IMPACT OF ELECTRONIC BRAILLE NOTE-TAKING DEVICES ON ACADEMIC PERFORMANCE OF LEARNERS WITH VISUAL IMPAIREMENT IN SELECTED SPECIAL PRIMARY SCHOOLS IN KENYA

DAVIES KIPROTICH

EM06/MP/MN/10543/2019

A THESIS PRESENTED TO THE SCHOOL OF EDUCATION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF EDUCATION IN SPECIAL NEEDS EDUCATION OF MAASAI MARA UNIVERSITY, SCHOOL OF EDUCATION

AUGUST, 2023

DECLARATION

I certify that this thesis has not been previously presented for a degree in Maasai Mara University or at any other University. This thesis is my original work and all sources of information have been supported by relevant references.

DAVIES KIPROTICH

EM06/MP/MN/10543/2019

Signature:_____

Date: _____

Declaration by supervisors:

This thesis has been submitted for examination with our approval as university supervisors.

DR. LILIAN MILIMU

Department of Education Foundation and Psychology,

School of Education,

Maasai Mara University.

Signature:_____

Date: _____

DR. NAFTALI ROP

Department of Education Foundation and Psychology,

School of Education,

Maasai Mara University.

Signature:_____

Date: _____

DEDICATION

To my dear parents, William K. Keter and Irene C. Keter,

Words can hardly express the depth of my gratitude for everything you have done for me throughout my life. Your unwavering love, support, and guidance have been the driving force behind my journey, and I am forever indebted to you both. This Study is dedicated to you both, as a tribute to your love, support, and unwavering belief in me. Your presence in my life is a precious gift that I will forever cherish.

With love and gratitude.

ACKNOWLEDGEMENT

I am deeply grateful to God Almighty for His grace that has been with me throughout my studies. I express my heartfelt appreciation to my supervisors, Dr. Milimu Lilian and Dr. Rop Naftali, for their expert guidance and meticulous review of the content in this study. Additionally, I am thankful to my lecturers, Dr. Mutai, Dr. Rono, Prof. Maithya, Dr. Ann Maina, and Dr. Mwaura, for their valuable assistance, snippets of wisdom, guidance, and encouragement.

I am indebted to Maasai Mara University for providing me with the opportunity to pursue my masters, and I extend my gratitude to my parents for their unwavering support in my education. My 'Support System' consisting of Elizabeth, Leonidah, and Sheila has been invaluable, and I cannot thank them enough. Sheila Jebet, thank you for always being in my corner.

I would like to express my thanks to all the respondents who participated in this study. Special thanks go to my friends and family for their unwavering moral and financial support throughout my journey in this study.

ABSTRACT

Academic performance of learners with visual impairment in Kenya has been dismal over the years. Researches on performance for the visually impaired learners have pointed at various factors among them teachers' attitudes, teaching environment, facilities, parents' attitudes, setting of exams and time among other factors. Little has been attributed to lack of technology and limited use of technology which is the question for this study. Various technological advancements, including Electronic Braille note-taking (EBN) devices, have been developed and are now readily accessible for utilization. This study therefore intended to examine the impact of EBN devices on academic performance of visually impaired learners in special primary schools in Kenya. The study was guided by the following objectives: to determine the adequacy of electronic Braille note-takers, to determine the teachers' preparedness on the utilization of electronic Braille note-takers in Braille instruction, to find out the learners' attitudes towards the use of electronic Braille note-taking devices in learning and to deduce the impact of EBNs on the performance of learners with visual impairment in primary schools in Kenya. This study was directed by the theory of technology acceptance model (TAM). TAM centers on the connections that take place between an individual's perception of technology and their subsequent behaviour in using that technology. The study used a descriptive design while applying both quantitative and qualitative approaches. The study targeted a population of 15 Special schools with a population of 1982 learners, 238 teachers and 15 headteachers. Six special schools were deliberately selected for sampling: St. Francis Special School in West Pokot County, Kiomiti Special School in Kisii County, Marigat Special School in Baringo County, Korara Special School in Bomet County, Thika Special Primary School in Kiambu County and Kibos Salvation Army School for the Visually Impaired in Kisumu County. The data collection tools were piloted at Likoni Special School for Visually Impaired. The findings of the pilot study were subjected to Cronbach Alpha reliability test and Validity Coefficient Index to ensure the validity and reliability of the tools. Descriptive and thematic analyses were conducted on the data, with the results presented through tables and figures. The study's findings revealed insufficiency in the availability of EBN devices in schools catering to visually impaired learners. The teachers in special schools for the Visually Impaired learners were not well prepared to incorporate EBNs in instruction. The LVIs in Kenyan special primary schools exhibit a highly favourable disposition toward the integration of EBNs in their educational practices. The utilization of EBN devices has shown a positive influence on the academic achievements of the learners. These findings are intended to serve as valuable insights for the government and stakeholders of schools catering to visually impaired learners, urging them to enhance the supply and distribution of EBN devices to improve their sufficiency. Additionally, the study recommends the establishment of dedicated time for regular training sessions, both for learners and teachers, to effectively incorporate EBNs in teaching and learning processes.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AT	-	Assistive Technology
AAT	-	Alternative Assistive Technology
EBN	-	Electronic Braille Note-taking devices
ICT	-	Information and Communication Technology
IEP	-	Integrated Educational Program
KCPE	-	Kenya Certificate of Primary Education
KCSE	-	Kenya Certificate of Secondary Education
KICD	-	Kenya Institution Curriculum Development
KIB	-	Kenya Institute for the Blind
LVI	-	Learners with Visual impairments
MoE	-	Ministry of Education
MoeST	-	Ministry of Education Science and Technology
NACOSTI	-	National Commission for Science, Technology and Innovation
OCR	-	Optical Character Recognition
SNE	-	Special Needs Education
SPSS	-	Statistical Packages for Social Sciences
STD	-	Standard (class level in the 844 curriculum)
STEM	-	Science, Engineering, Technology and Mathematics
TAM	-	Technology Acceptance Model (theory)
TVI	-	Teachers of Learners with Visual Impairment
USB	-	Universal Serial Bus
VI	-	Visually Impaired
SD	-	Secure Disk

CHAPTER ONE

INTRODUCTION

The backdrop of the study, the problem statement, the purpose and objectives of the investigation, the research questions, the significance of the study, the assumptions, the constraints and delimitations of the study, and the definition of operational terminology are all presented in this chapter.

1.1 Background

According to the International Eye Foundation (2007), a United States-based organization, the global number of blind individuals stands at 45 million presently. Furthermore, the foundation approximated that every five seconds, one person in the world becomes blind. According to a WHO report, one-sixth of the world's population has vision impairment. WHO estimates that 1.3 billion people worldwide have some degree of vision impairment, with 188.5 million having mild to moderate impairment, 217 million having moderate to severe impairment, and 36 million being totally blind (WHO, 2018). Medical Express predicts that the estimated number of visually impaired people would increase from 36 million to 115 million in 2050 due to population growth. There is an urgent need for an efficient aid for visually impaired people given the rising number of them. (Kanak, Mandhushi, & Singal, 2020).

Individuals with visual impairments face three main challenges: independent travel, access to information and a lack of meaningful experiences. To overcome these limitations, they rely on assistive technology, which encompasses various devices and systems aimed at enhancing their functioning, independence, and overall quality of life. For visually impaired learners, assistive technology plays a crucial role in gaining competitive employment and academic

performance by supplying tools for better communication and information access. However, the equitable distribution and appropriate instruction on using these assistive tools remain ongoing challenges (Kelly & Smith, 2011).

Assistive technology is vital not only for individuals with visual impairments but also for people living with a range of different types of disabilities. These technologies can enhance their physical abilities, economic productivity, and prevent secondary health conditions. There is a wide range of available Assistive Technology (AT) products, varying from low to high-tech, allowing individuals with disabilities to improve their well-being and quality of life. However, accessing these tools and resources has been hindered by documented shortfalls in both funding mechanisms and services (Addis, Britton, & Davies, 2016).

The World Health Organization (WHO) reports that 90% of the world's blind population resides in developing countries, with millions of visually impaired individuals in China, Africa, and India. Some African countries have experienced significant rates of blindness due to various factors, including political and ethnic conflicts (WHO, 2006; Belay, 2005).

Despite the growing interest and commitment to Information and Communication Technology (ICT) in African education systems, there are still challenges in making it accessible for all learners. The lack of basic electronic infrastructure and communication means hinders the provision of adequate teaching and learning materials. However, there has been an improvement in budget allocations towards ICT and other learning tools, including accessible materials for visually impaired learners (Belay, 2005).

In Kenya, the government recognizes the importance of quality education and has invested heavily in the education sector, including special education. ICTs are seen as essential in delivering quality education, and the government continues to invest substantially in ICT in

education and training. However, availability of ICT facilities for Special Needs Education (SNE) remains quite low across all educational levels (Ministry of Education, 2021).

Traditionally, Braille, a tactile orthography for visually impaired individuals, was written on embossed paper using mechanical Braille machines, which was costly and physically demanding. Recent technological advancements have led to the development of Electronic Braille note-taking devices with refreshable Braille displays, such as the Orbit reader. These devices offer advantages like reducing the need for manufacturing Braille materials on paper (Kilimanjaro Blind Trust, 2017).

The academic performance of learners with Visual Impairments in Kenya is below average which is indicated by poor performance in KCPE and KCSE examinations. Studies have pointed out the ineffective equipment as one of the major factors leading to dismal performance. The mechanical Braillers for example are costly in terms of maintenance and procurement. They are heavy, noisy to use, easy to breakdown and requires equally expensive and bulky Braille papers and textbooks. Another mechanical option is the slates and styluses which are widely used especially for learners in earlier developmental stages. Slates and styluses are however confusing to use since writing is done in reverse from right to left and reading is then done from left to right (Njue, 2021).

Charitable organizations have taken the initiative to supply EBN devices to support learners with visual impairments (LVIs) in achieving their educational objectives. Additionally, individuals can obtain these devices personally or through school procurement. To assess the effectiveness of these devices, their impact on the academic performance of visually impaired learners needed to be compared. The study aimed to investigate the influence of EBN devices on academic performance by examining three key factors: their sufficiency, teacher preparedness, and learner attitudes.

1.2 Statement of the Problem

The academic performance of learners with visual impairments in Kenyan special primary schools has been notably poor, consistently falling below the national mean in the KCPE examination. The teaching of Braille in these schools has also been unsatisfactory, partly due to the inadequacy of the writing equipment, such as the expensive and maintenance-heavy Braillers and the confusing nature of writing with slates and styluses in reverse. To address these challenges, Electronic Braille note-taking (EBN) technology has been introduced as a potential solution, particularly in Africa and other developing countries. However, there is little information on the utilization and effectiveness of EBN devices in aiding visually impaired learners' academic performance. The extent to which EBNs can influence the academic outcomes of visually impaired learners in Kenya remains unclear. Therefore, it is crucial to assess the adequacy of EBN devices, teacher preparedness in using the technology, and the learners' attitudes towards this new alternative, as it may significantly enhance their academic performance and help them realize their full potential in their studies.

1.3 Purpose of the Study

This study was designed to investigate the impact of electronic Braille note-taking devices on the academic performance of visually impaired learners in selected special primary schools in Kenya.

1.4 Research Objectives

The study paper sought to achieve its general objective of leveraging EBN devices in enhancing Braille instruction by focusing on the following specific objectives:

1. To examine the adequacy of electronic Braille note-taking devices in Schools catering to VI learners in Kenya, specifically Special Primary Schools.

2. To determine the teachers' preparedness on the use of electronic Braille note-takers in Braille instruction in Schools catering to VI learners in Kenya, specifically Special Primary Schools.

3. To find out the learners' attitudes towards the use of EBN in learning in Schools catering to VI learners in Kenya, specifically Special Primary Schools.

4. To establish the impact of the EBN devices on the academic performance of LVIs in Schools catering to VI learners in Kenya, specifically Special Primary Schools.

1.5 Research Questions

1. How are the electronic Braille note-takers adequate for use in Schools catering to VI learners in Kenya, specifically Special Primary Schools?

2. Are the teachers prepared on the use of electronic Braille note-taking in Braille instruction in Schools catering to VI learners in Kenya, specifically Special Primary Schools?

3. What are the learners' attitudes on the use of electronic Braille note-taking devices in learning in Schools catering to VI learners in Kenya, specifically Special Primary Schools?

4. What impact do EBN devices have on academic performance of learners with visual impairment in Schools catering to VI learners in Kenya, specifically Special Primary Schools.?

1.6 Significance of the Study

This study aimed to shed light on the impact of EBN devices on the performance in Braille use of learners with Visual Impairment. The findings of this study could be crucial in enlightening the policy makers in the Kenyan Ministry of Education, the Kenya Institute for the Blind (KIB) and the stakeholders of schools with learners with impairment on the impact of EBN devices on academic achievement. It might inform the course content developers and printers on alternative delivery of course content. This study could also provide data that will

contribute to the existing knowledge in Kenya on assistive technology in improving the learning environment for LVIs. The use of EBN devices as an alternative assistive device may bridge the gap of disparity in ineffective Braille writing and reading methods thus helping the LVIs reap full benefits from education. Technological developments are rapid and there is need to provide accurate information on one of the technological advancements in education such as in Braille instruction.

"Future researchers could determine whether the impact of implementing these devices warrants educators' doing so on a larger scale" (Farnsworth JR & Luckner, 2008).

1.7 Scope of the Study

The study was conducted in Schools catering to VI learners in Kenya, specifically Special Primary Schools. The study was confined to learners with visual impairment who use EBN devices for reading and writing in Braille. Learners and teachers included in the sample were those in session in their respective institutions during time of the study. The target group of learners were either totally blind or with low vision who used Braille as their means of reading and writing since they were the direct beneficiaries of the EBN devices. The respondents of the study were drawn from Grade 5 and Class 7 learners and teachers in these schools. Grade 5 and STD 7 learners were picked since they were the potential candidates and had the most experience using EBN devices after the candidate classes. While there are various factors influencing the academic performance of LVIs, this study specifically concentrates on the influence of EBN devices on learners' performance in Braille use.

1.8 Assumptions

This study was based on the assumptions that, the respondents would respond as honestly as possible; the schools under study had and used electronic Braille note-taking devices; the

teachers who conduct Braille instruction to the learners had some basic knowledge on operating the electronic Braille note-taking/reading devices and that the existing KICD curriculums recommended the use of electronic Braille note-taking devices.

1.9 Limitations

Majority of the learners with visual impairment were unable to read the interview questions that had been written in normal print on their own thus it made the researcher to administer the questionnaires as interviews.

1.10 Operational Definition of Terms

Adequacy This is an is a facet of readiness which was evaluated in the study through the assessment of device availability and the perceived level of sufficiency concerning the devices.

Alternative assistive technology They encompass various audio, electronic, and multimedia technologies utilized by learners with visual impairment, which include Note-takers, talking books, OCR scanners, audio tapes, computers with speech output, live readers, and refreshable Braille display machines., all of which do not rely on traditional Braille.

Attitude A person's actual feeling or way of thinking about something or someone based on their perceptions. It was measured in the study by the analysis of the existing levels of perception against pre-identified set of opinions.

Braille This is a system of raised dots that are used as the letters of the alphabet in the Braille system of touch reading and writing for the blind. It also provides symbols to denote letter groups and representations for punctuation marks.

Impact The influence or effect that EBN devices have in changing the academic performance of a learner with special needs. It was determined in this study by determining the correlation between the academic performance and the use of EBN devices.

Learner with visual impairment The study includes learners with low vision, partially blind, and totally blind children who are enrolled in the special primary schools under

investigation.

Performance This is the measurement of achievement of learners with visual impairment across various academic subjects. It was determined in this study by the LVI's scores in examination.

Preparedness This refers to readiness expected in terms of; availability of electronic note-taking devices, features of the devices, use of the devices and attitude towards them.

Refreshable display Refreshable Braille displays consist of electronic Braille note-takers equipped with small pins that electronically move up and down through six holes, representing a Braille cell. These displays contain a row of such cells, and the number of cells displayed can vary. Users read Braille by moving their fingers across the cells, much like reading Braille on paper. The pins move up and down, reflecting the words in a Braille file.

Special School A school that offers educational services to learners with special needs.

Visual Impairment Any kind of vision loss ranging from partial vision to total blindness.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter seeks to review the existing literature and identify clear gaps which have not been addressed in the field. Studies that have been done in relation to the availability of EBN devices, utilization of EBN devices of Braille instruction, teacher preparedness in the use of EBN devices and LVI's attitudes towards the use of EBN devices will be critically examined.

2.1 The Adequacy of EBN Devices in Kenyan Special Primary schools for the VI

Assistive technology (AT), which encompasses specialized equipment intended to facilitate computer access for individuals with disabilities, is gaining popularity among people with vision impairment as computer usage becomes more prevalent in society. Nevertheless, in developing and emerging economies, the adoption of ATs still lags behind that of developed countries (Okonji & Ogweezy, 2019)..

People with different types of disabilities often require assistive technologies (ATs) to enhance their physical abilities and overall performance. ATs encompass a variety of devices and systems that are specifically designed to support and improve an individual's functioning and independence, ultimately promoting active participation and a better quality of life. Additionally, these technologies can help prevent further deterioration of their condition. The range of ATs available varies from simple to advanced products, offering individuals with disabilities the opportunity to enhance their well-being and overall quality of life. Currently, there is a significant global demand for assistive products, with more than one billion people relying on them. It is projected that this number will surpass two billion by the year 2030 (Addis, Britton, & Davies, 2016).

The integration of assistive technology, especially those with ICT connectivity, in schools offers learners new resources and pedagogical tools, enabling them to acquire skills required for the information society, improving administrative processes, and supporting teacher training. The ICT in education policy of 2021 aimed to ensure that each learner has access to an assistive ICT device during learning periods that require its use. However, the device-to-pupil ratio in primary schools by January 2020 was approximately 1:8, falling short of the goal to equip each learner with a device (Ministry of Education, 2021).

The quantification of the distribution and availability of assistive technology (AT) in many African countries remains insufficient. The World Health Organization acknowledges that access to suitable AT and related services is often restricted in resource-limited settings, such as those found in Africa. Numerous barriers contribute to limited AT coverage and accessibility in these countries, including individual and national poverty, environmental challenges, ineffective procurement systems, lack of support services, a scarcity of service providers, and inadequate training for available service providers (Addis, Britton, & Davies, 2016).

Studies have revealed gaps in the availability and accessibility of assistive technology for learners with visual impairments. Some special education schools and institutes fail to provide sufficient AT for learners with blindness, resulting in a lack of awareness among these learners about the importance of assistive technology (Saira & Shahida, 2016). Another study assessing the availability of AT for visual impairment in schools for the blind found that while some AT devices like Braille slates and styluses were commonly available, there was a significant shortage of other ATs, hindering the educational needs and performance of learners. Creating and implementing a prioritized inventory of Assistive Products, such as the WHO Assistive Products list, could help address these shortages and improve access to

essential assistive technologies for individuals with disabilities. (Senjam, Foster, & Bascaran, 2020).

A study was conducted in Nigeria to explore the awareness and obstacles to the adoption of assistive technologies among visually impaired individuals. The research employed a mixed-method approach, utilizing qualitative interviews with 20 participants and structured questionnaires distributed among 423 participants aged between 20 and 92. The findings revealed that almost a third of the respondents demonstrated a good awareness of the existence of ATs, but only a few of them possessed a good understanding of their usage (Okonji & Ogweezy, 2019).

A separate research study aimed at examining the accessibility of assistive technologies for special education in Nigerian educational institutions involved 1,115 teachers from primary, secondary, and tertiary institutions across the country. The findings revealed that the majority of these institutions lacked the necessary assistive technologies for learners with visual impairment. This highlights the significant implication that essential assistive technologies for providing quality education to visually impaired individuals are not being effectively utilized in Nigeria (Mudasiru, Fakomogbon, & Issa, 2012).

Alabi, Dominic, and Ibrahim (2018) conducted a study to examine the availability and utilization of assistive technologies in special education schools. Their findings indicated that these technologies were insufficiently available, and even the existing ones were considered inadequate. Moreover, special education teachers did not effectively use the available assistive devices to teach learners with disabilities.

According to the National Special Needs Policy (2009) in Kenya, learners with specific disabilities and special needs require specialized educational resources tailored to their

individual needs. However, the high cost of such equipment remains a hindrance to the government's goal of providing inclusive education for all. The policy emphasizes the need for in-service training of teachers and support staff on the assessment and maintenance of specialized equipment. It also aims to enhance accessibility and utilization of software to facilitate quick access to information and educational materials. To address these challenges, the Kenyan Government, through the Ministry of Education, should allocate the required funds for the acquisition and provision of modern assistive equipment, such as Braille electronic note-takers and audio Mathematics textbooks, to cater to visually impaired learners in special primary schools (Chege, Chomba, & Awori, 2018).

Another study in Kenya focused on the impact of AT on teaching and learning of integrated English among VI learners in special secondary schools. The research revealed that observability of assistive technology did not significantly affect teaching and learning outcomes, but factors like compatibility, complexity, trialability, and relative advantage did influence the learning experience. To enhance teaching and learning for visually impaired students, the school management, along with the Ministry of Education and other stakeholders, should carefully consider these factors when adopting assistive technology (Wachiuri, 2015).

In a study assessing the adoption of computer-based assistive technology for persons with disabilities in Kenya, Mbugua (2012) highlighted the need for greater awareness and sensitization efforts to promote disability mainstreaming. Adequate funding and availability of affordable assistive technologies were also identified as crucial aspects to enhance their usage. Additionally, the impact of Kenya's inclusive society provisions on assistive technology adoption merits further research.

Gitari (2020) conducted a case study at Thika School for the Blind to investigate the impact of assistive technology on the Kenya Certificate of Secondary Education (KCSE) performance of visually impaired learners. The study found that while many learners relied on Braille for reading and writing, computers and iPads were preferred as suitable assistive devices. Factors like the nature of visual impairment, availability of assistive technology tools, and lesson objectives influenced the selection of technology. Challenges such as inadequate computers and limited computer literacy skills among learners and teachers hindered the effective use of assistive technology. The study concluded that schools for visually impaired learners in Kenya primarily rely on traditional methods, with less emphasis on utilizing computers and iPads.

Another study examined the availability and use of adaptive technology devices for VI student teachers in Primary Teacher Training Colleges in Kenya. The findings indicated a lack of availability and utilization of Computer screen magnification, optical character recognition, Braille note-takers, and description video services. among visually impaired student teachers. Similarly, Ejoru (2019) found limited accessibility of alternative assistive technology devices in Turkana County, Kenya, such as Refreshable Braille display machine, OCR scanner, and the Optacon note taker. While audio tapes, live readers, and talking books were available, their distribution and supply were limited.

In summary, various studies conducted in Kenya have highlighted the need for greater accessibility and effective utilization of assistive technologies for learners with disabilities. Adequate funding, awareness, training, and provision of modern assistive devices are essential steps towards promoting inclusive education and enhancing the learning experience for visually impaired individuals.

The previous studies covered the availability of ATs in general with very few studies done in Kenya to investigate the availability of ATs. The adequacy of EBN devices in Kenya needed to be investigated to supplement the information available on the availability of AT hence the need for this study. The introduction of EBN devices to the market, schools, and institutions is relatively recent, leading to limited research data on their application as alternative assistive technology. However, the device could be available in the market and in institution of learning but not adequate for the number of learners requiring the hence the need for this study. Therefore, this study was conducted to determine the extent of schools' resources in terms of availability and sufficiency.

2.2 The Teachers' Preparedness on the Use of EBN Devices in Braille Instruction.

Gerald & Lahm (2002) contend that professional developmental opportunities for practising teachers are limited, yet the rapid advancements in technology necessitate training in a continuous state to keep their skills sharp and up to date. Effectively teaching a learner with visual impairment requires the teacher to thoroughly understand the learners' needs, be familiar with a wide variety of teaching strategies, and seamlessly integrate the most suitable assistive technology-based interventions. Hence, it is crucial to assess teachers' awareness of evaluation methods to determine their capacity to recommend the most appropriate alternative assistive technology devices to use (Hibel, Farkas & Morgan, 2010).

In Kentucky, a survey was conducted to assess the assistive technologies being used by learners with visual impairments and identify any unmet training needs of the teachers. While the teachers had access to computer-based technologies, they lacked proper training and support for teaching these technologies to their learners, resulting in only half of the learners using them (Abner & Lahm, 2002).

Teacher knowledge and ease with assistive technology (AT) are crucial for effective instruction of learners with visual impairments. Previous studies has identified essential AT competencies required for teaching learners with VI. To investigate the impact of pre-service teacher training in AT on self-rated competency levels, the study focused on selected competencies for general education teachers instructing learners with VI. It is essential to explore avenues to enhance teacher competencies and comfort with AT to improve access and utilization of AT in the classroom, leading to academic and social-emotional gains for learners with disabilities (Jones, Rudinger & Williams, 2018).

Zhou et al. (2011) found that a lack of knowledge and skills among teachers of learners with visual impairments hindered the use of technology in schools. Many teachers lacked confidence in teaching various forms of assistive technology, particularly related to Braille literacy, screen reading software usage, electronic Braille devices, Braille translation software, and securing funds for technology devices. The researchers recommended strengthening training in specialist teacher preparation programs and in-service training for qualified teachers of learners with visual impairment. They also emphasized the need for ongoing professional training as assistive technology evolves (Pogrund & Parker, 2009).

Cássia et al. (2008) examined the application of assistive technology, especially information technology, in the education of blind and low-vision learners from the perspective of their teachers. They found that specific computer programs were very crucial for low-vision learners.

In a study conducted in Nigeria, teachers in special needs schools had a positive attitude toward the use of assistive technologies but lacked competence in using them. The study recommended training and retraining of teachers to enhance their skills in using assistive technology for learners with disabilities (Onivehu, Ohawuiro & Oyeniran, 2017).

Recommendations from practitioners and researchers suggest integrating alternative assistive technology use into teacher training programs to enhance teachers' awareness and understanding of alternative assistive technology-based education (Van Laarhoven & Conderman, 2011). However, studies in Nigeria and Kenya found that teachers often lacked the necessary background knowledge and skills for implementing inclusive education and using educational technology facilities for learners with visual impairment (Eke & Inyango, 2015; Ejoru, 2019).

While existing studies have focused on teachers' preparedness in employing alternative assistive technology in general, there is a specific need to understand teachers' preparedness in using electronic Braille note-taking devices. This study aims to assess the level of preparedness of teachers in incorporating electronic Braille note-taking devices for Braille instruction in institutions for the visually impaired.

2.3 LVI's Attitudes Towards the Use of EBN Devices

In recent times, the topic of assistive technology in special needs education has sparked debates and controversies due to varying attitudes towards its use. While some individuals perceive assistive technology as a valuable tool that empowers learners with disabilities to succeed, others hold the belief that it may make them overly reliant on technology (Edyburn, 2006). Understanding the learners' perspectives on this matter is of utmost importance, and this study sought to delve into their own viewpoints.

Assistive technology has presented individuals with visual impairment with a valuable opportunity to improve their overall quality of life. In a study conducted by Sachdeva & Suomi (2005), the researchers aimed to shed light on the impact of negative socio-psychological factors on the lives of individuals who are totally blind and heavily dependent

on assistive technology. The study participants expressed some frustrations with the use of assistive technology, citing irregularities in its application and limited accessibility as key challenges. Despite these difficulties, the participants continued to reliance on AT in their daily lives. The study suggests that further exploration is necessary to investigate whether training could help alleviate resistance to adopting new technology, particularly among individuals who heavily use assistive technology.

Martiniello & Jarry (2018) conducted a study with the objective of obtaining a comprehensive understanding of the perception and utilization of Braille technology. The findings revealed that technology is being employed to some extent in Braille instruction, particularly among older learners who have had limited exposure to Braille technology. The study recommended further research to explore the learning benefits of technology-supported Braille instruction.

D'Andrea (2019) investigated preferences and practices among learners who utilize Braille and found that the learners exhibited distinct and robust preferences for their utilization of Braille and technology. The study revealed that learners felt technology made school work easier, but they also acknowledged some disadvantages, such as technology malfunctions.

In Cyprus, a study by Katsoulis (2005) reported that learners showed a preference for using technological devices, while Greek teachers were more conversant in new technology, potentially encouraging their learners to use technological devices.

A study by Ejoru (2019) in Turkana County found that knowledge about AT technology had a significant positive impact on attitudes towards its adoption among stakeholders. However, overall attitudes were mixed, suggesting the need for improved usefulness of ATs.

In Kenya, limited research has been conducted on learner attitudes towards electronic Braille note-takers. Hence, this study aims to investigate the the naure of attitudes of Kenyan learners with VI towards the use of EBNs and its impact on their academic performance, focusing on the primary school level, where the foundation of learning is crucial.

2.4 The Impact of EBN Use on the Performance of LVIs

Learners who are visually impaired rely on assistive technology not only to participate in literacy tasks but also to have access to the curriculum. Despite recognizing the importance of assistive technology, there remains a significant gap in research concerning how these technological advancements have influenced the writing and reading practices of learners who use Braille (D'Andrea, 2010). Consequently, it becomes crucial to explore and understand the impact of these technology on the academic performance of VI learners, as this study endeavours to do.

Currently, visually impaired individuals with expertise in Braille systems can adeptly access information from computers and electronic devices through specialized tools like Braille note-takers, Braille writers, and customized Braille displays. Among these, the Braille note-taker, also referred to as the Braille PDA, is particularly invaluable and portable, offering the convenience of Braille or QWERTY keyboards for storing information. It facilitates discreet browsing through the utilization of a Braille display (Hynes et al., 2019). Additionally, Braille note-takers, resembling the traditional Perkins Brailler, integrate Braille refreshable displays or audio output to provide users with immediate feedback on the typed information. The knowledge can be stored within the note-taker for later reference, and in cases where substantial data needs to be saved, it can be transferred to a computer using USB cable or Bluetooth, as these devices may not have extensive internal storage. Moreover, these devices offer additional functionalities like printing the output on a Braille printer and providing basic

organizational tools such as calendars, as well as enabling email communication (Aranyanak, 2014).

EBNs, equipped with refreshable Braille displays and internet connectivity, along with various software applications, empower users to perform a multitude of tasks for academic, office, or personal purposes (NLS, 2021). These EBN devices serve as versatile tools, acting as aids for both reading and writing, offering internet access, recording short messages, performing calculations, managing time and appointments, and facilitating essay creative literature writing and printing (Chong, 2000).

A study conducted in the United States among learners aged between 13 to 22 who read Braille and use Assistive Technology revealed that these learners employed Braille and technology not only for editing papers and reading textbooks but also for engaging in various other complex school tasks, such as online research, essay writing, and creating class projects. Moreover, they embraced multi-literacy activities, including creating presentations, utilizing Google Docs, participating in interactive writing tasks, and employing blogs for classroom activities. Email communication with instructors and the submission of assignments electronically were also common practices (D'Andrea, 2019).

Furthermore, D'Andrea (2010) reported that learners who utilized both hard copy and electronic Braille, depending on the context, derived substantial benefits. The study on the Acquisition of Literacy Skills by Young Children Who Are Blind emphasized the appropriateness and growing necessity of early introduction of Braille technology across the curriculum. The integration of technology acted as a motivational factor for learners, leading to enhanced learning outcomes in Braille instruction.

Other studies have consistently demonstrated the positive impact of electronic Braille devices, such as electronic note-takers, on fluency and proficiency in Braille literacy. These devices not only provide additional motivation for learners but also prove to be less disruptive compared to traditional mechanical Braille writers. The provision of audio feedback in electronic Braille devices further aids learners in maintaining focus and acquiring Braille proficiency at an accelerated pace (Bickford & Falco, 2012; Cooper & Nichols, 2007).

Additionally, the Impact of Assistive Technology on Curriculum Accommodation for a Braille-Reading Student study revealed that Braille note-takers fostered learners' independence, enabling them to work more efficiently and complete homework with reduced fatigue compared to traditional methods. Furthermore, these devices empowered teachers and paraprofessionals without prior experience in literary Braille to generate and emboss Braille documents, thereby freeing up vision specialist teachers to focus solely on teaching (Farnsworth JR & Luckner, 2008).

In Canada, the use of Braille note-takers with refreshable Braille displays has enabled teachers to accurately and effortlessly translate electronic files between Braille and print formats. Learners using Braille note-takers can access documents in various Braille formats, send and receive emails, store class notes, and perform scientific calculations, thereby enhancing their educational experience (Kelly, 2001).

Regarding the impact of AT devices on the educational achievement of learners with VI, research indicates that providing necessary assistive technologies, such as screen readinf sofrware, Smart Braillers, tablets, smart phones, computers, non-visual desktop access, note-takers, enlarged screens, and audio books., in learning centers is essential to ensuring visually impaired learners can achieve at the same level as their non-impaired peers. Learners and teachers involved in the research study attested to the fact that AT provides a superior means

for learners to access information and knowledge independently, easily, quickly, and frequently, thus positively influencing educational achievement among secondary school learners. The integration of assistive technology further fosters high levels of interaction between learning material, learners themselves, and the teacher (Kelly, 2001).

Research conducted in Rwanda highlighted the use of various assistive technologies by visually impaired learners, such as Braille machines, abacus, EBNs, embossers, thermo-formers, slate, and stylus. These technologies have proven invaluable in addressing special needs issues and equipping visually impaired learners to compete favorably with their non-impaired peers in both education and the job market (Bolingo, 2019).

Similarly, a study in Kenya focused on the use of modern AT and its influence on the educational achievement of learners with visual impairment. It revealed that teachers actively supported the integration of assistive technologies, leading to significant contributions in terms of curriculum coverage and early completion, consequently fostering positive educational outcomes among learners with visual impairment (Oira, 2016).

In summary, the reviewed studies provide valuable insights into the features and uses of EBN devices and their effect on the academic achievment of learners with VI. While existing research has shed light on the positive effects of these devices, there is still a need to directly establish the relationship between EBN devices and the academic performance of Kenyan learners with VI. Thus, the primary objective of this study is to critically examine the utilization of EBN devices and compare learners' academic performance before and after their use, aiming to understand the true impact of these devices on academic achievement.

2.5 Theoretical Framework

This study was directed by the theory of Technology Acceptance Model (TAM). TAM, or the Technology Acceptance Model, is based on the fundamental assumption that using technology positively impacts productivity. It primarily examines how a person's perception of technology influences their behaviour towards using it (Davis & Venkatesh, 2003). The model comprises four key constructs: perceived ease of use, perceived usefulness, intention to use, and actual use. Among the various factors influencing teachers' intentions and actual usage of technology in the classroom, two crucial elements are their beliefs about the technology's usefulness and the value it brings (Abbitt, 2011).

This theory was important to this study since it elucidates the use of EBN and its correlation to academic performance. TAM promotes the use of technology and desired results to be achieved through technology; the technology in question has to be in use. There are several factors that affect the use of Assistive Technology such as EBN devices to achieve academic performance and TAM elaborates this through its constructs. Firstly, the extent to which technology is integrated into instruction relies on the acceptance of its users. Secondly, the recognition that adopting new EBN technology will lead to enhanced overall performance directly impacts an individual's willingness to use the devices. Thirdly, the intent to use EBN devices acts as a mediator between perceptions and their actual usage. Research indicates that when users perceive a technology as valuable and user-friendly, it directly enhances their intent to use it, subsequently influencing their actual usage. Fourthly, perceived use and usefulness indirectly influence actual usage, while the intent to use directly affects it.

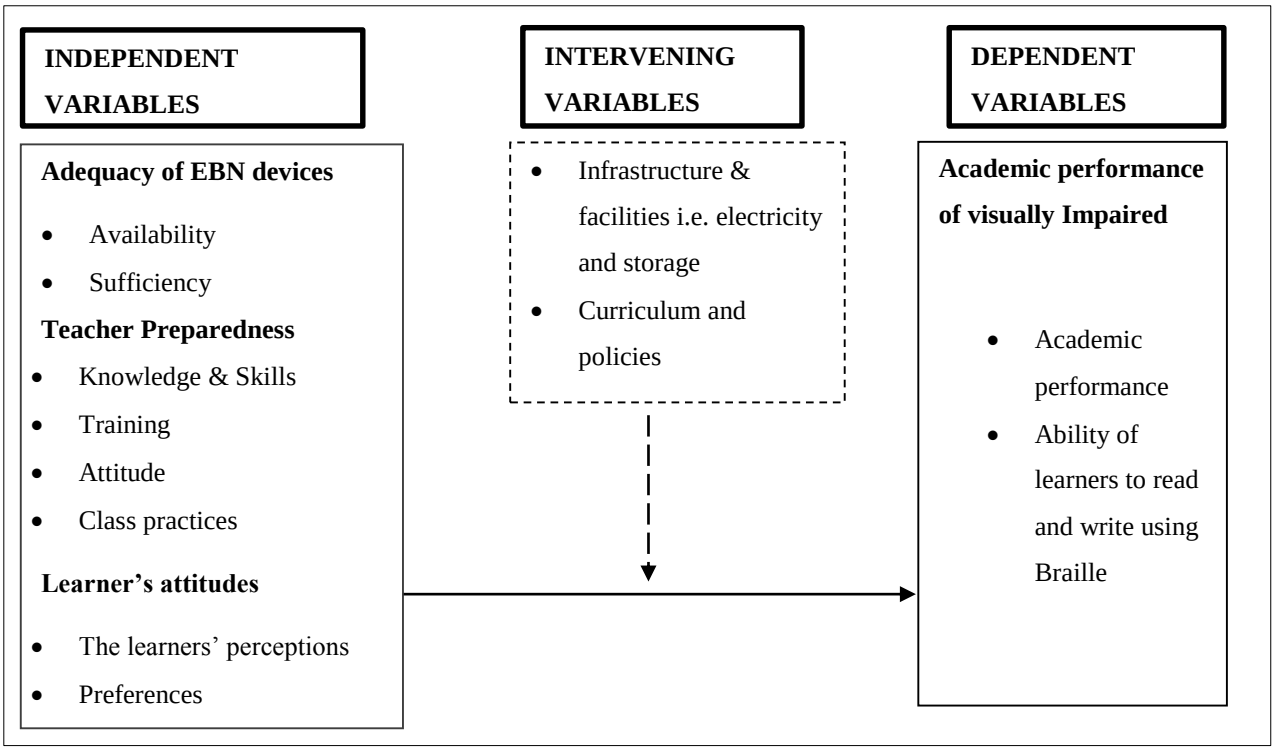
This research study assessed the use of EBN devices by learners and teachers in relation to the impact on the use of the device on academic results. The study considered the factors that affect the use of technology in particular the EBN devices.

2.6 Conceptual Framework

This study was based on a total 3 sets of variables, where two of these sets interacted through a cause-and-effect interrelationship, ultimately leading to improved educational achievement for learners with VI. The proposed framework indicates that the independent variables are the adequacy of electronic note-takers, teachers' preparedness, and the learners' attitude toward using EBNs. The dependent variable is the learners' performance, which is the outcome affected by the aforementioned cause variables.

The study has three intervening variables that are controlled as follows: infrastructure and facilities that the note-takers use, the policies that guide the use of adaptive technology and the curriculum implemented in schools. The relationship which the three sets of variables is as displayed in figure 1.

Figure 1 Conceptual Framework on the Impact of EBN Devices on the Academic Performance of Learners with Visual Impairment



Source: Researcher (2021)

This study aimed at examining the use of EBN devices and the academic performance of learners with Visual Impairment in Kenya. Figure 1 above shows that there is a direct relationship between the independent and dependent variables. The infrastructure, government policy and the curriculum are moderating factors in the relationship between variables in this study. Technology is meant to improve on any aspect of life thus the adequacy and use of EBN devices is seen to have effect on the academic achievement of learners with Visual Impairments. If the EBN devices are adequate and are leveraged in instruction, the performance of learners will be improved. The degree of teacher preparedness directly influences the utilization of these devices, ultimately impacting the performance of visually impaired learners and their proficiency in reading and writing Braille. The attitudes of LVIs towards the use of these devices also have a direct effect on their performance. Positive attitudes and preferences will result in leveraging EBN devices hence better performance. However, negative attitudes will result in less use of the devices hence an unimproved academic performance.

Intervening variables in this study included infrastructural amenities such as availability of electricity and proper storage facilities. The curriculum and policies also acted as the intervening variables. The intervening may have or may have not affected the independent variables in the way they have an effect on the dependent variable. For instance, without electricity, however adequate the EBN devices were, they could not affect the academic performance since they were not in use. Proper storage spaces for the EBN devices also were necessary for the safe-keeping of the devices so as to maintain their usefulness. Curriculum and policies intervene depending how educational institutions implement them. The educational policies and curriculum in Kenya for instance promote the use of technology in

instruction. When effectively implemented, EBN devices would significantly enhance the academic performance of learners in a positive manner.

2.7 Summary of Literature Review

Due to their recent introduction to the market, schools, and institutions, there is a scarcity of research data on the application of EBN devices as alternative assistive technology. Numerous studies have determined the availability, the TVIs preparedness on the use, the learners' attitudes and impact of Assistive technologies on education.

The reviewed studies covered the availability of ATs in general with very few studies done in Kenya to investigate the availability of ATs. Even though the device could be available in the market and in institution of learning but not adequate for the number of learners requiring the hence the need for this study.

Other studies mainly focused on determining the TVIs preparedness in employing the use of Alternative assistive technology in general. There was a necessity to conduct a study that could provide insights into the particular area of teachers' readiness in using EBN devices.

Few studies have been carried to ascertain learner's attitudes towards electronic Braille note-takers globally. Most of the reviewed studies were conducted oversees and at secondary level and tertiary level of education.

The reviewed studies also provided information on how assistive technologies (ATs) affect the academic achievement of learners with visual impairments (LVIs). However, this study aimed to explore the specific interaction between EBN devices and the academic performance of LVIs, which had not been previously investigated in Kenya.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter provides an overview of the research methodology, including the research design, study location, target population, sample size, and sampling techniques. It also discusses the research instruments, their piloting, and the reliability and validity of these instruments. Furthermore, the chapter explains the data collection techniques, data analysis methods, and addresses logistical and ethical considerations.

3.1 Research Design

To achieve the study's objectives, a descriptive survey design was employed, which involved gathering information about one or more phenomena using questionnaires, interview schedules, and observation. This design facilitated the accurate description of the utilization of EBNs and the exploration of opinions, competencies, attitudes, and suggestions for improvement. Descriptive research was deemed suitable as it enabled the study to use collected data to describe the variables influencing the use of EBNs and their impact on the academic performance of LVIs over time. Moreover, this design accommodated the mixed methods approach, allowing for the collection of both quantitative and qualitative data.

3.2 Study Area

The study was carried out in the following six counties in Kenya: Kisii County, Bomet County, Baringo County, Kiambu County, Kisumu County, and West Pokot County. The six counties provided an ideal study area due to the presence of well-established special schools for visually impaired (VI) learners. These schools have the same admission criteria. The

study focuses on the well-established Special Schools in these counties since they were the most likely to have a rich variety of assistive technology being utilized by learners with Visual Impairment.

3.3 Target Population

The study focused on the population of special primary schools in Kenya that cater to learners with VI. There were a total of 15 such special schools, comprising 1,982 learners, 238 teachers, and 15 headteachers.

For the research, the accessible population was selected from specific senior classes, which included Grade 5 and STD 7 classes. These classes were chosen because the learners in them were considered potential candidates in their respective curriculum and were more likely to comprehend the study instruments due to their seniority after the candidate class. To avoid disrupting the examination preparations of Grade 6 and STD 8 learners, they were excluded from the study. Both Grade 5 and STD 7 learners were capable of understanding and engaging with the research instruments effectively. Additionally, Grade 5 learners represented potential candidates in the new Competency-Based Curriculum (CBC).

3.4 Sampling

3.4.1 Sampling Technique

The study utilized purposive sampling to identify six special schools that met specific criteria. These schools were well-established and had a track record of at least five years of learners sitting for national examinations. Well-established schools were selected because they were the most endowed with assistive technology.

3.4.2 Sample Size

Out of the 15 special schools in Kenya, the study selected a sample of 6 schools, which represents 40% of the target population. This sample included 793 learners, 96 teachers, and 6 headteachers. According to Kothari & Garg (2014), a suitable sample size for a descriptive survey should be at least 30% of the population when the total population is less than 1000, making the selected sample size appropriate for this study. A sample of sample of 103 Grade 5 and 107 STD 7 pupils (210 learners in total) from the 6 sampled schools, their 96 teachers and 6 headteahers participated in the study as presented in the Table 1 below.

Table 1 Sample Size

	School	County	Number of learners	Number of learners in Grade 5	Number of learners in STD 7	Total (5 and 7)	Number of Teachers	Number of Head teachers
1	St. Francis Special School	West Pokot	185	11	14	25	13	1
2	Korara Special Primary School (VI)	Bomet	125	15	18	33	8	1
3	Kibos (SA) Primary School for VI	Kisumu	120	14	10	24	13	1
4	Kiomiti Special School for VI	Kisii	85	9	8	17	8	1
5	Marigat Special School for VI	Baringo	57	12	20	32	12	1
6	Thika SA Special Primary	Kiambu	221	42	37	79	42	1

School for the Blind						
Total	**793**	**103**	**107**	**210**	**96**	**6**

Source: Ministry of Education, Directorate of Special Needs Education; SNE Primary Enrolment of Learners with Visual Impairment (2021)

3.5 Research Instruments

The researcher utilized questionnaires and observation schedules as the primary data collection tools for the study. Questionnaires were chosen due to their standardized answers, making data compilation easier. Additionally, they were cost-effective and required less effort from the researcher compared to verbal or telephone surveys (Kabir, 2016). Observation schedules were also employed as they provided first-hand data on the usage and effectiveness of EBN devices. Moreover, they allowed the researcher to validate the responses obtained from the questionnaires, ensuring the authenticity of the data collected.

3.5.1 Learners' Questionnaire

The questionnaire was specifically designed to collect primary data from the perspective of the targeted learners with visual impairment, focusing on their views, attitudes, and competence in using EBN devices. The questionnaire mainly comprised closed-ended questions, supplemented by a few open-ended questions to facilitate more comprehensive and detailed responses from the participants.. Additionally, some questions utilized a five-point Likert scale, requiring respondents to select the most appropriate choice. To ensure accessibility and convenience, the questionnaire was administered as interviews in most cases, considering the visual impairment of the learners. The questionnaire can be found in Appendix I.

3.5.2 Teacher's Questionnaire

The questionnaire served as a valuable tool for gathering primary data from the perspective of teachers who were responsible for teaching learners with visual impairment. It predominantly consisted of close-ended questions, supplemented by a few open-ended questions to encourage detailed responses. Certain questions utilized a five-point Likert scale, enabling respondents to express their preferences or opinions more precisely. The primary focus of the questionnaire was to explore the teachers' preparedness in using EBN devices and their perceptions regarding the attitudes and impact of these devices on the learners. To streamline the process of data collection, the questionnaire was administered using the drop and collect technique, ensuring convenience for the participating teachers. For further reference, the questionnaire can be found in Appendix II.

3.5.3 Head Teacher's Questionnaire

This instrument served as a means of gathering primary data from the perspective of the head teachers of the special primary schools involved in the study. The tool was predominantly comprised of close-ended questions, with a few open-ended queries encourage detailed responses. Some questions utilized a five-point Likert scale, providing respondents with a range of options to choose from. The main focus of the questionnaire was to assess the sufficiency of the EBN devices, gauge the level of teacher preparedness, and elicit the opinions of the head teachers regarding the influence of these devices. To ensure convenience and streamline the data collection process, the questionnaire was administered using the drop and collect technique. For reference, the questionnaire has been included in Appendix III.

3.5.4 Observation Schedule

This instrument was designed to collect data as directly observed by the researcher. The data was collected according to each objective and recorded in the observation schedule. The researcher collected the data using this tool in person. This instrument has been attached as Appendix IV.

3.6 Piloting Research Instrument

Pilot testing, particularly for crucial components like the questionnaire and survey operation, is a vital step during the development phase (Kabir, 2016). A pilot study is useful in assessing the practicality of a study by detecting flaws in research instruments which acts a basis for correction so as to improve quality of data collected (Kothari & Garg, 2014).

In preparation for this research, the pilot study was carried in one school to validate the study design and procedures. According to standard practice, the pilot sample size should be around 1-10% of the main sample size (Mugenda & Mugenda, 2003). The selected school for the pilot study was Likoni Special School for the Visually Impaired, located in Mombasa County. This school was chosen because it shared similar characteristics with the schools involved in the main study. Like the sampled schools, Likoni Special School used Braille as its instructional medium and incorporated adaptive technology for the VI learners. The pilot study helped ensure the feasibility and effectiveness of the research approach before proceeding with the main study.

During the pilot stage, the researcher administered 1 headteacher questionnaire, 6 teacher questionnaires and 20 learner questionnaires. The responses were then used to test the validity and reliability of the instruments. The findings of the study were not included in the

actual study. After the pilot study, the findings were used to adjust the research instruments to maximise their reliability and validity.

3.6.1 Validity

Validity refers to the degree to which a study accurately represents or measures the specific concept that the researcher intends to assess (Yin, 2003). The concept of validity in this study refers to the extent to which the results obtained from the research instrument accurately represent the phenomenon being studied, as stated by Orodho (2012). To ensure validity, both face validity and content validity were assessed for the questionnaire used in the study. Face validity focused on ensuring that the questionnaire was simple, precise, and comprehensive enough to gather the required data, and it also considered the overall structure and flow of the question items. To achieve face validity, the questionnaire was reviewed and moderated by a Special Education Specialist from the Department of Special Needs Education at Maasai Mara University.

On the other hand, content validity was evaluated by involving two experts from the school where the pilot study was conducted. These experts were asked to provide their responses and feedback on the questionnaire. The responses from the experts were then used to calculate the validity coefficient index (VCI). This index was computed by dividing the average number of common responses from the two experts by the total number of questions on the questionnaire. By conducting both face and content validity assessments, the study aimed to ensure the accuracy and appropriateness of the research instrument in capturing the relevant data for the study.

$$\text{VCI} = \frac{\text{Average of number of common responses}}{\text{Total number of question items on the tool}}$$

Table 2 Validity of Instruments

Questionnaire	**Headteachers'**	**Teachers'**	**Learners'**
Average number of common responses	25	16	16
Number of Questions	28	21	19
VCI	**0.88**	**0.76**	**0.84**

The validity coefficient indexes were found to be 0.89, 0.76 and 0.84 for the learner questionnaire, the teacher questionnaires and the headteacher's questionnaires respectively. Amin (2005), recomends a VCI of 0.6 and above as acceptable for an instrument to be valid.

3.6.2 Reliability

Reliability, in the context of this study, pertains to the consistency with which an experiment, test, or any measuring procedure yields consistent and reproducible results across multiple trials, as described by Yin (2003). Ensuring the reliability of the research instrument is crucial to minimize measurement errors and enhance the credibility of the study's findings. A reliable instrument will produce similar outcomes when administered to the same group of participants under similar conditions, contributing to the confidence in the accuracy of the data collected. In this research study, the reliability of the instruments was assessed by subjecting the findings of the pilot study to the Cronbach alpha reliability test. This was calculated using the Cronbach alpha reliability formulae with the assistance of excel spreadsheet as follows:

$$\alpha = \left(\frac{N.\acute{C}}{\acute{u} + (N-1).\acute{C}}\right)$$

Where Ć was the average variance, ύ was the average co-variance between item pairs, and N represented the number of the items. The questionnaires yielded alpha coefficient indexes of 0.74, 0.87 and 0.83 for the learner questionnaire, the teacher questionnaires and the

headteacher's questionnaires respectively. The questionnaires were proven reliable since the alpha coefficient indexes were above the recomended 0.7.

3.7 Data Collection Procedure

A letter was first obtained by the researcher from the Dean School of Education and the office of Post Graduate Studies, Maasai Mara University, addressed to the NACOSTI where authority was sought. Upon receiving a research permit from NACOSTI, the researcher sought permission from respective County Education offices of the respective counties to visit the schools under study. The researcher asked the respondents for their permission and clarified the true actual nature of the study.

Data from the teachers was collected through a drop-and-pick method where the questionnaires were delivered to the targeted schools and collected after a few days. Data from the learners was collected through administering the questionnaires as interviews so that the learners with visual impairment would respond since the questionnaires were in print form. The questionnaires were delivered to the respective Head teacher's offices and the teachers were briefed by the researcher in an effort to seek their assistance in collecting data from the learners. The whole process of data collection was conducted personally by the researcher.

3.8 Data Analysis

Prior to analyzing the responses, the filled-out questionnaires underwent a comprehensive data preparation process, involving several steps such as editing, coding, data entry, and data cleaning. This rigorous data preparation phase aimed to ensure that the information collected was accurate, complete, and ready for analysis.

The data analysis encompassed two main approaches: descriptive statistics and inferential statistics. Descriptive statistics were employed to summarize and present the quantitative data in a concise and meaningful manner. Measures such as means, percentages, and frequencies were calculated to provide a clear overview of the key findings. These statistical summaries helped to quantify the participants' responses and their distribution, allowing for a better understanding of the trends and patterns in the data.

On the other hand, the qualitative data collected from open-ended questions were subjected to thematic analysis. This involved identifying recurring themes, patterns, and trends in the participants' narrative responses. The qualitative analysis aimed to gain deeper insights into the participants' perspectives, experiences, and attitudes concerning the research topic.

To effectively communicate the results, the findings were presented in a visually accessible manner. Figures, tables, and charts were utilized to represent the data visually and facilitate easier comprehension. These graphical representations helped to highlight key points, comparisons, and trends within the dataset, making the presentation of the results more engaging and accessible to the audience.

By employing a combination of both descriptive and inferential statistical techniques, along with thematic analysis for qualitative data, the study ensured a comprehensive and thorough analysis of the collected information. The utilization of figures, tables, and charts further enhanced the clarity and effectiveness of presenting the findings to the readers, enabling them to grasp the outcomes easily and draw meaningful conclusions from the research.Following the data analysis, conclusions and recommendations were drawn regarding the impact of EBN devices on the academic performance of learners with visual impairments.

3.9 Logistical and Ethical Considerations

Permission was sought by the researcher from the management of the university to allow the progress of the study. The researcher further sought written permission (letters) from the National Commission for Science, Technology, and Innovation (NACOSTI) through Maasai Mara University, Post Graduate Directorate before going to the field for data collection. The researcher provided the respondents with an assurance of the confidentiality of their responses and promised to share the study findings with them. The researcher sought consent from the teachers in order to interact with the learners for the purpose of data collection. The researcher ensured that the research did not cause any harm whatsoever to all the respondents.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter is a presentation, analysis and interpretation the collected data. Data was mainly collected through questionnaires and observation schedules designed by the researcher. This chapter is structured around four main themes, aligned with the study's objectives. For each theme, data is presented, analyzed, and discussed using frequency tables, percentages, and means where appropriate.

4.0.1 Response Rate

In order to assess the impact of EBN devices, questionnaires were distributed to learners, teachers, and head teachers in the six selected schools. The researcher administered a total of 210 questionnaires to the participants. From the learners, 195 responses were obtained, representing a response rate of 92.86%. Out of the 96 questionnaires distributed to the teachers, the researcher received 91 responses, yielding a response rate of 94.79%. Similarly, 6 questionnaires were given to the head teachers, and 5 responses were received, resulting in a response rate of 83.3%. The responses were presented in Table 3 below.

Table 3 Response Rate

Category	**Questionnaires administered**	**Questionnaires Returned**	
		Frequency	Percentage
Teachers	96	91	94.79%
Learners	210	195	92.86%
Headteachers	6	5	83.30%

Source: Researcher 2022

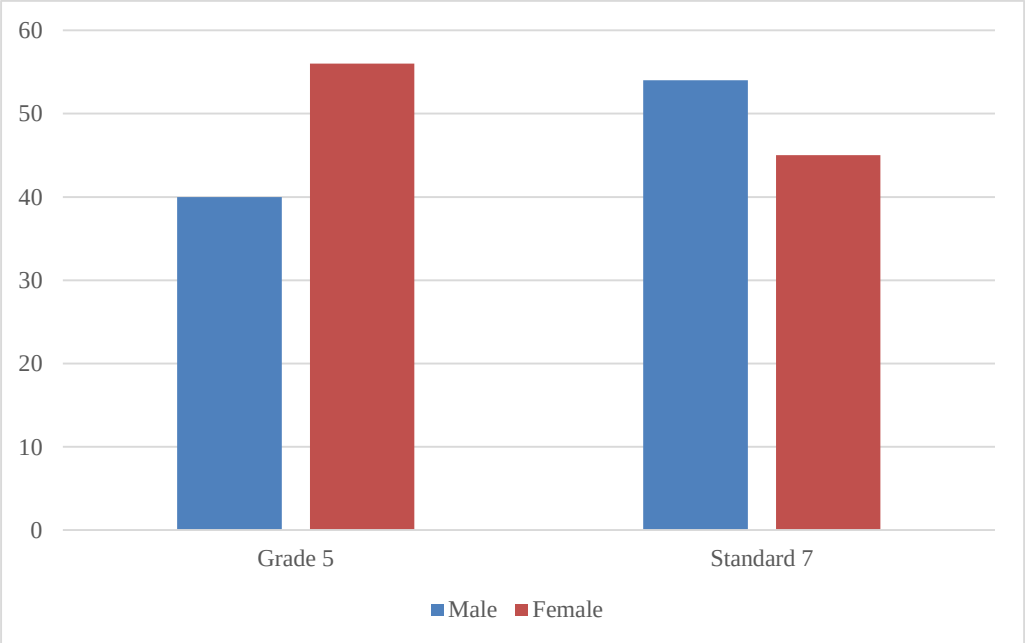
The obtained response rate was considered sufficient for analysis purposes just as recommended by Mugenda and Mugenda (2003), that a response rate of 70% or above is deemed adequate for a study. The high rate of return can be attributed to the researcher's personal administration of the questionnaires. However, there were some instances of non-response, mainly due to misplacement of the questionnaires or the absence of respondents during the data collection process.

4.0.2 Demographics

4.0.2.1 The Distribution of Respondent Learners by Class and Gender

Among the 195 learner respondents, 96 (49.23%) were in Grade 5 whereby 56 (28.72%) were female and 40(20.51%) were male. 99 (50.77%) were in standard 7 whereby 45 (23.08%) were female and 54 (27.69%) were male. The respondents were between the age of 10 and 20. The distribution of the respondent learners according to their class level and gender is presented in figure 2 below.

Figure 2 Distribution of Respondent Learners According to Their Class Level and Gender

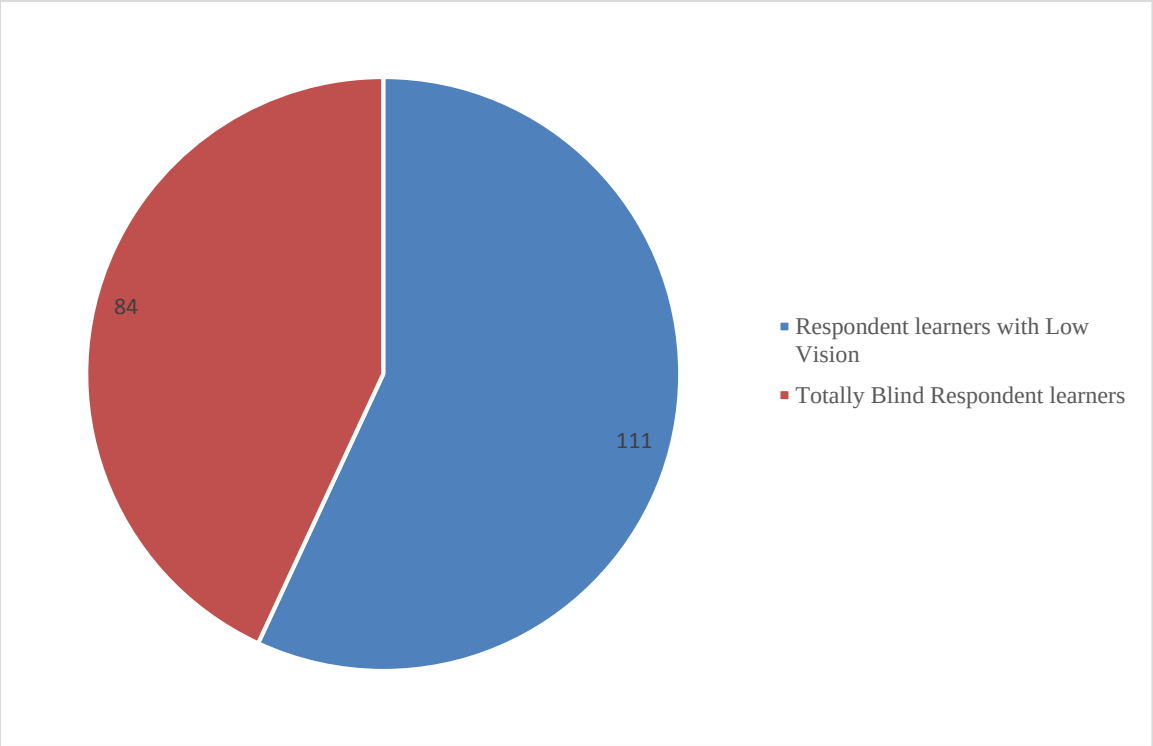


4.0.2.2 Distribution of Respondent Learners by Their Form of Visual Impairment

All the respondent learners (100%) had a form of Visual Impairment: either low vision or blind. 111(56.92%) of the respondent learners had low vision while 84(43.08%) were totally blind.

The distribution of respondent learners as per their form of Visual Impairment is presented in the figure 3 below.

Figure 3 Distribution of Respondent Learners as Per Their Form of Visual Impairment



4.0.2.3 Distribution of Respondent Teachers by Their Teaching Experience

The head teachers' level of experience were as shown in table 4 below.

Table 4 Distribution of Teachers by Teaching Experience

Response	General Teaching Experience				Teaching Experience in their current school.			
	Teachers		Head teachers		Teachers		Head teachers	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1 year	8	8.79%	0	0	19	20.88%	1	20%
2-3 years	18	19.78%	0	0	14	16.38%	0	0%
4-5 years	25	27.47%	0	0	31	34.07%	1	20%
6-10 years	26	28.57%	1	20%	19	20.88%	1	20%
Above 10 years	14	15.38%	4	80%	8	8.79%	2	40%

Source: Researcher 2022

From the table 4, a majority of the respondent teachers, 26 (28.57%) had a teaching experience of 6-10 years, 25(27.47%) had an experience of 4-5 years, 14 (15.38%) had an experience of over 10 years while 8 (8.79%) had a teaching experience of 1 year and below. Most of the respondent teachers, 31 (34.07%) had a teaching experience of 4-5 years in their current school, 19 (20.88%) had an experience of 6-10 years, 19 (20.88%) had an experience of 1 year or less while 14 (16.38%) had experience of 1 year and below. One of the headteachers had a teaching experience of 6 to 10 years while the other 4 had teaching experience of over 10 years. This implies that most of the teachers in the selected special primary schools in Kenya had a high teaching experience of 5 years and above. This means that the majority of the teachers have enough teaching experience to have interacted with the EBN device in the instruction of their learners. It was important to establish the level of experience of the teachers so as to demonstrate their likelihood of exposure to the use of EBNs in the instruction of learners with Visual Impairment.

4.1 Adequacy of EBN Devices

Objective one aimed at examining the adequacy of EBNs in schools specifically designed to provide educational services for learners with visual impairment.. The researcher gathered the information using the questionnaires and the observation schedules.

4.1.1 The Quantity of the EBN Devices

The adequacy of EBN devices in each school was assessed by comparing the number of devices available to the enrolment of learners in each school. The results are shown in Table 5.

Table 5 Quantity of EBN Devices

School	Enrolment	Number of EBN devices	Ratio
1	125	16	1 : 8
2	120	40	1 : 3
3	57	20	1 : 3
4	85	8	1 : 11
5	185	29	1 : 6
6	221	45	1 : 9
Total	793	158	1 : 5

Source: Researcher 2022

As shown in Table 5, a total of 158 EBN devices were distributed among 793 learners, resulting in a mean ratio of 5 learners to 1 EBN device. This indicated that the quantity of EBN devices was insufficient to meet the ratio needs of the learners. The headteachers' views also aligned with this finding, as all 5 respondents (100%) stated that the EBN devices were not adequate.

In four schools, the devices were distributed based on the seniority of the learners, with priority given to those who were totally blind. In the other two schools, distribution was based on the number of learners in a class, leading to the sharing of devices among the learners. This sharing arrangement was not ideal for effective utilization of the devices, and it did not achieve the recommended 1:1 device-student ratio suggested by Liu & Wang (2022), which is associated with better learning experiences and performance for learners.

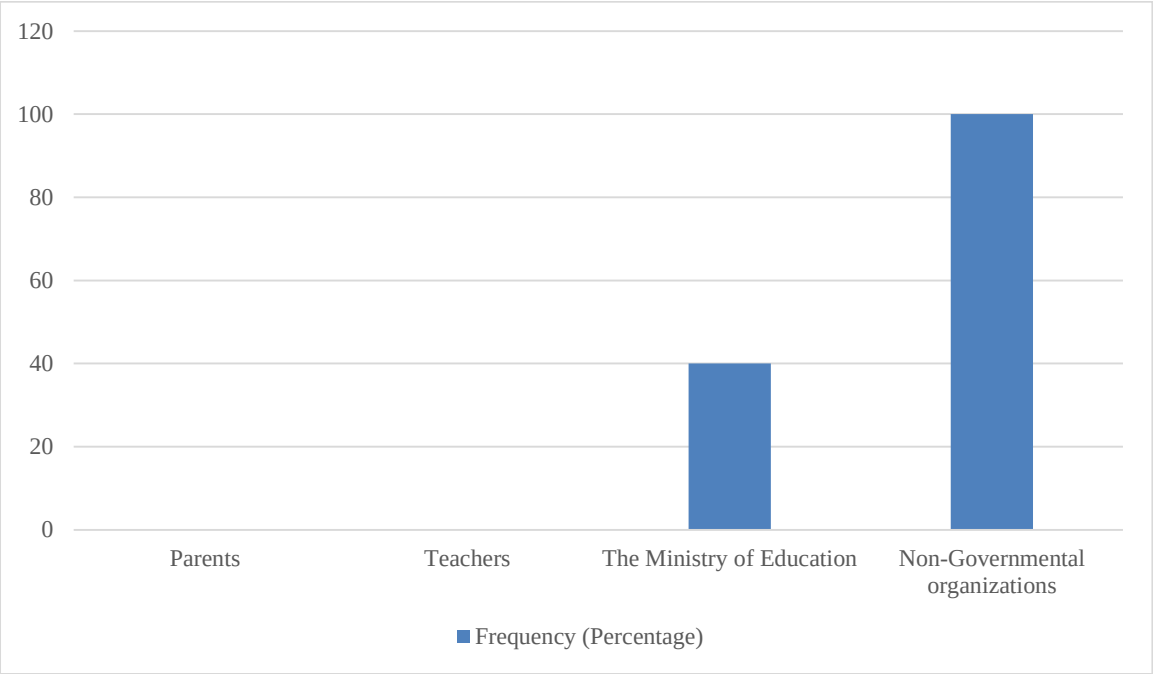
These findings are fairly consistent with the results of previous studies conducted by Alabi, Dominic, and Ibrahim (2018) and Ejoru (2019). Alabi, Dominic, and Ibrahim (2018) found that assistive technologies were inadequately available in special education schools, and the few devices that were available were insufficient to meet the needs of the learners. Additionally, the teachers in these schools did not effectively utilize the available assistive devices for teaching learners with disabilities. Similarly, Ejoru (2019) reported that Electronic AAT devices, such as optacon, OCR scanner, note taker and refreshable Braille display machines, were also inadequate in the schools under study. These studies highlight the persistent issue of inadequate availability and utilization of AT in special education settings.

The EBNs were evidently inadequate. There is need to ensure the adequacy of EBNs so as to achieve a 1:1 ration of EBNs to learners. This could aid in the achievement of desired academic performance of learners with visual impairment.

4.1.2 Providers of the EBN Devices

The study sought to identify the providers of EBN devices in an effort to identify the reasons for the level of adequacy witnessed in the schools. The headteachers were asked to identify who provided the EBNs through their questionnaires and the findings were presented as follows in the figure 4 below.

Figure 4 Providers of the EBN devices



From the figure above, 2(40%) of the headteachers identified the ministry of education as the providers of the EBN in their schools. All the Headteachers identified non-governmental organizations as the providers of their EBN devices. The researcher observed that most the EBN devices in the schools under study were branded with labels of non-governmental organization such as Kilimanjaro Blind Trust Africa (KBTA). This meant that most of the EBNs in the schools under study were provided by non-governmental organization. Little efforts have been made by the government to provide LVIs with EBNs. The type of EBN device observed and identified by the 5 (100%) of the headteachers was the Orbit Reader 20. This was an EBN with a 20-cell refreshable Braille display which was capable of editing, saving, organizing and retrieving Braille files in electronic form.

The headteachers attributed the inadequacy of the EBN devices to the cost implications of acquiring these devices. They also mentioned that the number of enrolled learners far exceeded the number of EBN devices provided by non-governmental organizations. This

situation reflects the government's limited efforts in providing the much-needed assistive devices for learners with visual impairments. Oira (2016) similarly found that teachers supported the use of assistive technologies and emphasized the need for these devices to be made available in learning centers. This would enable visually impaired learners to perform well educationally, on par with their non-impaired peers. Both learners and teachers in the study acknowledged that assistive technology offered a superior and independent means for learners to access information and knowledge easily, quickly, and frequently without relying on others as they may have had to do in the past.

4.1.3 Adequacy of EBN Devices According to the Respondents

To further ascertain the adequacy of the EBNs according to the users, the respondents were also requested to give their opinions. The researcher presented a list of three statements to the 210 learners, 96 teachers, and 6 headteachers who served as the study respondents. The responses received from them were then analyzed. The data was primarily sourced using a Likert scale questionnaire format, where positively stated statements were scored as follows: strongly agree (SA), agree (A), Not Sure (NS), disagree (D) and strongly disagree (SD) as 5,4,3,2,1 respectively. For negatively stated statements, the scoring was reversed. The results for the three sets of opinion statements were presented, analyzed, and discussed separately, and then compared to draw meaningful insights from the data.

Table 6 Respondents' Views On Adequacy Of EBN Devices

Statement	SD	D	NS	A	SA	Total	Mean
Learners' Views on Adequacy statements							
EBN devices are inadequate for my use in class	1	16	2	113	63	195	1.95
I use EBN in all my academic writing and	12	101	1	78	3	195	3.19

reading							
I often use EBN in all learning periods	4	104	0	75	12	195	3.32
Mean							**2.82**
Teachers' Views on Adequacy Statements							
EBN devices are inadequate for my use in Braille instruction in classrooms	1	31	6	19	34	91	2.41
All learners in my class use EBN in all academic writing and reading	12	46	0	29	4	91	2.64
I often use the EBN in my teaching periods	19	34	0	38	0	91	2.63
Mean							**2.56**
Head teachers' Views on Adequacy Statements							
I believe EBN devices are inadequate for use in Braille instruction in my school	2	2	0	1	0	5	2
Learners in my school use EBN in all academic writing and reading	0	4	0	1	0	5	2.4
As a head teacher, I often use the EBN in my teaching periods	0	4	0	1	0	5	2.4
Mean							**2.27**
Overall mean							**2.55**

Source: Researcher 2022

Table 6 presents the average means for teachers, headteachers, and learners, showing values of 2.56, 2.27, and 2.82, respectively. The overall average mean is recorded as 2.55. A

majority of the learners (113) agreed that the EBN devices were inadequate for academic writing and reading, with 63 of them strongly agreeing. On the other hand, most learners (101) disagreed with the statement that the devices were adequate for their academic tasks. During their learning periods, a majority of 104 learners disagreed with the use of EBNs in every learning session. Similarly, a majority of teachers (34) strongly agreed that the EBN devices were inadequate, while headteachers also shared this opinion, with 2 strongly disagreeing and another 2 disagreeing with the adequacy of the EBN devices. The overall views of the headteachers on the adequacy of the EBNs were recorded at a mean of 2.27. From the responses and calculated means, it is evident that the general opinion is that the EBN devices are inadequate, leading to learners and teachers not using them for their classwork.

These findings align with previous research conducted by Mudasiru, Fakomogbon & Isssa (2012), who found that the majority of institutions lacked the necessary assistive technologies for learners with visual impairment. Ejoru (2019) also discovered the unavailability of Braille note-takers. Ngetich (2017) reported that Braille note-takers, description video services, computer screen magnification appications and optical character recognition were not accessible and hence not used by visually impaired student teachers in selected primary Teacher Training Colleges. These studies further support the conclusion that the inadequacy of EBN devices hinders their usage by learners and teachers.

The insufficiency of EBN devices affects each learner's ability to utilize them effectively, leading to non-uniform productivity. Addressing the inadequacy of these devices in special schools for learners with VI is crucial to improve academic performance.

4.2 Teacher Preparedness in Using EBN for Instruction

4.2.1 Respondents' Views on Teacher Preparedness on the Use of EBN

Two hundred and ten (210) learners, ninety-six (96) teachers, and six headteachers participated in the study as respondents. The study used a list of four (4) statements, and the responses collected were analyzed. The data collection was done through a five-point Likert scale questionnaire, where positively stated statements were assigned the following positive scores: strongly agree (SA), agree (A), Not Sure (NS), disagree (D) and strongly disagree (SD) as 5,4,3,2,1 respectively . Conversely, the negatively stated statements were scored in reverse. The results for each set of opinion statements were presented, analyzed, and discussed independently, and then a comparison was made among the three sets.

Table 7 Respondents' Views On Teacher Preparedness.

Statement	SD	D	NS	A	SA	Total	Mean
Teachers' Views on Teacher Preparedness							
As a teacher, I use EBN devices when teaching in class	42	26	0	21	2	91	2.07
As a teacher, I have knowledge of features the EBN	12	61	5	13	0	91	2.21
As a teacher, I am able to make full use of all the features of the EBN	24	39	5	24	2	91	2.42
As a teacher, I am not well prepared to teach using the electronic Braille note-taker	13	25	3	27	23	91	2.76
Mean							**2.36**

Mean

Head Teachers' Views

My teachers use EBN devices when teaching in class	0	3	0	2	0	5	2.8
My teachers are aware of all the features of the EBN	1	1	0	3	0	5	3
My teachers, are able to make full use of all the features of the EBN	0	4	0	0	1	5	2.6
My teachers are well prepared to teach using the electronic Braille note-taker	1	1	1	2	0	5	2.4
Mean							**2.7**
Overall Mean							**2.53**

Source: Researcher 2022

Table 7 displays the average mean scores for teachers and headteachers, yielding values of 2.36 and 2.7, respectively, with a total average mean of 2.53. The majority of teachers (27) agreed that they were not well-prepared to utilize EBNs, with 23 strongly agreeing, indicating a negative perception of their preparedness for using EBNs. Similarly, a majority of headteachers (2) agreed with the statement that their teachers were not well-prepared to teach using EBNs, showing their negative opinion on the teachers' readiness for EBN utilization. Overall, the responses indicate that teachers have uncertainties, lack confidence, or are unprepared to use the available devices to instruct visually impaired (VI) learners. Even though EBN devices are not readily available, teachers' lack of preparedness further hinders effective instruction for VI learners using the available resources.

These findings align with Nsimbila's (2014) research, which revealed that service providers lacked the appropriate skills to handle learners with visual impairment, particularly concerning assistive technology in various academic settings. Hasselbring & Glaser (2000)

also support these findings by stating that many teachers are inadequately trained in using AT effectively in their classrooms, and the expenses is a significant aspect of consideration for schools. While AT has the potential to level the playing field for learners with disabilities, overcoming barriers such as inadequate training and cost is essential for widespread adoption. Ejoru's (2019) study corroborates these findings, highlighting that teachers' level of preparedness was relatively low primarily due to limited access and availability of devices, fluctuating degrees of awareness regarding the usability of different assistive technologies, and limited exposure to device usage.

Teacher preparedness plays a crucial role in effectively utilizing EBNs to achieve desired outcomes. When teachers are unprepared, they lack confidence in using the resource for instruction, leading to ineffective device usage even if the technology is available in schools. This compounds the academic performance issues for learners, considering both the inadequacy of EBN devices, as concluded in the first objective, and the teachers' ill-preparedness, as indicated in the second factor.

4.3 Learners' Attitudes on the Use of EBN in Learning

The study presented a list containing five (5) statements to a total of two hundred and ten (210) learners, ninety-six (96) teachers, and six headteachers, making up three sets of study respondents. The responses received were then analyzed. Data collection was conducted using a five-point Likert scale questionnaire format, where positively stated statements were assigned positive scores as follows: strongly agree (SA), agree (A), Not Sure (NS), disagree (D) and strongly disagree (SD) as 5,4,3,2,1 respectively. Conversely, negatively stated statements were scored in reverse. The results for each set of opinion statements were presented, analyzed, and discussed independently, and subsequently compared among the three sets.

Table 8 Respondents' Views On Attitude Statements Towards EBNs

Statement	SD	D	NS	A	SA	Total	Mean
Learners' opinions on learner attitudes towards EBN							
I enjoy using EBN in learning activities	1	26	1	40	127	195	4.57
I prefer EBN device over other Braille writing and reading equipment	10	0	7	58	121	195	4.75
I would ask my parent/guardian to acquire a note-taker for my personal use	0	9	8	64	114	195	4.78
I would not recommend other learners with VI to use the electronic Braille note-taker in learning	102	58	26	7	2	195	4.58
As a learner, I believe my attitude towards the use of EBN device has a positive impact on my academic performance	4	6	12	117	56	195	4.70
Mean							**4.68**
Teachers' Views							
							Mean
My learners enjoy using EBN in learning activities	0	4	1	52	34	91	4.27
My learners prefer EBN device over other Braille writing and reading equipment	0	0	6	46	39	91	4.36
My learners are motivated to learn through Braille using EBN	1	2	2	40	46	91	4.41
I believe my learners would not recommend other LVIs to use the electronic Braille	27	56	8	0	0	91	4.21

note-taker in learning							
As a teacher, I believe my learners attitude towards the use of EBN device has positive impact on their academic performance	0	5	18	35	33	91	4.05
Mean							**4.26**
Head teachers' views							**Mean**
My learners enjoy using EBN in learning activities	0	1	0	1	3	5	4.2
My learners prefer EBN device over other Braille writing and reading equipment	0	1	0	2	2	5	4
My learners are motivated to learn through Braille using EBN	0	0	1	1	3	5	4.4
I believe my learners would not recommend other LVIs to use the electronic Braille note-taker in learning	1	3	1	0	0	5	4
I believe my learners attitude towards the use of EBN device has positive impact on their academic performance	0	0	1	1	3	5	4.4
Mean							**4.15**
Overall Mean							**4.36**

Source: Researcher 2022

Table 4.6 displays the average mean scores for teachers, headteachers, and learners, resulting in values of 4.26, 4.15, and 4.68, respectively, with a total average mean of 4.36. The majority of the respondent learners (127) strongly agreed that they enjoyed and preferred using EBN devices in learning activities. Similarly, a majority of the respondent teachers (52) agreed with the statement that their learners enjoy using EBN devices in learning activities, with 34 of them strongly agreeing. Additionally, the majority of the respondent headteachers (3) strongly agreed that their learners enjoyed using EBN devices in learning activities. The overall attitudes of the learners towards EBN use, according to the headteachers, were recorded at 4.26, indicating very positive attitudes towards EBN use among headteachers. The findings and calculated means strongly suggest that the learners also held very positive attitudes towards EBN use.

These findings are in agreement with a study done by Martiniello, Wittich, & Jarry (2018), which found that Teachers of the Visually Impaired (TVIs) strongly believed that technology increased learner motivation and improved learning outcomes. This indicates that the extent of technological proficiency and the attitudes of instructors towards the advantages of these technologies can impact the choice to integrate AT in Braille instruction. However, these findings slightly differ from the conference proceedings by Katsoulis (2005), whose research discovered that learners in Cyprus seemed to prefer using technological devices, but their average usage fluctuated at low values when it came to reading and writing Braille. The findings of Bickford & Falco (2019) also support the positive attitude of learners towards technology, suggesting that with proper instruction, learners can quickly adapt to using EBN devices, are very motivated to use these devices thus demonstrate improved outcomes.

The learners' positive attitude towards utilizing EBNs in learning provides an opportunity for teachers, parents, and curriculum designers to leverage technology to enhance the academic performance of the learners. Incorporating this technology into delivering learning material

can harness the learners' eagerness to use technology and contribute to their academic improvement.

4.4 Impact of EBN Use on the Performance of LVIs

4.4.1 Respondents' Views on the Impact of EBNs on the Performance of learners

The study provided a list of five (5) statements to a total of two hundred and ten (210) learners, ninety-six (96) teachers, and six headteachers as the three sets of study respondents. The responses received were then analyzed using a five-point Likert scale questionnaire format, where positively stated statements were given positive scores as follows: strongly agree (SA), agree (A), Not Sure (NS), disagree (D) and strongly disagree (SD) as 5,4,3,2,1 respectively. Conversely, negatively stated statements were scored in reverse. The results for each set of opinion statements were presented, analyzed, and discussed independently, and subsequently compared among the three sets. The table containing the respondents' views on the impact of Electronic Braille Notebooks (EBNs) on the academic performance of learners with visual impairments (LVIs) is presented as Table 4.7, and its findings will be discussed below.

Table 9 Respondents' Opinions On The Impact Of EBNs On The Performance Of LVIs

Statement	SD	D	NS	A	SA	Total	Mean
Learners' views on impact of EBN							
As a learner, I believe that adequate EBNs have positive impact on my academic performance	2	10	13	85	85	195	4.67
I believe that teacher preparedness on the use of EBN has a positive impact on my academic performance	13	11	12	86	73	195	4.44
I believe that the EBN has improved my ability to read and write in Braille	6	17	14	87	71	195	4.47
As a learner, I believe that the	101	58	11	11	15	195	4.42

EBN is ineffective in learning							
As a learner, the EBN has had a positive impact on my academic performance	1	8	26	102	58	195	4.59
	Mean						**4.52**
Teachers' views						**Total**	**Mean**
As a teacher, I believe that adequacy of EBNs affect my learners' academic performance	9	15	11	30	26	91	3.54
I believe that teacher preparedness on the use of EBN has an impact on the learners' academic performance	1	4	5	34	47	91	4.34
I believe that the electronic Braille note-taker has improved my learner's ability to read and write in Braille	0	0	6	59	26	91	4.22
As a teacher, I believe that the EBN is ineffective in instruction	32	50	8	1	0	91	4.24
EBN has had a notable positive impact on the academic performance of my LVIs	2	3	6	49	31	91	4.14
Mean							**4.10**
Head teachers' Views							**Mean**
I believe that adequacy of EBNs affect my learners' academic performance	0	1	1	3	0	5	3.4
I believe that teacher preparedness on the use of EBN has an impact on the learners' academic	0	0	0	2	3	5	4.6

performance							
I believe that the electronic Braille note-taker has improved my learner's ability to read and write in Braille	0	0	1	2	2	5	4.2
I believe that the EBN is ineffective in learning	2	2	1	0	0	5	4.2
EBN has had a notable positive impact on the academic performance of my LVIs	0	1	0	3	1	5	3.8
Mean							**4.04**
Overall Mean							**4.22**

Source: Researcher 2022

Table 9 displays the average mean scores for teachers, headteachers, and learners, resulting in values of 4.1, 4.04, and 4.52, respectively, with an average mean of 4.22. The majority of respondents agreed that the Electronic Braille Notebooks (EBNs) have significantly improved learners' Braille reading and writing skills, with a frequency of 87 respondents and 71 of them strongly agreeing. Similarly, a majority of teachers (59) strongly agreed that EBNs have positively impacted learners' Braille reading and writing skills, and 26 teachers simply agreed with the given statement. The findings also revealed that a majority of the respondent headteachers (4) agreed that EBNs have improved learners' Braille reading and writing skills. The cumulative frequencies and calculated means support the conclusion that all respondents were of the opinion that EBNs have had a positive impact on learners' academic achievement.

These particular findings align with the research conducted by Bickford and Falco (2012), where they sought to measure the efficacy of using EBNs in Braille instruction in literacy, based on the Patterns curriculum. Their study found that utilizing electronic devices and note-takers led to greater improvements in proficiency and fluency, and it also increased learners'

motivation during instructional phases compared to traditional techniques. Cooper and Nichols (2007) also reported similar advantages of using technology.

As an assistive technology, EBNs are designed to make daily activities easier, and the positive impact on the academic achivement of LVIs is demonstrated by these findings. Despite their inadequacies, EBN devices managed to positively impact learners' academic performance. Therefore, it is crucial to ensure that these devices are readily available and utilized to achieve the desired academic outcomes for LVIs.

4.4.2 The Academic Performance of LVIs

In order to further evaluate the effects of EBNs, the headteachers were requested to provide information on the academic performance of their schools in recent years, both before and after the introduction of EBNs for use. The results of this assessment are presented in Figure 5 below.

Figure 5 Academic Performance of LVIs in KCPE Performance

	2017	2018	2019	2020	2021
School 1	210.06	178.4	234.64	203.82	188.95
School 2	202.1	222.5	198.06	239.43	190.64
School 3		190.17	201	210.14	230.47
School 4					240
School 5	198.2	174.56	201.43	210.08	212.43
School 6	178.4	210.06	203.82	188.95	234.64
Average Mean scores	197.19	195.138	207.79	210.484	216.1883333

As presented in the figure 5 above, the performance of LVI based on the data provided by the headteachers has risen slightly over the recent years. As stated by the head teachers and confirmed through observation by the researcher, the EBN devices were first availed for use by LVIs in the year 2019. The average mean scores were recorded at 197.19 in the year 2017, 195.138 in the year 2018, 207.79 in the year 2019, 210.48 in the year 2020 and 216.19 in the year 2021. These results suggest that the Electronic Braille Notebooks (EBNs) may have had a positive impact on the learners' academic performance.

These findings are in contrast to the study conducted by Bickford & Falco (2019), which did not show consistent differences among learners between the outcomes of teaching and

learning using the traditional methods of Perkins Brailler and Braille paper, compared to using the EBNs which have a refreshable Braille display. The teachers in that study expressed concerns about the learners' ability to perceive spatial relationships using refreshable Braille. However, another study by Bickford & Falco (2012) found that the utilization of EBNs led to greater improvements in proficiency and fluency, and it also motivated the learners during instructional phases compared to traditional techniques.

4.4.3 Challenges Facing the Use of EBNs

To gain deeper insights into the factors influencing the impact of EBNs on academic performance, the study explored the limitations associated with their use. This was achieved by including an open-ended question in the questionnaire, where learners, teachers, and headteachers were asked to describe the challenges they encountered while utilizing EBN technology in teaching and learning. The findings were also validated through the researcher's observations and were subsequently discussed thematically as follows:

Breakdowns: Respondent headteachers mentioned that some learners were careless, leading to damage of the delicate EBN devices. Learners reported issues like unresponsive Braille keys, defects in the refreshable Braille display, and occasional freezing of the devices during use. The EBNs were also susceptible to breakdown when exposed to liquids, and the charging ports were prone to damage if not handled carefully. In cases of breakdown, the lack of nearby experts for repairs and maintenance was an additional challenge.

Storage: Some EBN devices lacked internal storage and relied solely on external storage such as SD cards. The external placement of SD cards made them prone to loss, as curious learners often explored the features of the EBNs, leading to misplacement.

Electric Power: EBNs relied on electricity, and schools with unstable power supply encountered difficulties in using the devices. Additionally, limited charging stations caused learners to wait in turns for their devices to charge.

Swahili Braille Contraction: EBNs were designed to contract Braille in English and other major language groups, but not in Swahili. This posed challenges when dealing with text files in Swahili, as they could not be contracted appropriately, potentially confusing learners. Converting Swahili literature into contracted Braille files required specialized software, and the availability of such software was limited and expensive.

Training: Effective utilization of EBNs required proper training, which demanded significant time and effort. However, the tight schedules in schools often made it challenging to allocate extra time for such training. The training process involved extensive rote learning of EBN commands and extensive practice, adding to the workload of respondents who were already engaged in regular class activities. Some headteachers emphasized the need for retraining teachers on EBN usage.

These challenges significantly impacted the use of EBNs in achieving the desired academic performance. While EBNs did have a slight positive impact on learners' performance, these challenges, either individually or in combination, hindered the realization of the full potential of EBNs. Similar concerns were raised by D'Andrea (2019), whose study participants noted that a disadvantage of assistive technology is its potential to malfunction or crash, often at inconvenient times. The challenges encountered during technology use could lead to negative attitudes among learners and may even discourage the use of EBNs.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSSIONS AND RECOMMENDATIONS

5.0 Introduction

The chapter outlines the summary of findings from the study as carried out. It will also outline the conclusions drawn from the findings by the researcher. At the end of the chapter, the researcher will give recommendations and suggestions for further studies.

5.1 Summary of Findings

The researcher distributed a total of 210 questionnaires and received responses from 195 learners, resulting in a response rate of 92.86%. Out of the 96 questionnaires distributed to teachers, 91 were returned, representing a response rate of 94.79%. Additionally, 6 questionnaires were given to headteachers, and 5 were returned, yielding a response rate of 80%. The high response rate was attributed to the researcher administering the questionnaires personally.

Objective one focused on assessing the adequacy of EBNs in special primary schools for the visually impaired. Respondents agreed that there were issues regarding the adequacy of EBN devices. The distribution of devices at an average ratio of 1 EBN to 5 learners posed a significant challenge for both learners and teachers.

The second objective aimed to determine the teachers' preparedness in using electronic Braille note-takers for Braille instruction in selected Special Schools for the Visually Impaired. The overall opinion of the respondents indicated that the teachers were not well-prepared to incorporate EBN devices into learners' instruction.

The third objective aimed to explore the learners' attitude when making use of EBNs in learning in Schools meant for the VI. The overall opinion of the respondents suggested that the learners had a very positive attitude towards the use of EBNs in their learning.

The fourth objective aimed to assess the impact of EBN devices on the academic performance of LVIs in Schools for the Visually Impaired. The overall opinion of the respondents indicated that the EBNs had a positive impact on learners' academic performance. The average mean of LVIs' performance steadily increased after the introduction of EBNs in 2019, further demonstrating the potential positive impact of EBNs on learners' academic performance.

5.2 Conclusion

The study findings and conclusions drawn from the targeted respondents clearly highlight the necessity of technology as a teaching tool, particularly for learners with visual impairments (LVI). The use of assistive technology, such as EBNs, can significantly aid learners in improving their academic performance, which has traditionally lagged behind the national average in national examinations. EBNs may hold the key to helping these learners reach their full potential in academics.

The key findings of the study are as follows:

(i) The EBN devices in the selected schools for visually impaired learners were found to be inadequate.

(ii) Teachers in the selected special schools for visually impaired learners were not well-prepared to incorporate EBNs in their instructional practices.

(iii) The LVIs in the sampled Special Primary schools displayed a very positive attitude towards the use of EBNs in their learning activities, which is evident from their slight improvement in academic performance.

(iv) The EBN devices had a positive impact on the academic performance of learners in the sampled special schools for the visually impaired.

This study reiterates the importance of integrating technology in the instruction of learners, especially those with special needs. The observed positive impact of EBN devices indicates a promising potential if certain factors are addressed, such as ensuring adequate availability of devices, adequately preparing teachers to utilize them effectively, and distributing the technology to all deserving schools.

5 .3 Recommendations

The study's findings demonstrated that the use of EBN devices had a positive impact on the academic performance of learners with visual impairments (LVIs). Based on these findings, the researcher made several recommendations regarding the use of EBN devices to achieve desired goals for LVIs.

i. The Kenyan government and stakeholders in special schools should take steps to boost the acquisition and distribution of EBN devices to schools for the visually impaired, aiming to meet the recommended 1:1 ratio for effective use.

ii. Training institutions responsible for providing training to teachers for the visually impaired and Braille technicians should incorporate EBN device usage training, including instruction on simple repairs and maintenance, as more technicians are trained. The Teachers Service Commission, in collaboration with school administrations, should include EBN device training in teacher development programs through in-service courses.

iii. Capitalizing on LVIs' very positive attitude towards EBN devices, learning and assessment materials should be delivered to them through these devices. Curriculum developers, teachers, and parents of LVIs should utilize EBN devices as the primary mode of delivering learning content, taking advantage of the learners' positive attitudes.

iv. Teachers and headteachers in schools with visually impaired learners should leverage the available EBN devices to improve the academic performance of the learners. Despite any inadequacies, teachers should fully utilize the devices since they have been proven to enhance performance.

Incorporating these recommendations will help maximize the potential benefits of EBN devices for learners with visual impairments, leading to improved academic outcomes.

5.4 Recommendations for Further Study

The researcher identified some areas which requires further investigation to gain a further insight into the use of EBNs by LVIs.

i. A further study into the use of EBNs by LVIs in secondary schools and tertiary institutions.
ii. A study into the ways in which EBN devices can be improved further to ensure better usability.
iii. There is also a need to determine the required amount of time to obtain maximum benefits from the use EBN devices.

References

Abbitt, J. T. (2011). An Investigation of the Relationship between Self-Efficacy Beliefs about Technology Integration and Technological Pedagogical Content Knowledge (TPACK) among Preservice Teachers. *Journal of Digital Learning In Education*, 134-143.

Abner, G. H., & Lahm, E. (2002). Implementation of Assistive Technology with learners who are Visually Impaired: Teachers' Readiness. *Journal of Visual Impairment & Blindness.*

Addis, B. M., Britton, J., & Davies, C. (2016). Challenges and Barriers to the Use and Provision of Assistive Technology in Africa: A Systematic Review. Queen's University.

Alabi, T. O., Dominic, S., & Ibrahim, I. K. (2018). Availability Adequacy and Utilization of High-Tech Assistive Technology in Special Education Schools in North West Nigeria. *Educational Technology*, (pp. 589-594).

Amin, M., Rezaei, S., & Abolghasemi, M. (2014). User satisfaction with mobile websites: the impact of perceived usefulness (PU), perceived ease of use (PEOU) and trust. *Nankai Business Review International*, 258-274.

Aranyanak, I. (2014). An experimental analysis of Braille reading using a high-resolution tracking system. National University of Ireland Maynooth, 24-100.

Atanga, C., Jones, B. A., & Krueger, L. E. (2019). Teachers of learners With Learning Disabilities: Assistive Technology Knowledge, Perceptions, Interests, and Barriers. *Journal of Special Education Tehnology*.

Aypay, A., Celik, H. C., & Sever, M. (2013). Technology Acceptance in Education. *Turkish Journal of Educational Technology*.

Bausch, M. E., & Hasselbring, T. S. (2004). Assistive technology: Are the necessary skills and knowledge being developed at the preservice and inservice levels? *Teacher Education and Special Education*, 97-104.

Belay, T. E. (2005). African Perspective on Visual ImpairmentsICT's and Policies: A Personal Experience, A Variety of Perspectives and Technological Solution. UNESCO, 5-7.

Bhardwaj, R. K. (2018). Information Access Mechanism for Visually Impaired learners in Higher Educational Institutions: A Study. *Journal of Library & Information Technology*, 387-395.

Bhatt, A., & Kumari, A. (2015). Assitive Technology For the Visually ImpairedChildren for Their Academic Excellence. *Global Journal Of Medical Case Report*.

Bickford, J. O., & Falco, R. O. (2012). Technology for Early Braille Literacy: Comparison of Traditional Braille Instruction and Instruction with an Electronic Notetaker. *Journal of Visual Impairment & Blindness*, 679-673.

Bolingo, A. (2019). Impact Of Assistive Technology On Education Performance Of Learners With Visual Impairment At The University Of Rwanda - College Of Education. *University Of Rwanda*, 36.

Cássia, C. A., Monteiro, G. B., Rabello, S., Gasparetto, M. R., & Carvalho, K. M. (2008). Assistive technology applied to education of learners with visual impairment. *Investigacion Original*.

Chege, M. W., Chomba, J. M., & Awori, B. B. (2018). Factors Influemcing the Use of Assistive Technology In Teaching Mathematics To Learners With Visual Impairments In Special Primary Schools In Kenya. *Academic Research International*, 154-159.

Chen, Q., & Kazman, R. (2007). Investigating antecedents of technology acceptance of initial eCRM users beyond generation X and the role of self-construal. *Electronic Commerce Research*, 315-339.

Chong , M. (2000). The current state of technology for the blind and the challenge for the twenty-first century. *The Braille Monitor*, 53-68.

Cooper, H. L., & Nichols, S. K. (2007). Technology and Early Braille Literacy: Using the Mountbatten Pro Brailler in Primary-grade Classrooms. *JVIB*, 13-17.

D'Andrea. (2009). Acquisition of Literacy Skills by Young Children Who Are Blind. *Journal of Visual Impairment & Blindness*, 585-594.

D'Andrea, F. M. (2019). Preferences and Practices among learners who Read Braille and use Assistive Technology. *Journal of Visual Impairment & Blindness*.

Davis, F. D., & Venkatesh, V. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Managment Science*, 186-204.

De Vaus, D. A. (2002). *Surveys In Social Research.* Routledge.

Development Initiatives. (2020). *Status of Disablity in Kenya: Statistics from the 2019 Census.* Nairobi.

Edyburn, D. L. (2006). Assistive technology and mild disabilities. *Special Education Technology Practice*, 18-28.

Ejoru, W. E. (2019). *Stakeholders Level of Preparedness On Use of Alternative Assistive Technology Among Learners with Visual Impairment in Turkana County.* Turkana: Maseno University.

Eke, V. U., & Inyango, M. O. (2015). Teachers' Preparedness for Pupils with Visual Impairment Inclusive Education in Cross River State, Nigeria. *Journal Of Humanities And Social Science*, 35-40.

Farnsworth JR, C. R., & Luckner, J. L. (2008). The Impact of Assistive Technology on Curriculum Accommodation for a Braille-Reading Student. *Heldref Publications*, 178-186.

Farrel, G. (2007). *ICT in Education in Kenya.* 3-10: World Bank Group.

Fee, E. (2011). The Invention Of Braille. *American Joournal of Public Health*.

Gall, M. D., & Borg, W. (2007). *Educational Research: An Introduction.* Utah: Pearson.

Gerald, A. H., & Lahm, E. A. (2002). Implementation of Assistive Technology with learners who are Visually Impaired: Teachers' Readiness. *Journal of Visual Impairment & Blindness*, 98-105.

Gitari, J. M. (2020). Influence of Assistive Technology on Kenya Certificate of Secondary Education (Kcse) Performance for Visually Impaired learners at Thika High School for the Blind, Kenya. University of Nairobi.

Habulezi, J., Batsalelwang, K. P., & Malatasi, N. M. (2017). Factors Influencing the Poor Academic Performance of Learners with Vision Impairment in Science Subjects in Kgatleng District in in Science Subjects in Botswana. *International Journal of Learning, Teaching and Educational Research*, 28-39.

Hasslebring, T. S., & Glaser, C. W. (2000). Use of Computer Technology to Help learners with Special Needs. *Children and Computer Technology*, 102-122.

Hibel, J., Farkas, G., & Morgan, P. L. (2010). Who Is Placed Into Special Education? *Author Manuscript*, 312-332.

Hynes, R. J., Jebaraj, J. J., Kumar, S. J., Immanuvel, S., & Sankaranarayanan, R. (2019). Portable electronic Braille devices – An overview. *AIP Conference Proceedings 2142, 140018.* AIP Publishing.

(IEF), T. I. (2007). Eyecare in Developing Nations. *The International Eye Foundation (IEF).* The International Eye Foundation (IEF).

Jones, B. A., Rudinger, B., & Williams , N. (2018). Training pre-service general educators in assistive technology competencies for learners with visual impairments. *British Journal of Visual Impairment*.

Kabir, S. M. (2016). Methods of Data collection. Curtin University.

Kamei-Hannan, C., & Lawson, H. (2012). Impact of a Braille-Note on Writing: Evaluating the Process, Quality, and Attitudes of Three learners Who are Visually Impaired. *Journal of Special Education Technology*.

Kanak, M., Mandhushi, V., & Singal, G. (2020). A Survey on Assistive Technology for Visually Impaired. *Science Direct*, 100-188.

Katsoulis, P. (2005). Teachers' and blind learners' attitudes towards Braille: A comparative study. *12th International Council for Education of People with Visual Impairment (ICEVI) World Conference* (pp. 1-9).

Kelly, S. K. (2011). The Use of Assistive Technology by High School learners with Visual Impairments: A Second Look at the Current Problem. *Journal of Visual Impairment & Blindness*, 235-239.

Kelly, S. M., & Smith, W. M. (2011). The Impact of Assistive Technology on The Performance of learners With Visual Impairments: A Synthesis of the Research. *Journal of Visual Impairments & Blindness*, 73-83.

Kenya Institute of Management. (2009). *Fundamentals of Research Methods.* Nairobi, Kenya.

Kiarie, M. W. (2004). Education of learners with Visual Impairments In Kenya: Trends and Issues. *International Journal of Special Education*, 18.

Kilimanjaro Blind Trust. (2017, October 28). Retrieved February 6, 2021, from Assistive Technology: https://kilimanjaroblindtrust.org/programs/assistive-technology/

Kombo, K. D., & Tromp, L. A. (2006). *Proposal and Thesis Writing.* Nairobi: Pauline Publications Africa.

Kothari, C. R., & Garg, G. (2014). *Research Methodology: Methods and Techniques.* New Delhi: New Age International Publishers.

Laarhoven, T., & Conderman, G. (2011). Integrating Assistive Technology into Special Education Teacher Preparation Programs. *Journal of Technology and Teacher Education*.

Liu, W., & Wang, C. (2022). Liu, W., & How Roles in Collaboration Respond to the Exchange of Device-Student Ratio Under the Impact of External Scripts? *Educational Technology & Society*, 15 - 30.

Martin, G., & Ritz, J. (2012). Reserach Needs for Technology Education: A US Perspective. *Journal of Technology Education*.

Martiniello, N., Wittich, W., & Jarry, A. (2018). The perception and use of technology within Braille instruction: A preliminary study of Braille teaching professionals. *British Journal Of Visual Impairement*, 6-12.

Mbugua, W. W. (2012). Adoption of Computer-Based Assistive Technology For Persons With Dissability In Kenya. *Semantics Scholar*, 3-52.

Ministry of Education. (2021). Retrieved from ICT in Education and Training Policy: https://www.education.go.ke/sites/default/files/2023-01/ICT%20IN%20EDUCATION%20AND%20TRAINING%20POLICY%202021.pdf

Mudasiru, Y. O., Fakomogbon, M. A., & Issa, I. A. (2012). Availability of Assistive Technologies in Nigerian Educational . *International Journal of Social Sciences and Education* .

Mugenda, A., & Mugenda , O. (2003). *Research methods quantitative and qualitative approaches.* Nairobi: Act Press.

Mulloy, M. A., Gevarter, C., Hopkins, M., Sutherland, S. K., & Ramdoss, T. S. (2014). Assistive Technology for learners with Visual Impairments and Blindness. *Springer*.

Muma, S., & Obonyo, S. (2020). The Prevalence and Causes of Visual Impairment among Children in Kenya – The Kenya Eye Study. *BMC Opthamology*, 3-5.

National Library Service For The Blind and Print Disabled. (2020). Retrieved February 6, 2021, from Braille Displays and Notetakers: https://www.loc.gov/nls/resources/blindness-and-vision-impairment/devices-aids/Braille-displays-notetakers/

Ng'etich, H. T. (2017). Availability and use of adaptive technology devices for Visually Impaired student teachers in Primary Teacher Training Colleges in Kenya. *International Journal of Education and Research*, 21-24.

Njoroge, M., Njue, S. W., & Chege, F. N. (2014). Braille Competence Among Blind Learners: Materials and Teacher Factors In Thika and Meru, Kenya. *Journal Of Special Needs and Dissability Studies*, 1-8.

Njue, S. W. (2021). Performance of Learners with Visual Impairment in Summative Evaluation in Special Schools in Kenya. *Global Journal of HUMAN-SOCIAL SCIENCE: G Linguistics & Education*, 14.

NLS, N. (2021, March 21). *NLS(National Library Service For The Blind And Print Disabled - Library Of Congress)*. Retrieved from Braille Displays and Notetakers: https://www.loc.gov/nls/resources/blindness-and-vision-impairment/devices-aids/Braille-displays-notetakers/

Nsimbila, A. M. (2014). Analysis of Availability and Adequacy of Support Services for learners with Visual Impairments in Tanzania Institutions of Higher Learning. *The Open University of Tanzania*, 437.

Oira, M. (2016). Use of Modern Assistive Technology and Its Effects On Educational Achievement of learners With Visual Impairment At Kibos Special SecondarySchool Kisumu County, Kenya. *Kenyatta University*, 43-77.

Okonji, P. E., & Ogweezy, D. C. (2019). Awareness and barriers to adoption of assistive technologies among visually impaired people in Nigeria. *The Official Journal of RESNA*, 209-2019.

Onivehu, A. O., Ohawuiro, E. O., & Oyeniran, J. B. (2017). Teachers' Attitude and Competence in the Use of Assistive Technologies in Special Needs Schools. *Eric*, 21-32.

Orodho, J. (2012). *Elements of Education and Social Science Research Methods.* Nairobi: Masola Publishers.

Parette, H. P., Peterson, K. R., Smith, S., Gray, T., & Silver, P. H. (2006). The State of Assistive Technology: Themes from an Outcomes Summit. *Assistive Technology and Benefits*, 15-33.

Pogrund, R. L., & Parker, A. T. (2009). A Review of Research on the Literacy of learners with Visual Impairments and Additional Dissabilities. *Journal of Visual Impairment & Blindnes*, 635-648.

Price, S., & Oliver, M. (2007). A Framework for Conceptualising the Impact of Technology on Teaching and Learning. *Educational Technology & Society*.

Roth, G. A., & Fee, E. (2011). The Invention of Braille. *American Journal of Public Health*.

Russomanno, A., O'Modhrain, S., Matthew , W. R., & Gillespie, B. R. (2015). Refreshing Refreshable Braille Displays. *Researchgate*, 2-12.

Sachdeva, N., & Suomi, R. (2005). Assistive Technology For Totally Blind –Barriers to Adoption. *TUCS/Turku School of Economics, University of Turku*, 6-15.

Saira, S., & Shahida, S. (2016). The Scope of Assistive Technology in Learning Process of learners with Blindness. *Eric*, 46-54.

Senjam, S. S., Foster, A., & Bascaran, C. (2020). Assistive technology for visual impairment and trainers at schools for the blind in Delhi. *The Official Journal of RESNA*.

Soderstrom, S., & Ytterhus, B. (2010). The use and non- use of assistive technologies from the world of information and communication technology by visually impaired young people: a walk on the tightrope of peer inclusion. *Taylor Francis Online*, 303-315.

The ICT Sector Policy Guidelines of March 2006. (2021, May 20). Retrieved from Communications Authority of Kenya: https://ca.go.ke/document/the-ict-sector-policy-guidelines-of-march-2006/

The National Special Needs Education Policy Framework. (2009). Nairobi, Kenya: Republic of Kenya.

Van Laarhoven, T., & Conderman, G. (2011). Integrating Assistive Technology into Special Education Teacher Preparation Programs. *Journal of Technology and Teacher Education*, 491-495.

Vankatesh, V., & Bala, H. (2013). Advancing the technology acceptance model with a focus on interventions. *Manuscript in Preparation*.

Vankatesh, V., & Davis, F. D. (2013). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*.

Wa Munyi, C. M. (2014). *Analysis of Teachers's Perceptions On Instruction Of Braille Literacy In Primary Schools For Learners With Visual Impairment In Kenya.* Nairobi: Kenyatta University.

Wachiuri, R. N. (2015). Effect of assistive technology on teaching and learning of intergrated English among visually impaired learners in special secondary schools in Kenya. *Nairobi University*.

WHO. (2006). Global Initiative For the Elimination of Avoidable Blindness. *Vision 2020 The Right to Sight.* World Health Organization.

WHO. (2018). *Blindness and vision impairment.* Retrieved from https://www.who.int/health-topics/blindness-and-vision-loss#tab=tab_1

Wiazowski, J. (2014). Can Braille Be Revived? A Possible Impact of High-End Braille and Mainstream Technology on the Revival of Tactile Literacy Medium. *Taylor Francis Online*.

Witte, L., Steel, E., Gupta, S., Ramos, V. D., & Roentgen, U. (2018). Assistive technology provision: towards an international framework for assuring availability and accessibility of affordable high-quality assistive technology. *Taylor Francis*.

Yin, R. K. (2003). *Case Study Research: Design and Methods.* Sage Publlications.

Zhou , Zhou, L., Parker, A., Smith , D. W., & Griffin, S. (2011). Assistive Technology for learners with Visual Impairments: Challenges and Needs in Teachers' Preparation Programs and Practice. *Journal of Visual Impairment and Blindness*, 197-210.

APPENDICES

APPENDIX I: LEARNER QUESTIONNAIRE

This questionnaire aims at getting your opinion in relation to use of Electronic Braille Notetakers (eg. Orbit Readers). The data you provide will be kept confidential and used solely for its intended purpose. Please complete the questionnaire honestly and in a manner that reflects your individual experiences. Rest assured that your identity will be kept confidential, and there is no need to include your name on the questionnaire.

Section I

1. Grade/Class _____
2. Age _____
3. Gender: Male ☐ Female ☐
4. Form of Visual Impairment:

   Low vision ☐ Totally Blind ☐
5. Is there any other special needs challenge that affects your learning?

   Yes ☐ NO ☐
6. If 'Yes' to number 5, indicate your challenge below

   Hearing Impairment ☐

   Physical Impairment ☐

   Cerebral Palsy ☐

   ☐

Epilepsy

Other: ☐ Specify _____

Section II

Objective 1: Adequacy of EBN devices

Please use the provided guide to respond to the following statements in the table by ticking the box that best represents your views. Use a scale of 1-5, where SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, and SA = Strongly Agree. Choose the answer that honestly reflects your views.

Statement	SD	D	NS	A	SA
EBN devices are inadequate for my use in class					
As a learner, I use EBN in all my academic writing and reading					
As a learner, I often use EBN in my learning period					

Objective 2: Teacher preparedness in using EBN for instruction

Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
i. All teachers use EBN devices when teaching in class					
ii. As a learner, my teachers guided me on the features of the EBN devices					
iii. As a learner, my teacher guided me on how to use EBN fully					
iv. As a learner, I believe that my teachers that are not well prepared to teach using the electronic Braille note-taker					

Objective 3: Learners' attitude on the use of EBN in learning

Please use the provided guide to respond to the following statements in the table by ticking the box that best represents your views. Use a scale of 1-5, where SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, and SA = Strongly Agree. Choose the answer that honestly reflects your views.

Statement	SD	D	NS	A	SA
I enjoy using EBN in learning activities					
I prefer EBN device over other Braille writing and reading equipment					
I would ask my parent/guardian to acquire a note-taker for my personal use					
I would not recommend other learners with VI to use					

the electronic Braille note-taker in learning					
As a learner, I believe my attitude towards the use of EBN device has a positive impact on my academic performance					

Objective 4: Impact of EBN use on academic performance of LVIs

(i) In what ways has the Braille note-takers enhanced your ability to learn through Braille?

Ways	**Tick where applicable**
i. Giving note/hand-outs to learners or other reading literature to learners	
ii. As a way of learners accessing course books	
iii. As an assessment tool i.e. tests and assignments	
iv. As a way for learners to practice Braille skills i.e. reading and writing	
v. Teaching computer skills i.e. as a screen reader	
vi. Its portability	
vii. Noiselessness	
viii. Other: Specify _____	

ix. _____	

(ii) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
As a learner, I believe that adequacy of EBNs affects my academic performance					
As a learner, I believe that teacher preparedness on the use of EBN has an impact on my academic performance					
As a learner, I think believe that the electronic Braille note-taker has improved my ability to read and write in Braille					
As a learner, I believe that the EBN is ineffective in learning					
As a learner, the EBN has had a positive impact on my academic performance					

Are there any challenges you have faced when using the EBN?

_____

_____

_____

_____

_____

_____

Thank you for your participation.

APPENDIX II: TEACHER QUESTIONNAIRE

This questionnaire aims at getting your opinion in relation to use of Electronic Braille Notetakers (eg. Orbit Readers). The data you provide will be kept confidential and used solely for its intended purpose. Please complete the questionnaire honestly and in a manner that reflects your individual experiences. Rest assured that your identity will be kept confidential, and there is no need to include your name on the questionnaire.

Section I

1. Gender: Male ☐ Female ☐

2. For how long have you been attending to your present school?

   1 year ( ) 2-3 years ( )

   4-5 years ( ) 6-10 years ( )

   Above 10 years ( )

3. Is there any other special needs challenge that affects your service delivery?

   Yes ☐ NO ☐

4. If 'Yes' to number 3, indicate your challenge below

   Hearing Impairment ☐

   Physical Impairment ☐

   Visual Impairment ☐

   Other: Specify _____

Section II

Objective 1: Adequacy of EBN devices

Please use the provided guide to respond to the following statements in the table by ticking the box that best represents your views. Use a scale of 1-5, where SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, and SA = Strongly Agree. Choose the answer that honestly reflects your views.

Statement	SD	D	NS	A	SA
i. EBN devices are inadequate for my use in Braille instruction in classrooms					
ii. As a teacher, all learners in my class use EBN in all academic writing and reading					
iii. As a teacher, I often use the EBN in my teaching periods					

Objective 2: Teacher preparedness in using EBN for instruction

(i) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
i. As a teacher, I use EBN devices when teaching in class					
ii. As a teacher, I am aware of all the of features the EBN					
iii. As a teacher, I am able to make full use of all the features of the EBN					
iv. As a teacher, I am not well prepared to teach using the electronic Braille note-taker					

(ii) Where did you train on the use of the electronic Braille note-takers in teaching learners?

Trainer	**Tick where applicable**
(iii)My employer (In service training)	
(iv)Non-Governmental Organization	
(v) Device manufacturers	
(vi)School/College (pre service training)	
(vii) Online	
(viii) School administration	

(ix)Fellow teachers	
(x) Self-taught	
(xi)No Training at all	

(xii) What did your training cover? (Tick where applicable)

Training	**Tick where applicable**
(i) Features of the note takers	
(ii) Device	
(iii)Creating and saving files	
(iv)Editing files	
(v) Organizing and deleting files	
(vi)Addition and accessing files	
(vii) Connection of the note-takers to computers and other portable devices	
(viii) Using the note-taker as a screen reader	
(ix)Other: specify _____	

Objective 3: Learners' attitude on the use of EBN in learning

Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
(i) My learners enjoy using EBN in learning activities					
(ii) My learners prefer EBN device over other Braille writing and reading equipment					
(iii) My learners are motivated to learn through Braille using EBN					
(iv) As a teacher I would not recommend other TVI teachers to use the electronic Braille note-taker in instruction					
(v) As a teacher, I believe my learners attitude towards the use of EBN device has positive impact on their academic performance					

Objective 4: Impact of EBN use on academic performance of LVIs

(i) In what ways has the Braille note-takers enhanced your ability to teach through Braille?

Ways	**Tick where applicable**
(i) Giving note/hand-outs to learners or other reading literature to learners	
(ii) As a way of learners accessing course books	
(iii) As an assessment tool i.e., tests and assignments	
(iv) As a way for learners to practice Braille skills i.e., reading and writing	
(v) Teaching computer skills i.e., as a screen reader	
(vi) Its portability	
(vii) Noiselessness	
(viii) Other: Specify _____	

(ii) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
(i) As a teacher, I believe that adequacy of EBNs affect my learners' academic performance					
(ii) As a teacher, I believe that teacher preparedness on the use of EBN has an impact on the learners' academic performance					
(iii) As a teacher, I believe that the electronic Braille note-taker has improved my learner's ability to read and write in Braille					
(iv) As a teacher, I believe that the EBN is ineffective in learning					
(v) EBN has had a notable positive impact on the academic performance of my LVIs					

Are there any challenges you have faced when using the EBN in Braille instruction?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Thank you for your participation.

APPENDIX III: HEAD TEACHER'S QUESTIONNAIRE

This questionnaire aims at getting your opinion in relation to use of Electronic Braille Notetakers (eg. Orbit Readers). The data you provide will be kept confidential and used solely for its intended purpose. Please complete the questionnaire honestly and in a manner that reflects your individual experiences. Rest assured that your identity will be kept confidential, and there is no need to include your name on the questionnaire.

Section I

1. Gender: Male ☐ Female ☐

2. For how long have you been attending to your present school?

   1 year ( ) 2-3 years ( )

   4-5 years ( ) 6-10 years ( )

   Above 10 years ( )

3. Is there any other special needs challenge that affects your service delivery?

   Yes ☐ NO ☐

4. If 'Yes' to number 3, indicate your challenge below

   Hearing Impairment ☐

   Physical Impairment ☐

   Visual Impairment ☐

   Other: Specify _____

Section II

Objective 1: Adequacy of EBN devices

(i) What is the current enrolment of learners in your school?

(ii) How many electronic Braille note-takers are available for your use in teaching learners with Visual Impairment?

(iii)Who provides the Electronic Braille Note-takers for your use?

Provider	Tick where applicable
a. Parents	
b. Teachers	
c. The ministry of Education	
d. Non-governmental organizations	
e. Other: Specify _____	

(iv)Which types of EBNs are available for your use?

Actillino ☐

Braille Note Touch Plus ☐

☐

Orbit Reader

Braille Sense U2 ☐

Other: Specify _____

(v) Would you say that the EBNs in your school are adequate?

Yes ( ) No ( )

(vi)If NO, what could be the reason(s) for the inadequacy?

_____

_____

(vi) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
i. As the head teacher, I believe EBN devices are inadequate for use in Braille instruction in my school					
ii. Learners in my school use EBN in all academic writing and reading					
iii. As a teacher, I often use the EBN in my teaching periods					

Objective 2: Teacher preparedness in using EBN for instruction

(i) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
i. As a teacher, I use EBN devices when teaching in class					
ii. As a teacher, I am aware of all the of features the EBN					
iii. As a teacher, I am able to make full use of all the features of the EBN in instruction learners					
iv. As a teacher, I am not well prepared to teach using the electronic Braille note-taker					

(ii) Where did your teachers train on the use of the electronic Braille note-takers in teaching learners?

Trainer	**Tick where applicable**
(iii)My employer (In service training)	

(iv) Non-Governmental Organization	
(v) Device manufacturers	
(vi) School/College (pre service training)	
(vii) Online	
(viii) School administration	
(ix) Fellow teachers	
(x) Self-taught	
(xi) No Training at all	

(xii) What does the training cover? (Tick where applicable)

Training	**Tick where applicable**
(i) Features of the note takers	
(ii) Device	
(iii) Creating and saving files	
(iv) Editing files	
(v) Organizing and deleting files	

(vi) Addition and accessing files	
(vii) Connection of the note-takers to computers and other portable devices	
(viii) Using the note-taker as a screen reader	
(ix) Other: specify _____	

Objective 3: Learners' attitude on the use of EBN in learning

Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
My learners enjoy using EBN in learning activities					
My learners prefer EBN device over other Braille writing and reading equipment					
My learners are motivated to learn through Braille using EBN					
I would not recommend other headteachers to use the electronic Braille note-taker in their instruction					

As a head teacher, I believe my learners attitude towards the use of EBN device has positive impact on their academic performance					

Objective 4: Impact of EBN use on the academic performance of LVIs

(i) In what ways has the Braille note-takers enhanced your ability to teach through Braille?

Ways	**Tick where applicable**
a. Giving note/hand-outs to learners or other reading literature to learners	
b. As a way of learners accessing course books	
c. As an assessment tool i.e. tests and assignments	
d. As a way for learners to practice Braille skills i.e. reading and writing	
e. Teaching computer skills i.e. as a screen reader	
f. Its portability	
g. Noiselessness	
h. Other: Specify _____	

(ii) Please indicate your views on the following statements by using the guide provided below and ticking the box that best represents your response:

On a scale of 1-5:

SD = Strongly Disagree, D = Disagree, NS = Not Sure, A = Agree, SA = Strongly Agree

Choose the response that honestly reflects your views.

Statement	SD	D	NS	A	SA
As a head teacher, I believe that adequacy of EBNs affect my learners' academic performance					
As a head teacher, I believe that teacher preparedness on the use of EBN has an impact on the learners' academic performance					
As a head teacher, I believe that the electronic Braille note-taker has improved my learner's ability to read and write in Braille					
As a head teacher, I believe that the EBN is very effective in learning					
EBN has had a notable positive impact on the academic performance of my LVIs					

(iii) When did you acquire EBN for your use in Braille instruction? (The year and Date if possible)

_____

(iv) Kindly provide information on the performance of your learners in their KCPE performance in for the following years

Year	**Mathematics Mean score**	**English Mean score**	**Kiswahili Mean score**	**Science Mean score**	**SSRE Mean score**	**Total Mean scores**
2017						
2018						
2019						
2020						
2021						
2022						

(v) Could their performance before and after the acquisition of EBN been affected by the use of EBN?_____

(vi) Are there any challenges you have faced when using the EBN in Braille instruction?

_____

_____

Thank you for your participation.

APPENDIX IV: OBSERVATION SCHEDULE

	Objective	**Observation**
1	Adequacy of EBN devices	
2	Teacher preparedness in the use of EBN devices	
3	Learners' attitude towards the use of these devices	
4	Impact of EBN us on the academic performance of LVIs	

APPENDIX V: NACOSTI RESEARCH AUTHORIZATION LETTER

Maasai Mara University

BOARD OF POSTGRADUATE STUDIES

OFFICE OF THE DIRECTOR

P.O. BOX 861 – 20500
Narok, Kenya www.mmarau.ac.ke

Tel: +254 – 20 -2066042
+254 – 20 - 8081874

23rd March, 2022

RESEARCH PERMITS SECTION
NACOSTI
UTALII HOUSE

REF: DAVIES KIPROTICH (REG. NO. EM06/MP/MN/10543/2019)

We wish to confirm that the above named is a *bona fide* Masters student at Maasai Mara University pursuing a Master of Education degree in Special Needs Education in the School of Education. His proposed research is *'Impact of electronic Braille note – taking devices use on academic performance of visually impaired learners in special primary schools in Kenya'*. He would like to apply for a research permit from NACOSTI before he can proceed for field work and data collection.

We further confirm that the candidate has adhered to all research protocol requirements of Maasai Mara University and the proposed research has been rated as having no known adverse impacts on the environment and does not pose any ethical concerns.

This is therefore to request your office to issue him with a research permit.

Faithfully yours,

RAbila

Prof. Romulus Abila, PhD.
DIRECTOR, BOARD OF POSTGRADUATE STUDIES
abila@mmarau.ac.ke, https://orcid.org/0000-0001-8762-7153

APPENDIX VI: NACOSTI RESEARCH LICENSE

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **800517**

Date of Issue: **05/April/2022**

RESEARCH LICENSE

This is to Certify that Mr.. Davies Kiprotich of Maasai Mara University, has been licensed to conduct research in Baringo, Bomet, Kiambu, Kisii, Kisumu, Mombasa, Westpokot on the topic: IMPACT OF ELECTRONIC BRAILLE NOTE-TAKING DEVICES USE ON ACADEMIC PERFORMANCE OF VISUALLY IMPAIRED LEARNERS IN SPECIAL PRIMARY SCHOOLS IN KENYA for the period ending : 05/April/2023.

License No: **NACOSTI/P/22/16669**

800517

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

APPENDIX VII: RESPECTIVE COUNTY DIRECTORS OF EDUCATION'S AUTHORIZATION

MINISTRY OF EDUCATION

State Department of Early Learning and Basic Education

Telephone: Kiambu (office) 0768 970412

Email:directoreducationkiambu@yahoo.com
When replying please quote

COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY
P. O. Box 2300
KIAMBU

KBU/CDE/DEPT/ 8/VOL.I

10th June, 2022

Mr. Davies Kiprotich
Maasai Mara University
P.O Box 861-20500
NAROK, KENYA

RE: RESEARCH AUTHORIZATION

Reference is made to NACOSTI letter NACOSTI/P/22/1669 dated 5th April, 2022.

You have been authorized to research on **"Impact of electronic braille note-taking devices use on academic performance of visually impaired learners in special primary schools in Kiambu County, Kenya"** for a period ending 5th April 2023.

Please accord him the necessary assistance. You are requested to share with us a copy of your research findings when you conclude your research.

FOR THE COUNTY DIRECTOR OF EDUCATION ★ KIAMBU COUNTY ★ 10 JUN 2022

EMILY NYAGA
For: COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY

MY EDUCATION, MY FUTURE ***MY EDUCATION, MY FUTURE***

OFFICE OF THE PRESIDENT

MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

COUNTY COMMISSIONER, KIAMBU

Telephone: 066-2022709
Fax: 066-2022644
E-mail: countycommkiambu@yahoo.com
When replying please quote

County Commissioner
Kiambu County
P.O. Box 32-00900
KIAMBU

Ref.No: **ED.12/1(A)/VOL.V/122**

10TH JUNE, 2022

Mr. Davies Kiprotich
MAASAI MARA UNIVERSITY
P. O. BOX 861-20500
NAROK, KENYA
Telephone No:272519
www.mmarau.ac.ke

RE: RESEARCH AUTHORIZATION

Reference is made to National Commission for Science, Technology and Innovation Letter Ref No. **NACOSTI/P/22/16669** dated **5th April, 2022**.

You have been authorized to conduct research on ***"IMPACT OF ELECTRONIC BRAILLE NOTE-TAKING DEVICES USE ON ACADEMIC PERFORMANCE OF VISUALLY IMPAIRED LEARNERS IN SPECIAL PRIMARY SCHOOLS IN KENYA,"***. The data collection will be carried out in ***Kiambu County*** *for a period ending* **5th April, 2023.**

You are requested to share your findings with the County Education Office, Kiambu, upon completion of your research.

PP

Festus Kimeu
FOR: COUNTY COMMISSIONER
KIAMBU COUNTY

Cc National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
NAIROBI

County Director of Education
KIAMBU COUNTY

All Deputy County Commissioners (***For information and record purposes***)
KIAMBU COUNTY

MINISTRY OF EDUCATION
State Department of Early Learning and Basic Education

Telephone: Kiambu (office) 0768 970412

Email:directoreducationkiambu@yahoo.com
When replying please quote

COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY
P. O. Box 2300
KIAMBU

KBU/CDE/DEPT/ 8/VOL.I

10th June, 2022

Mr. Davies Kiprotich
Maasai Mara University
P.O Box 861-20500
NAROK, KENYA

RE: RESEARCH AUTHORIZATION

Reference is made to NACOSTI letter NACOSTI/P/22/1669 dated 5th April, 2022.

You have been authorized to research on **"Impact of electronic braille note-taking devices use on academic performance of visually impaired learners in special primary schools in Kiambu County, Kenya"** for a period ending 5th April 2023.

Please accord him the necessary assistance. You are requested to share with us a copy of your research findings when you conclude your research.

FOR THE COUNTY DIRECTOR OF EDUCATION ★ KIAMBU COUNTY ★
10 JUN 2022

EMILY NYAGA
For: COUNTY DIRECTOR OF EDUCATION
KIAMBU COUNTY

OFFICE OF THE PRESIDENT

MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT

COUNTY COMMISSIONER, KIAMBU

Telephone: 066-2022709
Fax: 066-2022644
E-mail: countycommkiambu@yahoo.com
When replying please quote

County Commissioner
Kiambu County
P.O. Box 32-00900
KIAMBU

Ref.No: **ED.12/1(A)/VOL.V/122**

10TH JUNE, 2022

Mr. Davies Kiprotich
MAASAI MARA UNIVERSITY
P. O. BOX 861-20500
NAROK, KENYA
Telephone No:272519
www.mmarau.ac.ke

RE: RESEARCH AUTHORIZATION

Reference is made to National Commission for Science, Technology and Innovation Letter Ref No. **NACOSTI/P/22/16669** dated **5th April, 2022**.

You have been authorized to conduct research on ***"IMPACT OF ELECTRONIC BRAILLE NOTE-TAKING DEVICES USE ON ACADEMIC PERFORMANCE OF VISUALLY IMPAIRED LEARNERS IN SPECIAL PRIMARY SCHOOLS IN KENYA,"***. The data collection will be carried out in ***Kiambu County*** *for a period ending* **5th April, 2023.**

You are requested to share your findings with the County Education Office, Kiambu, upon completion of your research.

PP

Festus Kimeu
FOR: COUNTY COMMISSIONER
KIAMBU COUNTY

Cc National Commission for Science, Technology and Innovation
P.O. Box 30623-00100
NAIROBI

County Director of Education
KIAMBU COUNTY

All Deputy County Commissioners (***For information and record purposes***)
KIAMBU COUNTY

REPUBLIC OF KENYA
MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

Telegrams: "ELIMU",
Telephone: 052-22265
When replying please quote
email:cdebometcounty@gmail.com
Ref/CDE/BMT/ED/AUTH/74/VOL.II/28

COUNTY EDUCATION OFFICE,
BOMET COUNTY,
P.O. BOX 3-20400,
BOMET.

7th June, 2022

Mr. Davies Kiprotich
Maasai Mara University
Po. Box 861-20500
Narok

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION.

Reference is made to the letter dated 5th April, 2022 Ref: No. NACOSTI P/22/16669/800517 from NACOSTI requiring the above-mentioned person to conduct research on **"Impact of Electronic Braille Note- Taking Devices Use on Academic Performance of Visually Impaired Learners in Special Primary Schools in Bomet County, Kenya,"** for the period ending 5th April, 2023.

The purpose of this letter is to inform you that authority has been granted for him to carry out the study in Bomet County, including learning Institutions among others.

Kindly accord him the assistance he requires to carry out the exercise.

COUNTY DIRECTOR OF EDUCATION
BOMET
P. O. Box 3 - 20400, BOMET

APOLLO APUKO
COUNTY DIRECTOR OF EDUCATION
BOMET COUNTY.

Copy

CEO- NACOSTI

SYSTEM CERTIFICATION ISO 9001 SGS

REPUBLIC OF KENYA

MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING AND BASIC EDUCATION

-Email: elimu|cdewest pokot @ education.go.ke
Web: www.education.go.ke
-cdewestpokot@yahoo.com.
When replying please quote date $ Ref.

COUNTY EDUCATION OFFICE
WEST POKOT COUNTY
P.O. BOX 17
KAPENGURIA.

15th June, 2022

REF: WPC/EDUC/ADM/15/20/VOL.1/31

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORITY – DAVID KIPROTICH REG. EM06/MP/MN/10543/2019

Following your authorization from the National Commission for Science, Technology and innovation, I hereby permit you to carry out research on "***Impact of electronic Braille note- taking devices use on academic performance of visually impaired learners in special primary school in Kenya***".

COUNTY DIRECTOR OF EDUCATIO.
WEST POKOT COUNTY
15 JUN 2022
P.O. Box 17 KAPENGURIA

(ARITELUK BENSON)
FOR COUNTY DIRECTOR OF EDUCATION
WEST POKOT COUNTY.

OFFICE OF THE PRESIDENT

MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telephone: Kisumu 2022219/Fax: 2022219
Email: ckisumucounty@gmail.com

COUNTY COMMISSIONER
KISUMU COUNTY
P.O. BOX 1912-40100
KISUMU

Ref: CC/KC/ RES/1/3/VOL IV/291

Date: 24th June, 2022

All Deputy County Commissioners
KISUMU COUNTY

RE: RESEARCH AUTHORIZATION: MR. DAVIES KIPROTICH

Reference is made to a letter from the National Commission for Science, Technology and Innovation no. NACOSTI/P/22/16669 dated 5th April, 2022 on the above underlined subject matter.

The above named is from Maasai Mara University. He has been authorized to carry out a research on "***Impact of Electronic Braille Note-taking Devices use of Academic Performance of Visually Impaired Learners in Special Primary Schools in Kenya***
The research period ends on 5th April, 2023.

Kindly accord him the necessary assistance.

JOSEPHINE OUKO
COUNTY COMMISSIONER
KISUMU COUNTY

Copy to: Mr. Davies Kiprotich
Maasai Mara University

REPUBLIC OF KENYA

MINISTRY OF EDUCATION
State Department of Early Learning & Basic Education

Telegrams "schooling", Kisumu
Telephone Kisumu 057 - 2024599
Email: countyeducation.kisumu@gmail.com

When replying please quote

COUNTY DIRECTOR OF EDUCATION
KISUMU COUNTY
PROVINCIAL HEADQUARTERS NYANZA
3RD FLOOR
P.O. BOX 575 - 40100
KISUMU

REF: CDE/KSM/GA/3/24/ VOL_V/14

24th June, 2022

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION
DAVIES KIPROTICH - NACOSTI/P/22/16669

The above named is from Masai Mara University.

This is to certify that he has been granted authority to carry out research on ***"Impact of Electronic Braille Note-Taking Devices use on Academic Performance of Visually Impaired Learners in Special Primary Schools in Kenya"*** for the period ending **5th April, 2023**

Any assistance accorded to him to accomplish the assignment will be highly appreciated.

ENOCH S. OKWEMBA
For: COUNTY DIRECTOR OF EDUCATION
KISUMU COUNTY

REPUBLIC OF KENYA

MINISTRY OF EDUCATION

State Department of Early Learning and Basic Education

Telegram: "EDUCATION"
Telephone: 058-30695
Email address cdrkisii@gmail.com
When replying please quote

COUNTY DIRECTOR OF EDUCATION
KISII COUNTY
P.O. BOX 4499 - 40200
KISII

REF: CDE/KSI/RESEARCH/V/8/134

Date: 06th June, 2022

DAVIS KIPROTICH
MAASAI MARA UNIVERSITY
P.O BOX 861- 20500
NAROK.

RE: RESEARCH AUTHORIZATION

Following your research Authorization vide your letter **Ref.NACOSTI/P/22/16669** to carry out research in Kisii County,this letter refers.

I am pleased to inform you that you can carry out your research in the County on **"Impact of electronic braille note-taking devices use on academic performance of visually impaired learners in special primary schools in Kisii County,Kenya"** for a period ending **05th April,2023**.

Wish you a successful research.

COUNTY DIRECTOR OF EDUCATION
KISII COUNTY
06 JUN 2022
P. O. Box 4499 - 40200, KISII.

Pius Ng'oma
County Director of Education
Kisii.