independent variable is one which the researcher manipulates to determine its influence on the other variables. It predicts the amount of variation produced on other variables (Gay, 1992). In this study, the assistive technology alongside computers, infrastructure, skilled manpower/teachers and student interaction were the independent variables. The dependent variable depends on what the independent variable does (Frankel & Wallen, 2009). In this case, the dependent variable was education achievement for the visually impaired learners. Intervening/extraneous
variables include independent access to information, effective exploration of curriculum, confidence, social networking and collaboration and access to all human rights.

3.4 Target Population

Mugenda and Mugenda (2012) define population as the set of elements, units, objects or subjects in the universe for a particular study comprising entire group of individuals, objects items, cases, articles or things with some common attributes or characteristics. In this study, the school population comprised 133 students with varied levels of visual impairments. The students were admitted to the school based on their performance/merit in KCPE. Male students were seventy three and female students were sixty, teachers were ten, one transcriber and one librarian.

Table 3.1: School population

<table>
<thead>
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<th>Streams</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
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<tr>
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<td>1</td>
<td>31</td>
<td>27</td>
<td>58</td>
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<tr>
<td>Form 2</td>
<td>1</td>
<td>12</td>
<td>08</td>
<td>20</td>
</tr>
<tr>
<td>Form 3</td>
<td>1</td>
<td>11</td>
<td>09</td>
<td>20</td>
</tr>
<tr>
<td>Form 4</td>
<td>1</td>
<td>19</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
<td><strong>73</strong></td>
<td><strong>60</strong></td>
<td><strong>133</strong></td>
</tr>
</tbody>
</table>

The target population was 133 students in the whole school, teachers were ten, one transcriber and a librarian.
3.5 Sampling Techniques

All students in form two and three participated in the study. They were purposefully sampled. Purposive sampling according to Mugenda and Mugenda (2012), is a non-probability sampling technique that requires the researcher to choose subjects or units according to the type of information needed. The researcher in this context purposely selected units or subjects possessing the required characteristics who were visually impaired. This technique allowed for the generalization of the results obtained to other similar schools and students. The reason for selecting the form two and three students only was that they had completed enough time in the school and had settled down after introduction of the subjects. ICT being one of the subjects taught formed the foundation of the area of research since assistive complements ICT among students with visual impairment. Second, all of them had some form of visual impairment; hence they needed skills in assistive technology for independent exploration. They therefore, had a strong foundation in developing careers adequately.

3.5.1 Purposive Sampling

This method of purposive sampling was ideal for this study because it picks a small group with similar characteristics to describe the entire spectrum of students with visual impairment (Wallen and Fraenkel 2012); Kombo and Tromp (2006) recommend 10% of the target population as the ideal sample size. The researcher opted for purposive sampling because of its power to bring about in-depth analysis of central issues in assistive technology for the visually impaired. In addition, all students participated in forms two and three because of their small number and having visual impairment tenets.
3.6 Sample Size

According to Mugenda and Mugenda (2012), sample size comprises units, subjects, objects or items in the sample. It determines the precision of which population parameters are estimated, hence accuracy of inferences made from the sample data to the population. In this study, the sample size of 40 students, ten teachers, one transcriber and one librarian took part in the study. The sampled number of respondents comprised 23 male and 17 female students in form two and three, ten teachers, one transcriber and a librarian. This group was quite manageable and conformed to special needs requirements of a few students for better or quality service delivery. Table 3.2 below shows sampling frame and respondent distribution.

Table 3.2: Sampling Frame

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Target Population (N)</th>
<th>Sample Size</th>
<th>Sample (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>133</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Teachers</td>
<td>10</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Transcriber</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Librarian</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>145</strong></td>
<td><strong>52</strong></td>
<td></td>
</tr>
</tbody>
</table>

3.7 Research Instruments

The research instruments in this study were questionnaires, interviews and observation schedules. The instruments were to ensure adequate data collection since multi-technique approach supplements one another (Mwiria & Wamahiu, 1995). The
choice of instruments was guided by the nature of data collected and objectives of the study.

3.7.1 Questionnaires

The questionnaires were designed to collect data directly from respondents/participants. Two types of questionnaires were designed to collect data from students and teachers. The questionnaires consisted of questions that were both open and closed-ended. The questionnaires were designed to capture various variables of the study on assistive technology and contribution to education achievement for students with visual impairment. The questionnaires were selected because they help the researcher to collect a large amount of information in a short period of time (Orodho, 2004).

3.7.2 Interview Schedule

Mugenda and Mugenda (2012) affirm that an interview schedule as a research tool is used by the researcher to guide an open-ended interview. The researcher used probing to clarify issues obtained for further information that enriched the data. They were a set of questions an interviewer asked the interviewee. They made it possible for the researcher to obtain data required to meet the specific objectives of the study. They standardized the interview as they followed pattern uniform to all respondents, (Mugenda & Mugenda, 2003; Orodho, 2005). The researcher opted for this instrument because of its consistency in data collection. The interview schedules were designed for the librarian and the transcriber, and others were for the teacher teaching computer lessons who interacts most frequently with students and the learning materials and the environment. They were designed to gather information on the true
nature of students and how they consider modern assistive technology and old technologies.

**3.7.3 Observation Checklist**

The researcher prepared a checklist comprising all the available assistive technologies that enable visually impaired students to independently search for academic information. Through the checklist, the researcher had an opportunity to involve students and teachers to ascertain the functionality of assistive technologies used in the learning process. Also, the effectiveness of each assistive technology was noted. The observation checklist was filled by the researcher in the classroom when lessons were gathering information on the level of participation of students during computer lessons in comparison to other normal lessons. Checklists were also used to investigate proficiency of keyboarding skills and level of assistive technology utilization.

**3.8 Piloting**

Piloting enabled the researcher to correct ambiguities detected in the instruments as affirmed by (Kasomo, 2006). It was conducted at Thika High School for the Blind in Thika Municipality, Thika District, Kiambu County. Thika Municipality lies 45km North-East of Nairobi, between latitudes 3° 53” and 1° 45” South of the equator and between longitudes 36°, 35, and 37° 25’ east of the prime meridian. The school was ideal due to its long tradition in teaching students with visual impairment. It was the first and only national school for students with visual impairment until the year 2009 when Kibos came into existence. It caters for boys and girls equally. Therefore, it provided the best and enriched environment for piloting.
3.9 Validity and Reliability of Instruments

Validity measures what it is supposed to measure (Frankel & Wallen, 2009). Before the actual collection of data using the instruments, piloting was done to validate them by correcting ambiguities. Orodho (2009) states that validity or accuracy of research instruments is based on research results. Reliability of the instrument was ascertained through test re-test method. Questionnaires were administered to Thika High School for the Blind and the responses of learners were kept for two weeks and the same questionnaires were given back to the same students. The responses were compared to at 95% significance level. A correlation coefficient of $r=0.7$ was deemed satisfactory to term the instruments as reliable. After conducting the tests the researcher got an $r$ value of 0.75 therefore adopting the instrument.

3.10 Data Collection Procedure

Before going to the field, the researcher sought a research permit from the Ministry of Education, Science and Technology that authorized him to carry out research in selected schools as per the regulation. The researcher then proceeded and visited the schools to establish rapport and sought permission from the administration then carried out the study. To avoid failure due to logistical issues, there was a prior arrangement which was organized by the school administration for appropriate dates of visiting the schools for actual data collection. On the day of actual collection after data, the researcher self-administered the questionnaires to the students and collected them after a period of one week. The researcher also conducted the interviews within this week. The checklist was filled within one day.
3.11 Data Analysis and Presentation

The data were analyzed using both quantitative and qualitative techniques with the aid of Statistical Packages for Social Sciences (SPSS). The SPSS was to generate descriptive statistics and to establish the relationship between independent and dependent variables of the study. The research findings were presented using frequency tables, percentages, pie charts, and bar graphs. On the other hand, qualitative analysis was done using thematic approach, where interview results from the respondents were put into related themes. The qualitative findings were interpreted and related to other findings.

3.12 Logical and Ethical Consideration

The researcher observed ethical considerations while conducting the study, respondents participated in the study on voluntary bases. The respondents were not also required to indicate their names on the questionnaires. The researcher also assured the respondents that the information they provided would be used for academic purposes only.
CHAPTER FOUR
RESULT PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction
This chapter presents the findings and interpretation of the study findings. The chapter has been sub-divided into sections and sub-sections. The demographic information of the respondents has been presented first. The demographic information presented includes age, nature of disability and mode of reading for the learner respondents. For the teacher respondents, it includes information on age, academic and professional qualifications and teaching experience. After the demographic findings of the study have been discussed, the researcher presented the research findings on the basis of the study objectives and questions. The quantitative data were analyzed using both descriptive and inferential statistics. The descriptive statistics were used to describe and summarize the data inform of graphs, tables, frequencies and percentages. All tests of significance were computed at $\alpha = 0.05$. For the qualitative data, a thematic analysis approach was used.

4.1 Demographic Information of the Respondents
The data used in this study were drawn from the population of 133 students, 10 teachers, 1 librarian and 1 transcriber at Kibos Special Secondary School. From this population, the sampled respondents were 40 learners ($n=40$), 10 teachers ($n=10$), 1 transcriber ($n=1$) and 1 librarian ($n=1$). The return rate of the questionnaires was 90% (36) from the learner respondents. The return rate from the teacher respondents was 100% (10). Given that the questionnaires were administered personally by the
researcher, it was noted that 96.5% of the questionnaires were appropriately filled. The demographic characteristics of the respondents were summarized below.

4.2.1 Learners Respondents

4.2.1.1 Learners Age Distribution

The age of the learners was considered an important aspect of learning process; hence its distribution among the respondents was explored. Table 4.1 below shows the percentage distribution of the learner respondents in terms of their age and gender.

Table 4.1: Distribution of learner respondents' age

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Frequency (n=36)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 14</td>
<td>1</td>
<td>2.8%</td>
</tr>
<tr>
<td>15-16</td>
<td>10</td>
<td>27.8%</td>
</tr>
<tr>
<td>17-18</td>
<td>14</td>
<td>38.9%</td>
</tr>
<tr>
<td>19 &amp; above</td>
<td>11</td>
<td>30.6%</td>
</tr>
</tbody>
</table>

The exploratory data analysis reveals that the majority (38.9%) of the learner respondents were in the age group of 17-18 years, 30.6% of them were aged 19 years and above, 27.8% of learner respondents were 15-16 years old and the rest (2.8%) of the learner respondents were 14 years and below. The mean age of the respondents was about 17 years (17.3 years), while the median and the modal age of the learner respondents were also each 17 years. From the above findings, it can be deduced that the respondents were between the ages of 17-18 years. This can be attributed to late joining of school due to disability. It is also good to note a good number of them (30.6%) are 19 years and above. This can also be attributed to late joining of school,
slow development of milestones, and lack of some sensory organs like senses concerned with vision.

4.2.1.2 Learners Class and Age Distribution

Table 4.2 shows the learners class and age distribution. It reveals that majority of the learner respondents, 55.6% were in form three; whereas only 44.6% of learner respondents were in form two.

Table 4.2: Learners class and age

<table>
<thead>
<tr>
<th></th>
<th>&lt; 14 Years</th>
<th>15-16 Years</th>
<th>17-18 Years</th>
<th>19 &amp; above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form 2</td>
<td>1(100%)</td>
<td>6(60.0%)</td>
<td>5(35.7%)</td>
<td>4(36%)</td>
</tr>
<tr>
<td>Form 3</td>
<td>0(0.0%)</td>
<td>4(40.0%)</td>
<td>9(64.3%)</td>
<td>7(64%)</td>
</tr>
<tr>
<td>Total</td>
<td>1(2.8%)</td>
<td>10(27.7%)</td>
<td>14(38.9%)</td>
<td>11(30.6%)</td>
</tr>
</tbody>
</table>

From Table 4.2, it was evident that form three students who participated in this study were generally older than the form two students; 64% of the students who were 17 years and above were form three students and only 36% of them were form two students. On the same scenario, majority (64%) of the student respondents aged 16 years and below were form two students, only 36% of them were form three students. This was expected because in most cases, age of a student advances with the advancement of level of education.

4.2.1.3 Learners Visual Disability Distribution

Table 4.3 shows distribution of learner respondents’ level of visual impairment.
Table 4.3: Disability distribution according to nature of impairment

<table>
<thead>
<tr>
<th>Visual impairments</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally Blind</td>
<td>13(36.1%)</td>
</tr>
<tr>
<td>Low Vision</td>
<td>23(63.9%)</td>
</tr>
<tr>
<td>Sighted</td>
<td>35(97.2%)</td>
</tr>
<tr>
<td>Blind</td>
<td>1(2.8%)</td>
</tr>
</tbody>
</table>

Table 4.3 it indicates that although majority 23(63.9%) of the learner respondents had low vision, a significant proportion 13(36.1%) of them were suffering from total blindness. It also revealed that nearly all 35(97.2%) of the learners suffering from visual impairment acquired them. Only one student which is negligible proportion was born blind. This implies that most of visual impairments are acquired. On further inquiry, the findings of study show that majority 26(72.5%) of the respondents whose sight was lost after birth suffered the problem before the age of ten years. Only 7(18.8%) of them said they lost their sight after ten years of age, but 3(8.7%) of the respondents could not recall when they lost their sight. These results can be attributed to many contributing factors to impairments after birth. These factors include diseases, nutrition, accidents.

4.2.2 Teacher Respondents

The age of the teachers was considered an important aspect of teaching process; hence its distribution among the respondents was explored.
4.2.2.1 Teachers Age Distribution

Table 4.4 below shows the percentage distribution of the teacher respondents in terms of age and gender.

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-30 Years</td>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>31-40 Years</td>
<td>2</td>
<td>20%</td>
</tr>
<tr>
<td>41-50 Years</td>
<td>3</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

The analysis of teacher respondents age reveals that half (50.0%) n=5 of the teacher respondents were in the age group of 21-30 years, a fifth (20.0%) n=2 of them were aged 31-40 years and the rest (30.0%) n=3 of the teacher respondents were 41-50 years of age. From the above results, a big number of teachers who responded to our study were aged between 21-30 years, this can be attributed to the fact that majority of teachers in Kibos Special Secondary School are employed by the BoG and are not on permanent basis. It is also true to say the experienced human resource in this school is inadequate since majority of teachers are under contract and may be lacking the necessary experience to teach students with disability.

4.2.2.2 Teachers Qualification Distribution

Table 4.5 shows the teachers professional qualification distribution. It reveals that majority (70.0%) n=7 of the teacher respondents who participated in the study had bachelor of education degree.
Table 4.5: Teacher Respondents Professional qualification

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma</td>
<td>2</td>
<td>20%</td>
</tr>
<tr>
<td>B/education</td>
<td>7</td>
<td>70%</td>
</tr>
<tr>
<td>Masters</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Those who had diploma in education formed a fifth of the teacher respondents population, while only 10% (n=1) of the teachers who participated in the study had masters degree. From these results majority it is true to say that majority of teachers at Kibos Special Secondary School have attained adequate education required in teaching students with special needs.

4.2.2.3 Teachers Training Distribution

The study was also interested in knowing whether teachers at Kibos Special Secondary school had received training on visual impairment as part of their special education programme. As results indicate in table 4.6, majority (80%) of the teachers admitted that they had not taken training on teaching students with visual impairment.

Table 4.6 shows distribution of teacher respondents’ training as visual impairment teachers.
Table 4.6: Training distribution

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2</td>
<td>20.0%</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>80.0%</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100%</td>
</tr>
</tbody>
</table>

From the above result, it be deduced that graduate special education teachers are not adequately trained to be able to teach learners with visual impairment, a role which involves more of practical activities than theory. This is mainly because students with visual impairment see by hearing and learn by doing, a fact which is supported by constructivist theory.

Table 4.7: Experience of the Teachers

<table>
<thead>
<tr>
<th>Teaching experience</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 year</td>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>1-5 years</td>
<td>2</td>
<td>20%</td>
</tr>
<tr>
<td>11-20 years</td>
<td>3</td>
<td>30%</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.7 shows distribution of the teacher respondents, revealed that a half (50%) n=5 of the teacher respondents had less than 1 year experience. A considerable number of them (30%) had 11-20 years of experience while another 20% had 1-5 years of experience. From these findings, it can be deduced that majority of teachers in Kibos Special Secondary School have minimal experience. This, as indicated
above, is contributed by the fact that there are few permanent teachers in the school. Therefore, the BoG had to employ more teachers to supplement the few government employed teachers.

4.3 Assistive Technology Engaged in the Teaching of Students with Visual Impairment

The first research objective was to establish the assistive technology engaged in the teaching of students with visual impairment at secondary tier of education for students with visual impairment at Kibos Secondary for the Visually Impaired. To address this objective of the study, a research question, “What were the types of assistive technology used by teachers and learners in the process of learning for students with visual impairment at Kibos special Secondary School?” was addressed. The researcher designed two questionnaires to collect views of the teacher and learner respondents on the assistive technology engaged in the teaching of students with visual impairment at Kibos Special Secondary School.

The items in the questionnaire were related to facts/perceptions on assistive technology used in teaching and learning among students with visual impairments. Both teachers and students respondents were presented with statements or items that were deemed to have connotations on the use of assistive technology for the visually impaired secondary school learners but with specific reference to Kibos Special Secondary School. The respondents were asked to tick each statement based on their perception on the statement in regard to teaching and learning of visually impaired students. The researcher computed percentage frequencies of the responses from the teachers and students and tabulated the results as shown in tables 4.8, 4.9 and 4.10.
4.3.1 Use of Assistive Technology

The study found that a number of assistive technologies were being used during the teaching learning process in Kibos Special Secondary School. All (100%) the teacher respondents confirmed that the school had a computer laboratory. In fact, this information was corroborated by 56.8% of the student participants in the study who confirmed that there was computer laboratory in their school. This fact was also further supported by the majority (59.5%) of students respondents who agreed that they had computer lessons in the school library twice per week.

On the issue of whether the technology in the laboratory computers were adapted to fit the needs of students with visual impairment, 10% of the teachers held the opinion that the computers were not fully adapted for use by the visually impaired learners. However, an overwhelming majority (90%) of the teacher respondents believed that the technologies in the computer laboratory were well-adapted to fit the needs of the visually impaired learners.

4.3.2 Items Used in Writing and Reading

To investigate the items used in writing and reading by the visually impaired learners, the percentage of responses of the learner respondents was computed as shown in Table 4.8.
Table 4.8: Students response on assistive technology they use in writing and reading during their free time

<table>
<thead>
<tr>
<th>Items</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braille machine</td>
<td>33.3%</td>
</tr>
<tr>
<td>Computer</td>
<td>29.0%</td>
</tr>
<tr>
<td>Slate and stylus</td>
<td>20.3%</td>
</tr>
<tr>
<td>Ipads</td>
<td>11.6%</td>
</tr>
<tr>
<td>Others</td>
<td>5.9%</td>
</tr>
</tbody>
</table>

Table 4.8 shows some of the equipment used by learners in the process of learning, revealed that braille machines were most frequently used by a third (33.3%) of the cases. Computer was also used in more than a quarter (29.0%) of the times during learning and teaching. Whereas, ipads use was not very common among teaching and learning equipment in Kibos Special Secondary School, it was used in 11.6% of the times, which was quite significant. Other items used for reading and writing including use of large print and laptop took 5.9% times during teaching and learning.

These findings show that most students and teachers recommended the use of braille machine for various reasons. Given the fact that braille machine is a primary medium of reading and writing for people who are blind or have low vision, most students argued that they can access information more quickly and perform tasks that involve reading or writing more efficiently using braille than by listening to a personal reader or using alternative technologies such as audio recordings, talking computer, or other electronic devices. Some student respondents also observed that experienced users of braille are often able to read or take notes in braille much more quickly than the use
other methods. In addition, an interview with learners indicated that a significant proportion of the student respondents who preferred the use of braille as a teaching and learning aid said that braille makes it possible for blind people to read and take notes independently, and at the same time increases the amount of written material that is accessible to them.

On the same note, reasonable proportion of the learner respondents who recommended use of computers in education argued that computers when fitted with optical character readers, speech output, refreshable braille screen displays, and braille printers allow visually impaired learners to participate in computer exercises and on-line research. In addition, web pages used in various courses designed so that they are accessible to those using braille and speech readers promote computer research among the visually impaired learners at individual levels without assistance.

Use of slate and stylus was also recommended by sizeable (20.3%) proportion of the learner respondents. This can attributed to the fact the slate and stylus are exceedingly flexible and can be used under many circumstances because they’re very portable. There is also no maintenance on them; the stylus is only sharpened occasionally but mostly they don’t have to be sharpened and the slates are very durable. One learner respondent observed that:

A slate and stylus can do many things computer devices cannot do easily; it gives immediate hard copy. For example I just want to Braille a phone number and either throws it in my bag or give it to somebody I can do it with a slate and stylus right then and there, and hand it out.

Although use of ipads was not recommended by the majority of the learner respondents to be given preference in education system, however, the few who
recommend it said that ipads are suitable for use because they come with built-in accessibility applications relating to vision, hearing, mobility limitations, and learning disabilities. The ipads used by people with visual impairments come with a screen reader that provides immediate access to applications and the internet suitable to visually impaired user.

4.3.3 Modern Assistive Technology Media Available in Classroom

To establish the instructional media available for learners with visual impairments the researcher developed a table of percentage frequencies on responses of teacher respondents shown in Table 4.9. The analysis of the teacher responses (Table 4.9) on the instructional media available in classrooms, the research findings revealed that various instructional media, which refer to devices and materials employed in teaching and learning were being used by the teachers.
Table 4.9: Instructional media available for learners with visual impairment

<table>
<thead>
<tr>
<th>Instructional material</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braille writers</td>
<td>90%</td>
</tr>
<tr>
<td>Braille books</td>
<td>80%</td>
</tr>
<tr>
<td>Cramnier abacus</td>
<td>70%</td>
</tr>
<tr>
<td>Cubelithm slate and cubes</td>
<td>50%</td>
</tr>
<tr>
<td>Tylor frame and types</td>
<td>30%</td>
</tr>
<tr>
<td>Slate and stylus</td>
<td>80%</td>
</tr>
<tr>
<td>Tactual maps and globes</td>
<td>20%</td>
</tr>
<tr>
<td>Talking calculators, clocks</td>
<td>80%</td>
</tr>
<tr>
<td>Tactile graphic kit</td>
<td>20%</td>
</tr>
<tr>
<td>Templates and writing guides</td>
<td>20%</td>
</tr>
<tr>
<td>Brailed ruler, compass, protractor set squares etc.</td>
<td>70%</td>
</tr>
<tr>
<td>Optacon (optical-tactual– connector)</td>
<td>10%</td>
</tr>
<tr>
<td>Large print textbooks</td>
<td>90%</td>
</tr>
<tr>
<td>Markers and reading windows</td>
<td>40%</td>
</tr>
<tr>
<td>Braille papers</td>
<td>80%</td>
</tr>
<tr>
<td>Tactual diagrams</td>
<td>40%</td>
</tr>
<tr>
<td>Sound balls</td>
<td>10%</td>
</tr>
<tr>
<td>Magnifying glass</td>
<td>80%</td>
</tr>
<tr>
<td>3-D material (realia and models)</td>
<td>30%</td>
</tr>
<tr>
<td>Telescope, microscope and binocular</td>
<td>50%</td>
</tr>
</tbody>
</table>

Instructional media incorporates all the materials and physical means an instructor might use to implement instruction and facilitate students achievement of instructional objectives. They include hardware like blackboards, radio, television, tape recorders, video tapes and recorders and projectors; and, software like transparencies, films, slides, teacher-made diagrams, real objects, cartoons, models, maps and photographs.
However, this study shows that for the visually impaired learners, their instructional media differ depending on the nature of the eye disability.

Findings of the study show that use of braille writers and large print textbooks were the most prevalent instructional media used in Kibos School for the Blind, in nine out ten cases (90%) of the two instructional media were each available for the learners. The other instructional media used more frequently in classrooms were braille books, slate and stylus, talking calculators and clocks, braille papers and magnifying glass.

In seven out of ten (70%) lessons conducted in Kibos School for the Blind, Cramnier Abacus and brailed ruler, compass, protractor set squares were available in classes. Cubelithm board and cubes, and telescope, microscope and binocular were availed to the learners in half (50%) of the instructional interactions. Optacon (optical-tactual–connector) and sound balls were minimally used each getting a response of 10%, this is attributed to the fact that these equipment are only used during sporting activities. The findings can also support the fact that students with disability are rarely involved in sporting activities.

4.4 The Kind of Assistive Technology Used in Kibos Special Secondary School

The second objective of the study was to identify the kind of technology used in Kibos Special Secondary Schools that embraces teaching and learning of students with visual impairment. This objective was answered by exploring the question of the study: “How many of the equipment / devices are assistive technology used in the teaching learning process for students with visual impairment at Kibos Secondary for the Visually Impaired?”.
4.4.1 Modern Assistive Technology Available in Kibos Special Secondary School

The findings of the study show that the screen reader –JAWS (Job Access with Speech) was the most popular assistive technology used in teaching / learning process in Kibos Secondary School for the blind. 80% of the teachers who participated in the study through interviews confirmed that Jaws programme was available in the school and frequently used. It is screen reader, developed for computer users whose vision loss prevents them from seeing screen content or navigating with a mouse. The same sentiments were shared from the observation done during the lessons in class sessions.

It was revealed that Non-Visual Desktop Access (NVDA) Daisy book as an access technology was 60% available in Kibos Secondary School for the blind for teaching and learning. Non-Visual Desktop Access (NVDA) is a free and open-source screen reader for the Windows Operating System, enabling the blind and people with visual to use their computers for no more cost than the computer and operating system itself.

The study revealed that micro computers with speech synthesis, braille input and output devices, braille translation software were each 40% available in Kibos School for teaching and learning. This indicates that they were used in less than half time the lessons were conducted.

It was also found that some equipment used by teachers and learners in the process of teaching and learning, such as Mega dots, Braille 2000 and Window eyes intellitalk were each used in one out of ten (10%) cases only. This can be attributed to the fact that they are expensive and can only be acquired through donation. However, the worst cases were talking books and Dolphin pen, which were each never used at all in Kibos School for the blind, due to the fact that Dolphin pen was developed for
commercial purpose but it is very expensive making it very unpopular among students with visual impairment.

4.4.2 Frequency and Level of Assistive Technology Used in School

Learners’ views were sought to establish the use of computer in Kibos School as the main assistive technology. The findings complements ICEVI (2009) study, that computer was mainly used as an assistive technology. All the teacher respondents confirmed that the school had a computer laboratory. In fact, this information was corroborated by 56.8% of the students who participated in the study; they confirmed that there was computer laboratory in their school. This fact was also further supported by the majority (59.5%) of student respondents who agreed that they had computer lessons at school. The findings of the study show that majority (70%) of the learner respondents confirmed that they attend lessons at least twice a week.

On what motivates the learners to regularly use computers, the learner respondents responded as indicated in Table 4.10.

Table 4.10: Motivating aspects of computers

<table>
<thead>
<tr>
<th>Computer item</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaws</td>
<td>87.5%</td>
</tr>
<tr>
<td>Large print access like in large and lunar</td>
<td>77.5%</td>
</tr>
<tr>
<td>Intellitalk</td>
<td>12.5%</td>
</tr>
<tr>
<td>Write out loud</td>
<td>12.5%</td>
</tr>
<tr>
<td>Window eyes</td>
<td>10.0%</td>
</tr>
<tr>
<td>Megadots</td>
<td>0.0%</td>
</tr>
<tr>
<td>Any other specify</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
According to table 4.10, it was evident that significant majority (87.5%) of the learners held the view that the screen reader-Jaws was most powerful tool that motivates them to use computers regularly. More than three quarters (77.5%) of the learners held the opinion that large print access like in large and lunar in computer propels the visually impaired learners to use the computers. Intellitalk facility and write out loud programme in the computer each motivated 12.5% of the learners who participated in this study in the computer use. Window eyes in the computer and availability of Mega dots in the computer did not at all motivate any learner to use computers as an Assistive Technology, this can be attributed to the fact the these applications are complicated therefore not favourable for students.

4.4.3 Activities Done By Learners When on Computer

The learners were found to have varied activities while in computer laboratory, as was indicated by Table 4.12. The analysis of the learner responses indicates that 40% of the learner respondents were in most cases accessing news whenever they were using computers.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat in face-book</td>
<td>25.0%</td>
</tr>
<tr>
<td>Link to the email or g-mail</td>
<td>32.5%</td>
</tr>
<tr>
<td>Access the news</td>
<td>40.0%</td>
</tr>
<tr>
<td>Play games</td>
<td>57.5%</td>
</tr>
<tr>
<td>Link to the U-tube</td>
<td>20.0%</td>
</tr>
<tr>
<td>Joins twitter and tweet</td>
<td>12.5%</td>
</tr>
</tbody>
</table>
The study findings show that significant proportion of the respondents was engaged in leisure activities whenever they were using computers. This is illustrated in the table above where majority (57.5%) of the learners were involved in playing games whenever they got access to the computer, 32.5% of them were always involved in the computer to link to the email connections and a quarter (25%) of them were always chatting in face-book whenever they were on computers. A fifth (20%) of them used computers to link to U-tube and another 12.5% of the respondents were always in twitter whenever they were using computers. The results above indicate that assistive technology can move a long way in making students with visual impairment more independent and enjoy life like any other student in regular school.

4.5 Criteria Used to Select the Best Assistive technology that Suit Student’s Individual Needs

To examine the criteria used to select the best assistive technology that suits the individual needs of students with visual impairment at Kibos Secondary for the Visually Impaired, a set of questions were pre-developed by the researcher to investigate the same. The questions were presented to the teacher respondents and their responses on the questions were summarized in form of percentages as shown in Table 4.12.
Table 4.12: Criteria used to select the appropriate assistive technology

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson objective</td>
<td>80%</td>
</tr>
<tr>
<td>Nature of the topic</td>
<td>50%</td>
</tr>
<tr>
<td>Severity of the impairment</td>
<td>50%</td>
</tr>
<tr>
<td>Age of onset of the impairment</td>
<td>30%</td>
</tr>
<tr>
<td>Experience of the learner</td>
<td>60%</td>
</tr>
<tr>
<td>Instructional materials available</td>
<td>90%</td>
</tr>
<tr>
<td>Functional vision of the student</td>
<td>100%</td>
</tr>
<tr>
<td>Other criteria (specify) content and level of disability</td>
<td>30%</td>
</tr>
</tbody>
</table>

The study findings show that the selection of appropriate assistive technology that suits individual needs of learners with visual impairments is based on various criteria. The term assistive technology (AT) is used here to mean any item, piece of equipment, or product system used to increase, maintain, or improve functional capabilities of a learner with visual impairment. Assistive technology devices and services such as computer screen-readers, when appropriately selected, aid learning for many students with visual impairments.

Table 4.12 shows that there are various levels of significance attached to different criteria used to select assistive technology to be used in the process of teaching and learning. The findings demonstrate that functional vision of the student was the most important factor to be considered when selecting assistive technology. This aspect of the learner was chosen by all (100%) of the teacher respondents as apriority factor.
Another very important factor considered when selecting the assistive technology, as was illustrated by the findings of this study, was the availability of instructional materials. This factor was supported by 90% of the teachers who participated in the study.

Four out five (80%) of the teacher respondents felt that lesson objective was a very important factor considered in identifying the assistive media that suits the individual educational need of the visually impaired learner. It was also established that experience of the learner was an important factor to be considered in identifying relevant and suitable teaching and learning assistive device for an individual learner. This factor was put forward by 60% of the teachers who took part in this study.

The findings of the study also indicated that the nature of the topic and severity of the visual impairment in the learner were very important factors that have to be considered when selecting a suitable assistive technology relevant to individual learner educational needs. These factors were each identified by 50% of the teacher respondents.

In addition, 30% of the teacher respondents also felt that age of onset of the impairment of an individual learner was a very important consideration to be made when selecting suitable assistive technology to be used for the purposes of advancing educational pursuit of a visually impaired learner.

Lastly, 30% of the teacher respondents had the view that other criterion apart from the ones mentioned above, could also influence assistive technology selection. These
criteria identified as others include institutional resource constraints, course content appropriateness, learner characteristics and skill levels.

4.6 Challenges Faced by Teachers and Students with Visual Impairment while Using Modern Assistive Technology

The fourth objective of the study was to find out the challenges faced by teachers and students with visual impairment while using assistive technology for students with visual impairment at Kibos Secondary for the Visually Impaired. To investigate this objective the research question; “Are there problems/challenges faced by teachers and learners while utilizing the new assistive technology media in learning for students with visual impairment at Kibos Secondary for the Visually Impaired?” was addressed. Questionnaires were administered to the teachers and students who participated in the study and were expected to express their views on the concept of assistive technology. The findings show that both teachers and visually impaired learners face a number of challenges in their acquisition and use of assistive technology.

4.6.1 Challenges Faced by Teachers

The findings of the study reveal that lack of adequate resources is a great impediment towards acquisition and provision of assistive technology. Just like in many schools in Kenya, Kibos Secondary for the Visually Impaired, have just a few computers in their laboratories for use by the students and teachers. The limited number of computers in the school causes a great challenge to access regular class schedules, thus restricting frequent computer lessons by all students.
The study findings show that lack of appropriate and adequate knowledge and skills in computer causes a great challenge to teachers in acquisition and use of computer. Majority of the teacher respondents held the view that most teachers do not have adequate computer knowledge and skills to use the relevant visually impaired programmes or teach the learners on their use. The implication of this is that effective use of computers as tools or equipment of curriculum delivery in terms of teaching and learning is interfered with because computers are located in the computer laboratory not in classrooms. Although the findings of the study show that computers are available at Kibos secondary for the visually impaired, they are under-utilized given teachers’ lack of the requisite skills and creativity to use them frequently and effectively in their teaching.

Another challenge faced by teachers, as established by this study, is that care and maintenance of the equipment and software which is essential is always inappropriate or insufficient. These equipment are delicate and require good care and regular servicing by trained personnel, which again could not be employed by the school due to insufficient resources.

The study findings show that another challenge faced by visually impaired teachers was difficulty in correctly identifying the specific needs of visually impaired learners. No single solution for access to technology is appropriate for every student with a visual impairment. Even students with the same visual loss may require instruction in different types of assistive technology based upon their unique needs. In particular, students with visual impairments may require assistive technology which may focus upon speech access, braille access, print access, or any combination of these access
modes. However, most of the teachers who participated in this study pointed out that majority of the teachers lacked appropriate skills to accurately identify the needs of these learners so as to select the appropriate assistive technology appliance.

### 4.6.2 Challenges Faced by Students

Just like teachers, the learners face a number of problems in utilizing the assistive technology media in learning. Their challenges were investigated by use of a questionnaire, designed in Likert-scaled format. The learners’ responses were summarized in frequency percentages as shown in Table 4.13.

**Table 4.13: Students’ responses on challenges facing application of assistive technology**

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistive technology is enabling us to enjoy and exercise human rights on equal basis with other individuals.</td>
<td>40.5</td>
<td>48.6</td>
<td>5.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Computer lessons are not enjoyable and should be scrapped out of the curriculum.</td>
<td>10.8</td>
<td>2.7</td>
<td>27.0</td>
<td>59.5</td>
</tr>
<tr>
<td>Our teacher does not attend to my problems in following practical lessons as I need more time to internalize the ideas with computer.</td>
<td>45.9</td>
<td>21.6</td>
<td>16.2</td>
<td>16.2</td>
</tr>
<tr>
<td>Computers are not enough in our laboratory; we waste time as a few students dominate using them regularly while some of us are missing.</td>
<td>67.6</td>
<td>24.3</td>
<td>2.7</td>
<td>5.4</td>
</tr>
<tr>
<td>The speech synthesizer is not easy to follow when talking; therefore, I can’t use the computer as required.</td>
<td>32.4</td>
<td>24.3</td>
<td>21.6</td>
<td>21.6</td>
</tr>
</tbody>
</table>
The study finding, as indicated in Table 4.13, shows that although significant majority, 89.1% (strongly agree: 40.5%; agree: 48.6%) of the learner respondents agree that assistive technology enables them to enjoy and exercise human rights on equal basis with other individuals, more than two thirds (67.6%) of them however observe that computers are not enough in their laboratory. They argue that they waste time as a few students dominate using them regularly while some of them are missing.

This fact was also supported by nearly a quarter (24.3%) of the learner respondents who also agreed that lack of adequate computers impede the full adoption of computer/ICT as an assistive technology for the visually impaired learners. True to the generally held notion that needs of the teacher for instruction and the needs of the student for access must be balanced with available equipment, inadequate number of computers poses a great challenge to both teachers and learners. For effective teaching and learning, students should have 1:1 access to computers. However, due to impairments, students use other senses to obtain information from the environment such as audio, tactile and magnification. Therefore, there are good reasons for individual computers to suit individual requirement.

Another challenge faced by the learners in the use of computers as assistive technology gadget was that some aspects of the computer e.g. the attached devices like mouse, keyboard and speakers may be defective, hence interfering with full functioning of the computer. For example, 56.7% of the learner respondents observed that the speech synthesizer is not easy to follow when talking; therefore, they cannot fully benefit from the computer as required. Although 21.6% of the learner respondents denied any failure with the speech synthesizer, it was evident that it
requires extra ordinary advance testing and preparations to ensure that the equipment are in use when need arises.

It also emerged that although nearly three out of five (59.5%) of the student respondents strongly denied that computer lessons were not enjoyable, 10.8% others strongly agreed that computer lessons were truly not enjoyable and should be scrapped out of their curriculum. This claim could have been due to inadequacy in their numbers associated with computers.

The results of the study also revealed that teachers do not attend appropriately to the problems of the students during practical lessons. This was revealed by over two thirds (67.5%; strongly agree: 45.9%; agree: 21.6%) of the students who took part in the study. They claimed that their teachers do not give them adequate time despite the fact that they need more time to internalize the ideas with computer. Only less than a fifth (16.2%) of the student respondents held the opinion that teachers attend appropriately to their problems.

4.7 Ways Teachers and Students with Visual Impairments Cope with the Various Types of Assistive Technology

Research shows that in secondary schools for the visually impaired in Kenya, there is general lack of technical skill to effectively use assistive technology devices and software. At Kibos Special Secondary School there was a teacher who had the skill on the use of assistive technology who taught all students. This creates monotony in the subject but classes were designed to fit the time at least twice in a week. Patience from the teacher and students is the guiding factor that has ensured continuity in the study. This concurs with Groenewegen (2005) who postulates that students in
Kenyatta University where he taught did not have skills to use assistive technology devices. The implication is that since students with visual impairment did not come from the same secondary school, many of them were not exposed properly to such skills due to lack of enough time to attend all students adequately or lack of enough computers and AT devices for early exposure. The school is managing the challenge by allocating learners specific amount of time for interaction with the computer. This is to ensure equity of access. The challenge of teachers being not skilled is dealt with by in-service training of teachers on the use of such devices for quality teaching.

### 4.8 Impact of Assistive Technology on the Educational Achievement of Students with Visual Impairment

The last research objective was to find out the impact of assistive technology on the educational achievement of students with visual impairment at Kibos Special Secondary. To investigate this impact, the researcher developed a questionnaire designed to determine the impact of assistive technology in the education of the visually impaired learner. In exploring the impact of assistive technology constructs, items were drawn relating to concepts which were important components of the impacts of assistive technology measurements. They were Likert-scaled item type questions, in which teacher respondents choose from 4-point score; strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD). Their responses were summarized as in Table 4.15.
Table 4.14: Teachers’ responses on impact of Assistive Technology

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Agree (%)</th>
<th>Agree (%)</th>
<th>Disagree (%)</th>
<th>Strongly Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology use is the way to go</td>
<td>70</td>
<td>20</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>A lot of work is covered as far as curriculum is concerned</td>
<td>40</td>
<td>20</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is high level interaction between the learning material,</td>
<td>40</td>
<td>50</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>learners themselves and the teacher through the assistance of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>assistive technology in expanding possibilities in practical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>subjects like geography, mathematics, physics, chemistry etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>40</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Through assistive technology the visually impaired are able to</td>
<td>30</td>
<td>60</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>gather more information in the curriculum independently.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistive technology motivates students with visual impairment to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>select science subjects and perform them well.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings of the study show that a large majority (70%) of the teacher respondents strongly held the opinion that use of assistive technology is the way to go, with another 20% of them agreeing that use of assistive technology should be enhanced in special schools such as Kibos Special Secondary for the Visually Impaired.
It emerged from the finding of the study that the use of assistive technology has great contribution to the curriculum coverage and completion; hence, it positively influences the educational achievement of students with visual impairment. To this end, 40% of the teacher respondents strongly agreed that a lot of work is covered as far as curriculum is concerned when using assistive technology equipped ICT facilities. This was supported by another 20% of the respondents who also agreed that coverage of syllabus content is enhanced when assistive technology is used. The constructivists support practical involvement of students to make learning interesting and worthwhile. Passive students don’t gain academically as required compared to active participation.

Nine out of ten (strongly agree: 40%; agree: 50%) teachers who took part in this study generally agreed that there was high level interaction between the learning material, learners themselves and the teacher through the assistance of assistive technology. This, they added, helps in expanding possibilities of quality performance in practical subjects like geography, mathematics, physics and chemistry; this was indicated by the fact that by use assistive technology, students with visual impairment could do assignments on their own, research for additional materials, do online assignments and also could do calculations using computers. Only 10% of the respondents negated the statement. It was equally observed by 50% of the respondents who strongly agreed that through assistive technology the visually impaired are able to gather more information in the curriculum independently. Their sentiment was also supported by 40% of the respondents.
The findings of the study show that, assistive technology motivates students with visual impairment to select science subjects and perform them well. This is illustrated in the table above where the majority of the respondents (strongly agreed: 30%; agreed: 60%) indicated that assistive technology motivates students to select science-related subjects and perform well in them. The results can be attributed to the fact that assistive technology helps students with visual impairment to read more notes outside teachers' notes, access mathematical formulas and also aid them in doing calculations.
CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This last chapter presents the summarized findings of the study. Subsequently, conclusions are made in view of the findings and recommendations proposed after conclusions.

5.1 Summary of the Findings

5.1.1 Assistive Technology Engaged in Teaching Students with Visual Impairments at Secondary Level

The findings on assistive technology used in secondary schools established that a number of assistive technologies were being used and there is a computer laboratory where computer lessons are conducted. On the issue of the computer having adequate adaptation to fully support learning of visually impaired students, a small number of teacher respondents disputed while majority of them believed that the assistive technology was well-adapted to support learning among the students with visual impairment.

5.1.2 Kind of Technology Used in Secondary Schools that Embrace Teaching and Learning of the Visually Impaired Students

Findings on the assistive technology used by students in schools for the visually impaired revealed that the Braille machine was the most frequently used, followed by computer, while the ipad was not common among students and teachers in the
learning process. Large print devices both optical and non-optical also featured during the teaching and learning process.

Majority of students admitted that computers when fitted with optical character readers, speech output, refreshable braille screen displays and braille printers allow them to participate in computer exercises and online research. Although ipads were not recommended by the majority of the student respondents to be given preference in education, a few who recommended it said that ipads are suitable as they possess built-in accessibility application related to vision, hearing, portability and comply with learning disabilities. ipads used by persons with visual impairments come with a screen reader that provides immediate access to applications and internet.

Findings on the instructional media available for learners with visual impairments in the classroom show that use of braille and large print materials were the most prevalent among the visually impaired. Other instructional media used were Braille books, slate and stylus, talking calculators, braille paper and optical low vision devices.

Findings on the use of computer assistive technology as the main media of their learning indicated that computer lessons were conducted twice for each form in a week. On the issue of motivation to learn computer, students admitted that the screen reader jaws made lessons interesting and was the most powerful tool among the visually impaired; other assistive technologies were the large print and the lunar that compelled students to comfortably use computers.
The findings on activities students engage in while on computer lessons were: leisure activities including playing games, linking to email, chatting in face book, linking to U Tube and twitter. Over seventy five per cent of the students believed that internet, through assistive technology, can benefit them academically. It is imperative from the findings to recognize the potential of assistive technology in education of students with visual impairments.

5.1.3 Criteria Used to Select the Best Assistive Technology that Suits Students with Visual Impairment

Findings on the criteria used to select best technology that suits student’s individual needs demonstrate that functional vision was the most important factor considered when selecting any assistive technology, followed by instructional media available, then lesson objective, experience of the student, nature of the topic, severity of visual impairment and the age of onset of the visual impairment in that order.

5.1.4 Problems/Challenges Facing Teachers and Students While Using Assistive Technology

Findings on challenges faced by teachers and students with visual impairments on the use of assistive technology revealed that limited number of computers available was a great challenge to access for regular class schedules hence restricting frequent class computer lessons. The other challenge is that majority of teachers are conversant with analog assistive technology but lack adequate skill to apply while using modern assistive technology. Care and maintenance of the equipment and software are always insufficient or inappropriate. Assistive technology and related equipment are delicate and require good and regular servicing. The other challenge faced by teachers is
teachers are not in a position to determine the type of application that their students need. Therefore, they seek consultations from manufacturers who may not be always accessible. Teachers also could not troubleshoot some application malfunctioning and would seek assistance of technician leading to time wastage.

5.1.5 The Impact of Assistive Technology on Educational Achievement of Students with Visual Impairments

Findings on the impact of assistive technology on educational achievement of students with visual impairment revealed that majority of the teacher noted that Jaws, non-visual desk top access, note takers, ipad, tablets, enlarged screen, smart braillers, audio books, smart phones and computers that are the necessary assistive technologies that should be availed to learning centres if the visually impaired are going to achieve educationally at the same level as other students without impairment.

According to the students and teachers involved in the study, the technology provides a better alternative way of students accessing information and knowledge independently, easily, quickly and frequently without bothering any other person as it has been the case in the past. It further emerged that the use of assistive technology has enormous contribution toward curriculum coverage and early completion, hence, positively influencing educational achievement on secondary school students. The study also supports the view that there is high interaction between the learning material, students themselves and the teacher through assistive technology. The general implication is that the potential of modern assistive technology is paramount, and immense in achieving quality education of students with visual impairments.
Therefore, should be given a trial in all schools and institutions implementing educational curriculum in Kenya.

5.2 Conclusion

From the findings of the study, schools of the visually impaired utilize the braille machine, abacus, embossers, thermoform, slate and stylus as major equipment of assistive technology. Current technology consisting of computers, ipads, ipods, smart braille machines which are more efficient, time saving and reliable are not common and well utilized by students with visual impairment due to scarcity, lack of resources to buy them, lack of the legal framework and policy to guide the teaching of such technology and lack of skilled teachers to offer such essential services to students. The urge for the global community to go digital and introduction of technology in many facets of life has made technology crucial in our time and more urgent to students with visual impairment who risk being left behind if the policy guiding and making technology for all a reality will not be drafted and implemented. It is from this kind of understanding the study emphasizes technology addressing issues of special needs as a necessary requirement especially for the visually impaired. Students with visual impairment compete fairly with those without special needs in education sector and job market.

5.3 Recommendations

In view of the above conclusions, the following recommendations have been made:

- The National government through the Ministry of Education Science and Technology should recognize the potential of assistive technology in supporting education achievement for students with visual impairment.
• Schools for students with visual impairment should be equipped with modern assistive technology which are less bulky, quick, easier to use and motivating as it encourages independence in learning.

• The best assistive technology is the ones which can support a student with a specific disability to access the general curriculum and later be independent in general functioning in any society. Therefore, there should be criteria for selecting such to ensure relevancy in individual student achievement.

• There should be teacher empowerment to ensure adequate computer literacy and assistive technology skills meant to teach students with visual impairment adequately.

• Teachers, students, parents, guardians and all stakeholders of institutions managing students with visual impairment should be sensitized about the enormous benefits associated with assistive technology so that everybody works towards embracing it for sustainable educational independence.

5.4 Suggestions for Further Research

• Research should be conducted to establish the role of the Government in provision of assistive technology to students with visual impairment.

• Research should be conducted to establish the best instructional strategies that can ensure better curriculum delivery in technology among students with visual impairment.

• A study should be carried out to establish measures to be put in place to ensure quality access to education among students with other types of disability.
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Appendix A

Informed Consent

My name is Oira Maaga a post-graduate student from Kenyatta University. I am conducting a study on assistive technology as a factor of improving educational achievement of students with visual impairment at Kibos Special Secondary School Kisumu County, Kenya. The information will be used by the Ministry of Education and Ministry Of Public Health and sanitation to improve access and quality for screening of students with visual impairment in assessment centres, hospitals as well as in other regions in Kenya.

Procedure

Participation in this study will require that I ask you some questions and also examine you in order to screen and provide the best assistive technology to access education. I will record information from you in a questionnaire and interview guide. You have the right to refuse participation in this study. You will get the same care academically and medically whether you agree or disagree to join the study.

Please remember that participation in the study is voluntary. You may ask questions related to the study anytime.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you provide or receive.
Discomfort and risk
Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at anytime.

Benefits
If you participate in this study, you will help us to learn how to provide effective assistive technology that will improve the education achievement of students with visual impairment and reduce the risk of being discriminated and left out from the rest of students in Kenya.

Confidentiality
The interviews will be conducted in a private setting within the school. Your name will not be recorded on the questionnaire. The questionnaire will be kept in a locked cabinet of the researcher.

Contact information
If you have any questions, you may contact Dr. Nzoka supervisor 1 on 0722 557421 or Dr. Otube supervisor 2 on 0727405421 at the Kenyatta University Ethical Review Committee secretariat on Kuerc@ku.a.c.ke.

Participant statement
The above information regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study any time. I understand that I will get the same care and educational nourishment whether I
decide to leave the study or not and my decision will not change the care I will receive from the assessment centre today or that I will get from any school/clinics at any time.

Name of student……………………………………………………………….

Signature   …………………………………………………………………..
Appendix B

Questionnaire for Teachers of Visually Impaired Learners

The purpose of this questionnaire is to search for information that will be used to provide a general description of the use of assistive technology in making information communication technology and the kind of technology used in Kenyan Secondary Schools relevant to teaching and learning of students with visual impairment.

Please respond to all questions honestly and accurately. The information given will be treated with utmost confidentiality. Your acceptance to answering this questionnaire will be highly appreciated.

Put a tick (√) in the appropriate bracket or simply write your answers in the spaces provided.

Section A

Background Information of the Teacher

Indicate the name of your school ________________________________

1. What is your appropriate age range?
   (a) 20 years and below [ ]
   (b) 21-30 years [ ]
   (c) 31-40 years [ ]
   (d) 41-50 years [ ]
   (e) 50 years and above [ ]
2. What are your academic and professional qualifications?

<table>
<thead>
<tr>
<th>Academic</th>
<th>Professional</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPE/CPE/KCPE</td>
<td>UT</td>
</tr>
<tr>
<td>KISE</td>
<td>P2</td>
</tr>
<tr>
<td>AECE/KCE/KCSE</td>
<td>P1</td>
</tr>
<tr>
<td>B-A</td>
<td>S1</td>
</tr>
<tr>
<td>B.ED</td>
<td>DIP ED</td>
</tr>
<tr>
<td>MA/MED/MSC</td>
<td></td>
</tr>
</tbody>
</table>

Any other specify ________________________________

3. What is your teaching experience of the visually impaired students?

(a) Less than 1 year [    ]
(b) 1-5 years [    ]
(c) 11-20 years [    ]
(d) 21-30 years [    ]
(e) 31 and above years [    ]

4. Are you trained to teach visually impaired learners?

(a) Yes [    ]
(b) No [    ]

5. Which subjects do you teach? Please state

____________________________________________________________________

6. Total number of lesson per week? ________________________________

____________________________________________________________________

7. What are some of the challenges/difficulties faced while teaching the visually impaired students in your subject? List: ______________________________
Section B

Technology used during the teaching learning process

1. Is the school having a computer laboratory?  (a) Yes [ ]  (b) No [ ]

2. Is the technology in the lab comp adapted to fit the needs of the students with visual impairment?  (a)Yes [ ]  (b) No [ ]

3. If your answer is number two is yes, indicate by ticking on the appropriate column whether the following access technology is available or not

<table>
<thead>
<tr>
<th>Assistive technology available</th>
<th>Available</th>
<th>Not Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Jaws Programme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Dolphin Pen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non visual desk to access NVDA daisy book</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talking books</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech compressor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro computers with speech synthesis and Braille input and output devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I pads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Megadots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Braille 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Braille translation software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window eyes intellitalk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. In the classroom, what is the major instructional media available for learners with visual impairment? Tick (√) where appropriate

<table>
<thead>
<tr>
<th>Instructional material</th>
<th>Available</th>
<th>Not available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braille writers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Braille books</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cramnier abacus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubelithm slate and cubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tylor frame and types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slate and stylus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactual maps and globes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talking calculators, clocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactile graphic kit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Templates and writing guides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brailled ruler, compass, protractor set squares etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opticon (optical-tactual – connector)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large print textbooks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markers and reading windows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Braille papers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactual diagrams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound balls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnifying glass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-D material (renlia and models)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telescope, microscope and binocular</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Utilization of assistive technology in classroom teaching

1. (a) Do you use the facilities with assistive technology in teaching?
   Yes [ ] No [ ]
   If No Give reasons for your answer ________________________________

(b) If your answer above is yes how often?
   More than once a week [ ]
   Once a week [ ]
   Once in two weeks [ ]
   One a month [ ]
   One a term [ ]
   Any other specify ________________________________

2. (a) What criteria do you use to select the appropriate assistive technology that suits individual needs of learners with visual impairment? Tick where applicable (√)

   (i) Lesson objective [ ]
   (ii) Nature of the topic [ ]
   (iii) Severity of the impairment [ ]
   (iv) Age of onset of the impairment [ ]
   (v) Experience of the learner [ ]
   (vi) Instructional materials available [ ]
   (vii) Functional vision of the student [ ]
(viii) Any other criteria (specify) ____________________________
___________________________________________________

(b) For each of the above criteria ticked, justify its consideration by making a statement.
(i) __________________________________________________
(ii) __________________________________________________
(iii) __________________________________________________
(iv) __________________________________________________
(v)  __________________________________________________
(vi) __________________________________________________
(vii) ________________________________________________
(viii) ________________________________________________

3. (a) Specify how your students utilize assistive technology in classwork
(i) Individual mono tasking
(ii) In pairs or small groups
(iii) Whole class in one entity
(iv) Only teaching using assistive technology equipped facility when the lesson is in progress.

Any other (specify) __________________________________

4. (a) What is the mode of communicating content in your subject area?
(i) Lecture method [ ]
(ii) practical/project work [ ]
(iii) Demonstrations [ ]
(iv) Class discussion [ ]
Section C

1. Challenges facing teachers and students
   (a) List some of the problems you encounter while acquiring assistive technology in your class of visually impaired students

2. How do you cope with the challenges posted by assistive technology (List them).

D. Impact of assistive technology in the education of the VI

1. Technology use is the way to go. Tick (✓) one of the appropriate statement
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]
2. A lot of work is covered as far as curriculum is concerned when using assistive technology equipped ICT facilities.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]

3. There is high level interaction between the learning material, learners themselves and the teacher through the assistance of assistive technology is expanding possibilities in practical subjects like geography, maths, physics, chemistry etc.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]

4. Through assistive technology the visually impaired are able to gather more information in the curriculum independently.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]
5. There is high practical subject selection and passing through the assistance of independent reading through use of assistive technology among visually impaired learners in secondary schools.

(a) Strongly agree [ ]

(b) Agree [ ]

(c) Disagree [ ]

(d) Strongly disagree [ ]
Appendix C

Questionnaire for Learners who are Visually Impaired

This questionnaire seeks for information about the use of modern assistive technology in facilitation/enhancing of learning by the visually impaired learners and perception of information communication technology. Kindly respond to all questions honestly and accurately. Any information given will be treated confidentially. Do not write your name, put a tick (in the bracket ( ) or write your answer in the space provided.

Personal Information

(a) Name of the School

(b) Form

(c) Age

1. What is the nature of your disability?
   (a) Total blindness [ ]
   (b) Low Vision [ ]

2. Were you born with sight? Yes [ ] No [ ]
   (i) If the answer in (2) above is no at what age did you lose your sight

3. What is your mode of reading?

4. Name some of the equipment and tools you use when reading and writing

______________________________________________________________________________________________
5. (i) Tick some of the items that you use in your writing and reading during your free time.

(a) Computer [ ]
(b) ipad [ ]
(c) Braille machine [ ]
(d) Slate and stylus [ ]

Any other (specify) ________________________________

(ii) Which of the items above do you recommend to be given preference in your education system and why?

________________________________________________________________________

________________________________________________________________________

Access Technology and Use

1. (a) Do you have computer lessons? Yes [ ] No [ ]
   (b) If yes where do you learn them ________________________________

2. (a) Is there a computer laboratory in the school?
   Yes [ ] No [ ]
   (b) How many computers are there? ________________________________

3. How many times do you visit the computer laboratory in a week?

________________________________________________________________________
   (b) What motivates you to use the computer regularly? Tick where applicable. Availability of __________

   (i) Jaws
   (ii) Large print access like in large and lunar [ ]
   (iii) Intellitalk [ ]
4. What are some of the activities that you do while in the computer laboratory?

Tick appropriately

(i) Chat in facebook [ ]
(ii) Link to the email or gmail [ ]
(iii) Access the news [ ]
(iv) Play games [ ]
(v) Link to the U-tube [ ]
(vi) Joins twitter and tweet [ ]

5. (a) Do you use computer to revise or do assignment given to you?

Yes [ ] No [ ]

(b) If yes, list the subjects that you find it easier to get information from the internet while revising

______________________________________________________________
______________________________________________________________

6. Do you believe that the internet through assistive technology can benefit you academically?

Yes [ ] No [ ]

If your answer is No give reasons ________________________________

______________________________________________________________
______________________________________________________________

(iv) Write out loud [ ]
(v) Window eyes [ ]
(vi) Megadots [ ]

Any other specify ________________________________
Impact of modern Assistive Technology on Education of Visually Impaired Learner/Student

1. Since the time I knew how to access information in the computer I have ____

   Tick where applicable

   (i) Dropped in most subject areas [ ]
   (ii) Improved in most subject areas [ ]
   (iii) Gained self confidence [ ]
   (iv) Known how to link up with the outside community [ ]
   (v) Can revise for exams independently [ ]
   (vi) I have been opened up socially [ ]

2. Through independent revision using the computer in which subject have you improved? ____________________________________________

3. What do you suggest can be done to enable you enjoy using the computer most ____________________________________________
   _______________________________________________________

Challenges Facing Learners in the Area of Information Communication Technology. Using Likert Scale

1. Assistive technology is enabling us to enjoy and exercise human rights on equal basis with other individuals.

   (a) Strongly agree [ ]
   (b) Agree [ ]
   (c) Disagree [ ]
   (d) Strongly disagree [ ]
2. Computer lessons are not enjoyable and should be scrapped out of the curriculum.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]

3. Our teacher does not attend to my problems in following practical lessons as I need more time to internalize the ideas with computer.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]

4. Computers are not enough in our laboratory; we waste time as a few students Dominate using them regularly while some of us are missing.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]

5. The speech synthesizer is not easy to follow when talking; therefore, I can’t use the computer as required.
   (a) Strongly agree [   ]
   (b) Agree [   ]
   (c) Disagree [   ]
   (d) Strongly disagree [   ]
Appendix D

Interview Schedule for Transcriber and Librarian

1. For how long have you worked as a transcriber and librarian? ___________

2. Where were you trained? ____________________________

3. Do you have any skills in Braille? ______________________

4. What is unique in handling students with visual impairment in computer?

5. What are your contributions in promoting ICT in students with visual impairment?

6. Tick on the assistive technology that you find popular with students in your school

   (i) Jaws

   (ii) Dolphin pen [ ]

   (iii) Intellitalk [ ]

   (iv) Screen magnification [ ]

   (v) Screen readers [ ]

   (vi) Write out loud [ ]

   (vii) Window eyes [ ]

Any other specify ________________
6. How are computers and the assistive technology acquired in this school? Tick
Where necessary.

(i) Donation by CCK [ ]
(ii) Donation from NGOs [ ]
(iii) Bought by parents [ ]
(iv) Government provision [ ]
(v) Through harambee [ ]

Any other specify __________________________________________

8. How often do teachers of this school visit the computer laboratory? Tick

(i) Every day/daily [ ]
(ii) Twice a week [ ]
(iii) Thrice a week [ ]
(iv) Fortnight [ ]
(v) Once a month [ ]

9. What kind of service do you provide teachers when they visit the laboratory?
_______________________________________________________________
_______________________________________________________________

10. How frequent do students come to the lab to practice?_______________

(a) What service do you offer to students? _________________________

11. How do you measure the ability of visually impaired students in computer
skills?__________________________________________________________
12. Which problems face learners when using the computers?

____________________________________________________________________

____________________________________________________________________

13. Are these skills in computer contributing to the learning of these students?

Tick. Yes [ ] No [ ]

If no give reasons ______________________________________________________

____________________________________________________________________
Appendix E

Observation Schedule for the researcher

To be used in class as the lesson progress

1. General Information
   (a) Name of School ________________________________
   (b) Form ________________________________
   (c) Number of students total blind _______ Low vision _______
   (d) Subject _______ Lesson _______
       Time _______ Objective _______

Teachers Section
   (a) List down the assistive technology that you utilized in training.
       ___________________________________________________________________
       ___________________________________________________________________
       ___________________________________________________________________

   (b) Comment on how students interact with the assistive technology while
       the lesson is on.
       ___________________________________________________________________
       ___________________________________________________________________
       ___________________________________________________________________

   (c) Are students independently doing their work effectively?
       ___________________________________________________________________
       ___________________________________________________________________
       ___________________________________________________________________

   (d) What can be done to improve the use of computer in such school?
       ___________________________________________________________________
(e) Do you face any challenges as a teacher? Comment

_________________________________________________________

(f) What is your advice to the Ministry of Education and the government in general about computer access to students with visual impairment?

_________________________________________________________
Appendix F

Research Authorization Letter

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
  224349,310571,2219420
Fax: +254-20-318245,318249
Email: secretary@nacostigovke
Website: www.nacostigovke
When replying please quote Ref No.

NACOSTI/P/15/0345/5609

Maaga Oira
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Assistive technology as a factor of education achievement for students with visual impairment at Kilos Secondary School Kisumu County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Kisumu County for a period ending 28th March, 2016.

You are advised to report to the County Commissioner and the County Director of Education, Kisumu County before embarking on the research project.

On completion of the research, you are required to submit two hard copies and one soft copy in pdf of the research report/thesis to our office.

Said Hussein
For: Director General/CEO

Copy to:

The County Commissioner
Kisumu County.

The County Director of Education
Kisumu County.

Appendix G

Research Permit

THIS IS TO CERTIFY THAT:
MR. MAAGA OIRA
of KENYATTA UNIVERSITY, 0-40100
Kisumu, has been permitted to conduct
research in Kisumu County

on the topic: ASSISTIVE TECHNOLOGY
AS A FACTOR OF EDUCATION
ACHIEVEMENT FOR STUDENTS WITH
VISUAL IMPAIRMENT AT KIBOS
SECONDARY SCHOOL KISUMU COUNTY,
KENYA

for the period ending:
28th March, 2016

Applicant’s
Signature

Director General
National Commission for Science,
Technology & Innovation

CONDITIONS

1. You must report to the County Commissioner and
the County Education Officer of the area before
embarking on your research. Failure to do that
may lead to the cancellation of your permit
2. Government Officers will be interviewed
without prior appointment.
3. No questionnaire will be used unless it has been
approved.
4. Excavation, sampling and collection of biological
specimens are subject to further permission from
the relevant Government Ministries.
5. You are required to submit at least two(2) hard
copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to
modify the conditions of this permit including
its cancellation without notice.