EFFECT OF ASSISTIVE TECHNOLOGY ON TEACHING AND LEARNING OF INTERGRATED ENGLISH AMONG VISUALLY IMPAIRED LEARNERS IN SPECIAL SECONDARY SCHOOLS IN KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

I dedicate this thesis to the dear brethren in Higher Ground Ministries International and dear Lamjingshai. Your prayers and encouragement were very instrumental in pursuit of my PhD.

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ABBREVIATIONS AND ACRONYMS

AA	Alternative and Augmentative Communication
ABC	African Braille Centre
ASSIST	All Students in Supported Inquiry based Science with
AT	Assistive Technology
ATFSCP	Assistive Technology Funding and System's Change Project
ATP	Assistive Technologies Programme
B/V I	Blind or Visually Impaired
CBR	Community based Rehabilitation
CEC	Council for Exceptional Children
CWD	Children with Disabilities
GSB	Ghana Society for the Blind
IDEA	Individual with Disabilities Education Act
IEP	Individual Education Programmes
JAWS	Job Access with Speech
KIEP	Kenya Integrated Education Programme
KICD	Kenya Institute of Curriculum Development
KISE	Kenya Institute of Special Education
LV	Low Vision
NACOSTI	National Commission for Science, Technology and Innovation
NGO	Non-governmental Organizations
OTA	Office of Technology Assessment
SEN	Special Education Need

SpED	Special Education Division
SPSS	Statistical Package for Social Sciences
SSI	Sight Savers International
SST	Sight Savers Tanzania
TEA	Tanzania Education Authority Technology
TLB	Tanzania League for the Blind
V I	Visually Impaired
WHO	World Health Organization

ABSTRACT

The study aimed at investigating effect of assistive technology on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya. The objectives of the study were to determine the extent to which compatibility,trialability,observability, complexity and relative advantage of Assistive Technology affects teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya. The research design was descriptive research design. The target population was 4 principals, 48 teachers and 480 students.The sampling techniques were simple random sampling and purposive sampling.The sample size was 4 principals, 48 teachers and 218 students, yielding sample size of 270. The data was collected using questionnaires, observation schedule and focus group interviews. The data was analyzed quantitatively using Statistical Package for Social Sciences and qualitatively using content analysis. Compatibility of an Assistive Technology significantly affects teaching and learning of integrated English among visually impaired users. In the second objective, results indicated that complexity of AT significantly affect teaching and learning of visually impaired learners.The trialability of AT statistically significantly affects teaching and learningof visually impaired learners.In objective four, observability does not statistically significantly affect teaching and learning of visually impaired.The relative advantage of Assistive Technology does statistically significant affect teaching and learning of integrated English among the visually impaired.The Observability of AT does not affect teaching and learning of visually impaired learners but compatibility, complexity, trialability and relative advantage affects teaching and learning of visually impaired learners.The management should make an assessment of how compatible an AT device.They should carefully consider how easy to use or understand AT before adoption. The management should test AT before they are used by learners. They should consider observability but not as much as the other variables. It would be important for management to consider whether an AT would be value to the users before they are purchased by the school.Therefore to enhance teaching and learning of visually impaired, it is important for school management liaising with Ministry of Education and other stakeholders such Sights Savers, Kenya Institute of Special Education to consider compatibility, trialability, complexity and relative advantage of Assistive Technology.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

In the world there have been rapid increases of visually impaired persons cases in need of assistive technology especially with the fast growing information and communication technological trends. World Health Organization (WHO) estimates that the number of visually impaired will double from 180 million to 360 million by 2020 unless a joint action is made to curb the menace and also provide visually impaired persons with assistive technology (WHO, 2009).

It is the right of every visually impaired person to have access to equal quality education same as that of sighted learners (United Nations, 2006).To bridge the gap in regard to access of quality education between sighted and the visually impaired students, government who are members of the United Nations must then come up with feasible policies that create equality and quality education for both sighted students and visually impaired students.With information communication technology domineering teaching and learning in the world today there is a dire need for assistive technology to compensate the visually impaired. The assistive technology enables visually impaired learners to be able to accomplish what they could not without the Assistive Technology.

United Nations defines assistive technology as “technology adapted or specially designed to improve the functioning of people with disabilities” (Borg, Lindstrom, & Larsson, 2009). Assistive Technology (AT) is a broad concept, covering anything that might be used to compensate for lack of certain abilities (Reed & Bowser, 2005).This ranges from low-tech like grip for a pens, to more advanced items like hearing aids and glasses, to high-tech devices such as braillers and computers with specialized software for helping persons to read (WHO, 2009; Petty, 2012).

Assistive Technology (AT) is an interdisciplinary field of knowledge comprising products, resources, methodologies, strategies, practices and services (Petty, 2012). These are aimed at promoting the functionality of visually disabled people with regard to autonomy, quality of life and social inclusion. The term assistive refers to a technology that enables a visually impaired person to do what he/she cannot do without these devices (Cook & Hussey, 2002).

The barriers to successful and effective use of AT devices relate to several factors, such as limited financial resources (Fifield & Fifield, 1997), high cost of equipment (Wehmeyer, 1998), a lack of knowledge and support from teachers (Alper & Raharinirina, 2006) and eligibility issues for possessing devices (Zhang, 2000). According to Johnson (2011), lack of knowledge and awareness among people with disabilities, reluctance to use the devices, poor device performance, changes in needs or priorities, and feelings of stigmatization were the main reasons for the underuse of assistive technology devices.

The United States Office of Technology Assessment (OTA) published a report in 1997 on Technology and Handicapped people, which recognized the potential of assistive technology in compensating for functional limitation and extending the capability of people with disabilities (Galvin, 1997).The Individual with Disabilities Education Act (IDEA) of amendments required assistive technology devices and services to be considered in the Individualized Education Programmes (IEP) process in order to meet educational goals (Turnbull, 2005).

Jwaifell and Gasaymeh (2013) study of Jordan school basing on complexity variable found that all participants found Interactive White Board to be easy to use.A lack of compatibility in AT with individual needs may negatively affect the individual's AT use (McKenzie, 2001). Compatibility is the extent to which an AT can be used with other ATs and also is usability by the learners. Hoerup (2001) describes that each innovation influences student opinions, beliefs, values, and views about teaching. According to Rogers (2003), trialability is the degree to which an innovation may be experimented with on a limited basis.

Scherer and Galvin, 1996 hypothesis of their study was that there is a relationship between assistive technology discontinuance among individuals with disabilities and a combination of independent variables (relative advantage, support, consumer involvement, trialability, changes in consumers, re-invention and compatibility).

According to study by Hussin (2013) in Malaysian, some VI students described experiencing technical difficulties when using Digital Talking Textbooks (DTTs). These difficulties discouraged the use of DTTs. This finding is consistent with a study by Holcombe (2000), who concluded that an innovation with less complexity has a higher possibility of being adopted than an innovation with complicated features. Problem poses where new books that uses latest software, have to first be converted to a version that can be interpreted to be compatible with the screen reader devices. This takes lengthy time putting visually impaired students not to be at par in terms of syllabus coverage with their peers who are sighted students.

Three classifications based on visual acuity measures have been offered by (World Health Organization, 1993) as follows; Low vision: Less than 6/18 but better than 6/60 Severe low vision: Less than 6/60 but better than 3/60 . Blind: Less than 3/60 to No Light Perception (NPL). This report enabled the manufacturer of ATs for VI to develop devices that addresses the need for each class of VI.

Kelley (2008) investigated AT use among students who are visually impaired in the U.S.A. The study estimated the level of assistive technology experience with text-to- speech devices and screen reading software nationwide and some of the contextual circumstances that may have contributed to the use of this special technology for the blind. The key finding of the study was that the vast majority of students with visual impairments in the U.S.A were not using enough assistive technology. Instead, majority of the students used braille.

Given the diversity of AT for persons with visual impairments, teachers in the U.S.A were unfamiliar with the diverse types of AT available for specific needs. Students may require AT for support including speech access; Braille access; large print access; tactile communication systems, or any combination of these modes. In addition, teachers understood AT, Information Communication Technology and web educational packages designed for general instruction to be collectively understood as AT. Not knowing what AT devices are available and the variable understanding of general applications result in AT not being fully adopted and utilized to benefit students. While all teachers possessed limited skill and knowledge in AT, a handful of teachers emerge as champions of AT to varying degrees. This undermines the effective implementation of AT by the teachers denying the learners an equal platform with the sighted learners. It also poses a challenge in equitable distribution amongst the 3 VI categories as classified by WHO.

The Performance Contract consists of the disability mainstreaming indicator. This to ensure employers' reserve 5% of employment to persons with disabilities who are qualified and provide reasonable accommodation to facilitate their working environment and also ensure any employee who acquires a disability is provided the appropriate assistive technology. The academic success of students who are blind or visually impaired, whether in special, integrated or inclusive school settings depends on a variety of factors. Among these is their ability to access the classroom curriculum. Curriculum access for visually impaired students requires provision of books and resource materials. However, these need to be provided in an appropriate format for example Braille, large print, e-text and audio at the same time and at the same level including book edition (Kelley et al, 2001).

In essence, assistive technology has potential to be the "great equalizer" for persons with visual impairments (Michaels & McDermott, 2003). Given the necessary AT for the inclusive learning the student was able to perfectly learn at par with the sighted students. The examples of assistive technology integration (or lack of it) point to the pressing need for a comprehensive response from the education in the community. Individuals with disabilities, parents, districts and states desperately need, and are aggressively seeking, guidelines for effective integration of assistive technology (Hart, 2000).

Many career opportunities requiring access to visual information are now accessible to those who have visual impairments through the application of appropriate technology. It is generally accepted that assistive technology has positive impact on the lives of the person with visual impairments (Kapperman, Sticken, &Heinze, 2002; Strobel, Fossa, Arthanat & Brace, 2006). However, the advance in technology on the other hand has been cited as a factor for declining Braille use and Braille literacy (Spungin, 1989). In addition, assistive technology omits grammatical structure, spelling and traditional text formats. Therefore, as assistive technology market continues flourishing with devices and software that make the visual world significantly more accessible to person with visual impairment, educators need to evaluate their applicability and effectiveness to literacy related needs.

Research indicates that there have been numerous problems in the use of AT for the blind in learning institutions (D'Andrea, 2010). There has been lack of piloting in schools for the blind before implementation of assistive technology. D'Andrea (2010) affirms that despite the federal regulation that AT services should be provided in learning institutions, half of high school students with visual impairment were not provided AT services. One of the problems emanates from lack of technical skills to use some of the AT devices and software.

According to Kelly and Smith(2011), in general Assistive technology can enable students who are visually impaired to achieve educational success and gain competitive employment by providing tools for increased independent access to information and for effective communication. The current challenge is to provide appropriate access to and instruction on blindness and low vision specific assistive technology through individualized assessment of assistive technology needs, appropriate instruction in the use of assistive technology as tools, and equitable distribution of assistive technology. Assistive technology has a positive impact on the lives of individuals with visual impairments (Cooper & Nichols, 2007; Kapperman,Sticken, &Heinze, 2002; Strobel,Fossa, Arthanat, & Brace, 2006).

Kapperman, Sticken and Heinze (2002) demonstrated that approximately 60 percent of the academic students with visual disability in Illinois who could have benefited from the use of special technology for individuals with visual disability were not receiving that opportunity. Bennett and Bennett (2003) showed that trialability, compatibility, relative advantage and complexity influenced faculty members’ likelihood of adopting a new technology into their teaching. A study in Canada examined how one can help students with special needs use assistive technologies to smoothly transit from elementary to secondary school (Specht, Howell & Young, 2007).A Norwegian study examined how environmental factors, braille and assistive technologies affect the learning and literacy of 11 severely visually-impaired students (Vik, 2008).

The study came to a conclusion that when an AT environment is enhanced the student performed equally and 6 of them better than their sighted, low, vision and partially blind student.

In Australia, a survey conducted indicated that most visually impaired learners attend public funded schools (Jolley, Steer, Gale & Gentle, 2001). Respondents' estimates revealed that there were approximately 4,500 students who were visually impaired attending Australian public and private sector primary and secondary level systems or agency educational programmes. Out of the 4,500 students reported, some 2,700 did not have an intellectual disability that precluded them from using print or braille to attain literacy and numeracy. Estimated numbers by gender indicated that 755 were female and 1,845male (Åke, Nena & Hannu, 2010). When high latest version of AT in Australian public schools was introduced and a policy of maintenance and monitoring introduced there was great migration of VI students from private schools to public schools and also high level of enrolment of VI learners.

According to a report (Tamru,2005) 90% percent of the world blind people live in developing countries of which 9 million in India, seven million in Africa, and 6 million in China, Ethiopia, Sudan and Liberia, DRC Congo,Eritrea,Somalia sustaining the large percentage of visually impaired in Africa. The most vulnerable being the youth. In light of this report the youth age range from 14-35yrs high percent revolving around those of school going age. To bridge the divide of teaching and learning between the already existing reality of VI learners and the sighted learners there is great need to offer a level playing ground especially in Africa which lacks the resources required due to poor resource management and prevalent poverty levels.In South Africa, Gale and Cronin (1998) have argued that educational goals for students who are blind or vision impaired should be the same as for other students, with some modifications and adaptations according to individual needs. This is in order to address the compatibility and complexity of Assistive Technology to both the user and environment.

The rapid development of information Communication Technology (ICT) has impacted on the education sector in South Africa. According to Microlink (2015) Assistive Technology delivers greater inclusivity in the education and working environment by empowering individuals to achieve their true potential. The outcome of AT provision and training have empowered the VI people to live work and study on equal playing field.

Nasser (2015) states that the provision of AT mostly the learning Access Suite in South Africa through microlink have seen class room benefit from an added dimension of learning and development support especially with severe cases of visual impaired students.The learning Access suite creates a more inclusive engagement for learners and providers educators/teachers with the means to support their students more effectively,enhancing teaching and learning of VI learners.The focus has shifted to the increasing use of ICTs to address teaching, learning and administrative needs (Archer, 2003; Engelbrecht, Oswald and Eloff, 2003), even for visually impaired learners.

The Integrated Education Project (IEP) was set up by Sight Savers, Ghana, the Special Education Division (SpED) and the Ghana Society for the Blind (GSB). The programme successfully integrated a totally blind student into a mainstream school in Hohoe District, Volta region (Michaels & McDermott, 2003). Given the necessary AT for the inclusive learning the student was able to perfectly learn at par with the sighted students. Therefore creating an all new environment of inclusive class where the students were able to perfectly adapt to the environment of the sighted given the new AT.

In East Africa, according to Sight Savers Tanzania's annual review report (2010), less than 10 percent of children who are blind or visually impaired (B/VI) or have low vision (LV) receive any kind of schooling. Realizing the effectiveness of assistive technologies in education for people with disabilities, Tanzania Education Authority (TEA), Tanzania League for the Blind (TLB) and Sight Savers Tanzania (SST) have been working very closely since 2009 to ensure the "Dolphin Pen" project which started in Kenya is scaled up in Tanzania so that students with visual impairment also benefit. Tanzania Education Authority, Tanzania League for the Blind and Sight Savers Tanzania jointly developed an "Assistive Technologies Programme" which began March 2011 (SST Annual Review Report, 2010). According to Tanzania Annual report (2013), Digital talking books did not enhance a good environment in a classroom situation. In the preliminary studies this issue emerged and a need to research on relative advantage, compatibility and complexity emerges as key.

The World Health Organization (WHO) estimated the number of persons with visual impairment in Kenya would be 620,000 by 2011 (WHO, 2009). In Kenya Society for the Blind (KSB) in partnership with the Ministry of Education and Sight Savers, the Kenya Integrated Education Programme (KIEP) has made EFA a reality for learners with visual impairment. This in response to the WHO report.

Piloting of Dolphin pen project began in February 2001 in Kenya; Nairobi, Eastern and rift valley provinces then before the county scenario came about with the new constitution. Dolphin pen is a mobile screen reader in the form of USB stick that can be used in any computer. The Dolphin pen magnifies text and provide a synthetic speech which give visually impaired students the same access to textbooks and basic information technology as their sighted peers. The project involved 41 visually impaired secondary students and 78 visually impaired trainer at 8 institutions. The institutions were equipped with a sight savers dolphin pen and refurbished laptop or access to a desktop computer(SST Annual Review Report, 2010).

According to the survey 10% of VI learners attend secondary schools, while out of 76%, 25% of VI learners attend primary schools. This is despite relatively well developed inclusive education system (Williams, 2013). According to the study the sight savers Dolphin pen costs approximately 150USD which is equivalent to 15,000 Kshs. In Kenya Sight Savers has been promoting inclusive education.

According to Victoria (2015) of Sight savers, school curriculum has been changing regularly with recommended text books changing almost on a yearly basis. This phenomena poses a great challenge for learners with visual impairment as producing a single text book in Braille takes over four months, thus students often finish a whole year without appropriate text books. This indicates that there is absolutely no level platform with the sighted students.

Ntemana and Olatokun (2012) reported observability had the highest influence on attitude of lecturers toward using information communication technology. Mugo (2013) established that the Blind and visually impaired students in Kenyatta University used the AT for the blind to perform various tasks including writing notes using braille machines and braille papers, using computers to type their work and communicate through emails and even browsing using screen readers for academic materials.

There are few policies and legislative approaches that promote the development and adoption of assistive technologies in Kenya. These include and are not limited to; The Constitution of Kenya (2010), Persons with Disabilities Act (2003), The United Nations on the Rights of Persons with Disabilities (UNCRPD) of (2006), and the Millennium Development Goals (MDGs). These legal frameworks ensure universal design of mainstream technologies. With these legal frameworks in place, the government of Kenya has seen many persons with disabilities get employment in higher positions e.g. County Commissioners, Governors and also senior management positions at the work place, Constitution (2010), Persons with Disabilities Act (2003).

The Kenyan government's education policies and goals are geared towards achieving Education for All (EFA) by 2015 in tandem with national and international standards. In an effort to achieve these goals, the government launched a special needs education policy framework in 2010 (Republic of Kenya, 2010).

The Government of Kenya in2003 passed the Persons with Disability Act (PDA). The ACT was designed to prohibit all manner of discrimination against persons with disabilities. In education matters, Section 18 of the PDA stipulates that: "no person or learning institution shall deny admission to a person with disability to any course of study by reason only of such disability, if the person has the ability to acquire substantial learning in that course; Learning institutions shall take into account the special needs of persons with disabilities with respect to the entry requirements, pass marks, curriculum, examinations, auxiliary services, use of school facilities, class schedules, physical education requirements and other similar considerations” (Kenya Law Reports).

However, under the requirements the government did not consider specifics such as cost of the infrastructure, influx of knowledge and a dynamic technology. For the VI learners to adapt and fit in must have AT’s modified and compatible to their individual VI classification and environment.

In an effort to address the issues and challenges around the provision of ICT-related services to persons with disabilities (PWDs), in Kenya the Communication Commission of Kenya (CCK) facilitated a multi-stakeholder workshop on "E-accessibility for Persons with Disabilities" on May 2012. Furthermore, during the Workshop, the Commission launched the Kenya Disability Web Portal an initiative of the Commission in Partnership with the United Disabled Persons of Kenya (UDPK), the National Council for Persons with Disabilities (NCPWD) and other stakeholders.

According to Kenya Institute of Special Education (KISE) some special schools have AT but in others they are not available or adequate due to cost. According to Ministry of Education (2012)there are 4 high schools for the blind in Kenya; Salvation Army School for the Blind,Thika, St. Lucy’s High

School for the visually impaired (Meru), Salvation Army special secondary School Kibos (Kisumu) and St Francis Kapenguria, of which the study covered all the four. These four public secondary schools for the blind caters for the 46 counties in Kenya.

This study focused on the four only public special secondary schools rather than mainstream school because the special secondary schools are expected to have put some measures in place to facilitate teaching and learning of visual disability students. Most studies have been done in America and Europe but few in African context. The empirical studies mentioned in the background have not determined the effect of AT on a subject area apart from Bisi (2013) who studied impact of AT on visually impaired student performance in Kiswahili in public primary teachers college. The AT were not available or adequate in all special secondary schools in Kenya.

1.2 Statement of the Problem

In 2015, the Ministry of Education (MOE) released a report which indicated that only 21 percent of visually impaired children were attending school. This indicates that the majority,79 percent, of visually impaired children do not have access to education. It is estimated that there are approximately 15,500 visually disabled children of school going age in Kenya. The MOE report(2009)shows that 1527 children were attending special schools and 1637were attending integrated /inclusive schools in Kenya. This case scenario shows that only 3164 (21percent)visually impaired learners are attending schools, meaning that 12336(79 percent)learners are out of school.

A Sight Saver review (2015) on how effective are current system for supporting education for children with visual impairment reported that the ratio of crucial ATs and the visually impaired learners in Kenyan school needed to be bridged. The study showed that the majority of the learners were out of school due to the complexity and incompatibility of ATs. Thus, there is need to establish how compatibility and complexity affect teaching and learning of VI learners.

According to the Sight savers report (2015) the difference between the VI learners and the ATs available was big where 5 learners had to use a dolphin pen in one computer in a class of fourty six. This needed research data to validate it. The Kenya Institute of Special Education has assistive technology such as Duxbury Braille Translator, dolphin pen and jaws for windows (Ministry of Education, 2012). These technologies are too expensive and are not available in all schools. This indicates there is a problem of teaching and learning of visual impaired students due inadequacy or unavailability of AT. The Kenya Institute of Special Education has assisted in facilitating availability of AT devices in some schools but have not been effectively utilized to enhance teaching and learning among visually impaired students(Sight savers report, 2015).

Flood (2013) cites accessibility of equipment from the libraries and KISE learning resource center as a major setback to effective learning of visually impaired. He also asserts that there is need to train on the very current ATs, for despite having Dolphin pen, Jaws for windows, tutors and students were still using braillers. Thus there was need to determine the relative advantage of latest AT versions with those that are being used currently for example upgrade of windows 7 to 10.According to Bisi (2013) assistive technologies such as talk book were available but inadequate in public primary teachers college in Kenya.

There have been conflict in empirical studies on AT and therefore this study sought to determine the effect of AT in teaching and learning of integrated English among visually impaired learners in special secondary school in Kenya. Integrated English used as focus of study because it employs the four skills: Reading, Writing, Listening, Speaking. Diverse ATs are used more in integrated English than other subjects.

1.3 Purpose of the Study

The purpose of the study was to investigate the effect of assistive technology on teaching and learning of integrated English amongst visually impaired learners in public special secondary schools in Kenya.

1.4 Objectives of the Study

The study sought to achieve the following objectives:

i) To examine the extent to which compatibility of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

ii) To establish the extent to which the complexity of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

iii) To examine the extent to which trialability of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

iv) To establish the extent to which observability of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

v) To examine the extent to which relative advantage of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

1.5 Research hypotheses

The study sought to test the following hypotheses.

H_{01}: There is no significant relationship between compatibility of Assistive Technology and teaching and learning of integrated English among the visually impaired learners

H_{02}: There is no significant relationship between complexity of Assistive Technology and teaching and learning of integrated English among the visually impaired learners.

H_{03}: There is no significant relationship between trialability of Assistive Technology and teaching and learning integrated English among visually impaired learners.

H_{04}: There is no significant relationship between observability of Assistive Technology and teaching and learning of integrated English among the visually impaired learners.

H_{05}: There is no significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visually impaired learners.

1.6 Significance of the Study

The findings of the study would help the Ministry of Education, Kenya in improving on inclusive type of an education aiming at ensuring teaching and learning. This study could be useful in informing government policies especially related to education of visually impaired learners. This study could be important in the management of various secondary schools on how they can integrate assistive technology in teaching and learning.

The results of study would be assist in coming up with ways to assist visual impaired students in improving their performance in integrated English and other subjects by use of AT. The study would also add to the body of knowledge on effect of AT devices in teaching and learning of visually impaired students. The study would form a basis for further research in Assistive technology especially in developing countries.

1.7 Limitations of the Study

The researcher faced the challenge of effective communication with visual impaired students. This was overcome by the principal and teachers organizing for assistive devices such as JAWS for windows for learners, to ensure the researcher was able to collect all the necessary data from the respondents.

Highly bureaucratic process of getting access to government authorities and rigid rules that protects the visually impaired institutions and mostly the visually impaired learners was a barrier. Given permits from the county director of education and ministry of education special needs department authorization and the parents representative consent on visually impaired learners was obtained to enable the researcher obtain the data.

Dynamic change in technology in the period of the research and also terms that have to do with the visually impaired, was a challenge because the researcher had to make sure is updated with current ATs information. To overcome this challenge the researcher had to consult the specialist in ATs and bodies that oversee the visually impaired education apart from the ministry of Education for example Sight Savers and Kenya Society for the blind.

1.8 Delimitations of the Study

Delimitations explain the boundaries the researcher imposes prior to initiating a study and are important to narrow the focus of a study (Creswell, 2009).The study was carried out in all the four public special secondary schools in Kenya. The study delimited itself to effect of assistive technology on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya**.** Other factors that affect the teaching and learning of visually impaired learners such as social structure shifts, demographic changes and educational reforms were left out so as to focus on AT and relationship with teaching and learning.

1.9 Basic Assumptions of the Study

The study was based on the following assumption:

That respondents were conversant with assistive technology. The researcher assumed that the respondents; Principals, teachers and students understood what assistive technology is. There were therefore expected to understand the application and importance of AT in teaching and learning.

1.10 Operational Definition of Significant Terms

The following terms were used as defined in the context of the study

Assistive Technology a device that would assist visually impaired learners in teaching and learning of integrated English

Compatibility It is the extent to which an assistive technology would be able to work with other devices being used by the visually impaired learners

Complexity is the extent of how simple or complex an AT is to the visually impaired learners in public special secondary school in Kenya.

Integrated English It is combined English and literature in teaching and learning of VI learners in special public secondary school in Kenya.

Observability this is about how the visually impaired learners are able to value the results and adopt the AT e.g JAWS for windows.

Relative advantage it is about whether the AT would enable visually impaired students in special secondary school, to be in a better position in teaching and learning

Trialability is about whether it is possible to test an AT before purchasing it.

Special Secondary Schools refers to schools set aside to meet the demands and needs of children with special needs which for this study it is the visually impaired students.

Visual impairment refers to both blindness and low vision.

Teaching and learning: Teaching is the process of disseminating knowledge and learning is the process of internalizing the acquired knowledge

1.11 Organization of the Study

The study is organized into five chapters. Chapter One comprised of introduction, the background to the study, statement of the problem, purpose of the study, objectives of the study, research hypotheses, and delimitations of the study, assumptions of the study, definition of significant terms and organization of the study. Chapter Two covers literature review with subsections of on critical issues in AT integration, theoretical and conceptual framework. The Third chapter is research design and methodology and consist of design of the study, location of the study, study population, sampling procedures, description of research instruments, reliability and validity, administration of research tools and data analysis techniques. Chapter Four covers data analysis, interpretation and discussion while Chapter Five contains the summary, conclusions, recommendations and suggestions for further studies.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviews literature on Assistive Technology in teaching and learning among the visual impaired learners. The chapter discusses definition of assistive technology, earlier studies on assistive technology in teaching and learning, summary of literature review, summary of gaps, theoretical and conceptual framework.

2.2 The Concept of Assistive Technology

Assistive technology refers to the devices and services that are used to increase, maintain, or improve the capabilities of a student with a disability (Dell, Newton, & Petroff, 2012; Abbott, 2007 ;Abbott et al, 2011).The foundation For Assistive Technology (FAST) defines AT as any product or service designed to enable independence for disabled and older people (FAST,2001). The British Educational Communication and Technology (BECTA) defined AT as their software and technology which helps people with disabilities and special needs to overcome the additional barriers they face in communication and learning (Becta, 2003; Acaimpesd, 2011; Kilda, 2008).Assistive technology is an interdisciplinary field of knowledge comprising products, resources, methodologies, strategies, practices, and services that aims to promote functionality for people with regard to visual disability independence, quality of life, and social inclusion (Cook, 2002; Adcet, 2011; Kitching & Jackson, 1997).

Bryant and Bryant (2003) grouped assistive technologies into seven categories, these include positioning and seating, mobility, augmentative and alternative communication, computer access, adaptive toys and games, adaptive environments, and instructional aids. However, Reed and Lahm (2005) categorized assistive technologies into thirteen categories based on the task for which each is useful: computer access, motor aspects of writing, composing written material, communication, reading, learning/studying, math, recreation and leisure, electric aids for daily living, mobility, vision, hearing and vocational. Wong and Cohen (2011) did general classification of assistive technology devices as a spectrum of equipment, from high to low tech that which can be applied in writing, reading, access to computers, communication, mobility and leisure.

According to Georgia's Assistive Technology (2011) the low tech devices do not require intensive training and are inexpensive. Low -tech devices examples are handheld magnifiers, large print texts, and canes. High tech devices are more sophisticated tools requiring special training to use the devices effectively. The devices are more expensive such as voice recognition, digital hearing aids, electronic organizers and communication devices with voices.

The American Foundation for the Blind classifies the types of assistive technology for students who are blind or low vision into four main categories, as shown in Table 2.1 (Presley & D’ Andrea, 2008; Afb, 2012; Koenig & Holbrook, 1993).

Table 2.1: Types of Assistive Technology for Students with Visual Impairments

Types of Technology	Devices
Technology for accessing print material	Large print, reading stand, acetate overlays, lighting, handheld and stand magnifiers, telescopes, video magnification systems, scanning and optical character recognition (OCR) systems, electronic whiteboards, Braille reading, tactile graphics, digital talking books, e-book readers, talking calculators, talking dictionaries
Technology for accessing electronic information	Large monitor, adjustable monitor arms, cursor-enlarging software, screen magnification software, accessible personal digital assistant (PDA), large print, online dictionaries, refreshable Braille displays, touch tablet, text reader, self-voicing applications, e-book reader, digital voice recorder
Technology for producing written communications	Felt-tip pen and bold marker, dedicated word processor, imaging software, drawing software, math software and spreadsheets, slate and stylus Braillewriter, electronic Braillewriter, Braille translation software, Braille embosser, accessible PDA

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. Specifically, students with visual impairments may require assistive technology which may focus upon speech access, braille access, print access, tactile communication systems, or any combination of these access modes. Determination of access mode(s) must be guided by skilled specialists in the education of students with visual impairments who have comprehensive expertise in blindness and low vision specific assistive technology and who can also access individual learning characteristics (Augusto & Schroeder, 1995; Ahrc, 2002; Koenig, 1996).

These specialists must collaborate with other special educators, general assistive technology specialists, general educational technology specialists, and educational evaluators to conduct thorough diagnostic evaluations to determine the specific needs of students with visual impairments. Then they must insure that those needs are met by planning, implementing, and continuously monitoring instruction in the use of appropriate technology, including sufficient training in the efficient use of specific technology (Smith, & Andersen, 2010; Alande & Eni, 2005; Leibs, 1999). Students with visual impairments must have access to and instruction with blindness and low vision specific assistive technology tailored to individual unique needs, learning styles and visual abilities.

Edyburn (2002) found that only 29 percent of 221 articles found explicitly referred to specific disability. There was 23 percent in the same review conducted one year later (Edyburn, 2003). According to (Jeff,etal.,2006; Alty, et al., 2006; Locke et al., 2004; Lynch, 2007) stressed on the importance of parental involvement to overcome barrier to adoption of AT. Community, family, school partnerships can provide avenues to cross the barrier, that face implementation of AT and literally learning in schools.

While the phrase assistive technology may makes some people think of computers and computerized devices, assistive technology can also be very low-tech. For example, pencil-grips (the molded plastic grips that slip over a pencil) are considered assistive technology. This study delves on high tech ATs that have relative advantage to those of low tech e.g. of high tech include JAWS, Dolphin pen and Learning Access Suite. Assistive technology that helps students with learning disabilities includes computers programs and tablet applications that provide text-to-speech (Kurzweil 3000), speech-to-text (Dragon Naturally Speaking), word prediction capabilities (WordQ), and graphic organizers (Inspiration). Some students with visual impairments have access to a wide range of blindness and low vision specific assistive technology devices, while others have none at all (Kelly, 2008; Alves, et al., 2009; Mbugua, 2012; McREL, 2004).

In addition some students with VI have access to teachers who are well-prepared to deliver special instruction in blindness and low vision using specific assistive technology, while others do not (Abner & Lahm, 2002; Apple, 1995). In comparison to other interventions, assistive technology may have a significant effect in helping students with disabilities progress towards the goals outlined on their Individual Education Plans (Watson, Ito, Smith, & Andersen, 2010; Atkins, 2009; Mendez-Shannon, 2010). This is in line with the current study. Assistive technology helps in two ways: it can help the student learn how to complete the task and it can help to bypass an area of difficulty. For example, when a student decides to listen to a digital version of a book, they are bypassing an area of difficulty. However, if the student focuses on the computer screen as highlighted words are read aloud, they can learn unfamiliar words.

The aim of technology is to improve the lives of human beings. Persons with visual impairments are no different and require the use of assistive technology (AT) to compensate for their vision loss. Some of the high-tech AT used by persons with visual impairments in today's technologically advanced world consist both hardware and software products including screen readers, screen magnifiers, closed-circuit televisions, electronic magnifiers, scanners and optical character readers, portable and refreshable Braille displays, digital and electronic data, digital readers, and accessible cell phones. No matter the diversity of devices, the power of AT as an enabler in the lives of students with disabilities is unequivocally reported .Yet the literature reports that students with disabilities and their teachers are underutilizing the AT available to them (Kelly, 2009; Smith, Kelley, Maushak, Griffin-Shirley, & Lan, 2009; Wong & Cohen, 2011; Baker, 1992).

Alper and Raharinirina (2006), in a comprehensive review of the literature on AT, concluded that individuals with disabilities are not fully benefiting from the use of AT in home, school and community settings. The researchers identified key shortcomings in the awareness, integration and education of professionals of AT in school settings. Other areas of concern included inadequate support and services for training for parents and lack of partnerships and collaboration among teachers, families, service providers and researchers. This is echoed with findings of students with visual impairments in the US.

In study of Illinois visually impaired students, 60% of students with visual impairments were not benefitting from AT (Kapperman, Sticken, &Heinze, 2002; Barendregt, et al., 2008; Miles, 1994). In another study, the figure was between 59% and 71% of students who were inclined to benefit from AT but did not have the opportunity to use it (Kelly, 2009; Miller, 1983).As much of teaching is, and will be delivered through technology, it is imperative that individuals with disabilities, in this case, students with visual impairments, are not left behind as Singapore seeks to “enrich and transform the learning environments of our students and equip them with the critical competencies and dispositions to succeed in a knowledge economy” (Ng, 2008). This study is significant as it is the first study of its kind to investigate the AT use of students with visual impairments and their teachers.

2.2.1 Assistive Technology and Visually Impaired Students

The benefit of using AT in teaching and learning has been studied (Hussin, MohdNor, & Suhaimi, 2008; Leporini, 2007; Martins, Steil, &Todesco, 2004; Pal, Vallauri, &Tsaran, 2011; Bart et al., 2011). It is generally accepted that assistive technology has a positive impact on the lives of individuals with visual impairments (Cooper & Nichols, 2007; Kapperman, Sticken, & Heinze, 2002; Strobel, Fossa, Arthanat, & Brace, 2006; Beacham & Alty, 2006). This is supported by this study in that all the five variables: relative advantage, complexity, compatibility, trialability and observability are put into consideration when using AT. It becomes an equalizer of teaching and learning for VI learners with their sighted peer.

However, most of the assistive technology devices that are used by individuals with visual impairments are deemed effective. Empirical studies showed that AT have a positive effect on students with visual disabilities (Cooper & Nichols, 2007; Kapperman, Sticken, &Heinze, 2002; Strobel, Fossa, Arthanat, & Brace, 2006; Beddington et al., 2008), and developing positive relationships in their academic performance (Huang & Russell, 2006; Trucano, 2005; Beigel, 2000). Assistive technology has positive effect on students' learning, especially, increasing reading speeds and comprehension rates (Corn et al., 2002; Howell, 1996; Kennedy, 2002; Merbler, Azar, &Ulman, 1999; Bera, 2011). Assistive technology is essential for students with visual disabilities to enhance learning, cognition, and social development (Sze, Murphy, Smith, &

Yu, 2004; Wong & Cohen, 201l; Berfield, 2003). This study supports the above studies especially by Copper (2007) and Russel (2006) in that AT especially Dolphin Pen would increase the chances of adoption and has a positive effect on students learning especially increasing their speed of reading.

The manual braillewriter is considered effective (or as having had a positive impact on education) because it has provided individuals with visual impairments with access to information (through the ability to write braille) faster than the slate and stylus (Kennedy, 2002; Black, 2011; Mugo et al., 2010). It may be true that the manual brailler is faster than the slate and stylus because of the obvious inherent characteristics of the two assistive devices. However, this sort of anecdotal evidence is not sufficient for other types of assistive technology (for example, two screen reading software applications compared with each other or two electronic note taking devices compared with each other (Wong & Cohen, 2011; Bohman & Anderson, 2005; Opin, 2012).

Assistive technology can be used in two ways: to support learning and to bypass a challenging task such as handwriting. In order to be effective, assistive technology needs to be embedded within quality instruction. According to Kelly and Smith 2011 the extent to which the field has researched on the effect of assistive technology used by students who are visually impaired on teaching and learning using rigorous, scientific-based methods is close to nonexistent. Thus this study examines the effect of AT on teaching and learning of integrated English among VI learners in public special secondary school in Kenya. The aim of technology is to improve the lives of human beings. Persons with visual impairments are no different and require the use of assistive technology (AT) to compensate for their vision loss. Some of the high-tech AT used by persons with visual impairments in today's technologically advanced world consist both hardware and software products including screen readers, screen magnifiers, closed-circuit televisions, electronic magnifiers, scanners and optical character readers, portable and refreshable Braille displays, digital and electronic data, digital readers, and accessible cell phones. No matter the diversity of devices, the power of AT as an enabler in the lives of students with disabilities is unequivocally reported (Kelly & Smith, 2011; Botelho, 2010).

More than half the 256 articles (156) that identified assistive technology that was used for classroom-based educational interventions by students who are visually impaired were discussions of theories, beliefs, or practices; product reviews; or product evaluations without research designs or methods. Despite the certainty of the worthiness and contribution of this large segment of research, no measure of the effectiveness or impact of the assistive technology on educational performance was presented in any of these articles (Kelly and Smith 2011; Peterson, 2002). Specifically, 48% of the articles were discussions of a theory, belief, or practitioner-based concept, and 13% were discussions of product reviews or evaluations. The knowledge base regarding assistive technology and education of individuals with visual impairments was shown to be largely devoted to this topic area. Of the 121 articles that discussed a theory, belief, or practice related to education-based assistive technology without a research method, a major portion included students with additional disabilities.

A large percentage of the literature consists of anecdotal evidence of the impact of assistive technology without evaluating the effectiveness of AT. Curriculum integration is the process of incorporating assistive technology devices to enhance teaching and learning. It is the implementation step to facilitate the use of assistive technology. It is a very key step because if carried out effectively it is expected to enable the visually impaired students to do what they could not have done without the assistive devices. Integration process requires innovation to ensure that the AT devices are relevant to the visually impaired students in teaching and learning process (Singal, 2008; Bps, 2009; Powell, 1969; Parisot, 1995).

Terms such as mainstreaming, integration, and inclusion have been used interchangeably to describe the educational movement of teaching students with and without disabilities in the same settings. According to Skrtic, Sailor, and Gee (1996) inclusive education means that "special education is no longer defined as a placement but as a system of supports provided to help address the needs of students with disabilities” (p. 150). The Individuals with Disabilities Education Act (IDEA, 2004) requires that children with disabilities, to the maximum extent appropriate, are provided a free and appropriate education (FAPE) in the least restrictive environment (LRE) and have access to the general education curriculum [IDEA Section 612 (a)(5)(A)].

Alper and Raharinirina (2006), in a comprehensive review of the literature on assistive technology concluded that individuals with disabilities are not fully benefiting from the use of assistive technology in home, school and community settings.

The researchers identified key shortcomings in the awareness, integration and education of professionals of assistive technology in school settings. Other areas of concern included inadequate support and services for training for parents and lack of partnerships and collaboration among teachers, families, service providers and researchers. This is echoed with findings of students with visual impairments in the US. In one study, 60% of students with visual impairments were not benefitting from assistive technology AT (Kapperman, Sticken, & Heinze, 2002; Brown, 1992). In another study, the figure was between 59% and 71% of students who were inclined to benefit from AT but did not have the opportunity to use it (Kelly, 2009). Assistive technology can improve teaching and learning in inclusive classrooms in various ways (Kleiman, 2010, Buhler, 2001; Santally, 2011).

All students with visual impairments are entitled to the independence and efficiency afforded by technology, including assistive technology. Appropriate assistive technology enables students who are visually impaired to access information and to complete tasks efficiently, thereby enabling them to achieve the highest level of independence possible. Emerging research suggests that technology promotes acquisition of literacy, provides more equal access to information required for employment, and for access to information, in general, and facilitates social and community networks (Kelly & Smith, 2011; Butterworth et al., 2011; Sarstedt, 2011, Schmidt, 1995).

Lowenfeld (1973) determined that there were three primary issues facing individuals with visual impairments: access to information, independent travel, and a lack of meaningful experiences. Assistive technology is used by individuals with visual impairments to compensate for these limitations. Assistive technology can enable students who are visually impaired to achieve educational success and gain competitive employment by providing tools for increased independent access to information and for effective communication(Kelly, 2008; Calder, 2010; Scholl, 1986). The current challenge is to provide appropriate access to and instruction on blindness and low vision specific assistive technology through individualized assessment of assistive technology needs, appropriate instruction in the use of assistive technology as tools, and equitable distribution of assistive technology. Access to and instruction with assistive technology must be driven by individual needs, not by logistical constraints such as availability of equipment, location or model of service delivery, or funding restraints(Hatton, & Erickson, 2008; Carney et al., 2003; Sherry, 1997). Currently, some students with visual impairments have access to a wide range of blindness and low vision specific assistive technology devices, while others have none at all (Kelly, 2008; Cast, 2011, 2012). Also, some students with visual impairments have access to teachers who are well-prepared to deliver special instruction in blindness and low vision specific assistive technology, while others do not (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman, Sticken, & Heinze, 2002; Murphy, Hatton, & Erickson, 2008; Parker et al., 1990; Sahfi, Zhou, Smith, Kelley, 2009; Smith, Kelley, Maushak, Griffin-Shirley, &Lan, 2009; Change, 2012). This inequity must be eliminated.

To assure that appropriate assistive technology devices and instruction are available to students, educational teams must carefully assess students' needs are considering both current and future needs and must specify goals and objectives for meeting these needs on the individual education plan, including intensity of instruction, who will provide the instruction, and the specific type of assistive technology required. As specified in IDEA (2004), school districts must assure that all students have equitable access to assistive technology devices and instruction as documented by the individualized education program.

2.2.2 Classification of Assistive Technology in education

Assistive technology can be classified into magnification types, text to speech,braille display,tactile images,portable reading devices,audio graphic calculator,large key calculators and electronic braille.Magnification-there are four types of magnification: relative-size (large format, bigger manipulatives), relative-distance (material presented closer to the student), angular (lens-based magnifiers), and projection (camera-based electronic magnifying devices). Specialized lighting-lamps and lights with various types of illumination may enhance the visibility of the working surface. Material positioning devices-page holders, book holders, or book stands, and slant boards enable better positioning of the material to decrease distance, angle or glare. Audio support-software or hardware that gives information through auditory channel in addition to the primary channel whether it is visual or tactile(Turnbull, 2005; Charman, 2012; Skrtic et al., 1996; Smith et al, 2001; Smith, 2008).

Text-to-Speech- software that converts digital text into audio. It is implemented in talking programs, like word processors, or is part of read aloud imported text. Portable reading devices- Hardware that supports various formats of audio text. Information may be stored either as audio files on media cards, or as soundtracks on CDs. Large key calculators-oversized numbers to accommodate vision needs. Audio graphic calculator- software or hardware they give students with visual impairments visual and auditory access to graphing capability(Sticken, & Heinze, 2002; Checkley et al., 2010; VanKraayenoord, 2007, Van Laarhoven et al., 2007).

Braille keyboard stickers make keyboard labels tactually accessible stickers with Brailled characters can be used. Power Chord Braille Keyboard is a computer keyboard based on 6 Braille keys with additional function keys. SIXIN is computer software that turns six home row keys into Braille keys allowing a student who is not proficient with QWERTY keyboard to type on the computer. Narrator (PC), VoiceOver (Mac) is a computer operating systems come with built-in voice output applications to support access. Third party screen reading software – full-fledged speech output program that gives full access to computer systems and menu-driven programs and applications(Edwards & Lewis, 1998; Chen et al., 2009; Winter, 1989).

Braille display is hardware devices that show up to one computer line at a time in Braille. As the user moves around the computer screen, tiny solenoid pins on the display raise and lower to form the Braille character of each computer screen character. Braille Writer is a special typewriter that produces immediate text in Braille as it is being typed Electronic Braille note-taker -a device with numerous functionalities used to input, store, and output text either in Braille or print. Depending on the model, note takers may have Braille or QWERTY keyboard, speech only output, or speech and Braille output (Kleiman, 2010; Chickering & Gamson, 1991).

Electronic Braille typewriters- a tool that is a combination of Braille Writer and electronic note-taker. It produces an immediate hardcopy of Braille, allowing prior insertion and proofreading of text. Tactile images-graphical information created and tactile format that is accessible for blind people. There are a number of methods to create tactile images. Some may require specialized equipment, while others can use low-tech materials. Tactile-audio - overlays and devices link to a computer to output audio information assigned to a specific area in the overly that is put over a touch sensitive board. Signmaker are a device that helps create Braille labels to be used for marking all kinds of objects(Laga, Steere, & Cavaiuolo, 2006;Cision, 2012).

Braille compass – a directional device with a raised arrow; Braille characters indicate the four directions of the world. Talking GPS are positioning tools that verbally inform a person about the current position and the route. Manipulatives are toys, shapes, models, and other objects to support learning process. They may be used as a replacement for images. Adapted games - board or computer games specially design to accommodate vision loss. Swing cell is a tool that assists instruction in Braille. Beeper ball or other acoustic ball is a play balls with sound-generating elements. Voice output measuring and household devices various kinds of adapted appliances with speech output and/or tactual markings, talking management software. Talking typing instruction software are programs to assist in keyboarding instruction(Ng, 2008; Collins, 1994; Connel et al., 1997).

Talking dictionary/large print is a hardware or software tools to assist in language related tasks. Word-prediction software – programs that support composition of sentences. Organization tools are software or hardware to facilitate organization and learning material management. Tactile-audio systems are haptic devices that enhance tactile exploration. 3-D images for concept development is a tactual images to complement or supplement textual information (Smith & Anderson; Cook & Hussey, 2002; Cook et al., 2002).

2.3 Availability of Assistive Technology

All students with visual impairments are entitled to the independence and efficiency afforded by technology, including assistive technology. Appropriate assistive technology enables students who are visually impaired to access information and to complete tasks efficiently, thereby enabling them to achieve the highest level of independence possible (Kleiman, 2010; Cooper, et al., 2008).

Emerging research suggests that technology promotes acquisition of literacy, provides more equal access to information required for employment, and for access to information, in general, and facilitates social and community networks (Kelly & Smith, 2011; Cotton & Evans, 1990).Although often educators use a range of supplementary aids and services to teach students with disabilities along with their non-disabled peers, many educators are not sufficiently familiar with assistive technology and how to use it effectively

(Margolis & Goodman, 1999; Cowenfeld, 1951). The 1990s saw a continuous growth in the integration of visually disability students and the piloting of Community- Based Rehabilitation (CBR) programmes for persons with disabilities through the mobilization of resources at community level and the assistance of NGOs (Ghana Education service, 2005; Cramer et al., 2011).Assistive technology are hardware and software products such as screen readers and voice recognition products that provide essential accessibility to computers for those with significant vision, hearing, learning and physical impairments.

The following are some few examples of the types of assistive technologies that provide reasonable accommodations for various types of disabilities(Kelly & Smith, 2011; Creswell, 2008, 2012).Text-to-speech (TTS) applications, such as JAWS, BookWise (Elkind, Cohen, & Murray, 1993) and Kurzweil 3000 (Laga, Steere, &Cavaiuolo, 2006) are screen readers that read aloud everything on computer screens, including text, pull-down menus, icons, dialog boxes, and web pages. Studies by Elkind et al., (1996) found out that adults using the TTS system reading performance improved but this were dependent on the user's severity of the disability. However, studies investigating the use of TTS for teenagers with severe reading disabilities, Farmer, Klein, and Bryson (1992) found no significant improvements with use of the system. Braille embossers transfer computer generated text into embossed Braille output.

Braille translation programs convert text scanned-in or generated via standard word processing programs into Braille, which can be printed on the embosser. Refreshable Braille displays provide tactile output of information represented on the computer screen, Microsoft (2012). Color Overlays according to Evans (2001) work by changing the background color of text from white to another color, which causes readers with visual stress to report less difficulty with sustaining reading and fewer incidences of headaches and eye strain.

Studies show that use of overlays improves reading rate and accuracy Jeanes et al., (1997). Also the optimal color for an overlay differs across from person to person, requiring the need to carefully select an appropriate color per person (Jeanes et al., 1997; Smith & Wilkins, 2007; Dautenhan, 1999). Optical character recognition (OCR) system allows users to scan printed documents, convert them into digital text and also serve as tools for correcting translation errors. However, the scanning process can be time-consuming since this is typically done one page at a time (Laga et al., 2006; Davis et al., 2010), and OCR is highly sensitive to the resolution and background color of the text being recognized (Bigham, et al , 2006; Day & Edwards, 1996).

Electronic Dictionaries often recommended for people with learning disabilities are specialized, portable devices that allow users to look up unfamiliar words on demand (Raskind & Higgins, 1998, De La Paz, 1999). Studies suggest that the use of dictionaries may improve reading comprehension among students with learning disabilities and are also included in some TTS systems like Kurzweil 3000 thereby obscuring the actual effect of the dictionary alone (Laga et al., (2006). Text Windows is a piece of cardboard with a small window cut-out to limit the amount of text seen at a time Pepper & Lovegrove (1999). The window size can range to show only one or two words at a time to one line of text or more. This approach is believed to help decrease interference level from the immediate words and therefore improving the reading speed and accuracy.

Pepper & Lovegrove (1999) suggest that single-word displays may be a viable accommodation, but it should be noted that they do not assess reading comprehension. Text Telephones (TTYs) are the telephones that people with hearing impairments use to communicate with others on the telephone. TTY/TDD conversion modems are connected between computers and telephones to allow an individual to type a message on a computer and send it to a TTY/TDD telephone or other Baudot equipped device Microsoft (2012).

Alternative input devices allow individuals to control their computers through means other than a standard keyboard or pointing device. Examples include: Alternative keyboards, Electronic pointing devices. Light signaler alerts monitor computer sounds and alert the computer user with light signals. This is useful when a computer user cannot hear computer sounds or is not directly in front of the computer screen. As an example, a light can flash alerting the user when a new e-mail message has arrived or a computer command has completed Microsoft (2012 (Laga et al., 2006; Dewsbury et al., 2004).

Estimates from the Ghana's Ministry of Manpower Development and Employment suggest that less than two percent of children with Special Education Need (SEN) and/or a disability are serviced through special schools and children who gain access to these schools are primarily residing in urban areas. A commonly used approach is cooperation of several different NGOs, each with their specific areas of expertise. Sight Savers have piloted several approaches on the use of computers in schools. The pilot programmes have been based on the use of recycled computers (supplied free by computer Aid) and the purchase of various versions of talking software such as Jaws, Dolphin pens, Microsoft (Lynch, 2007; Dwards, 2012; Edyburn, 2006, 2010, 2012).

In 2007 Sight Savers International (SSI) launched an AT for visually impaired learners' pilot project in Kenya. This is a project working towards advancement of AT for the blind and low vision learners in secondary and tertiary institutions. Sight Savers is committed to the integration of children with visual disability into mainstream education and supports the Special Education Division (SpED) in the area of capacity building to enhance its ability to monitor report and promote the integration of this disability group (Laga et al., (2006). The Kilimani Primary school in Kenya and the Mwereni

School in Tanzania were provided with a specific assistive technology called Sight Savers Dolphin Pen, which is a cooperative effort between Sight savers International and Dolphin. The main concern is to what extent are the assistive device having an effect on teaching and learning?

Access to and instruction with assistive technology must be driven by individual needs, not by logistical constraints such as availability of equipment, location or model of service delivery, or funding restraints. Currently, some students with visual impairments have access to a wide range of blindness and low vision specific assistive technology devices, while others have none at all (Kelly, 2008; Elliot & Gibbs, 2009; Elliot et al., 2003). Also, some students with visual impairments have access to teachers who are well-prepared to deliver special instruction in blindness and low vision specific assistive technology, while others do not (Abner & Lahm, 2002; Edwards & Lewis, 1998; Kapperman, Sticken, & Heinze, 2002; Murphy, Hatton, & Erickson, 2008; Parker et al., 1990; Sahfi, Zhou, Smith, Kelley, 2009; Smith, Kelley, Maushak, Griffin-Shirley, & Lan, 2009; Farr, 2010; Farr et al., 2010a). This inequity must be eliminated.

To assure that appropriate assistive technology devices and instruction are available to students, educational teams must carefully assess students' needs considering both current and future needs and must specify goals and objectives for meeting these needs on the individual education plan, including intensity of instruction, who will provide the instruction, and the specific type of assistive technology required. As specified in IDEA (2004), school districts must assure that all students have equitable access to assistive technology devices and instruction as documented by the individualized education program (Farr et al., 2010b).

Assistive technology devices enable individuals with disabilities to participate in society as contributing members. These devices are also credited with helping individuals with disabilities achieve optimal functional ability and independence (Phillips & Zhao, 1993). Furthermore, technology is recognized as a means for individuals with disabilities to access the mainstream society (Uslan, 1992) and as a mode to potentially equalize the capabilities of persons with and without disabilities (Scherer, 1993; Fast, 2001; Fowler, et al, 2007). According to the National Center for Health Statistics, more than 17 million Americans used an assistive technology device in 1994 to accommodate for impairment (National Center for Health Statistics, 1997, November 13).

The increase in assistive technology use may be attributed to the federal laws passed which support funding for assistive technology devices and services. Although these laws increase the accessibility of assistive technology, many recipients are dissatisfied with devices and services. Dissatisfaction typically results in discontinuance of assistive technology devices. A national survey on technology abandonment found that 29.3% of all devices obtained were abandoned (Phillips & Zhao, 1993). Discontinuance of assistive technology represents a waste of time and money. There is however, limited research documenting factors related to assistive technology discontinuance from consumers' perspectives. It is important to gain an understanding of these factors to aid professionals in designing assistive technology service delivery techniques.

Assistive technology can improve teaching and learning in inclusive classrooms in various ways (Kleiman, 2010; Fritz & Barner, 1996).Research demonstrated, however, that individuals with disabilities are not often given the opportunity to try out assistive technology devices prior to purchasing them. For instance, Parette, VanBiervliet and Holbrook (1990) found that almost half of the individuals with visual impairments sampled were unable to try out their devices prior to purchasing them. Individuals denied the opportunity to try out technology before purchasing it must rely on the judgment of the professional who selects the device for them (Parette & VanBiervliet, 1992; Fuller & Applewhite, 2011).

Theoretically, and pragmatically, trialability has been noted as an effective means to prevent technological discontinuance and promote ongoing use (Parette & VanBiervliet, 1992; Galajdova, Majenik & Simsik, 2005). It has not, however been fully incorporated into the process of distributing technology to individuals with disabilities.The degree to which technology is changed or modified by a user in the process of its adoption and implementation is termed re-invention (Rogers, 1995). Many individuals with disabilities have devised additions or modifications to their devices to meet their unique needs (Zola, 1982; Gale et al., 1998). As a result of re-invention, technology can become more appropriate in meeting an individual's present needs and more responsive to future needs that arise (Rogers, 1995; Gardner & Edyburn, 2000; Gaudkrodger & Lintott, 2007). Although re-invention was studied extensively from a broad theoretical perspective in the diffusion of innovations theory, empirical research relating re-invention to continued use of assistive technology by individuals with disabilities is nonexistent (Gersten & Edyburn, 2007)

Professional support (change agent contact') is also a factor related to ongoing use of technology in the diffusion of innovations theory (Rogers, 1995). Rogers indicated that professional support is one of the variables most highly related to continued use of technology. Additionally, research on assistive technology contends that individuals with disabilities without support are typically less successful than those who have it. For instance, individuals without social support often discontinue technology (Scherer, 1993b) with a loss of functioning, learning capacity, employment and/or quality of life (Galvin & Wobschall, 1996; Gersten et al., 2005). Support services in the form of device training (Raskind, 1993; Scherer, 1993a; Scherer & Galvin, 1996; Gindis, 2003), and device maintenance (Batavia, Dillard, & Phillips, 1990;

Scherer & Galvin, 1996; Tewey et al., 1994; Giusti et al., 2011) were also documented as essential to continued use of assistive technology.

Device training and maintenance are not always provided to individuals with disabilities receiving assistive technology devices. Parette and VanBiervliet (1992) found that out of the 680 individuals with mental retardation who were involved in the study, 32% reported not having enough training and more than one-third were dissatisfied with the amount of time required for service of their technology.

Diffusion theorists claimed that innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability and re-invention will be rapidly adopted and slowly discontinued (Rogers, 1995; Goffman, 1963). These concepts are examined in the present study to determine if they are applicable to continuance/discontinuance of assistive technology devices by individuals with disabilities. In addition to the variables in Rogers' theory described above, there are two other factors associated with abandonment. These are consumer involvement and changes in consumers' needs.

A review of the literature indicate that there is consensus that consumer involvement in the selection, acquisition, use and maintenance of assistive technology devices is important (Carroll & Phillips, 1993; Phillips &

Broadnax, 1992; Scherer, 1993; Turner et al., 1995; Gouzman, 1997). Other research results demonstrated that devices are discontinued less frequently when users believe their opinions are taken into consideration in the selection process (Gradel, 1991; Phillips & Zhao, 1993; Griths & Price, 2011).

A change in consumers' needs has also been cited as a significant cause of discontinuance of assistive technology devices (Tewey et al., 1994; Groenewegen, 2005). Researchers indicated that changes in individuals with disabilities' priorities and/or needs, rather than problems with assistive technology devices, often results in device discontinuance (Parker & Thorslund, 1991; Phillips & Broadnax, 1992: Scherer & Galvin, 1996; Guba & Lincoln, 1994). Overall, some technological discontinuance is to be expected as individuals with disabilities experience changes in their lives.

Researchers have studied a variety of consumer and assistive technology device variables in an effort to predict use versus discontinuance of assistive technology devices. However, to date, no studies examine the relationship between continuance/discontinuance of assistive technology devices and a combination of predictor variables (relative advantage, compatibility, trialability, re-invention, support, consumer involvement, and changes in consumers). The hypothesis of the study was that there was relationship between assistive technology discontinuance among individuals with disabilities and a combination of independent variables (relative advantage, support, consumer involvement, trialability, changes in consumers, re-invention and compatibility) (Scherer & Galvin, 1996; Hasselbring & Glaser, 2012).

2.4 Compatibility of Assistive Technology in Teaching and Learning

According to Jwaifell and Gasaymeh (2013) the process of adopting an innovation can be accelerated if the individual feels that this new innovation is compatible with their needs and experiences. Rogers (2003) stated that "compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (p. 15). For innovation in learning materials, the new idea may or may not be compatible with students' socio-cultural values, beliefs, or needs for the new technology.

A lack of compatibility in AT with individual needs may negatively affect the individual's AT use (McKenzie, 2001). Hoerup (2001) describes that each innovation influences student opinions, beliefs, values, and views about teaching. If an innovation is compatible with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase (Hatwell, 1993).

2.5Trialabilityof Assistive Technology in Teaching and Learning

According to Rogers (2003), “trialability is the degree to which an innovation may be experimented with on a limited basis” (p. 16). It refers to the period of Time allowing the adopter of the technology to experience the innovation. Trialability is positively correlated with the rate of adoption. The more an innovation is tried, the faster its adoption is. Jwaifell and Gasaymeh (2013) found that participants had the opportunity to try the Interactive White Board and they were free to continue or discontinue using it. Innovation may be changed or modified by the potential adopter. Increased reinvention may create faster adoption of the innovation. An AT would be expected to be used in a greater way if it allows for opportunity to be used on small scale before being used by all the visual disability learners in the school.

2.6 Observability of Assistive Technology in Teaching and Learning

According to Jwaifell and Gasaymeh (2013) study of Jordan schools, participants’ responses to the interview questions showed that they have the chance to examine the Interactive White Board in their educational practices and to take advantages of it. Rogers (2003) defined observability as“the degree to which the results of an innovation are visible to others” (p. 16).Though students are not able to observe how the new innovation works for them, they can share their personal experiences in using the innovation with others through both verbal and written forms.

Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997; Hainze, 1986). It would be expected that the more visible the AT to students and teachers then the more is considered to enhance teaching and learning among to visual disability students. According to Ntemana and Olatokun (2012) observability had the highest influence on attitude of lecturers toward using information communication technology.

2.7Complexity of Assistive Technology in Teaching and Learning

Jwaifell and Gasaymeh (2013) study of Jordan school basing on complexity variable found that all participants found Interactive White Board to be easy to use. Rogers (2003) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 15). Rogers stated that complexity is negatively correlated with the rate of adoption. One of the hurdles for an individual to adopt a new innovation is its complexity. If the innovation is too complicated or confusing, it takes longer time to achieve acceptance to the innovation and might lead toward rejection (Rogers, 2003).

According to study by Hussin (2013) in Malaysian, some VI students described experiencing technical difficulties when using Digital Talking Textbooks (DTTs). These difficulties discouraged the use of DTTs. This finding is consistent with a study by Holcombe (2000), who concluded that an innovation with less complexity has a higher possibility of being adopted than an innovation with complicated features. Rogers (2003) suggested that although the complexity may not be as important as the other attributes of the innovation, such as relative advantage or compatibility, it is an important barrier to adoption and may influence its implementation and rate of adoption.

A technological innovation might confront faculty members with the challenge of changing their teaching methodology to integrate the technological innovation into their instruction, so it might have different levels of complexity. If hardware and software are user-friendly, then they might be adopted quickly for the delivery of course materials (Martin, 2003; Hersh, 2012; Howell & Porter, 2003).When AT appears complex to use this would be expected to reduce its use by the learners. Aşkar, Usluel, and Mumcu (2006) stated that complexity is a commonly perceived innovation characteristic for preparation, teaching delivery, and managerial tasks in schools.

2.8Relative Advantage of Assistive Technology in Teaching and Learning

According to Jwaifell and Gasaymeh (2013) relative advantage is the strongest predictor of an innovation's rate of adoption. It refers to the benefits that person would consider when he/she is deciding to adopt the innovation. Rogers (2003) defined relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes” (p. 229).

The cost and social status motivation aspects of innovations are elements of relative advantage and when faculty members face the new demands placed on them, they will adopt technology (Casmar, 2001; Iness et al., 2004). When the teachers see that technology has value in their instruction, then they will use it (Finley, 2003; McKenzie, 2001; John, 1993, 2000; Jackson, 2009). Benefits could be in terms of economy, social status, reducing uneasiness, and saving of time and effort. A significant body of research from different disciplines such as agriculture, family planning, and health indicated that relative advantage has a positive relationship with the rate of adoption of various innovations (Rogers, 2003) Therefore it is important for teachers to be made to understand how an AT would add value to their teaching.

2.9Usage of Assistive Technology in Teaching and Learning

Using software such as Roger Wagner's hyper studio, teachers can create their own software that enhances a curricular activity or is individualized for a particular student. Assistive technology has potential to be the "great equalizer" for persons with visual disability (Michaels & McDermott, 2003). Many career opportunities requiring access to visual information are now accessible to those who have visual disability through the application of appropriate technology.

Hoppestad (2007) notes that "many of the success stories regarding AT interventions are anecdotal in nature due to a shortage of controlled experiments on the efficacy of AT." Similarly, Hourcade has also called for more empirically grounded guidelines for young people's use of technology in general (Hourcade, 2008; Johnson, 2004), suggesting that this is a shortcoming of related fields as well, perhaps due to the difficulty of conducting controlled experiments with young people and new technology. Edyburn also notes that persistently more is published in the field of practice involving special educational technology than research on it (Edyburn, 2003; 2004). Integrity of research is vital to the field, as without this there can be no compelling evidence for the use of one approach over another.

It is generally accepted that assistive technology has positive impact on the lives of the person with visual impaired (Strobel, Fossa, Arthanat & Brace, 2006; Karpov, 2005). The role of technology in early childhood special education is that of a tool for learning, communicating, equalizing opportunities and creating positive changes in the learning environment. Research has shown that technology can have especially great impact on the learning of children with disabilities (Bialo & Sivin, 1990; Kay, 1984).

A Canadian study examined how assistive technologies can help students with special needs transit from elementary to secondary school (Specht et al, 2007). A Norwegian study examined how environmental factors as well as Braille and other assistive technologies such as Auditory-Based Technologie and Computer Magnification affect the teaching and learning literature (Vik, 2008)**.** Assistive Technology can enable a learner to do things that would not be feasible otherwise and will also enable the student to have a normal or near normal level of fluency.

Assistive technology opens access to activities not available or possible for the disabled learner and will allow a child to persevere at tasks that would otherwise be too frustrating and time-consuming. The Integrated Education Project (IEP) set up by Sight Savers Ghana (Country Plan 2001 – 2003) in collaboration with the SpED and the GSB successfully integrated a totally blind student into a mainstream school in Hohoe District (Volta region). Copley and Ziviani (2004) identified six barriers to effective use of assistive technology devices among students with multiple disabilities, including: lack of appropriate staff training and support, negative staff attitudes, inadequate assessment and planning processes, insufficient funding, difficulties procuring and managing equipment and time constraints.

Hoppestad (2007) notes that "many of the success stories regarding AT interventions are anecdotal in nature due to a shortage of controlled experiments on the efficacy of AT." Similarly, Hourcade has also called for more empirically grounded guidelines for young people's use of technology in general (Hourcade, 2008), suggesting that this is a shortcoming of related fields as well, perhaps due to the difficulty of conducting controlled experiments with young people and new technology. Edyburn also notes that persistently more is published in the field of practice involving special educational technology than research on it (Edyburn, 2003; 2004). Integrity of research is vital to the field, as without this there can be no compelling evidence for the use of one approach over another.

2.10 Summary of Literature and Research Gaps

Rogers (2003) argued that innovations offering more relative advantage, compatibility, simplicity as opposed to complexity, trialability and observability will be adopted faster than other innovations. According to Jwaifell and Gasaymeh (2013) it can be concluded that relative advantages, compatibility, complexity, trialability and observability of an innovation accounted for ' adoption of interactive white board. The study is related to this study in that it looked at the five variables; relative advantages, compatibility, complexity, trialability, observability and focused on English. It differ from this current study in that it studied only the adoption of interactive whiteboards whereas the current study studied on all the available ATs and their effect on teaching and learning of intergrated English. Furthermore there is contextual difference in that Jwaifell and Gasaymeh (2013) was carried out in Jordan while this study was carried out in Kenya.

Aşkar, Usluel, and Mumcu (2006) stated that complexity is a commonly perceived innovation characteristic for preparation and teaching delivery. This study differ from the current study in that this study researched on complexity alone and left out relative advantages, compatibility, trialability and observability. According to study by Hussin (2013) in Malaysian, some VI students described experiencing technical difficulties when using Digital Talking Textbooks (DTTs). These difficulties discouraged the use of DTTs.Trialability is positively correlated with the rate of adoption. The more an innovation is tried, the faster its adoption is(Rogers, 2003).Hussin (2013) study related to this current study because it studied trialability but it differ because it did not consider relative advantages, compatibility, complexity and observability. Hoerup (2001) describes that each innovation influences student' opinions, beliefs, values, and views about teaching. If an innovation is compatible with an individual's needs, the rate of adoption of the innovation will increase. Hoerup (2001) related with current study because it studied compatibility but differ because it did not consider relative advantages, trialability, complexity and observability.

It is generally accepted that assistive technology has positive impact on the lives of the person with visual impairment (Strobel, Fossa, Arthanat & Brace, 2006).When the teachers see that technology has value in their instruction, then they will use it (Finley, 2003; McKenzie, 2001). This indicates that the teachers need to see the value of assistive technology to adopt it teaching and learning.This is related to this study in that it considered relative advantage of assistive technology; however it has not considered observability, compatibility, complexity and trialability. According to Ntemana and

Olatokun (2012) observability had the highest influence on attitude of lecturers toward using information communication technology. This relates to the current study because it considered observability but it differs in that it did not consider relative advantages, compatibility, complexity and trialability.

Studies by Kelly (2008); Kapperman, Sticker and Heinze (2002) in USA, Specht, Howell and Young, 2007 in Canada, Vik (2008) in Norway have been carried out on AT in developed countries. However, studies on AT in developing countries are limited, especially based on Roger’s model.

Countries like Kenya are faced with the problem of availability of suitable AT devices. When available, the integration in a manner to enhance teaching and learning is a challenge especially in special secondary schools for visually impaired in Kenya. The studies reviewed Jwaifell and Gasaymeh (2013) in Jordan, Aşkar, Usluel and Mumcu (2006), Kelly (2008), Kapperman, Sticker and Heinze (2002) , Specht, Howell and Young, 2007, Vik (2008) and Hussin (2013) have not considered the effect of AT in teaching and learning. This study sought to address the gaps by determining the effect of ATon teaching and learning of Integrated English among visually impaired learners in special secondary schools in Kenya.

2.11Theoretical Framework

This study is anchored on Rogers'stheory supported by Edyburn'stheory of 1998 on Technology Integration Process. Rogers'stheory is a criteria for judging the value of innovation (Rogers, 2003). Rogers's theory is based on five aspects; compatibility, complexity, Trialability, relative advantage and observability.The study was based on Rogers's theory because it considers various aspects that would enable the determination of integration of assistive devices in teaching and learning. Robinson (2009) reported that Roger's theory has been applied in more than 6,000 social science studies exploring the processes of social change. Hussin (2013) used Rogers's model in the study on experiences of students with visual impairments in adoption of digital talking textbooks in Malaysia: an interpretative phenomenological analysis.

Rogers's theory (2003) offers a comprehensive philosophy regarding the processes involved in accepting or discontinuing use of technology. According to this theory, discontinuance is a decision to discard an innovation after previously accepting it. The two types of discontinuance are replacement (rejection of an innovation for an improved one) and disenchantment (rejection of an innovation due to dissatisfaction). Relative advantage, compatibility, trialability and re-invention are concepts derived from the diffusion of innovations theory. They are examined in the present study to determine if they are related to continuance/discontinuance of assistive technology devices by individuals with disabilities.

Relative advantage is identified as a significant factor associated with continuance or discontinuance of technology. This factor relates to the characteristics of the device itself (Rogers, 2003) and examines the relative advantage that continued use of a device offers a user over discontinuing its use. A study of long term consumers of assistive technology devices indicated that three of the four most important criteria consumers used to assess assistive technology devices (effectiveness, operability and durability) were related to relative advantage (Batavia & Hammer, 1989).The second concept, compatibility, refers to the degree an innovation is perceived as consistent with the needs of the adopter (Rogers, 2003).

According to Rogers, compatibility is a factor related to continued use of an innovation. Trialability, the degree to which the user can experiment with the technology prior to acquisition, was also related to continued use of technology (Rogers, 2003). Rogers' Diffusion of Innovation theory has been the main starting point for many research into technology innovation and adoption domains, and still provides a widely used framework for forecasting purposes, service and infrastructure requirements, business modeling and policy measurements (De Marez, Evens, & Stragier, 2011).

According to Rogers (2003), compatibility is the "degree to which an innovation is perceived as consistent with existing values, past experiences and needs of potential adopters" (p15). The Assistive devices would be expected to be used if it is considered by learners and their teachers to meet their teaching and learning objectives. Complexity is the "degree to which innovation is perceived as relatively difficult to understand and use" (p15). When assistive devices appear complex to use this would be expected to reduce its use by the learners. Trialiability is the "degree to which an innovation is experimented with, on a limited basis" (p16). Observability is the degree to which results of an innovation are visible to others while relative advantage is the degree to which an idea is perceived better than the idea it supersedes" (Rogers, 2003, pp 16, 233).

Rogers (2003) argued that innovations offering more relative advantage, compatibility, simplicity (less complex), trialability, and observability are adopted faster than other innovations. Rogers does caution, "getting a new idea adopted, even when is has obvious advantages, is difficult" (p.1), so the availability of all of these variables of innovations speed up the innovation-diffusion process. Studies have shown that all these five factors influenced faculty members' likelihood of adopting a new technology into their teaching (Anderson et al., 1998; Bennett, & Bennett, 2003; Parisot, 1997; Surendra, 2001).

2.11.1 Influences of Adoption

The innovation-decision process explains how an innovation becomes adopted, rejected, or abandoned. It does not, however, explain why one technology may be adopted over another. Rogers's diffusion of innovations proposes five factors that shape the rate and likelihood of adoption. Some factors are inherent to the innovation, while others concern the adopters themselves and their usage of the innovation (Rogers, 2003).

Hoppestad (2007) notes that "many of the success stories regarding AT interventions are anecdotal in nature due to a shortage of controlled experiments on the efficacy of AT." Similarly, Hourcade has also called for more empirically grounded guidelines for young people's use of technology in general (Hourcade, 2008), suggesting that this is a shortcoming of related fields as well, perhaps due to the difficulty of conducting controlled experiments with young people and new technology. Edyburn also notes that persistently more is published in the field of practice involving special educational technology than research on it (Edyburn, 2003; 2004). Integrity of research is vital to the field, as without this there can be no compelling evidence for the use of one approach over another.

According to Sahin and Thompson (2006),Rogers's (2003) relative advantage, compatibility, and complexity attributes are related to attitudes of individuals. In Sahin and Thompson (2006) study, the participants reported positive attitudes toward the three attributes of innovations. Faculty members' positive attitudes toward these attributes are very important because these attributes are significant predictors of the diffusion of instructional innovations (Parisot, 1997; Surendra, 2001). It is crucial that faculty should perceive computer technologies as useful instructional tools and as being consistent with their beliefs (Jacobsen, 1998), and that they should not see computers as complex tools for instructional use.

2.11.2 Relative Advantage

Relative advantage is considered to be a variable in this study because adoption of technology is based on whether it enables or enhances teaching and learning. For a person to choose to use a technology for a specified task, it should provide some form of benefit for the task concerned. The innovation should demonstrate a relative advantage over other options, ideally including the technology currently used for the task. Better technologies will be adopted. However, what defines "better" is rarely a single, simple statistic. Increased performance, cheaper costs, increased social standing may all contribute to the sense of relative advantage (Jacobsen, 1998).

Rogers categorized innovations into two types: preventive and incremental (non-preventive) innovations. "A preventive innovation is a new idea that an individual adopts now in order to lower the probability of some unwanted future event" (Rogers, 2003, p.233). Preventive innovations usually have a slow rate of adoption so their relative advantage is highly uncertain. However, incremental innovations provide beneficial outcomes in a short period (Surendra, 2001).

When faculty members face the new demands placed on them, they will adopt technology (Casmar, 2001). If teachers see that technology has value in their instruction, then they will use it (Finley, 2003; Parisot, 1995; Spotts, 1999). To integrate technology successfully into teacher education courses, teacher education faculty should see the need providing helpful experiences for themselves and their students (Schmidt, 1995). To increase the rate of adopting innovations and to make relative advantage more effective, direct or indirect financial payment incentives may be used to support the individuals of a social system in adopting an innovation. Incentives are part of support and motivation factors (McKenzie, 2001).

2.11.3 Compatibility

Another factor is the compatibility of the innovation with the user's life and practices. This aspect is included in the study because literatures review of empirical studies for example McKenzie (2001) indicate that lack of compatibility would negatively affect the AT usage. An adopted technology will be integrated into one's life and therefore must mesh well.

Compatibility may be of a technical basis, such as software or hardware compatibility issues with a computer. Any interruption to one's workflow should also be minimal. Additionally, the technology should not cross one's value or belief system. For example, if a person is against the mistreatment of animals, any medication tested on animals would be incompatible (Jacobsen, 1998).Thus, even naming the innovation is an important part of compatibility. According to Rogers (2003), compatibility is a factor related to continued use of an innovation.

2.11.4 Complexity

Complexity is considered in this study because it has been pointed out in the literature as key in use of AT for example Jwaifell and Gasaymeh, 2013 study on interactive white board. When deciding to adopt an innovation, the inherent difficulty of using the technology is a major concern. Complexity refers to the sense of difficulty that the user has in using and understanding an innovation. The learning curve associated with learning how to use a technology is considered. Also considered are traditional human-technology interaction notions of usability and affordances as espoused by (Norman, 2002).

A potential user must also understand why the innovation is appropriate. The level of such an understanding need not be to an extreme depth but should at least convince the user of the innovation's value. In a case study of an attempt to promote the boiling of water in a Peruvian village, germ theory was used to motivate the adoption of boiling water. Villagers had difficulty accepting germ theory as the cause of illness. Thus, they overwhelmingly rejected water boiling as they failed to understand the motivation to do so (Rogers, 2003).

A technological innovation might confront faculty members with the challenge of changing their teaching methodology to integrate the technological innovation into their instruction (Parisot, 1995), so it might have different levels of complexity. If hardware and software are user-friendly, then they might be adopted successfully for the delivery of course materials (Martin, 2003).

2.11.5 Trialability

Trialability is included in this study because of the need to be able to test an AT before its complete adoption in teaching and learning in an education institution. Trialability is the opportunity for a potential user to experience using the innovation itself. Such trialability covers opportunities such as test drives, demonstration units, and simulations. The user gets the chance to try the technology without having to fully commit to purchasing or adopting it. Trials can be great sources of information searched for and needed during the Persuasion and Implementation stages. In particular, trials directly limit or prevent forming inaccurate assumptions about the technology (Jacobsen, 1998).

Trialability, the degree to which the user can experiment with the technology prior to acquisition, was also related to continued use of technology (Rogers, 1995). Research demonstrated, however, that individuals with disabilities are not often given the opportunity to try out assistive technology devices prior to purchasing them. Parette and VanBiervliet (1992) found that almost half of the individuals with visual impairments sampled were unable to try out their devices prior to purchasing them.

2.11.6 Observability

The fifth factor that shapes innovation diffusion is Observability. Observability is included as a variable in this study because review of literature for example Ntemana and Olatokun, 2012 indicates that it did influence use of technology by lecturers. Observability refers to how visible the use of the technology is to those around(Finley, 2003). For a person to adopt a technology, seeing, hearing about, or otherwise knowing that other individuals are using that technology dramatically encourages adoption. Observing a technology stimulates awareness of the innovation and conversations among one's peers.

Rogers found evidence for the power of observability when he plotted the number of adoptions over time. Consistently, these plots revealed a normal Bell curve, while plots of the cumulative number of adoptions over time showed a sigmoid or s-curve. Adoption is slow in the beginning as awareness of the technology is limited. As more and more people use the technology, the public becomes more aware of the technology and thus the rate of adoption increases until the technology is in common use and has saturated the market (Finley, 2003).

For Rogers, the power of observability encouraged research on what makes an innovation more readily noticed. Mass media is a major influence on the public's awareness of new innovations. The people we interact with on a regular basis are another. Some are complete strangers, but we might notice them using the newest cell phone or MP3 player (Martin, 2003). Our technology choices are influenced by their choices and recommendations. Thus, understanding the diffusion of an innovation is greatly facilitated by understanding the communication channels and social networks involved (Norman, 2002).

Diffusion studies identify who talks to who and how adoption spreads through the identified social network. Some individuals are more influential than others. Known as change agents, these persons are often highly connected within the network or are held in high esteem by their peers. Change agents may also hold a position of power, such as in the case of a manager or director position. Regardless, when a change agent decides to adopt or reject a technology, his peers will likely follow suit (McKenzie, 2001). The nature of the connections between members of a social network also influences the likelihood of diffusion. Power dynamics can force an adoption or rejection of a technology. While an employee might prefer to use an Apple computer, a company's decision to use exclusively IBM computers would override his personal choice (Sherry, 1997).

A person may consider the value of a peer's recommendation based on how similar they are to each other. Termed by Rogers as levels of homophily and heterophily , a person is more likely to accept and pursue a technology when recommended by peers who share similar attributes (homophily) rather than peers who differ on multiple attributes (heterophily) (Rogers, 2003;McKenzie, 2001). This is applicable to the study because special secondary schools are likely to adopt ATs that other special secondary schools have applied and worked for them.

2.11.7 Implications of Rogers theory in the study of Assistive technology adoption

Rogers theory has been widely accepted and used over the years. It is widely used to explain the adoption and use of technology in higher education (Medlin, 2001) in many disciplines. Scholars can understand the entire process by which adoption (or rejection) of an innovation occurs. The theory can also be statistically tested in a fairly simple way. Because of its scope and scholarly reputation, Rogers's theory is important for consideration in the study of AT adoption among people with reading disabilities.

The key to the diffusion process is the growing awareness of the technology among the intended user population. This awareness can come from seeing others using the technology or being told about it. This is a troublesome point when it comes to reading disabilities. As discussed in individuals with visually impaired they tend to avoid disclosing their disability and engage in tactics to hide their disability from others (Cory, 2005).As such, they are perhaps unlikely to be seen using an AT or talking with other users with VI about an AT.

Diffusion could be greatly constrained by this restricted amount of communication. Still, an understanding of the communication channels involved in ATs for VI adoption is warranted given the concerns about a lack of communication. However, it is important to not just consider individuals with VI in the network. Other people with knowledge about or interest in ATs (parents, teachers, and disability and AT specialists) will have potential influence in such a network (McKenzie, 2001).

One of the foremost criticisms of the diffusion model is the pro-innovation bias. This implies that the innovation, if adopted, will be beneficial to all the possible adopters equally. Hence, the underlying drawback is the assumption that adoption of the innovation is the right choice. Over-adoption comes into the picture when experts suggest rejection or fewer adoptions of an innovation (Isleem, 2003).

Diffusion theory is its linearity wherein it is assumed that one stage will be followed by the other in the innovation-decision process. This implies that either the diffusion of innovation theory is not applicable to all fields, or that the model does not always follow the linear path. The individual-blame bias is another criticism of the diffusion model where individuals are blamed for their non-adoption of the innovation. Rogers' diffusion theory has been used as a basic framework for a variety of diffusion studies, but not many scholars have examined it critically (Martin, 2003).

Rogers' diffusion theory has been widely applied to various fields. Rogers’s theory is multidisciplinary in nature and is widely applicable. Isleem (2003) studied the level of computer use by the teachers of Ohio public school for instructional purposes. This study is based on the theoretical framework of Rogers’ diffusion of innovation. The studies selected the following factors: expertise, access, attitude, support and teacher characteristics and their relationships with the level of use.

A study was undertaken where a questionnaire was distributed to all technology education teachers in the state of Ohio in the school year 2002-2003. The return survey rate was 66%. A survey-correlation research design was used. The study indicated that technology education teachers use computers for more mainstream applications rather than specialized applications. The level of use is significantly affected by the teachers' perceived attitude, expertise and access to computers (Isleem, 2003).A study by Spiering and Erickson (2006) demonstrated the application of Rogers’ theory to international education. They studied United States undergraduate college students who attended the information session regarding study abroad opportunities but do not translate them into actions. Surveys were sent to two groups of students who had studied abroad and those who did not and ranked their answers based on the five attributes of innovation as described by Rogers.

The results indicated that relative advantage and Trialability were the most important factors for deciding to opt for the study abroad program, where complexity and compatibility were the main reasons for deciding against it. The main recommendations were to change the role of the study abroad advisor to that of a change agent who can then help and influence the students, as well as make the faculty aware of the benefits of such a program so that they can, in turn, encourage students to do so (Spiering & Erickson, 2006).

Identifying the advantages and disadvantages of the innovation based on the perceived attributes of the same and designing the message campaign accordingly can also enhance the chances of adoption of the innovation. Identification of societal norms, which is another feature of the model, is an extremely important factor that workers must keep in mind while designing the messages (Haider & Kreps, 2004).

2.12Edyburn's Model

Edyburn's Model involves selecting, acquiring, implementing, and integrating instructional technologies into the curriculum (Edyburn, 1998).The process involves a significant commitment of time and effort and the model suggests that teachers work through the process in order to develop a technology toolbox that can be utilized to enhance teaching and learning in their classroom (Gardner & Edyburn, 2000).

Table 2.2: Edyburn's Model of the Technology Integration Process

Phase1	Phase 2	Phase 3	Phase 4
Selection	Acquisition	Implementation	Integration
Planning	Previewing	Organizing	Linking
Locating	Evaluating	Teacher Training	Managing
Reviewing	Purchasing	Student Training	Assessing
Deciding			Extending

Source: Gardner & Edyburn (2000).

This model is suitable because it considers the steps of selecting and acquiring the appropriate assistive technology. The phase 1 selection steps fits well with compatibility because it involves planning and ensuring that integration is in tandem with the students and teachers requirement. Phase 2 ensures that what is acquired is evaluated and this fit with Trialability. Phase 3 involves training which fits with complexity variable and this facilitate the understanding by student and teachers of AT integration thus enhancing implementation. The variable of relative advantage fits well with phase 2 since it involves evaluating alternatives and determining the most appropriate way.

Phase 4 on integration fits well with all variables since it is the final phase that ensures the success of the AT in teaching and learning.

2.13Conceptual Framework

The conceptual framework in figure 2.1 describes the relationship of independent variables, intervening variable and dependent variable. There were five independent variables and one dependent variable.

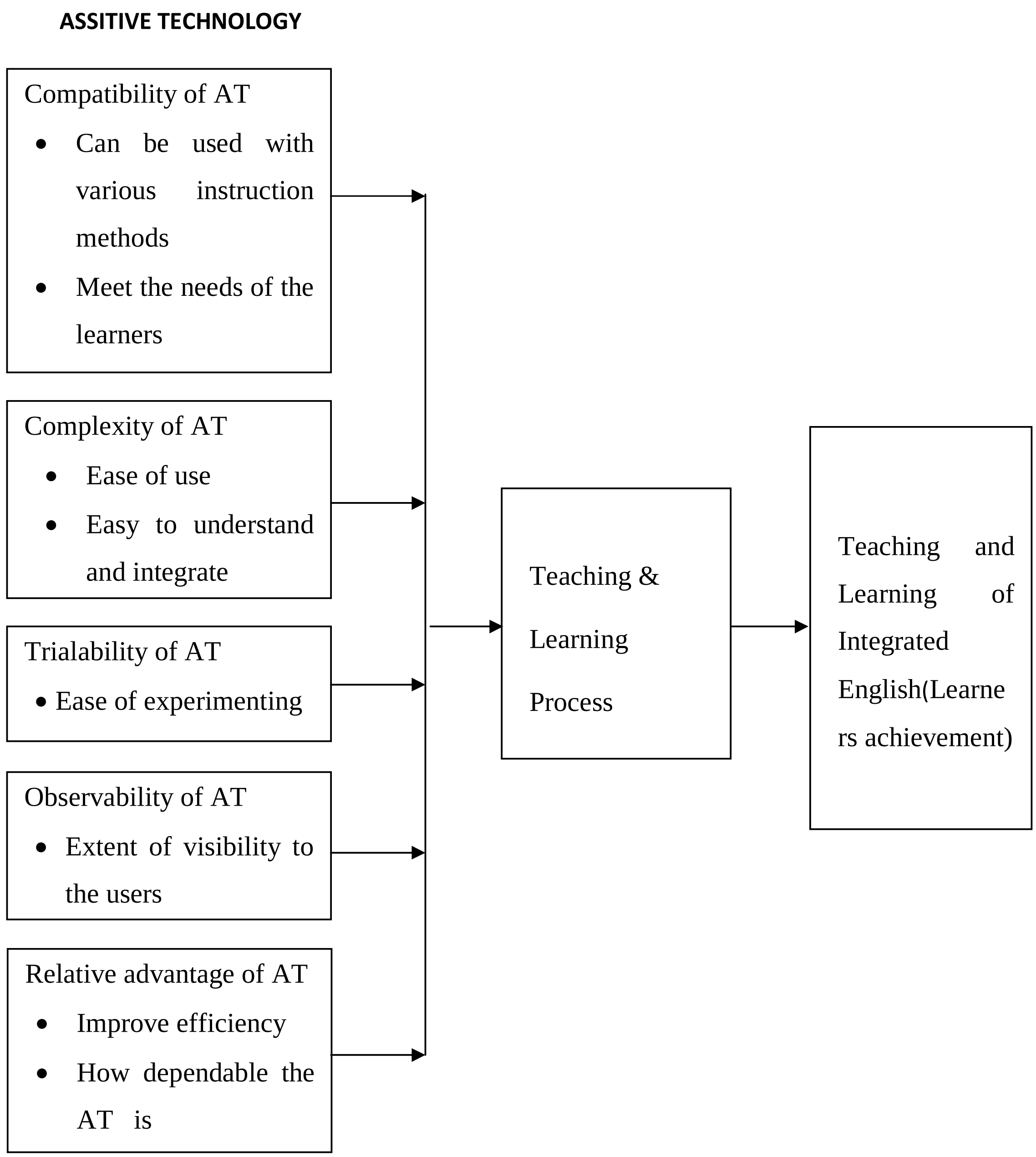


Figure 2.1: Effect of AT on teaching and learning of integrated English amongst the visually impaired students.

Independent Variables Intervening Variable Dependent Variable

Independent variables are compatibility, complexity, trialability, observability and relative advantage. These variables are derived from Rodgers theory and supported by Edyburn's theory on technology integration process. Compatibility is about the extent to which an AT device can be used with other AT devices to facilitate. Complexity describe to what extent does AT device is easy or hard to understand and use. Trialability is the extent to which the use of AT can be tested in small scale before employing its use among the visually impaired learners. Observability describe to what extent do the users of a given AT identify with it. Relative advantage is the extent to which an AT makes the users in a better position than before using AT.

The process is teaching and learning of the visually impaired learners. Output of teaching and learning process is the visually impaired achievement in integrated English (Learners achievement).The Independent variables would be expected to affect the teaching and learning process and in turn the learners achievement of visually impaired learners.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methods which were used in carrying out data collection and analysis of the study. This chapter consists of research design, target population, sample size and sampling procedures, research instruments, validity of the instruments, reliability of the instruments, data collection procedure and data analysis techniques.

3.2 Research Design

A research design should provide confidence to the scientific community that the findings derived from following the design capture the reality and possess high levels of reliability and validity (Cooper & Schindler, 2001). The study used descriptive survey design. Descriptive survey design is a method of collecting information concerning the current status of the phenomena to describe "what exists" with respect to variables or conditions in a situation (Orodho, 2003).

The design was suitable for this study because it provided an accurate and valid representation of the AT variables in teaching and learning amongst the visually impaired learners. This study was based on the positivism paradigm because it had predefined hypotheses. A paradigm can be defined as the "basic belief system or world view that guides the investigation" (Guba& Lincoln, 1994, p. 105). There are many distinct positions regarding the approach to scientific inquiry. The paradigms fall under the positivism approach and phenomenology. The positivists argue that true knowledge is scientific in character and describes inter-relationships between real and observable phenomenon. Positivists orientation is characterized by operational definitions, objectivity, hypothesis testing, causality and reliability (Cooper & Schindler, 2008; Mwiria & Wamahiu, 1996).

In positivism studies, the researcher is independent form the study and there are no provisions for human interests within the study and positivist studies usually adopt deductive approach. Moreover, positivism relates to the viewpoint that researcher needs to concentrate on facts. Positivism philosophy is in accordance with the empiricist view that knowledge stems from human experience. It has ontological view of the world as comprising discrete, observable elements and events that interact in an observable, determined and regular manner (Collins, 1994).

3.3Target Population

According to Kombo and Tromp (2006) target population refers to the larger group from which a sample is taken. According to Ministry of Education (2012) there are 4 public high schools for the blind in Kenya; Salvation Thika School for the Blind, St. Lucy's High School for the Blind (Meru), Kibos High

School for the Blind (Western Region) and St Francis Kapenguria (Rift valley Region). This study target population was all the 4 principals, 48 teachers and 480students.

3.4 Sample Size and Sampling Techniques

The sample size was determined using the Slovin's formula (Galero-Tejero, 2011). The Slovin's formula assumes a degree of variability (proportion) of0.05 and a confidence level of 95%.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = sample size; N = population size; e = the level of precision. In this study the level of precision is 0.05,

$$n = \frac{480}{1 + 480x(0.05)^2} = \frac{480}{2.2} = 218 \text{ Students}$$

Hence, 218students were selected for this study as sample size using simple random sampling method. To select teacher, purposeful sampling was used in this study. Purposeful sampling attempts to select the respondents based on certain characteristics or criteria (Kombo & Tromp, 2006; Johnson & Christensen, 2012).The criterion was that respondent was conversant with AT.

Total Sample size n = 4+48+218= 270

The Table 3.1 presents the sample size derived from the target population.

Table 3.1: Sample Frame

Group	Target population	Sample size
Principals	4	4
Teachers	48	48
Students	480	218
Total	532	270

3.5Research Instruments

The study relied on primary data and secondary data. The primary data was collected through the use of (a) teachers' questionnaire (b) principals' questionnaire (c) observation schedule (b) focus group discussion guide for students.

3.5.1 Questionnaire

The questionnaire reduces bias, enhances confidentiality and saves on time. The questionnaire for both teachers and principals had been designed to gather background information of the teachers and principals. The questionnaire had closed ended questions and open ended questions with information pertaining to the respondents' opinion on effect of AT in teaching and learning of integrated English amongst visually impaired learners in special secondary school in Kenya.

3.5.2 Observation Schedule

The schedule contains the following columns: type of technology, present AT in use, adequacy of AT, condition, present AT but not in use, not present and comments.

3.5.3 Focus Group Discussion Guide

The focus group discussion involved engagement of students so as to gather more information. There were 31 focus groups in the four special secondary schools, each group consisted 7 students.

The secondary data on learners' achievement, number of visually impaired learners, percentage of visual impaired learners attending schools and AT Devices available were obtained through document analysis from Kenya National Bureau of Statistics, Kenya Society for the Blind, Ministry of Education and Kenya Institute of Special Education. The secondary data on learners' achievement was obtained from the special secondary school records.

3.6 Validity of the Instruments

Mugenda and Mugenda (2003) define validity as accuracy and meaningfulness of inference which are based on research results. It is the degree to which results obtained from the analysis of data actually represents the phenomenon under study. It is a measure of how well an instrument measures what is supposed to measure (Cooper & Schindler, 2008). Content validity was established through expert judgment. The questionnaire was pretested by issuing questionnaires to five teachers from salvation Thika School for the blind, who were requested to complete the questionnaire and comment on the clarity and appropriateness of the items in the questionnaire. This was necessary in order to identify any ambiguous and unclear questions to the respondents and improve the questionnaire.

3.7 Reliability of the Instruments

Cooper and Schindler (2008) define reliability as a measure of degree to which a research instrument yields consistent results. There are three types (perspectives) of reliability; stability, equivalence and internal consistency(Cooper & Schindler, 2008).

Internal consistency was established through computation of Cronbach's alpha Coefficient using Statistical Package for Social Sciences (Cronbach & Richard, 2004).A Cronbach's alpha coefficient reliability of 0.70 or higher indicates that the instrument used was reliable (Cronbach & Richard, 2004).

The study had five independent variables namely relative advantage, compatibility, Trialability, complexity and observability. These variables were subjected to reliability tests using SPSS and the results were Cronbach's alpha 0.71 for teachers' questionnaire and 0.75 for Principals questionnaire. Nunnaly and Bernstein (1994) suggested a value of Cronbach's alpha of 0.70 and above indicate that the instrument was reliable. This therefore implies the teachers and principals questionnaires used in this study were reliable because Cronbach's alpha values were more than 0.7.

3.8 Data Collection Procedures

First the researcher was cleared by the Department of Educational Administration and Planning, then authorization was obtained from National Commission for Science, Technology and Innovation (NACOSTI). The researcher used Dolphin pen to assess on trialability among visually impaired learners in all the four special secondary schools. Dolphin pen access software on any USB drive and is used for visually impaired student who keep on using different disk drive.

Data was also collected through administration of questionnaires to principals and teachers. The questionnaires were delivered directly to the teachers and principals whereby teachers and principals were requested to fill the questionnaires. To enhance cooperation from the respondents, the researcher presented a letter of introduction to each school stipulating the intent of the study.

The observation schedule used checklist to determine available Assistive Technology and usage. The focus group discussion involved engagement of students so as to gather more information as per the research objectives. A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a product, concept, advertisement, idea or packaging (Kombo& Tromp,2006). Questions are asked in an interactive group setting where participants are free to talk with other group members. There were31 focus groups in the four special secondary schools, each group consisting of 7 students.

3.9 Operationalization of Variables

Table 3.2 describes the operationalization of variables of the study and the level of measurement.

Table 3.2: Operationalization of variables

Variable	Quantification	Measurement
Compatibility of AT	Usability with other AT devices	Ordinal scale
Complexity of AT	Ease of use in AT device	Ordinal scale
Trialiability of AT	How easily can the assistive technology devices be experimented	Ordinal scale
Observability of AT	The assistive technology devices are visible to teachers and learners	Ordinal scale
Relative advantage of AT	ATs improves efficiency when used in teaching and learning	Ordinal scale
Teaching and learning	Visual impaired learners Improvement in integrated English Performance, learners Achievement	Interval scale

3.10 Data Analysis Techniques

The study used both qualitative and quantitative methods of data analysis. Data was analyzed using Statistical Package for Social Sciences (SPSS) through a combination of both descriptive and inferential statistics. The data preparation involved data coding and presentation. The answers to closed questions were analyzed quantitatively using the descriptive statistics and simple linear regression model. Descriptive statistics used were means, frequencies and standard deviations. To establish availability of the Assistive technology devices in special secondary schools in Kenya descriptive statistics were used. Correlation analysis was used to determine relationship of independent variables and dependent variable. This was meant to check whether variables of study were related and to what extent. Regression analysis provided the proportion of variance in the dependent variable (teaching and learning) accounted for by the combination of independent variables and for contribution of each independent variable. This regression analysis was checking the extent to which an independent variable explained the changes or variation on dependent variable of this study. The coefficients explained the extent to which an independent variable influenced the dependent variable. Open ended questions were analyzed qualitatively using content analysis. This is because it would be expected to provide understanding of the meaning of the data on the answers to open ended questions. Table 3.3 provides a summary of research objectives, data that was collected and data analysis, techniques and tests.

Table 3.3Summary of Research Objectives, Data Collected and Analysis

Research objectives	Data collected	Analysis Technique
i)To examine the extent to which compatibility of assistive Technology affect teaching and learning of integrated English among the visually impaired learners.	Meets the needs of learners, can be used with instructional method and secondary data	Simple linear regression correlation r and coefficient of determination R^2 **,** F-test**,** t- test $P=\alpha+\beta_1X_1+e$ Normality,multicollinearity and homogeneity tests
ii)To establish the extent to which complexity of assistive Technology affect the teaching and learning of integrated English among the visually impaired learners.	Simplicity in usage, ease of useand secondary data	Simple linear regression correlation r and coefficient of determination R^2 **,** F-test, t- test $P=\alpha+\beta_2X_2+e$ Normality,multicollinearity and homogeneity tests
iii) To examine the extent to which trialability of assistive Technology affects teaching and learning of integrated English among the visually impaired learners.	Ease of experimenting, and secondary data	Simple linear regression correlation r and coefficient of determination R^2 **,** F-test, t- test $P=\alpha+\beta_3X_3+e$ Normality,multicollinearity and homogeneity tests
iv) To establish the extent to which observability of assistive Technology affects teaching and learning of integrated English among the visually impaired learners.	Devices visible to teachers and learners and secondary data	Simple linear regression correlation r and coefficient of determination R^2 **,** F-test, t- test $P=\alpha+\beta 4X4+e$ Normality,multicollinearity and homogeneity tests
v) To examine the extent to which relative advantage of assistive Technology affects teaching and learning of integrated English among the visually impaired learners.	How dependable the AT, the extent to which content are more visual, improves efficiency, and secondary data	Simple linear regression correlation r and coefficient of determination R^2 **,** F-test, t- test $P=\alpha+\beta 5X5+e$ Normality,multicollinearity and homogeneity tests

The F test of significance was performed to determine if the variables significantly contributed to the prediction of the dependent variable. Overall significance used F-test and p- values. When p-value $\leq$ 0.05, the null hypotheses were rejected, otherwise they were not rejected (accepted). To test individual significance, t- test and p-values were used using the same level of significance ($\alpha = 0.05$). Table 3.3 gives a summary of research objectives, data analysis and tests that were done.

3.11 Hypotheses Testing

The hypotheses were subjected to Simple linear regression analysis to determine the extent to which compatibility, complexity, trialability, observability and relative advantage of assistive technology explains the variation of teaching and learning of the visually impaired learners. The following describes the meaning of symbols in the model.

P is teaching and learning which is the dependent variable

X1 is compatibility

X2 is complexity

X3 is trialability

X4 is observability

X5 is relative advantage

X1, X2, X3, X4, and X5 are all independent variables which the regression models were testing whether they explained variation in P (teaching and learning) and to what extent.

α is constant

β's are population parameters which are the coefficient which indicates the Marginal change in P (dependent variable) on additional unit of the independent variable.

e is error - can be type 1 or type 11 error

Overall model: $P=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+e$

Model 1

$P=\alpha+\beta_1X_1+e$

Teaching and learning=f (constant +compatibility of assistive technology +error)

Model 2

$P=\alpha+\beta_2X_2+e$

Teaching and learning=f (constant +complexity of assistive technology +error)

Model 3

$P=\alpha+\beta_3X_3+e$

Teaching and learning=f (constant +trialability of assistive technology + error)

Model 4

$P=\alpha+\beta_4X_4+e$

Teaching and learning=f (constant +observability of assistive technology + error)

Model 5

$P=\alpha+\beta_5X_5+e$

Teaching and learning=f (constant + relative advantage of assistive technology + error)

3.12Ethical Considerations

Observation of research ethics helps to protect the rights of the research participants and promote the integrity of the research (Israel & Hay, 2006). The following measures were taken as a way of observing ethics in research. Firstly, researcher applied for a research permit from National Commission for Science, Technology and Innovation (NACOSTI). The permit was a sign of recognizing my research and approving the undertaking of the research.

It is important that research participants get informed before they are approached for data collection. To comply with this, the respondents were informed before data collection through the use of consent letters. Consent letters contained important information about the research, and the importance of their participation in the study. The consent was sought from the parents of the visually impaired learners through the principal. The aim was to seek their informed consent and ensure voluntary participation. Anonymity and confidentiality was observed in the research study. In this study, the names of participants in the entire study were kept anonymous and the data collected from the respondents is for academic purpose only.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATIONAND DISCUSSION

4.1 Introduction

The chapter presents the questionnaire return rate, demographic data, normality, multicollinearity and homogeneity tests, and results as per research objectives and discussion.

This study was based on the following objectives: To examine the extent to which compatibility of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners. To establish the extent to which complexity of Assistive Technology affects the teaching and learning of integrated English among the visually impaired learners. To examine the extent to which Trialability of Assistive Technology affect teaching and learning of integrated English among the visually impaired learners. To establish the extent to which observability of Assistive Technology affect teaching and learning of integrated English among the visually impaired learners. To examine the extent to which relative advantage of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

4.2 Questionnaire Return Rate

The researcher issued questionnaire to teachers and principals. Table 4.1 presents the questionnaire return rate.

Table 4.1: Questionnaire Return Rate

Category	Sample size	Returned	Percent
Principals	4	4	100
Teachers	48	44	91.7

Table 4.1 indicates that response rate from principals was 100 percent; while for teachers it was 91.7 percent. The students who participated in focus group discussion were 217 students which was a response rate of 99.5%. The response rate for students, teachers and principals were above the acceptable minimum levels of 30% response rate (Field, 2009).

4.3 Types of Assistive Technology devices

Table 4.2 presents the assistive technology that were available in the four public special secondary schools for visually impaired.

Table 4.2: Types of Assistive Technology devices

Type of Assistive technology	Availability	Number
Brailler	Yes	300
Magnifier	Yes	250
Jaws	Yes	45
Touch window	Yes	30
Talking word processor	Yes	25
Touch tablets	Yes	15
Speech output devices	Yes	14
Dolphin pen	Yes	5
Digitally recorded communication devices	No	-
Alternative key board	No	-
Alternate adapted mouse	No	-

Brailler had the highest number of 300 available in special secondary school in Kenya while the dolphin pens had lowest, only five.

4.4 Distribution of teachers by Gender

Table 4.3 indicates the frequency of gender of teachers among the public special secondary schools in Kenya for visually impaired.

Table 4.3Distribution of teachers by Gender

Gender	Frequency	Percent
Male	19	43.2
Female	25	56.8
Total	44	100.0

Table 4.3 indicates that out of total of 44 teachers who responded 25 were female and 19 males. This implies that in visually impaired public special secondary schools in Kenya majority of teachers were females.

4.5 Adequacy of Assistive Technology

The Table 4.4 indicates the extent of adequacy of assistive technology.

Table 4.4 Teachers responses on Adequacy of Assistive Technology

Adequacy	Frequency	Percent
Not Sufficient	11	25.0
Sufficient	11	25.0
Moderate	9	20.5
High	13	29.5
Total	44	100.0

Table 4.4 shows that 25percent of teachers responded that AT was not sufficient and another 25 percent that AT was adequate.

4.6 Training on Visually Impairment

Table 4.5 presents teachers responses on whether they had undergone training on VI or not.

Table 4.5: Training Undergone

Response	Frequency	Percent
Yes	41	93.2
No	3	6.8
Total	44	100.0

Table 4.5 indicates that 93.2 percent of teachers responded that they had undergone training on VI while 6.8 percent had not undertaken training on VI. Therefore majority of teachers had undergone training on VI.

The Table 4.6 presents teachers responses on the relevance of training on VI.

4.7Relevance of Training

Table 4.6 presents teachers responses on relevance of training on VI.

Table 4.6: Teachers Responses on the Relevance of Training

Response	Frequency	Percent
Yes	42	95.5
No	2	4.5
Total	44	100.0

Table 4:6 indicates that 95.5 percent of teachers responded that the training on VI was relevant while only 4.5 percent indicated that the training was

irrelevant. This implies that majority of teachers indicated that the training on VI they have undertaken was relevant.

4.8 Training Adequacy

Table 4.7 indicates the adequacy of training among teachers of visually impaired learners.

Table 4 .7Teachers response on AT Training Adequacy

Response	Frequency	Percent
Yes	16	36.4
No	27	61.4
Unsure	1	2.2
Total	44	100.0

Table 4.7 indicates 36.4 percent of teachers responded that the training on VI was adequate while 61.4 percent indicated that training on VI was inadequate. Majority of teachers indicated that the training on VI was adequate for teaching the visually impaired.

4.9 Normality Test, Multicollinearity Test and Homogeneity Tests

This study was based on five specific objectives and the independent variables of the study were relative advantage, compatibility, Trialability, complexity and observability while dependent variable was teaching and learning. To ensure that the data could be analyzed for hypotheses testing, the normality test, multicollinearity test and homogeneity tests were carried out as prerequisite for statistical analysis of the data. The variables were subjected to the normality, multicollinearity and homogeneity tests so as to determine whether the data can be subjected to regression analysis.

4.9.1 Normality Tests

The normality test was carried out to determine whether the sample data distribution was normal. Normality tests check whether the data is normally distributed among the visually impaired students. Data were tested against the null hypothesis that it is normally distributed. This implies for null hypothesis to be tested the data has to be normally distributed. Normality test was done using Shapiro –Wilk Test and quantile-quantile (Q-Q) plot.

The data was subjected to normality tests using Shapiro-Wilk test. The test for normality based on Shapiro-Wilk test was presented in Table 4.8.

Table 4.8: Tests of Normality using Shapiro-Wilk test

Variable	df	p-values
Relative advantage	44	.253
Compatibility	44	.054
Trialability	44	.062
Complexity	44	.172
Observability	44	.051

According to Field (2009) when the Shapiro–Wilk significant value (p-value) is less than 0.05 it indicates a deviation from normality otherwise data is approximately normally distributed. Shapiro-Wilktest the null hypothesis that the population is normally distributed. If p-value $\leq$0.05, null hypothesis is rejected and the data is not normally distributed (Cooper & schindler, 2008).

Table 4.8 indicates that relative advantage data for assistive technology is normally distributed because the p-value of 0.253 is more than 0.05 significance level. Trialability of assistive technology is normally distributed because the p-value is 0.062 which is greater than 0.05 significance level. Complexity assistive technology was normally distributed because the p-value of 0.172 is greater than 0.05 significance level. Compatibility assistive technology was normally distributed because the p value of 0.054 is greater than 0.05 significance level. Observability assistive technology was normally distributed because the p-value of 0.051 was more than 0.05 significance level.

The data was further checked for normality tests using Quantile-Quantile (Q-Q plot). The Q-Q plot was drawn to compare observed values and expected normal value. The Q-Q plots are required for verification. Q-Q plots are used for checking normality visually. Quantiles are values that split a data set into equal portion.

The normality test using normal Q-Q plots is presented in Figure 4.1.

Figure 4.1: Normal Q-Q Plot of Relative Advantage

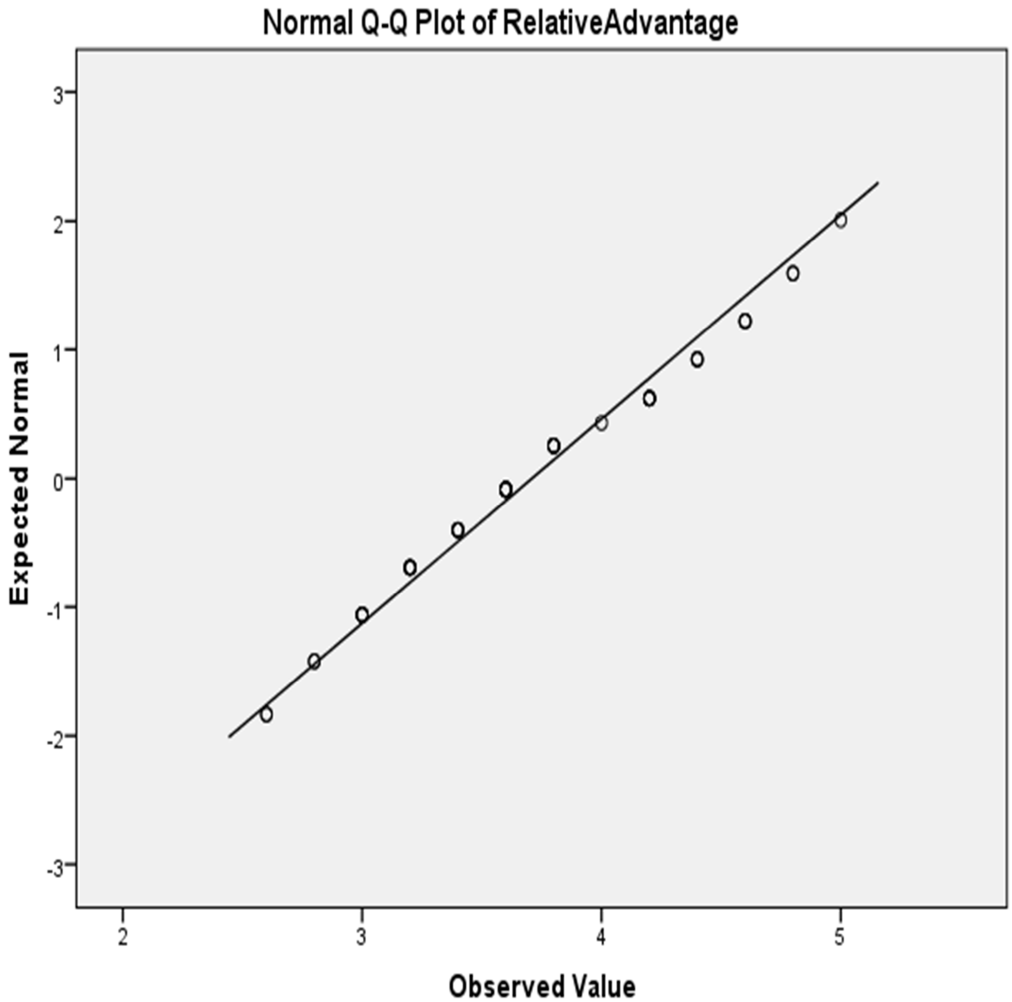


Figure 4.1 indicates that the study variables observed data is close to the expected values. The normal Q-Q plot of relative advantage indicates that indicates the data was normally distributed.

The researcher used Q-Q plot to test for normality by visual inspection (by checking closeness of observed and expected values. The normality test for compatibility of AT using normal Q-Q plots is presented in Figure 4.2.

Figure 4.2: Normal Q-Q Plot of Compatibility

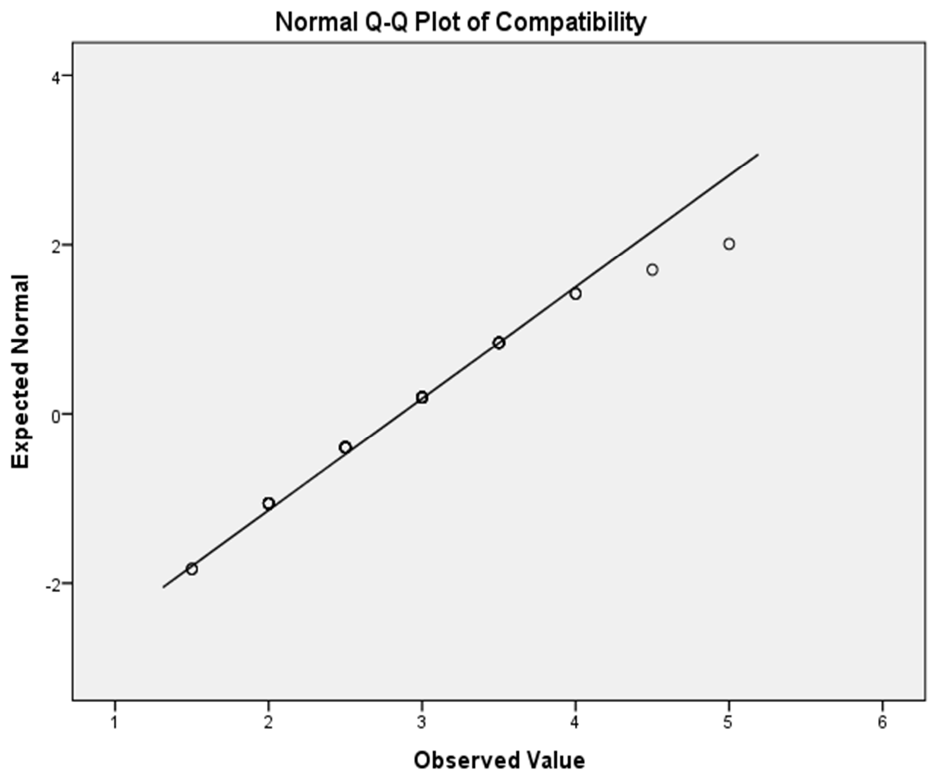
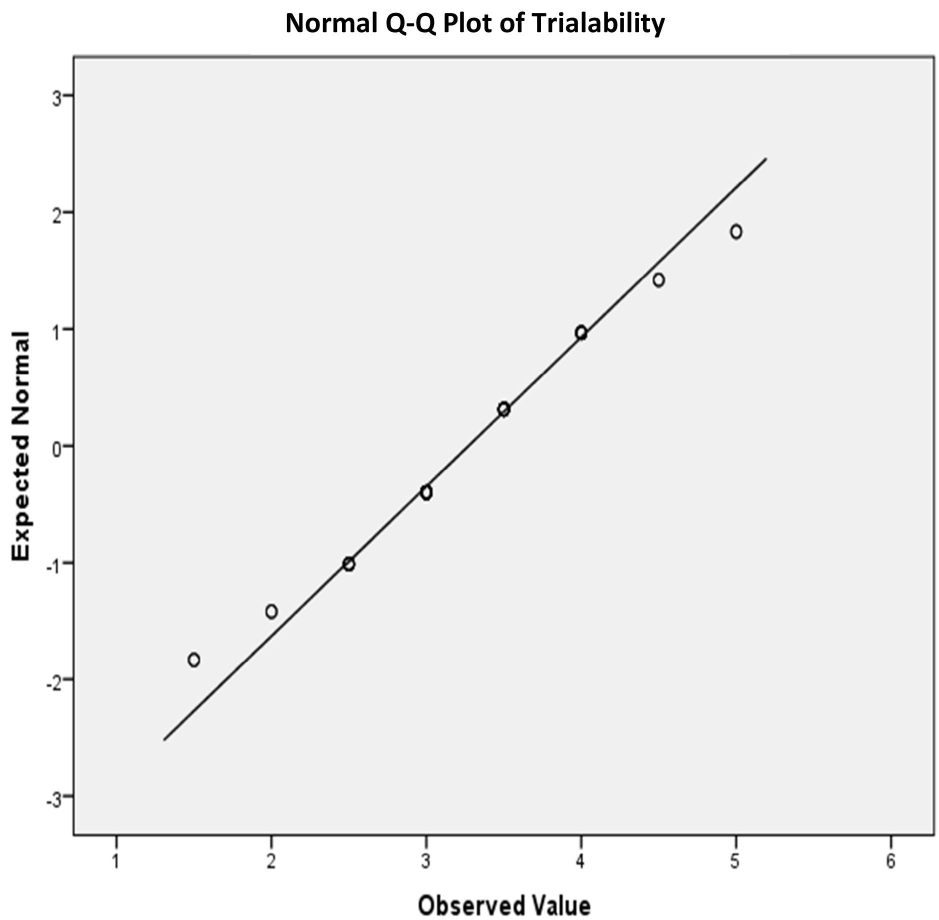


Figure 4.2 indicates that the study variables observed data is close to the expected values. The normal Q-Q plot of compatibility indicates that most data points are very close to the ideal diagonal line; this indicates the data was normally distributed (Field, 2009).

The researcher used Q-Q plot to test for normality by visual inspection. The normality test for Trialability for this study is presented in figure 4.3.

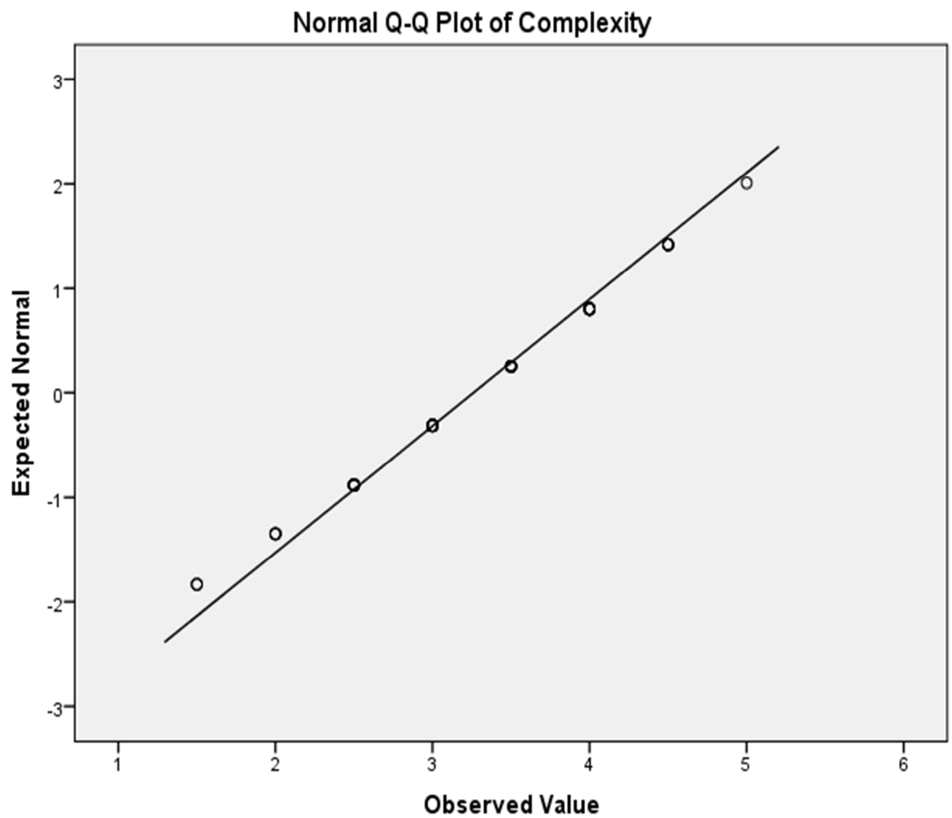
Figure 4.3: Normal Q-Q Plot of Trialability



The normality test using normal Q-Q plots in Figure 4.3 indicates that the study variables observed data is close to the expected values. The normal Q-Q plot of Trialability indicates that most data points are very close to the ideal diagonal line; this indicates the data was normally distributed.

The researcher used Q-Q plot to test for normality by visual inspection. The normality test for complexity of AT using Normal Q-Q is indicated in figure 4.4.

Figure 4.4: Normal Q-Q Plot for Complexity



The normality test using normal Q-Q plots in Figure 4.4 indicates that the study variables observed data is close to the expected values. The normal Q-Q plot of complexity indicates that most data points are very close to the ideal diagonal line; this indicates the data was normally distributed.

The researcher used Q-Q plot to test for normality by visual inspection. The normality test for observability of AT using normal Q-Q plots shown in Figure 4.5.

Figure 4.5 Normal Q-Q Plot for Observability

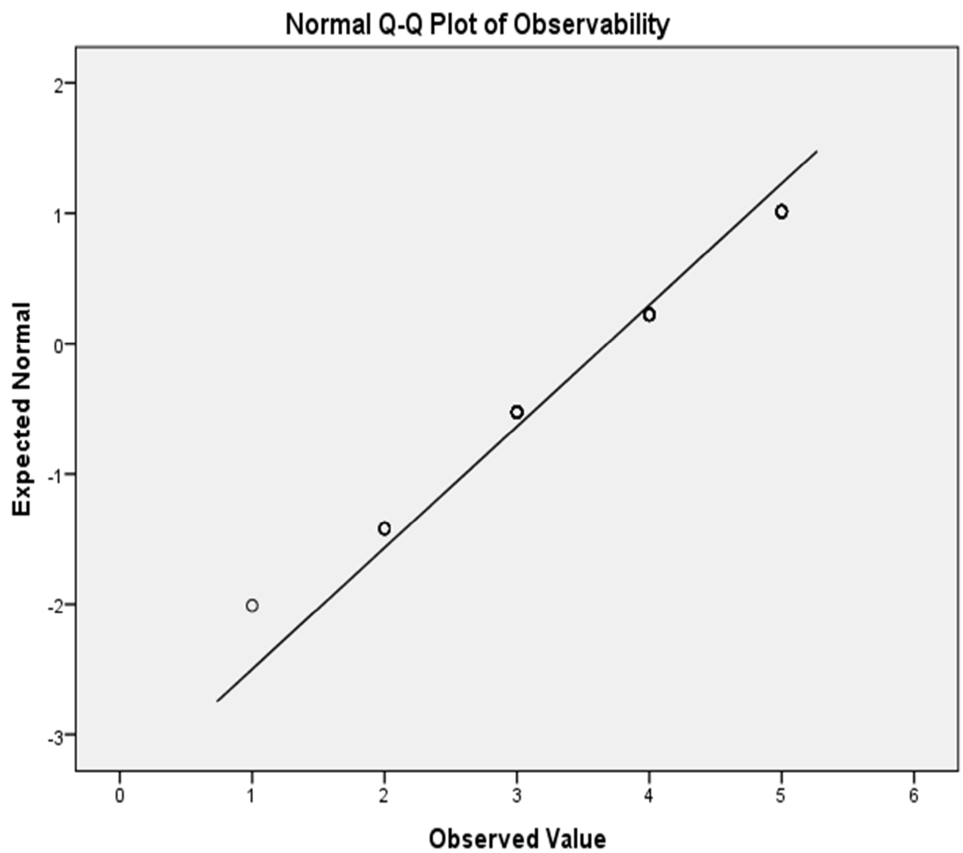


Figure 4.5 indicates that the study variables observed data is close to the expected values. The normal Q-Q plot of observability indicates that most data points are very close to the ideal diagonal line; this indicates the data was normally distributed. Therefore the data can be done regression analysis.

4.9.2 Multicollinearity Tests

The data was subjected to multicollinearity test. According to Cooper and Schindler (2008) collinearity is where two independent variables are highly correlated while multicollinearity is where more than two independent variables are highly correlated. This would have a negative effect on multiple regressions which would make it risky to interpret the coefficient as an indicator of the relative importance of predictor variables.

Multicollinearity tests on whether the independent variables were related where by if they were, no regression analysis would have been done. If no relationship among independent variables namely compatibility, complexity, relative advantage, trialability and observability (no multicollinearity) then regression analysis could be done. The multicollinearity test was carried to determine whether the independent variables of the study were highly correlated. There should be no multicollinearity (relationship between independent variables).Multicollinearity is the occurrence of several independent variables in a multiple regression model that are closely correlated to one another.

Multicollinearity can cause distorted results when attempting to study how well individual independent variables contribute to an understanding of the dependent variable. Multicollinearity can cause wide confidence intervals and unexpected p-values for independent variables. Multicollinearity and collinearity can be determined by calculations of tolerance and variation inflation factor statistics, which are measures of whether there is multicollinearity or not. To determine whether there was multicollinearity Variation Inflation Factor (VIF) and tolerance were determined. According to Hair et al. (2010), VIF should be lower than 10 and according to Menard (1995) a tolerance of less than 0.10 almost certainly indicates a serious multicollinearity problem.

The Table 4.9 indicates the tolerance and variation inflation factor.

Table 4.9: Tolerance and Variation Inflation Factor Statistics

Variable	Collinearity Statistics	
	Tolerance	VIF
Relative advantage	.499	2.005
Compatibility	.515	1.941
Trialability	.658	1.520
Complexity	.816	1.226
Observability	.603	1.658

a. Dependent Variable: teaching and learning

Table 4.9 indicates that the VIF were below 10 and tolerance levels were more than 0.10, therefore there was no multicollinearity.

4.9.3 Homogeneity Tests

Homogeneity tests on whether the variances are equal on set of data. Homogeneity of data occurs if all random variables in the sequence or vector have the same finite variance. This is also known as homoscedasticity. The assumption of homoscedasticity simplifies mathematical treatment. Serious violations in homoscedasticity (assuming a distribution of data is homoscedastic when in reality it is heteroscedastic) may result in overestimating the goodness of fit as measured by the Pearson coefficient. Levene's test was used to test for homogeneity.

The data was subjected to homogeneity test to test whether the variances ofthe five independent variables were equal. This involved use of Levene's test, which is used to assess the tenability of the assumption of equal variances (homogeneity of variance) (Field,2009). Levene's test looks at whether there are any significant differences between group variances and so a non-significant result is indicative of the assumption being met (Field,2009; Cooper & Schindler, 2008).

Levene's tests the null hypothesis that the population variances are equal. If Levene's test is significant at $p \leq 0.05$, then the null hypothesis is rejected and that the variances are significantly different therefore, the assumption of homogeneity of variances has been violated. If, however, Levene's test is non-significant ($p \geq 0.05$) then the variances are roughly equal and the assumption is tenable and null hypothesis is not rejected (Hair, et al., 2010; Field, 2009; Cooper & Schindler, 2008). Table 4.10indicates the homogeneity tests for all the five independent variables.

Table 4.10: Homogeneity Test

Characteristic	Levene Statistic	df1	df2	Sig.
Relative advantage	1.050	10	31	.298
Compatibility	1.260	10	31	.294
Trialability	1.355	10	31	.247
Complexity	1.800	10	31	.102
Observability	3.602	10	31	.073

Table 4.10 indicates that Levene's test was not significant for the Relative advantage of assistive technology (p-value=0.298), compatibility of AT (0.294), trialability (0.247), complexity (p-value= 0.102) and observability (p-value=0.073.The null hypothesis was not rejected because p-values were more than 0.05significance level. This meant that the variances were not significantly different (they were similar and the homogeneity of variance assumption is tenable). This means for all variables there was homogeneity of variances.

The principals' responses were received regarding complexity, relative advantage, compatibility, trialability and observability of AT. The researcher determined what is the mean and standard deviations of independent variables, based on the principals' response. Table 4.11 presents mean and standard deviation of independent variables based on teachers responses.

Table 4:11 Mean and Standard Deviation of five Independent Variables

N=4

Variable	Mean	Std. Deviation
Relative advantage	3.69	.13
Compatibility	3.42	.79
Complexity	2.38	.48
Observability	3.25	.87
Trialability	4.25	.74

Table 4.11 indicates that Trialability had the highest mean amounting to 4.25. This implies that principals rated trialability the highest in terms of influence on teaching and learning while complexity had the lowest mean of 2.38.This implies principals considered complexity of AT as least significant in terms of affecting teaching and learning.

The researcher determined whether there was significance mean difference among the five independent variables, based on principals' response. Table 4.12 presents one-sample test of independent variable.

Table 4.12: One-Sample Test of five independent variable

Variables	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Relative advantage	59.000	3	.000	3.68750	3.4886	3.8864
Compatibility	8.676	3	.003	3.41667	2.1634	4.6700
Complexity	9.922	3	.002	2.37500	1.6133	3.1367
Observability	7.506	3	.005	3.25000	1.8720	4.6280
Trialability	11.500	3	.001	4.25000	3.0739	5.4261

Results in Table 4.12shows that the mean difference of the five independent variables had no significance difference. This is because all the p values were below significance level of 0.05.

Section 4.10 determined the correlation of the independent variables of the study which were compatibility, complexity, trialability, relative advantage and observability and dependent variable (teaching and learning), based on principals’ response. Correlation is important because it shows whether the variables are positively correlated, negatively or not correlated.

4.10Correlation of the Independent Variables

The researcher determined the relationship between independent variables, based on principals' response. The independent variables were compatibility of AT, Trialability, observability, relative advantage and complexity of AT. The relationship between the independent variables based on principals' response is shown in Table 4.13. This information was important because it gives understanding of how the independent variables relationships are and also with the dependent variable.

Table 4.13: Relationship of independent variables and Teaching and Learning-based on Principals' Response

Variable		Teaching and learning	Relative advantage	Compatibility	Complexity	Observability	Trialability
Teaching and learning	Pearson Correlation	1	.774*	.122*	-.712*	.404	.789*
	Sig. (2-tailed)		.0.001	.020	.010	.596	.041
	N	4	4	4	4	4	4
Relative advantage	Pearson Correlation	.774*	1	-.494	.522	-.577	-.676
	Sig. (2-tailed)	.001		.506	.478	.423	.324
	N	4	4	4	4	4	4
Compatibility	Pearson Correlation	.122*	-.494	1	.479	.937	-.302
	Sig. (2-tailed)	.020	.506		.521	.063	.698
	N	4	4	4	4	4	4
Complexity	Pearson Correlation	-.712*	.522	.479	1	.302	-.981*
	Sig. (2-tailed)	.010	.478	.521		.698	.019
	N	4	4	4	4	4	4
Observability	Pearson Correlation	.404	-.577	.937	.302	1	-.130
	Sig. (2-tailed)	.596	.423	.063	.698		.870
	N	4	4	4	4	4	4
Trialability	Pearson Correlation	.789*	-.676	-.302	-.981*	-.130	1
	Sig. (2-tailed)	.041	.324	.698	.019	.870	
	N	4	4	4	4	4	4

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.13 shows correlation (relationship) among the variables of the study. When p-value was lower than significance level of 0.05 there was statistical significance but when p-value was above 0.05 there was no statistical significance. The correlation can be positive, negative or zero.

Table 4.13 shows that relative advantage of AT was positively (0.774) related to teaching and learning and the correlation was statistically significant at 0.05 significance level because p-value was 0.001 which is less than 0.05 significance level. Relative advantage of AT was negatively (-0.494) correlated to compatibility of AT but the relationship was not statistically significant. Relative advantage was positively (0.522) correlated to complexity but the relationship was not statistically significant. Relative advantage of AT was negatively correlated (-0.577) to observability of AT and the relationship was not statistically significant. Relative advantage was negatively correlated (-0.676)) to trialability but the relationship was not statistically significant.

Compatibility of AT was positively correlated (0.122) with teaching and learning and the relationship was statistically significant. Compatibility was positively correlated (0.479) with complexity but relationship was not statistically significant. Complexity was negatively (-0.712) correlated with teaching and learning and the relationship was statistically significant. Complexity had a negatively relationship (-0.981) with trialability and the correlation was statistically significant. Observability of AT was positively (0.404) correlated to teaching and learning but not statistically significant.

Trialability of AT was positively related (0.937) to observability but the relationship was not statistically significant. Trialability was negatively correlated (-0.302) to complexity but the relationship was not significant at 0.05 significance level.

4.11 Influence of Compatibility on Teaching and Learning

The first objective was to examine the extent to which compatibility of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.

The null hypothesis HO_1**:** there is no significant relationship between compatibility of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was tested at0.05 significance level. This information is based on teachers' response. Table 4.14 indicates relationship between the compatibility and teaching and learning based on teachers' responses.

Table 4.14: Relationship between Compatibility and Teaching and Learning- Teachers Response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.023[a]	.001	.000	1.05469
a. Predictors: (Constant), Compatibility				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.025	1	.025	.022	.042[b]
	Residual	46.720	42	1.112		
	Total	46.744	43			
a. Dependent Variable: teaching and learning b. Predictors: (Constant), Compatibility						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.102	.628		9.711	.000
	Compatibility	.032	.212	.023	.149	.042
a. Dependent Variable: teaching and learning						

The coefficient of determination was 0.001 indicating that compatibility explains 0.1 percent of variation in effective teaching and learning. The remaining 99.9 percent could be explained by other variables not within this study. The overall test of significance using F-value statistic was 0.022 which was significant because p-value (0.042) which was lower than0.05 significance level and the null hypothesis that there is no significant relationship between compatibility of Assistive Technology and teaching and learning of integrated English in special secondary school in Kenya was consequently rejected. This implies that compatibility of Assistive Technology significantly influence teaching and learning of integrated English in special secondary school in Kenya. This is in line with Mckenzie (2001) study who found that compatibility of AT has positive effect on the learners but in conflict with Kapperman, Sticken and Heinze (2002) who found that AT devices may not always be beneficial.

In order to establish individual significance t-test was carried out. From Table 4.14, compatibility (0.042) was statistically significant.

The Table 4.15 shows the relationship between Compatibility of AT and Teaching and Learning based on principals' responses.

Table 4.15: Relationship between Compatibility of AT and Teaching and Learning- Principals response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.122[a]	.015	.011	1.65001
a. Predictors: (Constant), Compatibility				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.082	1	.082	.030	.002[b]
	Residual	5.445	2	2.723		
	Total	5.528	3			
a. Dependent Variable: teaching and learning						
b. Predictors: (Constant), Compatibility						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.206	4.214		.998	.004
	Compatibility	.210	1.209	.122	.174	.002
a. Dependent Variable: teaching and learning						

Table 4.15 indicates relationship between the compatibility and teaching and learning. The coefficient of determination was 0.015 indicating that compatibility explained 1.5 percent of variation in teaching and learning. The remaining 98.5 percent could be explained by other variables not within this study.

The overall test of significance using F-value statistic was 0.030 which was statistically significant because p-value (0.002) was less than 0.05 significance level and the null hypothesis that there is no significant relationship between compatibility of Assistive Technology and teaching and learning of integrated English was consequently rejected. This implies that compatibility of AT statistically influence the teaching and learning of visually impaired learners in special secondary schools in Kenya. The results are similar to Mckenzie (2001) study which found that compatibility of AT had positive effect on the learners. In contrast Kapperman, Sticken and Heinze (2002) found that AT devices may not always be beneficial.

In order to establish individual significance t-test was carried out. From Table 4.15 the constant and compatibility coefficient were statistically significant because their p-values were below 0.05 significance level.

4.12 Influence of Complexity on Teaching and learning

The second objective was to establish the extent to which complexity of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners. The null hypothesis $H0_2$**:** that there is no significant relationship between complexity of Assistive Technology and teaching and learning of integrated English among the visually impaired learners in special secondary schools in Kenya was tested at 0.05 significance level. Table 4.16 indicates relationship between complexity and teaching and learning.

Table 4.16: Relationship between complexity and Teaching and learning-Teachers response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.126[a]	.016	.014	1.05473

a. Predictors: (Constant), Complexity

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.744	1	.744	.679	.043[b]
	Residual	46.000	42	1.095		
	Total	46.744	43			

a. Dependent Variable: teaching and learning b. Predictors: (Constant), Complexity

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.098	.656		9.301	.000
	Complexity	.027	.195	.021	.824	.0.043

a. Dependent Variable: teaching and learning

The coefficient of determination was 0.016 indicating that complexity explains 1.6 percent of variation in teaching and learning in special secondary school in Kenya. The remaining 98.4 percent could be explained by other variables not within this study.

The overall test of significance using F-value statistic was 0.679 which was statistically significant because p-value of 0.043 was less than 0.05 significance level. Therefore, the null hypothesis was rejected that there is no significant relationship between complexity of assistive technology and teaching and learning of integrated English among the visually impaired learners in special secondary schools in Kenya. This implies complexity of AT has statistically significant effect on teaching and learning of visually impaired learners. The results similar to Hussin (2013) study in Malaysia which found that complexity affect the use of AT but in contrast Alper and Vaharihima (2006) study showed that AT may not be fully beneficial.

In order to establish individual significance t-test was carried out. From Table 4.16, the constant (0.000) and complexity (0.043) were statistically significant.

Table 4.17indicates relationship between complexity and teaching and learning based on principals' response.

Table 4.17: Relationship between complexity and Teaching and Learning- Principals response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	-.712[a]	.507	.260	1.16775
a. Predictors: (Constant), Complexity				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.800	1	2.800	2.054	.001[b]
	Residual	2.727	2	1.364		
	Total	5.528	3			
a. Dependent Variable: teaching and learning b. Predictors: (Constant), Complexity						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.718	3.395		2.862	.004
	Complexity	-2.018	1.408	-.712	-1.433	.001
a. Dependent Variable:teaching and learning						

The coefficient of determination was 0.507 indicating according to principals,' complexity of AT explained 50.7 percent of variation of learners' achievement in special secondary school in Kenya. The remaining 49.3 could be explained by other variables not within the study.

The overall test of significance using F-value statistic was 2.054 which was statistically significant because p-value of 0.001 was less than 0.05 significance level. Therefore, the null hypothesis was rejected that there is no significant relationship between complexity of Assistive Technology and teaching and learning of integrated English among the visual impaired learners in special secondary schools in Kenya. This implies that complexity of AT influences significantly the teaching and learning among visually impaired learners. This in contrast to Kapperman, et al., 2002 study which showed that AT may not always benefit the users. The constant and coefficient of complexity were statistically significant because their p-values were less than 0.05.

4.13 Influence of Trialability on Teaching and learning

When employing an AT to test on trialability, researcher found that with dolphin pen of version 2010 and learning Access Suite a VI learner does not need to attend a special school but can be integrated in mainstream schools without disrupting the learning of other sighted students. To date most of AT are still being piloted especially by Sight Savers. The third objective was to examine the extent to which trialability of Assistive Technology affect teaching and learning of integrated English among the visually impaired learners. The null hypothesis HO_3**:** there is no significant relationship between trialability of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was tested at 0.05significancelevel.

Table 4.18indicates the relationship of Trialability and Effective Teaching and Learning based on teachers responses.

Table 4.18: Relationship between Trialability and Teaching and learning-teachers response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.077[a]	.006	.004	1.05186
a. Predictors: (Constant), Trialability				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.275	1	.275	.249	.003[b]
	Residual	46.469	42	1.106		
	Total	46.744	43			
a. Dependent Variable: teaching and learning b. Predictors: (Constant), Trialability						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.347	.691		9.189	.000
	Trialability	.102	.205	.077	.499	.003
a. Dependent Variable: teaching and learning						

The coefficient of determination was 0.006 indicating that trialability of AT explained0.6 percent of variation in teaching and learning of visually impaired learners in special secondary schools in Kenya. The remaining 99.4 percent could be explained by other variables not within this study.

The overall test of significance using F-value statistic was 0.249 which was statistically significant because p-value of 0.003 was less than 0.05 significance level. This implies that the null hypothesis that there is no significant relationship between trialability of Assistive Technology and teaching and learning of integrated English was consequently rejected. This implies that trialability of AT has significant effect on Effective Teaching and Learning. This was also supported by the trialability that was carried out in all the four schools using dolphin pen and on assessment using continuous assessment test, the performance improved when VI students were using Dolphin pen. This in line with to Finley (2003) who indicated that trialability increases the chances of adoption of an AT device. This also supported by Rogers (2003). However Kapperman,et al 2002 indicated that AT may not always benefit the users.

The Table 4.18 indicates that both constant was significant but trialability coefficient was not significant (-.102).

The Table 4.19 shows the relationship between trialability and teaching and learning based on principals' responses.

Table 4:19: Relationship between Trialability and Teaching and Learning- Principals response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.789[a]	.623	.434	1.02122

a. Predictors: (Constant), Trialability

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.442	1	3.442	3.300	.041[b]
	Residual	2.086	2	1.043		
	Total	5.528	3			

a. Dependent Variable: teaching and learning

b. Predictors: (Constant), Trialability

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.234	3.428		-.360	.003
	Trialability	1.449	.798	.789	1.817	.041

a. Dependent Variable: teaching and learning

Table 4.19 indicates the relationship of trialability andTeaching and Learning. The coefficient of determination was 0.623 indicating according to principals, Trialability of AT explained 62.3 percent of variation in teaching and learning of visually impaired learners in special secondary schools in Kenya. The remaining 37.7 percent could be explained by other variables not within this study.

The overall test of significance using F-value statistic was 3.300 which was not statistically significant because p-value of 0.041 which was less than 0.05 significance level. This implies that the null hypothesis that there is no significant relationship between Trialability of Assistive Technology and teaching and learning of integrated English was consequently rejected. The findings are similar to Finley (2003) who showed that Trialability increases the chances of adoption of an AT device. This also supported by Rogers (2003). However, Kapperman,et al 2002 indicated that AT may not always benefit the users. The Table 4.19 shows that constant and Trialability coefficients were statistically significant because p-values were less than 0.05 significance level.

4.14Influence of observability on Teaching and learning

The fourth objective of the study was to establish the extent to which observability of Assistive Technology affect teaching and learning of integrated English among the visually impaired learners. The null hypothesis

$H0_4$**:**there is no significant relationship between observability of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was tested at0.05 significance level.Table 4.20shows relationship of observability of assistive technology and teaching and learning.

Table 4:20: Relationship between AT Observability and Teaching and learning- Teachers response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.138[a]	.019	.008	1.04488

a. Predictors: (Constant), Observability

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.890	1	.890	.815	.372[b]
	Residual	45.854	42	1.092		
	Total	46.744	43			

a. Dependent Variable: teaching and learning
b. Predictors: (Constant), Observability

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.505	.569		11.436	.000
	Observability	-.134	.148	-.138	-.903	.372

a. Dependent Variable: teaching and learning

The coefficient of determination was 0.019 indicating that observability explained 1.9 percent of variation of effective teaching and learning. The remaining 99.1 percent could be explained by other variables not within this study. The overall test of significance using F-value statistic was 0.815 which was not significant because p-value of 0.372 was greater than 0.05 significance level. This indicates that the null hypothesis that there is no significant relationship between observability of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was accepted. This implies that observability of AT has no significant effect on Teaching and Learning. This in contrast to Ntemana and Olatokan (2012) who found that observability had significant effect on teaching and learning.

The Table 4.20 indicates that the constant is significant but the observability coefficient is not significant because its p-value of .0372 is more than 0.05 significant levels.

Table 4.21 Indicates relationship of observability of assistive technology and teaching and learning based on principals responses.

Table 4.21: Relationship between Observability of AT and Teaching and Learning- Principals response.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.404[a]	.163	-.142	1.52069
a. Predictors: (Constant), Observability				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.903	1	.903	.390	.596[b]
	Residual	4.625	2	2.313		
	Total	5.528	3			
a. Dependent Variable: teaching and learning b. Predictors: (Constant), Observability						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.867	3.381		.848	.601
	Observability	.633	1.014	.404	.625	.596
a. Dependent Variable: teaching and learning						

The coefficient of determination was 0.163 indicating that observability explained 16.3 percent of variation of Teaching and Learning**.** The remaining 83.7 percent was could be explained by other variables not within this study.

The overall test of significance using F-value statistic was 0.390 which was not significant because p-value of 0.596 was greater than 0.05 significance level. This indicates that the null hypothesis that there is no significant relationship between observability of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was accepted. This implies that there is no statistically significant relationship between observability of AT and teaching and learning of visually impaired learners in special secondary school in Kenya.

The Table 4.21 shows that the constant and observability coefficient are not statistically significant because their p-values were more than 0.05 significant level. This implies that observability of AT had no significant effect on teaching and learning among visually impaired learners. This in contrast to Ntemana and Olatokan (2012) who found that observability of AT had significant effect on students' performance.

4.15 Influence of Relative Advantage on Teaching and learning

The fifth objective was to examine the extent to which relative advantage of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners. The null hypothesis $H0_5$**:** there is no significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was tested at 0.05 significance level.

Table 4.22indicates the relationship between relative advantage and Teaching and Learning based on teachers' response.

Table 4.22: Relationship between relative advantage and Teaching and Learning- Teachers response

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.053[a]	.003	.002	1.05349
a. Predictors: (Constant), Relative Advantage				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.131	1	.131	.118	.001[b]
	Residual	46.614	42	1.110		
	Total	46.744	43			
a. Dependent Variable: teaching and learning						
b. Predictors: (Constant), Relative Advantage						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.336	.959		6.608	.000
	Relative Advantage	.088	.255	.053	.343	.001
a. Dependent Variable: teaching and learning						

The coefficient of determination was 0.003 indicating that relative advantage of AT explained 0.03 percent of variation in Teaching and learning among the visually impaired learners. The remaining 99.97 percent could be explained by other variables not within the study.

The overall test of significance using F-value statistic was 0.118 which was significant because p-value (0.001) is less than0.05 level of significance and the null hypothesis that there is no significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visual impaired learners was consequently rejected. This means that relative advantage significantly influence teaching and learning among visually impaired in special secondary school in Kenya.

The findings of this study are in conflict with to Alper and Vaharihinna (2006) who asserted that AT may not be fully beneficial to the users. Finley (2003) showed that relative advantage of an AT has no significant effect on its usability by VI learners. Table 4.23indicates that the constant was significant (0.000) while relative advantage coefficient was significant (0.001).

Table 4.23 indicates the relationship between relative advantage of AT and Teaching and Learning based on principals responses.

Table 4.23: Relationship between relative advantage and Teaching and Learning- Principals responses

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.774[a]	.598	.398	1.05357
a. Predictors: (Constant), Relative advantage				

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.308	1	3.308	2.980	.001[b]
	Residual	2.220	2	1.110		
	Total	5.528	3			
a. Dependent Variable: teaching and learning b. Predictors: (Constant), Relative advantage						

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35.900	17.952		2.000	.007
	Relative advantage	8.400	4.866	.774	1.726	.001
a. Dependent Variable: teaching and learning						

The coefficient of determination was 0.598 indicating that according to principals, relative advantage of AT explained 59.8 percent of variation in teaching and learning among the visually impaired learners. The remaining 40.2 percent could be explained by other variables not within the study. The overall test of significance using F-value statistic was 2.980 which was not significant because p-value (0.001) was less than 0.05 level of significance and the null hypothesis that there is no significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visually impaired learners was consequently rejected. This implies that relative advantage of AT influences significantly the teaching and learning of visually impaired learners.

The study findings are in conflict with Alper and Vaharihinna (2006) who asserted that AT may not be fully beneficial to the users. Finley (2003) indicated that relative advantage of an AT has no effect on its usability by VI learners. Table 4.23 Indicates that the constant and the relative advantage coefficient were not significant.

4.16 Influence of Compatibility, Observability, Relative Advantage, Complexity and Trialability onTeaching and learning

This is a combination of all the five independent variables. Table 4.24 indicates the relationship between Compatibility, Observability, Relative Advantage, Complexity and Trialability on Teaching and learning of visually impaired learners in special secondary schools in Kenya. The joint effect of the five independent variables as shown in Table 4.24 have coefficient of determination of 0.027 which indicates that they jointly explain 2.7 percent variation in Teaching and learning of visually impaired learners. This is greater than independent effect of each of the independent variables. The remaining 97.3 percent could be explained by other variables not within the study.

Table 4.24: Relationship Compatibility, Observability, Relative Advantage, Complexity and Trialability on Teaching and Learning

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.165[a]	.027	.011	1.09389

a. Predictors: (Constant), Observability, Trialability, Complexity, Compatibility, Relative Advantage

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.274	5	.255	.213	.0.04[b]
	Residual	45.470	38	1.197		
	Total	46.744	43			

a. Dependent Variable: teaching and learning

b. Predictors: (Constant), Observability, Trialability, Complexity, Compatibility, Relative Advantage

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.654	1.197		5.560	.000
	Relative Advantage	.075	.375	.046	.201	.003
	Compatibility	.012	.307	.009	.041	.005
	Trialability	.116	.263	.087	.440	.042
	Complexity	.030	.224	.023	.132	.009
	Observability	-.164	.200	-.169	-.819	.418

a. Dependent Variable: teaching and learning

The overall test of significance using F-value statistic was 0.213 which statistically significant because the p-value was 0.04 was less than 0.05 level of significance. The Table 4.24 indicates that the constant and the independent variables coefficients apart from observability coefficient were statistically significant because their p-values are less than 0.05 significance level.

4.17 Availability of Assistive devices in special secondary school in Kenya

The observations schedules indicated that most schools had braillers and were in use. Some special secondary school had Jaws, magnifiers and adapted instruction materials and were adequate and well utilized by the students. Most of the assistive technologies devices were in good condition apart from the magnifiers. The extent of adequacy was related to number of visually impaired students in the school. Schools with high numbers above 250 VI students had more AT devices than with small number of students.

These assistive technologies include the following brailler, NVDA, talking word processor, speech output devices and adapted instruction materials. The ATs are adequate apart from NVDA (Non Visual Desktop Access). Most of them are in good condition. The digitally recorded communication devices require new upgrade and new audio devices are needed. NVDA were highly used instead of jaws and dolphin which have the same output for zooming. The students also used Duxbury program (DBT) whose keyboard changes to a function like a brailler.

The Salvation Army Kibos Special Sec School in Kisumu has the following ATs: Brailler, Jaws, speech output devices, talking word processor/ word prediction and adapted instruction materials which are in use. The following ATs are available but not in use which include the following: alternative keyboards, touch tablets, digitally recorded communication devices and magnifiers. The braillers are not adequate. St Francis Kapenguria has only jaws for windows (screen reader).

Focus group discussions involved convening group of students to discuss the effect of assistive technology in teaching and learning of integrated English among visually impaired learners. The focus groups were done in all the four schools composed of 7 students per group. The students indicated that when they thought of assistive technology what comes to mind is the brailler,ipad, magnifiers, computers and jaws. They further pointed out that ATs are inadequate and the need for the school to invest in more ATs. Students admitted that the compatibility, Trialability, relative advantage and extent of complexity influence the use of ATs.In Salvation ArmyThika School for visually impaired, the students indicated they have varieties of ATs from the Braille where each of them have and other ATs.They have Jaws, which are enough and properly used. St Francis Kapenguria has only jaws of widow and was not in use.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1Introduction

The chapter covers the summary of the study, conclusions, recommendations and suggestions for further studies.

5.2 Summary of study

The purpose of the study was to determine the effect of assistive technology on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya. The study was anchored on Rodgers's theory supported by Edyburns theory.

The study had five objectives which were based on relationship of compatibility of AT, relative advantage, complexity, trialability and observability, with teaching and learning. Teaching and learning was based on learners' achievement. The analysis was carried out based on teachers' data and then based on principals. The objectives of this study were: to examine the extent to which compatibility of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners; to establish the extent to which the complexity of Assistive Technology affects the teaching and learning of integrated English among the visually impaired learners; to examine the extent to which trialability of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners; to establish the extent to which observability of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners and to examine the extent to which relative advantage of Assistive Technology affects teaching and learning of integrated English among the visually impaired learners.There were five null hypotheses which were tested at 0.05 significance level.

The null hypothesis $H0_1$based on teachers and principal responses was rejected, therefore there is significant relationship between compatibility of Assistive Technology and teaching and learning of integrated English among the visually impaired learners hypothesis at 0.05 significance level. The coefficient of determination based on the teachers' responses was 0.001 indicating that compatibility explained 0.1 percent of variation in teaching and learning. The remaining 99.9 percent could be explained by other variables not within this study. The coefficient of determination based on principals was 0.015 indicating that compatibility explained 1.5 percent of variation in Teaching and Learning**.** The coefficient of determination was more in principals' (0.015) response data as compared to teachers (0.001). This indicates that principals understood more than teachers on compatibility of AT effect on teaching and learning. The overall significance using F-value statistic was statistically significant for both teachers and principals. This implies for both teachers and principals were in agreement that the compatibility of AT significantly influences teaching and learning of visually impaired learners in special secondary school in Kenya.

The null hypothesis $H0_{2,}$ based on teachers and principals responses was rejected meaning that there was significant relationship between complexity of Assistive Technology and teaching and learning of integrated English among the visually impaired learners in special secondary schools in Kenya at 0.05 significance level. The coefficient of determination based on teachers responses was 0.016 indicating that complexity explained 1.6 percent of variation in teaching and learning in special secondary school in Kenya. The coefficient of determination was 0.507 according to principals' responses indicating that complexity of AT explained 50.7 percent of variation of teaching and learning in special secondary school in Kenya. The remaining 49.3 could be explained by other variables not within the study. The results indicate that Principals understood better than teachers the effect of AT complexity on teaching and learning The overall test of significance for data from teachers responses and principals using F-value statistic was statistically significant implying that they were in agreement that complexity of AT influence the teaching and learning of visually impaired learners in special secondary schools in Kenya.

The null hypothesis $H0_3$based on teachers and principals was rejected which means that there is significant relationship between trialability of Assistive

Technology and teaching and learning of integrated English among the visually impaired learners at 0.05 significance level. The coefficient of determination based on teachers data was 0.006 indicating that Trialability of AT explained 6 percent of variation in Teaching and learning of visual disability learners in special secondary schools in Kenya. The remaining 94 percent could be explained by other variables not within this study. The coefficient of determination based on principals responses was 0.623 indicating Trialability of AT explained 62.3 percent of variation in Teaching and Learning of visually impaired learners in special secondary schools in Kenya. The remaining 37.7 percent could be explained by other variables not within this study. The coefficient of determination for principals was higher than of teachers implying that principals understood more than teachers the effect of AT trialability on teaching and learning. The overall test of significance for both teachers and principals, using F-value statistic was statistically significant. This implies that they both agree that trialability of Assistive Technology significantly influence teaching and learning of integrated English of visually impaired learners in special secondary schools in Kenya.

The null hypothesis $H0_4$based on teachers and principals data was accepted meaning that there is no significant relationship between observability of assistive technology and teaching and learning of integrated English among the visually impaired learners, at 0.05 significance level. The coefficient of determination from teachers' data was 0.019 indicating that observability insignificantly explained 1.9 percent of variation of teaching and learning. The coefficient of determination according to principals' data was 0.163 indicating that observability insignificantly explained 16.3 percent of variation of teaching and learning. The overall test of significance based on teachers' data and principals' data using F-value statistic was not significant because p-values were greater than 0.05 significance level. This indicates that both teachers and principals agreed that observability of AT had no statistically significant influence on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya.

The null hypothesis $H0_5$based on teachers and principals was rejected meaning that there is no significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visually impaired learners at 0.05 significance level. Basing on data from teachers the coefficient of determination was 0.003 indicating that relative advantage of AT explained 0.3 percent of variation in Teaching and Learning among the visually impaired learners. The remaining 99.7 percent could be explained by other variables not within the study. Analysis results from principals data indicates that the coefficient of determination was 0.598 indicating that according to principals, relative advantage of AT explained 59.8 percent of variation in teaching and learning among the visually impaired learners. The remaining 40.2 percent could be explained by other variables not within the study. Therefore according to principals 59.8 percent relative advantage of AT explains teaching and learning of integrated English more than from the teachers (0.3 percent). This implies that principals understood better than teachers the influence of relative advantage of assistive technology on teaching and learning of visually impaired learners in special secondary school in Kenya. The overall test of significance using F-value statistic based on teachers and principals responses was statistically significant because p-values were less than 0.05 significance level. Therefore both teachers and principals were in agreement that relative advantage of Assistive Technology has an effect on teaching and learning of integrated English among the visually impaired learners in special secondary schools in Kenya.

The joint effect of compatibility, observability, relative advantage, complexity and trialability on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya was determined. According to the teachers, the joint effect of the five independent variables had coefficient of determination of 0.027 which indicates that they jointly explained 2.7 percent variation in teaching and learning of visually impaired learners. This is greater than independent effect of each of the independent variables. The remaining 97.3 percent could be explained by other variables not within the study. The overall test of significance using F-value statistic was statistically significant because the p-value were less than 0.05 level of significance. This means that when an a school management consider all the five independent variables when implementing or using AT then the performance of students would be better than when only one of the variables is considered. This implies that the school management have to carefully consider compatibility, relative advantage, complexity, trialability and observability of AT.

The principals' understand the visually impaired aspects better than the teachers. This is indicated by the higher coefficient of determinations in all the five hypotheses from the principals' data as compared to teachers' data. The data collected from principals indicated that independent variables explained teaching and learning more than the data from the teachers.

Most teachers and VI student raised an issue of lagging behind in syllabus coverage. They have a challenge of catching up with their non-VI colleagues especially when there are new recommended set books. This is because it takes time to convert the book to brailler to make the book usable by VI learners.

5.3 Conclusions

The study established that there was significant relationship between compatibility of AT and teaching and learning of visually impaired learners in special secondary school in Kenya. This implies that compatibility of AT affect the teaching and learning of visually impaired learners.

There was significant relationship between complexity of Assistive Technology and teaching and learning of integrated English among the visually impaired learners. This implies that complexity of AT affects teaching and learning of integrated English among the visually impaired learners.

The study established that there is significant relationship between trialability of Assistive Technology and teaching and learning of among integrated English among the visually impaired learners was rejected. This implies that how triable AT device is, has significant influences teaching and learning process of visually impaired learners among special secondary school in Kenya.

There is no significant relationship between observability of assistive technology and teaching and learning of integrated English among the visually impaired learners.. This means that observability of AT does not significantly influence on teaching and learning of visually impaired learners in special secondary school in Kenya.

The study established that there is significant relationship between relative advantage of Assistive Technology and teaching and learning of integrated English among the visually impaired learners. This means the relative advantage of AT does significantly influence teaching and learning of visually impaired learners in special secondary schools in Kenya.

The four independent variables of the study; trialability of AT, relative advantage of AT, compatibility of AT and complexity of AT had statistically significant effect on teaching and learning of integrated English among the visually impaired learners in special secondary school in Kenya. This therefore implies that by an AT fulfilling or considering the four features it is expected that there will be significant effect in teaching and learning of integrated English among VI learners. The observability variable did not statistically significantly affect teaching and learning of VI students and therefore according to this study, it is not key variable to influence teaching and learning of VI.

The study found that there are no equal distribution of donations of AT and monitoring is done mostly by the donors but not much by DQUASO to assess the quality issues and the advantage of AT to the VI. The teachers' pupils' ratio is low in special secondary school. Change in curriculum overlooks the time taken by special secondary schools for the VI to adopt and implement it creating a divide between sighted and VI students. The study established that why there is less performance in special schools, is because of limited or lack of relevant AT(Ministry of Education,2014).

5.4Recommendations

Based on the findings of the study the following are the recommendations.

i).The study found that compatibility of assistive device influence teaching and learning of visually impaired learners. Therefore there should be determination to what extent an assistive technology device would: meet the need of the VI learners in terms of category they fall under the WHO measure of acuity. Experts for example ophthalmologist and manufacturers should work in harmony with the KSB, MOE and KISE to ensure that VI learners are placed in institutions with ATs relevant to their degree of visual impairment. It is important to carefully assess the assistive devices compatibility with other more advanced assistive technology devices.

ii).The study found out that complexity of assistive technology influences the teaching and learning of visually impaired learners. It is important for school management to carefully consider the ease of use of an assistive technology (extent of complexity of an assistive technology device).This is important because in some schools they would have some assistive technology but were not being used. This study established that some teachers had adequate training but others did not, thus making usage of AT devices complex. Training can bridge the gap between complexity of AT and simplicity. The determination of complexity of an assistive technology should be done by the school management liasing with experts in assistive technology.

Complexity of AT can be minimized by the school management organizing for training of teachers who can then pass the technical know-how to their students. The schools principals should get professional recommendations on student placement and assistive technology to use. The Ministry of Education should formulate and implement policies to support special secondary schools in training teachers. There should be frequent in-service training of teachers (in-set) on new strategies methods and usage of relevant ATs. The ministry of education should ensure there is budget allocation on AT procurement, maintenance and monitoring. Kenya Institute of Curriculum Development, KNEC and KISE should work hand in hand with the visually impaired institutions especially where there is change in curriculum. The management should consult manufacturers/distributors to do an objective assessment of assistive technology complexity before purchasing them and should be done school.

The higher education institutions apart from offering Bachelor of special needs education, should consider delving to specific areas of specialization for example a degree that specializes on AT for each and every disability. Bachelor of education in Assistive technology should also be considered in the wake of information communication technology advancement.

iii). The study established that trialability of assistive technology influences teaching and learning of visually impaired. It is important for schools management to carefully consider to what extent an assistive technology can be tested (tried) on a pilot basis before the school invests in buying more assistive technology. The assessment of trialability should be done by the experts in AT, the school management together with teachers of visually impaired learners. They should liase with schools which already are using the assistive technology they require and work an arrangement where they can assess their trialability before they procure them.

iv).The study found that relative advantage of assistive technology influences teaching and learning of visually impaired learners. There should be objective assessment of whether an assistive technology would add value than already existing low-tech AT's. The school management should carefully determine whether an assistive technology would make a difference to the visually impaired learners in the learning process. It would be important for schools to benchmark with other special secondary schools locally and internationally. This would enable the school to understand how other schools have benefited or not benefited from using different AT devices. This would inform the management on whether they need to completely do away with existing assistive technology and replace with new assistive technology. Visually impaired learners would easily use an assistive technology that add value or supersedes their needs in the learning process.

The determination of relative advantage of the assistive technology should be done by the school management together with the teachers especially conversant with assistive technology that the school is planning to purchase. The assessment of relative advantage should be done before purchase of the assistive technology. This can be done by bench marking with other special schools that are using assistive technology they are intending to purchase. Documented experiences from other special schools on use of a particular assistive technology can provide information on the relative advantage.

v).Observability of assistive technology explained 1.9 percent of teaching and learning although the influence to teaching and learning was not significant. It is important to determine the observability of assistive technology. This is because during focus group discussion, VI learners laid an emphasis that they would want an assistive technology that they can identify with in terms of their visual impairment category. . The determination of assistive technology observability should be done by opthalomologist, an AT expert, the learner, the parent together with teachers conversant with assistive technology. Observability can be enhanced by involving students and their teachers before purchasing AT devices. Involvement is very key in the enhancing observability of AT in special secondary schools and its adoption. Assessment of observability should be done before purchasing any assistive technology.

vi) The study showed that some assistive devices like Job Access With speech, dolphin pen, interactive boards and Duxbury braile translator were not affordable. Some schools had varieties of assistive technologies but other schools had inadequate or totally unavailable ATs. The assistive technology should be made affordable for visually impaired learners' to promote equality and equity in education. There should be equity in distribution of assistive technology in the four special secondary schools in Kenya for visually impaired learners. The Ministry of Education should champion the formulation and implementation of zero tax policy. The formulation and implementation of tax policy need to be done by next year to make assistive technology more affordable.

vii) The Ministry of Education working with other stakeholders e.g. KISE, Sight Savers, should also provide clear guidelines on piloting of assistive technology to maximize on the intended benefits and availability in all the special secondary schools. This is because the study established that there is no clear policy on piloting in terms of time and the specific agency that should carry out this task.

viii) There should be additional 43 special secondary schools for visually impaired that should be constructed and equipped to ensure every county has at least has one VI school. This is because there are only four special secondary schools in Kenya which are not adequate to attend to all visually impaired students in Kenya. Thus the researcher recommends a speedy action by the National government in order to achieve the education for all (EFA) goal.

5.5 Suggestions for further studies

The study suggests the following

i) A similar study can be carried out in other visually impaired institutions for example teachers training college and in the public universities in Kenya to establish the relationship between selected variables and students/ teachers performance. The researcher suggests replication of the study in universities and other institutions of learning by use of Rogers theory of diffusion which was applied in this study. The theory had been applied in many studies especially in America. This therefore indicates the theory can be applied as theoretical framework even for the studies carried out in developing countries. The five perceived characteristics of the innovation are able to form a reliable theoretical background for studies of AT.

ii) Longitudinal study can be carried out to monitor the impact of Assistive Technology on teaching and learning over given period of time.

iii) The study can be replicated based on other theories apart from Rogers's theory.

iv) A study should be carried out considering effect of availability of AT on teaching and learning of visually impaired learners in Kenya.

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APPENDICES

APPENDIX I

INTRODUCTION LETTER

University of Nairobi

Department of Educational,

Administration and Planning

P.O.Box 30197-00100

Nairobi

The Principal

……………….. Secondary School

P.O.Box ……….

Dear Sir/Madam

Re: Request for data

I am a PhD student at university of Nairobi. As part of the requirement for the award of degree; I am expected to undertake a research study. I am asking for your participation in a study on effect of assistive technology on effective teaching and learning of integrated English among visual disability learners in special secondary schools in Kenya. Kindly answer all questions as completely as possible. Your cooperation will be appreciated.

Yours sincerely,

Reuben Nguyo Wachiuri

APPENDIX II

QUESTIONNAIRE FOR PRINCIPALS

The purpose of this questionnaire was to collect data on effect of assistive technology (AT) on teaching and learning of integrated English among visually impaired learners. Your participation in facilitating the study is highly appreciated. The identity of those giving information will be treated with confidentiality.

1. When was the institution established?

……………………………………………………………………..........................

2. What are total number of teachers?

……………………………………………………………………..........................

3. What is the total students' population?

……………………………………………………………………..........................

4. How many visually impaired students are there in the school?

……………………………………………………………………..........................

5. How many teachers trained on use of Assistive Technology in teaching and learning?

……………………………………………………………………..........................

6. Use the key provided to answer the following questions

1) Not at all (2) to a less extent (3) To moderate extent (4) to a large extent

(5) to a very large extent

Statement	(1)	(2)	(3)	(4)	(5)
Teachers are conversant with the use of assistive technology devices eg braillers, JAWS for windows, Dolphin pen….					
Teachers are involved in teaching visually impaired learners					

7.Use thekey provided to answer the following questions

(1) Not sufficient (2) sufficient (3) moderate (4) high.(5).very high

Statement	(1)	(2)	(3)	(4	(5)
Rate the school on adequacy of assistive technology					
School investment in assistive technology					
Rate of usage of assistive technology devices eg braillers, JAWS for windows..					

8. Use the key provided to answer following questions below(1) not at all. (2) to a less extent (3) To moderate extent(4) To a large extent.(5) To a very large extent

Relative advantage indicator	(1)	(2)	(3)	(4)	5)
How dependable are the assistive technology devices					
How hard is assistive technology devices to use					
Advantages to make integrated English course content more visual					
ATs improves efficiency when used in teaching and learning of integrated English					
Compatibility					
Does your assistive technology meet the needs of learners in integrated English					
Can be used with various instructional methods and techniques					
Can be used in all kinds of courses apart from integrated English					
Complexity					
The assistive technology devices are simple to use in teaching and learning integrated English					
It is easy to use ICTs even if one has not used them before.					

Observability					
The assistive technology devices are visible to teachers and learners of integrated English					
Observing others using ATs makes users see the advantages of using them					
Trialability					
How easily can the assistive technology devices be experimented					
It is better to experiment with ATs before adopting them.					
It was easy to use ICTs more frequently after trying them out.					

9 .What are the various types of assistive technology devices found in the school

…………………………………………………………………….........................

10 Does the school have documented policy on use of assistive technology in teaching and learning?

Yes…………… No……. ….

If yes explain

…………………………………………………………………….........................

…………………………………………………………………….........................

11. What are the challenges faced in implementation of AT in teaching and learning of integrated English

………………………………………………………………………..........................

12. What are the factors that promote or limit the integration of AT in teaching and learning of integrated English from your perspectives?

………………………………………………………………………..........................

13.How would describe the learners achievement in integrated English after use of AT?

………………………………………………………………………..........................

………………………………………………………………………..........................

(Records can be provided on learners achievement e.g. in terms of grades/marks in integrated English comparing before and after AT devices use)

APPENDIX III

QUESTIONNAIRE FOR TEACHERS

The purpose of this questionnaire is to collect data on effect of assistive technology on teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya

1. What is your gender……………….

2. How many visual impaired students are there in this school?

   …………………………………………………………………….....................

3. What are the genders of the students?

   Male…………. Female………

4. i) Which are the different types of Assistive Technology devices are you

familiar with?.................

   a) Brailler ………… b) Touch window………….

   c) JAWS for windows…………… d) Dolphin pen…………….

e) Magnifier………… f) Talking word processor ………

g) Touch tablets………….

h) Others Please specify………………………...

iii) Use the key below to rate the following statement?

1) Not sufficient 2) sufficient 3) moderate 4) high. 5) Very high

Statement	(1)	(2)	(3)	(4)	(5)
Adequacy of assistive technology?					
School investment in assistive technology?					
Usage of assistive technology devices by students?					

5.How would you describe learners achievement in integrated english after using AT?

…………………………………………………………………….........................

6. Have you gone through any form of training on assistive technology?

yes.......... No………

If yes, what type of a training ……………………………………………

Has the training been relevant……………………………………………

Has the training been adequate……………………

7. Use the key to rate the statement below? 1) to no extent 2) to little extent

3) to moderate extent 4) to high extent 5) to very high extent

Statement	(1)	(2)	(3)	(4)	(5)
Assistive Technology (AT) increases student performance of literature when properly implemented					
AT rather than curriculum method of instruction more important for success of special education studies					
AT interfere with central learning task of constructing meaning in integrated English					
Teachers ,student and parents collaborate in selection of AT to ensure success					
There is difference in success between low tech and high tech AT devices					
There is sufficient training offered in the implementation of High tech AT devices					
Having different types of AT available for trial use increase the implementation of AT					
Current use of AT within school system is appropriate					

8 .Are there any advantages of assistive technology in teaching and Learning of integrated English among visually impaired? If yes explain

……………………………………………………………………….........................

……………………………………………………………………….........................

Are there any disadvantages? If yes explain

……………………………………………………………………….........................

……………………………………………………………………….........................

9. Could you have taught a lesson to visually impaired just as well without the assistive technology? Explain

……………………………………………………………………….........................

……………………………………………………………………….........................

10. How well do you feel assistive technology use fits in with the way you teach?

……………………………………………………………………….........................

11.How complex or easy-to-use do you feel is the assistive technology devices that are available to you?

……………………………………………………………………….........................

12. Do your colleagues use assistive technology devices in teaching?

……………………………………………………………………….........................

13. Do you have the opportunity to integrate technology here at this school the way you want to?

………………………………………………………………….........................

14.Describe the most effective lesson you have taught that integrated AT?

………………………………………………………………….........................

15. In what ways in your opinion has AT affected the teaching and learning of integrated English among visual impaired students?

………………………………………………………………….........................

16. Have you seen evidence that AT helps visually impaired studentsin learning process?

………………………………………………………………….........................

17) Kindly indicate your opinion on effect of assistive technology in teaching and learning of integrated English among visually impaired learners. Strongly Disagree (SD) = 1: Disagree (D) = 2: Agree (A) = 3 Strongly Agree (SA) = 4) and very strongly agree (VSA)=5

Statement	(1)	(2)	(3)	(4)	(5)
The benefits of assistive technology (AT) will make me continue to use them in the future.					
The ease of use of Assistive technology will make me continue to use them					
The difficulty in learning to use Assistive technology will make me not use them in future					
What I have observed about the use of AT in my department will make me keep using them.					

APPENDIX IV

OBSERVATION SCHEDULE

Researcher recorded the presence or absence of each type of assistive technology

Type of Assistive Technology	**Present –In use**	**Adequacy of Assistive Technology**	**Condition**	**Present-Not in use**	**Not present**	**Comments**
Brailler/brailled materials						
Touch window						
JAWS for windows						
Dolphin pen						
Alternative keyboards						
Touch tablets						
Digitally recorded communication devices						

Magnifiers						
Speech output devices						
Alternate adapted mouse						
Talking word processor/word prediction						
Adapted instruction materials						

APPENDIX V

FOCUS GROUP DISCUSSION GUIDE FOR STUDENTS

Visually impaired students in groups of seven per school were convened to discuss effect of Assistive Technology in teaching and learning of integrated English among visually impaired learners in special secondary schools in Kenya. It was guided by the following questions:

1. What comes in mind when you think of assistive devices which can enhance understanding integrated English?
2. In your own opinion are the devices adequate? Which ones are available and had chance to use
3. Which are the various factors that affect or influence use of the devices?
4. How does complexity of the devices affect your use of AT devices and to what extent in learning integrated English?
5. Describe to what extent the testing of devices for a number of students before using them in the entire institution affects their benefit?
6. To what extent does the benefit of a device as compared to alternative affect the learning process?
7. How does the compatibility of assistive technology device affect the integrated English process?
8. Has AT use resulted to a greater achievement in integrated English subject (examination performance)

APPENDIX VI

ENGLISH CONTINUOUS ASSESSMENT TO TEST TRIALABILITY

It involved use of Dolphin pen, and continuous assessment test was administered before using and then using Dolphin pen

a) Rewrite each sentence below to make it communicate more sensibly.

(i) They left the field full of sweat.

(ii) Powerful and comfortable, the buyer really liked the car.

b) Fill in blank space

i) I stopped the child from chewing a................. of grass.

(ii) The doctor told her to take the .... of medicine according to the prescription.

c) For each of these words write another that is pronounced the same

i) Past

ii) Aren't

iii) Hole

iv) What

v) Male

APPENDIX VII

RESEARCH AUTHORIZATION LETTER

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NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

NACOSTI/P/14/2445/3020

Date:

24th September, 2014

Reuben Nguyo Wachiuri
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effects of assistive technologies in effective teaching and learning of visually impaired learners in special secondary schools in Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **selected Counties** for a period ending **27th February, 2015.**

You are advised to report to **the County Commissioners and the County Directors of Education of the selected Counties** before embarking on the research project.

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

DR. S. K LANGAT, OGW
FOR: SECRETARY/CEO

Copy to:

The County Commissioners
The County Directors of Education
Selected Counties.

APPENDIX VIII

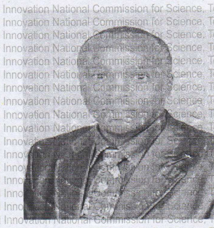
RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MR.REUBEN NGUYO WACHIURI
of UNIVERSITY OF NAIROBI, 4518-100
nairobi,has been permitted to conduct
research in *Kiambu , Kisumu , Meru , Mombasa , Transnzoia Counties*

on the topic: *EFFECTS OF ASSISTIVE TECHNOLOGIES IN EFFECTIVE TEACHING AND LEARNING OF VISUALLY IMPAIRED LEARNERS IN SPECIAL SECONDARY SCHOOLS IN KENYA*

for the period ending:
27th February,2015

Permit No : NACOSTI/P/14/2445/3020
Date Of Issue : 24th September,2014
Fee Recieved :Ksh 2,000



Applicant's Signature

Secretary
National Commission for Science, Technology & Innovation