UTILIZATION OF HI-TECH ASSISTIVE TECHNOLOGY BY TEACHERS AND LEARNERS WITH VISUAL IMPAIRMENT AT MADERA SECONDARY SCHOOL FOR THE BLIND IN UGANDA

BY

SANYA JACKSON OBALE

20/U/GMSN/13102/WKD

A DISSERTATION SUBMITTED TO THE DIRECTORATE OF RESEARCH AND GRADUATE TRAINING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER IN SPECIAL NEEDS EDUCATION OF KYAMBOGO UNIVERSITY

MARCH, 2024

DECLARATION

I, Sanya Jackson Obale, do solemnly declare to the Directorate of Research and Graduate Training of Kyambogo University that this dissertation is my own work and that no part of it has been submitted for another degree at this university or any other institution of higher learning for the same award.

Signature…… Date……..…….

APPROVAL

This dissertation was written following the guidelines on supervision of research projects laid down by Kyambogo University, and it is hereby submitted to the Directorate of Research and Graduate Training with our approval as supervisors.

Signature……... Date …….

Dr. Odeke Nato Joseph

Signature ……. Date …….

Dr. Ayub Ali Baguwemu

DEDICATION

This dissertation is dedicated to my family, especially my wife and children, Patience, Daniella, and Gabriella, not forgetting my son Edward, for their prayers and endurance during the entire time when I was away from them.

ACKNOWLEDGEMENT

This kind of work cannot be completed by one person. I want to express my gratitude to everyone who helped me through this process. First of all, I give God the glory for blessing me with life to seek and complete this significant goal in my academic and professional careers. Secondly, I would like to express my sincere gratitude to the entire study and the participants who contributed positively to the data that guided this study amidst the tight examination schedules but were able to sacrifice time to respond to the interviews as planned by the researcher. Thirdly, I sincerely appreciate the prayers and moral support of my family, especially my wife, Mrs. Akumu Morine, children, mother, and church, for enduring and understanding me while I was not available most of the time. Furthermore, I would like to express my sincere gratitude to the supervisors, the principal supervisor, Dr. Odeke J. N., and co-supervisor, Dr. Ayub Ali Baguwemu, for their positive criticism and supportive comments. Their direction molded the outcome of this dissertation. Sincere thanks go to the Uganda Independent Scholarship Trust Fund under the Ministry of Education and Sports for the partial scholarship awarded, which supported me with tuition and functional fees throughout my study.

My thanks also go out to the entire staff of the Faculty of Special Needs and Rehabilitation, particularly the Department of Special Needs Studies, who helped me academically by facilitating lectures and other study sessions and by providing me with moral support as I continued my career. To my graduate course mates, Noah, Sr. Lucy, Sr. Beatrice, Ayoli, Baluku, Benard, Betty, Elipu, John, Male, Paul, Phiona, Richard, Yvone, Oliver, and Scovia, thank you for being wonderful, loving, and cooperative friends. Despite acknowledging the assistance of the above-mentioned individuals, I declare that any shortcomings or errors revealed in this report are entirely my own and that no one should be held accountable.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AWSIP	All We See Is Possibility
CCTV	Closed Circuit Television
CPU	Central Processing Unit
CRPD	Convention on the Rights of Persons with Disabilities
DAISY	Digital Access Information Systems
DBT	Duxbury Braille Translator
DEMO	Demonstration
GBU	Ghana Blind Union
GOU	Government of Uganda
HAAT	Human Activity Assistive Technology
JAWS	Job Access with Speech
LWVI	Learners with Visual Impairment
MoES	Ministry of Education and Sports
MoICT	Ministry of Information and Communication Technology
NVDA	Non-Visual Desktop Access
OCR	Optical Character Recognition
PwDs	Persons with Disabilities
UBOS	Uganda Bureau of Statistics
UCC	Uganda Communications Commission
UK	United Kingdom
UNICEF	United Nation International Children's Fund
WHO	World Health Organization

ABSTRACT

Hi-tech assistive technology worldwide serves as a game changer for learners with visual impairments to increase, maintain, or improve functionality for everyone in educational institutions. However, there is less or unfair use of hi-tech assistive technology in Uganda. This study explored the utilization of hi-tech assistive technology by teachers and learners with visual impairments during teaching and learning at Madera Secondary School for the Blind in Uganda. The objectives of this study were to: examine the nature of available hi-tech assistive technology for teachers and LWVI; analyze the perceptions of teachers and LWVI on the use of hi-tech assistive technology; and find out how hi-tech assistive technology is utilized at Madera Secondary School for the Blind. This study used the Human Activity Assistive Technology (HAAT) model as a theoretical model. A case study design and a qualitative research approach were used. The sample for this study was eight (8) participants, comprising four (4) teachers and four (4) LWVIs. A purposive sampling technique was used in selecting participants. Semi-structured interviews and observation were used in collecting data. The data was thematically derived and presented. The study revealed that the hi-tech assistive technology available was computers and Demo JAWS. No teacher or LWVI were formally trained, but a few teachers had informal basic training in workshops to use the devices and software. Furthermore, hi-tech assistive technology simplifies access to information, is used to record and revise audio work and notes, and allows learners to participate in leisure activities, thus making them independent. However, they were challenged with inadequate knowledge and skills to operate devices and software; unstable power; and a lack of repair services. The study discovered that general science subjects were taught to 'O' level LWVI, whereas in 'A' level, LWVI offered arts combination. Conclusively, the devices and software were inadequate in schools compared to the number of teachers and LWVI; some were spoiled, whereas others were kept without a central processing unit. The study recommends that there should be consideration for the purchase and installation of licensed JAWS; manufacturers should pilot all the devices with the users; construct spacious resource rooms; and train teachers in the use of devices and software available in schools; speed up the domestication process of the Marrakesh treaty to freely access the cooperate rights to soft copy materials in accessible formats. This study is significant as it bridges the policy gaps and promotes AT and digital inclusion for teachers and LWVI in Uganda.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This study was about the utilization of hi-tech assistive technology by teachers and learners with visual impairments (LWVI) during teaching and learning at Madera Secondary School for the Blind in Uganda.

Hi-tech assistive technology in this study referred to the most complex or newest technology on the market that is adapted to aid teaching and learning for teachers and LWVI in schools. They appear in both hardware and software forms, but their use depends on the learners' needs or type of visual impairment. The researcher concentrated on hi-tech assistive technology for teachers and LWVI used during teaching and learning at Madera Secondary School for the Blind in Uganda.

Learners with visual impairment (LWVI) in this study refers to only totally blind learners and those with low vision participating in teaching and learning at Madera Secondary School for the Blind in Uganda.

The concept of visual impairment (VI) in this particular study refers to various eye conditions, including but not limited to blindness and low vision.

Utilization in this study refers to the action of making practical and profitable use of hi-tech assistive technology devices and software by teachers and LWVI during teaching and learning in schools. In this chapter, therefore, the background, statement of the problem, theoretical framework, purpose, objectives of the study, scope of the study, and significance of the study are highlighted.

1.1 Background of the Study

Globally, more than 2.5 billion people need one or more assistive products or software to help them overcome various physical, social, cultural, infrastructural, economic, educational, and accessibility barriers, yet nearly one billion of them are denied access, particularly in low- and middle-income countries where access can be as low as 3% of the need for these life-changing products (WHO, 2022). However, the nature and extent of utilization of hi-tech assistive technologies for persons with visual impairment vary among developed countries, considering their use as a norm.

In North America, hi-tech assistive technology is a strategy for improving educational opportunities for learners with visual difficulties as well as for the general learner population (Kisanga, 2020). Furthermore, hi-tech assistive technologies help in developing enhanced learning as well as the ability for self-expression and communication (Chukwuemeka & Samaila, 2020). Many LWVI want to communicate but cannot express them well; thus, hi-tech assistive technologies enable that communication (Koch, 2017).

In US schools, hi-tech assistive technologies are tools used by all learners to promote access to the general education curriculum. LWVIs' use of Hi-tech assistive technologies such as computers, magnification devices, and screen readers as academic tools for learning is paramount. This helps to promote teaching and learning if all teachers and LWVI in secondary schools are included (Manduchi, 2012). In addition to the use of hi-tech assistive technologies, teachers and LWVI are easily equipped to meet their expectations in difficult and ordinary settings in schools if provided and trained to use hi-tech assistive technology devices and software (Muriuki, 2015).

Technology in China that permits the production of tactile versions of visible pictures, for example, concrete maps, pictures, and graphs, enables teachers and LWVI to access information (Wong & Law, 2016).

In Africa, the use of hi-tech assistive technology for teaching and learning for LWVI is slowly and steadily taking root. Besides programs like JAWS for Windows and other technology like the portable version of Window-Eyes, the Zoom Text magnifier/reader and the Zoom Text keyboard are being considered for LWVI (Manduchi, 2012). Also, apply other programs like speech to Windows-compatible applications like Word and Outlook using additional tools like a speech-to-text engine, text-to-speech software, scanner/reader, talking calculator, voice recorder/CD player, and Braille printer/embosser. All these technologies are crucial to the livelihoods of teachers and LWVI; however, most of them are costly and challenging for African countries to acquire (Manduchi, 2012).

Kenya also introduced a DOT Braille watch, an innovation that is the equivalent of a smart gear that displays Short Messaging Services (SMS) notification in Braille, in addition to other services provided (Muriuki, 2015). The innovation enables LWVI and other people to read and perform any academic role with ease. Similarly, a variety of policies in Kenya aim at ensuring the inclusion and rights of LWVI to access information and provide compelling evidence of the thorough use of hi-tech assistive technology available in secondary schools (Muriuki, 2015).

There are about 8,945 learners with disabilities in Uganda, of which 4,020 are learners with visual impairment in secondary schools (senior one to senior six) who must use one or more hi-tech assistive technology devices and software to benefit from teaching and learning processes (Education Abstract, 2017; UBOS, 2014). This projection does not show the actual number of learners and teachers with visual impairments at Madera Secondary School for the

Blind. This study ought to bridge the gap of a lack of data on teachers and learners with visual impairments, most especially from the education abstracts and UBOS reports, to determine data for Madera Secondary School for the Blind.

Hi-tech assistive technology is widespread in secondary schools and the majority of teachers and LWVI in secondary schools, including Madera Secondary School for the Blind, might not yet have adopted this new hi-tech assistive technology for purposes of systematic teaching and learning enhancement (MoES, 2015). Although the government of Uganda and its partners have continued to distribute hi-tech assistive technology to secondary schools, including Madera Secondary School for the Blind, only 193 out of the 395 computers provided were used regularly, and 202 were found unused. Out of 120 MP3 players, 32 were regularly used and 88 were not in use (UCC, 2015). Additionally, forty Braille embossers were provided and 11 reported being used, whereas 29 were not in use; 154 card readers were supplied; and 42 were regularly used, whereas 112 were not in use (Agabirwe & Kiyingi, 2020). The reports above indicated less utilization of hi-tech assistive technology in secondary schools, including Madera Secondary School for the Blind. Looking at the gap in the figures of assistive technology not used, the findings of this study will guide the education sector to streamline the utilization procedure of hi-tech assistive technology for teachers and LWVI in secondary schools. Teachers and LWVI will be trained to gain skills and knowledge to utilize hi-tech assistive technology in schools to avoid the wastage of devices by keeping them on shelves and in different offices.

Utilization of all assistive technology in Uganda is guided by the Information, Communication, and Technology Policy (2014), as derived from the UN Convention on the Rights of People with Disabilities. Article 2 on communication in the UNCRPD mentioned written, audio, plain-language, human-reader, augmentative and alternative modes, text display, Braille, tactile communication, large print, and accessible multimedia systems on the market to be used by

persons with disabilities, including teachers and LWVI (UNCRPD, 2006). Most of the mentioned media seem to be less accessible by the users, and a study of this kind will address the gaps of inaccessibility to print media and create a pathway for teachers and LWVI to have corporate rights on softcopies of all educational materials with the help of hi-tech assistive technology in Uganda through adaptation of the Marrakesh treaty.

The PWDs Act (2020) stressed that hi-tech assistive technologies for teachers and LWVI enhance teaching and learning, thus making direct and personal achievement possible for the blind and learners with low vision in secondary schools. Similarly, Section 1.1 on "Defining ICTs and Disability for Uganda" highlights the newest assistive technology, including speech-to-text programs, screen readers, Victor readers, orbit readers, optical character recognition (OCR) programs, and Blaze ET. The highlight does not give a clear strategy for the implementation and utilization of hi-tech assistive technology in Uganda. The PWDs Act 2020 does not clearly direct the education implementers on digital inclusion to speed up quicker access to information, including print media. Additionally, Braille printers and embossers, mobile smart phones, the internet, automated teller machines (ATMs), digital systems like recorders, scientific talking calculators, computers, and laptops with JAWS were also mentioned (Makoza, 2019).

Most of the devices mentioned in Article 1.1 of the PWDs Act 2020 produce the work in unified English Braille format, of which Uganda is a signatory but has not yet adopted the format. These have created a very big gap for teachers who trained in ordinary braille to transcribe and read braille materials made in unified English braille format. This study intends to bridge the above gap by designing a strategy and policy that promote digital inclusion in Uganda and train teachers on the use of unified English braille to cope with the new educational trends.

A student with a disability is required under Section 6 of the People with Disabilities Act of 2020, sub-section (4), to offer the learner the necessary adapted learning materials. Currently, hi-tech assistive technology equipment and software enhance participation in school activities and promote the use of information assistive devices and technology software for teachers and LWVI (PwDs Act, 2020). The situation in Ugandan secondary schools, including Madera Secondary School for the Blind, seems to indicate reluctance to follow the 2020 Disability Act's recommendations. Thus, while schools appear to be in possession of hi-tech assistive technology for teaching and learning for teachers and LWVI, their utilization at Madera Secondary School for the Blind is still in question.

1.2 Statement of the Problem

Worldwide, hi-tech assistive technologies are used to enhance learning among learners with special educational needs, particularly learners with visual impairment (LWVI). While hi-tech assistive technology is widespread in the world, including Uganda, to help teachers and LWVI overcome challenges they encounter in reading, writing, and numerical manipulation, the majority of teachers and LWVI have not yet utilized it in the most favorable way. In the same way, only 193 out of the 395 computers provided are used regularly, and 202 are found unused. Out of 120 MP3 players, 32 are regularly used and 88 are not in use. Forty Braille embossers were provided, and 11 were used, as 29 were not in use; 154 card readers were supplied annually, and only 42 were regularly used, as 112 were not in use. These technologies are purposely used to promote teaching and lifelong learning. Government and development partners have continued to provide hi-tech assistive technologies to schools. What seems unclear, therefore, is why most of the hi-tech assistive technologies are kept and not optimally utilized by teachers and LWVI. The intention of this study is therefore to explore the utilization of hi-tech assistive technology by teachers and learners with visual impairments at Madera Secondary School for the Blind in Uganda.

1.3 Purpose of the Study

This study explored the utilization of hi-tech assistive technology by teachers and learners with visual impairments at Madera Secondary School for the Blind in Uganda.

1.4 Objectives

This study was guided by the following research objectives:

1. To examine the nature of the available hi-tech assistive technology for teachers and LWVI at Madera Secondary School for the Blind in Uganda.
2. To analyze the perceptions of teachers and LWVI on the use of hi-tech assistive technology at Madera Secondary School for the Blind in Uganda.
3. To find out ways hi-tech assistive technology is utilized by teachers and LWVI at Madera Secondary School for the Blind in Uganda.

1.5 Research Questions

This study was guided by the following research questions:

1. What is the nature of the available hi-tech assistive technology for teachers and LWVI at Madera Secondary School for the Blind in Uganda?
2. What are the perceptions of teachers and LWVI on the use of hi-tech assistive technology at Madera Secondary School for the Blind in Uganda?
3. In what ways is hi-tech assistive technology utilized by teachers and LWVI at Madera Secondary School for the Blind in Uganda?

1.6 Scope of the Study

The scope of this study is divided into three sections: content scope, geographical scope, and time scope.

1.6.1 Content Scope

This study is intended to explore the utilization of hi-tech assistive technology by teachers and LWVI; the nature of the available hi-tech assistive technology for teachers and LWVI; the perceptions of teachers and LWVI on the use of hi-tech assistive technology; and how hi-tech assistive technology is utilized by teachers and LWVI at Madera Secondary School for the Blind in Uganda.

1.6.2 Geographical Scope

This study was carried out at Madera Secondary School for the Blind. The school is located in the eastern region of Uganda. The school was chosen because it had teachers and learners both blind and with low vision conditions; the presence of assistive technologies mainly used by teachers and LWVI; and assistive technology hardware and software preferred for the secondary schools in Uganda.

1.6.3 Time Scope

The study was conducted from April 2022 to February 2024, taking a period of one year and six months, including main corrections.

1.7 Justification of the Study

Given that there is no evidence that a study of this kind has ever been carried out within the stated geographical scope of the study, it is justifiable that the study was carried out in the selected study area.

1.8 Significance of the Study

The results of this study might provide extensive details on the use of hi-tech assistive technologies by teachers and LWVI, as follows:

The Ministry of Education and Sports (MoES) will create a strategy for digital inclusion rules for the purchase of hi-tech assistive technology.

The study will fill the gaps identified in the current policies that are adapted for supporting education for LWVI in Uganda.

The government and its development partners in Uganda will design a strategy to pilot the hi-tech assistive technology devices and software with the users before scaling up the distribution to schools with the goal of enhancing access to LWVI education across the country.

It is a potential strategy to direct the education sector toward the utilization of hi-tech assistive technology by teachers and LWVI across all secondary schools.

The study will help speed up the inclusive education policy approval process, which will give a clear road map for the utilization of assistive technologies in all secondary schools in Uganda.

It will assist in identifying obstacles that prevent schools from utilizing hi-tech assistive technology to improve teachers and LWVI teaching and learning. This will help organizations and implementing partners, such as MoES, schools, NGOs, administration, and teachers in particular, identify the problems that hinder the use of assistive technology in secondary schools.

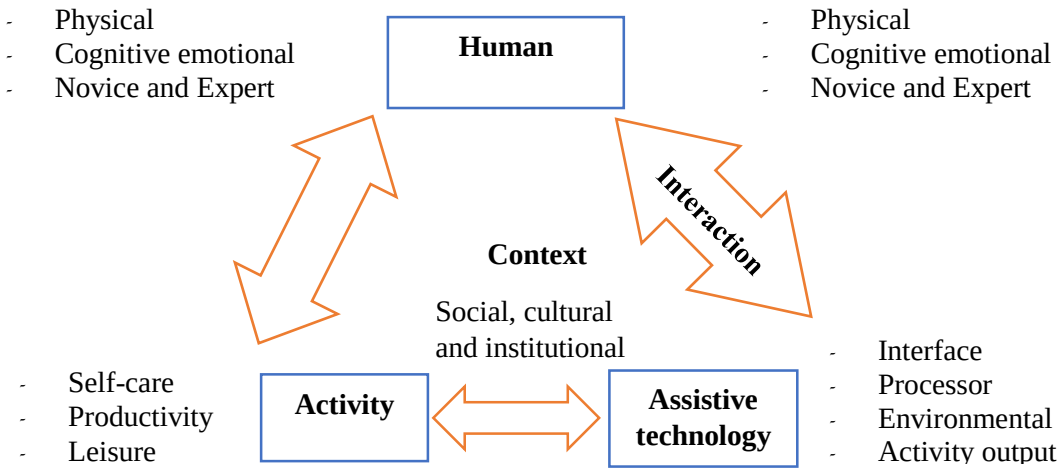
1.9 Theoretical Framework and illustrations based on the HAAT Model

In this study, the HAAT model was used to point out the relationships between the components and the research problem. Thus, the utilization of assistive technology, preferably hi-tech assistive technology, available in the environment or context of secondary schools enhances the interaction and involvement of the human beings, who are the LWVI and their teachers,

with the activities done during the instructional and learning process guided by the operational curriculum.

The model describes the basic aspects that affect the utilization of hi-tech assistive technology, and it has four important components within which none function in separation (Cook & Polgar, 2008). The "human" is the first major element and carries out many intrinsic tasks in the physical, cognitive, and emotional spheres. They exhibit skills and abilities that successively produce an outcome. They possess abilities such as power, teamwork, length of action, stability, and/or other physical attributes. Also display focus, judgment, decision-making, and application. Emotional elements are part of the affective factors. The model aims at developing people's participation, including LWVI, in the three domains of learning, similar to Bloom's taxonomy, which emphasizes the growth and development of an individual's head, hands, and heart.

Figure 1: Theoretical Model and illustrations based on the HAAT Model



Adapted by Cook and Polgar 2008

The second key element is "activity," which refers to self-care, daily living activities, academic, occupational, recreational, and play activities made possible by the use of hi-tech assistive technology. The element is a representation of how humans perform functions and how dominant they are over the individual. LWVI can successfully access materials during the

teaching and learning process through the use of hi-tech assistive technology devices and software. It signifies the practical outcome of human activity and has dominating power over individuals.

The third major component is "assistive technology," which refers to outside enablers like the devices and software used by LWVI and teachers to participate in specific activities where a sensory system can be replaced or enhanced by assistive technology. These include the interface, processor, environment, and activity output.

The "context" or "environment" in which the person lives, including their social, cultural, physical, and institutional contexts, makes up the final major factor. It referred to the location where teaching and learning took place from the viewpoint of the school. Each of the aforementioned factors is crucial to the proper or improper usage of hi-tech assistive technology.

Other people who use the HAAT model are occupational therapists. They state using the human activity assistive technology (HAAT) paradigm as a theory to include assistive technology into their service delivery because it examines how people interact with tasks or activities, assistive technology itself, and other people (Giesbrecht, 2013).

1.9.1 The critique of the HAAT model

It is applied in medical, educational, rehabilitation, social, and recreational practices. However, there are still inadequate practical tests on the model.

The HAAT model cannot adequately work alone without the merger of the human performance model, which provides context as one of the components where teachers and LWVI can operate.

The model does not take into consideration the training procedures for the users of hi-tech assistive technology products, although it aids in the choice of assistive technology for LWVI and teachers

1.9.2 Application of HAAT model in this Study

The HAAT model in the study clearly described the connection between the LWVI and their teachers as humans, who perform most of their activities through the utilization of assistive technology systems. By utilizing assistive technology and software solutions, LWVI are able to live more independently and rely less on other support personnel or caretakers in a secondary school setting.

Shay (2019) suggested that the HAAT model was utilized in describing the context or setting in terms of the physical environment. He or she observes that the physical environment includes homes, schools, and the workplace. Additionally, it was observed that while using the HAAT model in teaching, it is vital to know and consider the academic activities and abilities within which the user is expected to have interaction before designing assistive technology solutions.

The HAAT model in one of the studies showed that utilizing hi-tech assistive technology facilitates play as a foundation to judge overall performance for all other play activities for learners with disabilities (Baxter et al., 2012). In the study, therefore, the context in which play as an activity takes place became a motivational force. This helps when deciding the selection and adjustment of the hi-tech assistive technology devices and activities to be done in consideration of the child's intellectual abilities, motivation, and participation levels in secondary schools in Uganda.

1.9.3 Relevance of the HAAT model

The model linked well with the study in a way that the human, who in this case are the teacher, and the LWVI have to interact with the hi-tech assistive technology devices and software solutions available within the school setting to participate in teaching and learning activities. These increase participation and engagement in learning activities at school in the environment in which LWVI and teachers operate. In the study, mostly common available hi-tech assistive technology resources in the school represented the assistive technology remarked within the HAAT model. These hi-tech assistive technology resources are intended to act as external enablers in supporting LWVI to access syllabi and/or curriculum activities throughout the instructional process. LWVI and/or their teachers need to be knowledgeable and skilled in physical context, cognitive context, social context, and emotional context, during which hi-tech assistive technology resources are used to ease the instructional process. The motivation, adaptation, and utilization of hi-tech assistive technology in the classroom and the school are largely influenced by the teachers' knowledge. This also involves the presentation of information while exploring assistive technology resources for LWVI to extend their learning (Lucky & Achebe, 2012). Therefore, it is important for both teachers and LWVI to be trained intensively and continuously on the utilization of all readily accessible hi-tech assistive technology within the secondary schools, including Madera Secondary School for the Blind.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews prior empirical research studies that are pertinent to the current investigation. The purpose is to locate opinions and research produced by various organizations from across the globe that will allow the researcher to acquire the necessary perceptions for the operational choices related to the current research topic. This will be done in accordance with the subsequent objectives. The study objectives include: To examine the nature of hi-tech assistive technology available for teachers and LWVI; To analyse the perceptions of teachers and LWVI on the use of hi-tech assistive technology: To find out ways hi-tech assistive technology is utilized by teachers and LWVI in Madera secondary school for the Blind in Uganda.

2.1 The Nature of available hi-tech assistive technology for teachers and LWVI

This objective will focus on the nature of available hi-tech assistive technology in secondary schools that makes teachers and LWVI benefit from teaching and learning independently, as discussed below.

For easier accessibility to information by teachers and LWVI in education institutions, use hi-tech electronic and digital assistive technologies, which include a variety of solutions like JAWs, COBRA, Dolphin Guide, Zoom Text & Fusion, Supernova, Audio to Text, DBT, tactile view, and NVDA (Isaila, 2014). Similarly, hi-tech assistive technology software solutions commonly used and of value to teachers and LWVI include, but are not limited to, library information resources (Manduchi, 2012). The examples mentioned by Manduchi are electronic books, simulations, online PDF documents, internet websites, materials on storage media like flash drives and CD ROMs, e-mails, music, WhatsApp, Canva, Google Docs, zoom links,

Google Slides, and Monefy solutions, if made available, that can enhance learning in sub-Saharan African schools, like Madera Secondary School for the Blind in Uganda.

The use of screen readers in India revealed that JAWS was the program that teachers and LWVI used most frequently (Chandra, 2021). The next widely used screen reading program was NVDA (Non-Visual Desktop Access), which had the advantages of being open-source, portable, and simple to use with the USB (Kaulu, 2019). In a different view on the use of JAWS, the study carried out in Ghana revealed a problem with the use of JAWS as hi-tech assistive technology software. The gap identified is that there is always malfunctioning and sometimes sudden failure of the JAWS application when being used, hence retarding progress in teaching and learning. The same study reveals the use of most unlicensed JAWS, which keep disappearing during operational use by teachers and LWVI (Sah, 2013).

The Ministry of Information and Communication Technology listed speech-to-text programs, screen readers, Victor readers, orbit readers, optical character recognition (OCR) programs, and Blaze ET. MoICT also reveals Braille printers and embossers, mobile smart phones, the internet, automated teller machines (ATMs), digital systems like recorders, and Merlin 20 Closed Circuit Television (CCTV) magnifiers for learners with low vision. It also mentions scientific calculators, computers, and laptops with JAWS as working appropriately well for teachers and LWVI in secondary schools (MoICT, 2014).

Some of the most significant hi-tech assistive technology for teachers and LWVI are: software for speech recognition, screen readers, screen magnifiers, software for optical character recognition (OCR), Blaze ET, and text-to-speech (TTS). Also mentioned are oversized monitors, magnifiers with a closed circuit (CCTV), scanners, standalone reading machines, Dictaphones, Duxbury Braille translation software (DBT), braille embossers, refreshable Braille displays, digital books, focus blue Braille displays, omni readers, orbit readers, clear

readers, scientific talking calculators, and Victor Readers, which are used by teachers and LWVI in schools (Odeke, 2021).

Even though the government of Uganda and its partners have continued to fairly distribute hi-tech assistive technology in secondary schools, according to reports from the Ministry of Education and Sports (2015) and the Uganda Communications Commission (UCC, 2015), only 193 of the 395 computers provided have been used regularly, and out of 120 MP3 players, 32 are utilized. Forty Braille embossers were provided, of which 11 are used. Of the 154 card readers supplied, 42 are used by LWVI and teachers during the teaching and learning process (Agabirwe & Kiyingi, 2020).

Teachers and LWVI in several African nations, including Ghana, Kenya, Tanzania, Nigeria, and South Africa, use hi-tech assistive technology available for them to use in schools, and efforts are made by different governments to provide quality working devices to enhance teaching and learning processes. These efforts are at times hindered by financial constraints, which lead to limited or nonexistent budgetary allocations affecting the purchase and distribution of hi-tech assistive technology devices. Pilot projects based on buying different talking software versions, such as JAWS and Dolphin pens, and recycled old computers have been carried out, but still, the number of hi-tech assistive technology devices in schools is very low (Wachiuri, 2015).

The utilization of hi-tech assistive technology is necessary for teaching and learning for LWVI in secondary schools in order to more easily demonstrate their accessible academic programs, which are primarily in English, Literature, History, and Christian Religious Education (Setiawan et al., 2020). They add that the teacher can facilitate easier reading of English-related subjects by employing electronic text in conjunction with the JAWS application and an auditory method. Fansury et al., (2019) point out that using audiobooks as instructional

resources for LWVI in studying English and history may benefit students' learning. Teachers and LWVI made significant use of a variety of resources, including screen reader software like Non-Visual Desktop Access (NVDA). Also, Job Access with Speech (JAWS), clear readers, Victor readers, and CCTV magnifiers to succeed in English, history, and most humanities-related courses were highlighted (Susanto & Nanda, 2018).

Teachers and LWVI should use hi-tech assistive technology when they have access to laptops, computers, and other personal assistive technology devices with operating systems that have well-fixed accessibility features and settings, good processing power, and good storage power. To play audiovisual learning material and totally alter the visual look of texts, processing power is required (Smith & Kelly, 2014).

Furthermore, when hi-tech assistive technology devices are used and have a slow processing speed, it affects the usability of the accessible learning content, the attitude of the users, and keeps them thinking less highly of them (Mansa, 2017). Related to the above, Mansa conducted a study on providing hi-tech assistive technology to teachers and LWVI in Ghana. The study findings showed that teachers and LWVI find it challenging to access relevant information for academic work as most devices in the library are kept. This is because they are broken and have poor power and internet response (Mansa, 2017). Therefore, it is challenging to establish what assistive technology the teachers and LWVI in a given study environment have access to at Madera Secondary School for the Blind in Uganda.

2.2 The Perceptions of Teachers and LWVI on the use of hi-tech assistive technology

This objective will focus on the perceptions of teachers and LWVI on the use of hi-tech assistive technology in secondary schools, as discussed below:

2.2.1 Perception of teachers

Hi-tech assistive technology devices and software can be perceived in this situation to access the curriculum. Many teachers' lives, including those with visual impairments', have changed as a result of hi-tech assistive technology like computers, laptops, and mobile devices (Mulvenna et al., 2017). However, little emphasis has been given to how teachers utilize Hi-tech assistive technology in their teaching in schools, despite major developments in the education system (Williamson-Henriques, 2013).

Hi-tech assistive technology solutions are perceived to require a great deal of effort in order for teachers to access and properly utilize them (Ahmed, 2018). The authors' perception lists several issues, including lack of appropriate teacher preparation and/or training, difficulty obtaining and managing equipment, and time constraints. The author states that with the use of hi-tech assistive technology, some deficit areas are perceived to be improved, such as specialized writing, motor skills, reading, and math skills prepared for learners (Ahmed, 2018).

It is perceived that teachers occasionally show signs of high levels of anxiety when using hi-tech assistive equipment in the classroom, particularly when these gadgets are brand new. The issue is lacking consistency in the utilization of hi-tech assistive technology in the classroom. Teachers are alleged to have inadequate knowledge and expertise on the best ways to utilize hi-tech assistive technology in schools (Shikden, 2015). Teachers' views also revolve around lack of training as a factor in the utilization and potential abandonment of hi-tech assistive technology devices and software. This could be due to support staff not receiving sufficient training on how to operate contemporary Hi-tech assistive technologies (Coleman, 2016).

Generally, it is believed that teachers must be ready to teach LWVI both generalized and device-specific assistive technology skills, depending on the needs of the learners. For teachers to help LWVI fully participate in their schooling, jobs, and daily lives, certain skills are

required. However, if teachers are not prepared and trained in the necessary hi-tech assistive technology, then devices could pose yet another challenge for them to solve issues in teaching. They also point out that teacher of LWVI lack confidence in their capacity to effectively teach and train on the utilization of contemporary assistive technology devices and software as early as 1990. If teachers of the LWVI do not gain this confidence and undergo formal training to enhance their capacities regarding the utilization of hi-tech assistive technology, the learners will continue to receive services that do not meet their needs (Allman & Lewis, 2014).

Further opinions are that teachers of LWVI had poor levels of proficiency with hi-tech assistive technology and lacked confidence when utilizing it to teach their learners (Zhou et al., 2011). Teachers' limited ability to utilize Hi-tech assistive technology is perceived as resulting from less training, which negatively affects LWVI by preventing them from developing their abilities. This eventually leads to less successful outcomes in the secondary education system as far as teaching and learning are concerned (Siu & Morash, 2014). Other studies discovered that hi-tech assistive technology was being improperly utilized with teachers. This was because teachers perceived that technical issues with the tools due to a lack of training on how to utilize hi-tech assistive technology made them fearful, hence hindering full participation in the set teaching and learning programs (Al-Zboon, 2022).

The study conducted by the National Council on Disability in 1993 gives insight that maintenance and repair services for assistive technology, particularly hi-tech equipment for teachers and LWVI, can be a "severe problem" that may restrict functional capacity. It is claimed that an efficient assistive technology system must include prompt maintenance and repair of all available technology products. It should be noted that the repercussions of inadequate facilities for maintenance and repair go beyond how well users can perform different tasks at work. It was also noted that proactive equipment repair can lower the risk of

accidents and injuries caused by defective equipment (Hansen et al., 2014). Similarly, opinions from a study about the accessibility of hi-tech assistive technology revealed that assistive technology services were frequently in short supply and located far from the population in need. This also included the trained personnel required to ensure the proper prescription, fitting, user training, follow-up, maintenance, and repair of assistive devices as lacking (Chadha et al., 2014; Borg et al., 2015; Marino et al., 2015; WHO, 2016).

There are views among teachers that many countries have a shortage of hi-tech assistive technology devices and digital libraries. This shows that because of their low levels of technology and unstable power supplies, emerging nations like Tanzania, Uganda, and Kenya are in a worse condition of utilizing hi-tech assistive technology for teaching and learning in secondary schools (Gallegos., Gould., & Leblois., 2021).

2.2.2 Perception of learners with visual impairment (LWVI)

It is critical that LWVIs have the same opportunities as their classmates to participate in society (Fernández-Batanero et al., 2022). LWVI perceives that the availability of computers, mobile devices, and the Internet would promote independent learning (Smith, Ranie, & Zickuhr, 2011; Dahlstrom & Bichsel, 2014). However, despite equal ownership and use, there may still be technological inequities. For instance, low- and middle-income homes with Internet access are frequently under connected (Hargittai, 2010). This is due to recurrently unpaid monthly subscriptions, slow and faulty hi-tech assistive technology, and shared access, which still provide low significance in their utilization. LWVI find it extremely difficult to integrate hi-tech assistive technology into their lessons whenever computer connectivity is unstable due to poor internet connection (Rideout & Katz., 2016).

In addition, internet connectivity is an important facilitator in accessing electronic resources over a network, but there is a view by LWVI that limited access to hi-tech assistive technology in secondary schools contributes to less or no utilization of hi-tech assistive technology. Identified ideas affecting utilization by LWVI include bad internet connections, lack of understanding of how to connect products on the internet, lack of availability of the internet itself, high costs, lack of experts and technical staff to navigate the available internets, and lack of assistive technology policies (Kelly, 2011; Oira, 2012; Ampratwumet et al., 2016; WHO, 2016; UNESCO, 2019).

Some assistive technologies are perceived by LWVI as working offline or not relying on the internet in low- and middle-income countries. The majority of hi-tech assistive technologies need dependable internet connectivity because they require more intensive processing, for example, image recognition or voice calling (GSMA, 2016). Reliable 4G connectivity is also essential for smart phones, according to LWVI. This is due to the fact that many hi-tech assistive technologies are currently only functional in places with reliable connectivity. It is perceived that a considerable obstacle still exists in many areas in low- and middle-income countries like Uganda (Ampratwum et al., 2016).

The utilization of hi-tech assistive technology in the field of education for LWVI in secondary schools in sub-Saharan Africa has limitations (Lamond & Cunningham, 2020). A number of issues are perceived by LWVI, including limited money, unfavorable attitudes, inadequate evaluation and planning procedures, inadequate training and support for LWVI, difficulties managing equipment, and time-related constraints. Along these lines, numerous studies have emphasized the inadequacy of training among LWVI in the utilization of hi-tech assistive technology solutions that seem to be exact in the area of study (Fernández-Batanero et al., 2022).

The perception of incorporating hi-tech assistive technology into teaching and learning will not only help but also boost the chances for LWVI to achieve their educational goals (Chukwuemeka & Samaila, 2020). A high degree of less utilization and occasionally desertion of hi-tech assistive technology equipment is observed throughout developing countries (Sikhakhane et al., 2021). Various less-utilized hi-tech assistive technologies is maintained on shelves or in cabinets in classroom ICT resource rooms, as observed by LWVI. Therefore, LWVI are using hi-tech assistive technology devices ineffectively, and the potential abandonment of hi-tech assistive technology devices, particularly among LWVI in most African nations, has been attributed to a lack of training (Connor & Beard, 2015).

In a nation like Uganda, the education system is undergoing numerous reforms that encourage inclusive education but may necessitate the utilization of hi-tech assistive technology to ensure that everyone, including LWVI, benefits (Mwantimwa, 2021). Therefore, to ensure that all learners, regardless of their disability, have good learning experiences, hi-tech assistive technology can help them accomplish tasks, offering LWVIs a chance for a bright future, but the challenge is that most of the devices distributed to be utilized in schools are few in number (Hunt, 2021). However, access to advanced assistive technology is still limited for certain LWVIs due to inadequate resources, including budgetary constraints, which prevent LWVIs from fully participating in classroom activities (Watson et al., 2017).

Learners with disabilities, particularly those with visual impairments, have limited access to information and awareness of the benefits of assistive devices (UNESCO, 2019; Ampratwune et al., 2016). Similar findings were found in Kisanga and Kisanga's 2019 UNESCO report, where digital access to information and knowledge for learners with disabilities was found to be limited and unknown about the enormous potential of assistive technology to improve LWVI education. They found that most LWVI lacked the knowledge and expertise necessary

to employ hi-tech assistive technology devices and that there was insufficient funding to support training in this area for learners (Kisanga & Kisanga, 2020).

The physical, human, and technical preparedness of the space designated for hi-tech assistive technology in schools was perceived as inadequate by LWVI (Jugee & Santally, 2016). They claim that across the continent, many secondary schools do not have enough room for computers and other assistive devices. They also lack the infrastructure in place to enable the utilization of hi-tech assistive technology in secondary schools, as they usually do not have teachers who are proficient in using most of the hi-tech assistive technology devices. The utilization of hi-tech assistive technology devices in schools is perceived as hampered by the absence of clean surroundings where laptops or desktops may be handled efficiently to avoid being damaged by dust, debris, heat, or water (Jugee & Santally, 2016). According to the findings, LWVI are unable to utilize available technology devices because of a lack of physical infrastructure, such as labs, during the teaching and learning process.

The policy document sections 12(6) and 15(b) mandate that a minister in charge of communications create regulations outlining the requirements for LWVI to have access to information and distributing a complete set or package for the assistive technology devices given to secondary schools (PwDA, 2020). Additionally, it stipulates that the government must support the use of informational assistive technology devices in accordance with the World Health Organization's 2011 joint position paper, Standard Rules on the Equalization of Opportunities 1993 for Persons with Disabilities, including those with visual impairment. All therefore give guidelines for the production, distribution, service provision, repair/maintenance, and use of hi-tech assistive technology devices according to the same policy documents. It is stated that "making assistive technology available, accessible, affordable, adaptable, acceptable, and of appropriate quality requires efficient use of often

limited resources. Therefore, it is perceived that possible production processes are frequently determined by the materials and labor available. The materials and production processes that can be used are determined by the service delivery systems that are available, notably for repair and maintenance. It is crucial to pick materials and production processes to the greatest extent, provide economical local repair and maintenance, and distribute them to schools in full sets or as a complete package (PwDA, 2020).

Although LWVI utilizes hi-tech assistive technology, there is a feeling that it improves learning for LWVI in the area where the study took place, which still struggles with using computer assistive technology efficiently. There is a perception that 95 percent of LWVI have trouble utilizing Job Access with Speech (JAWS), also known as screen readers, because most secondary schools only access and utilize unlicensed software called Demo JAWS (Ampratwumet et al., 2016).

2.3 Ways hi-tech assistive technology used by teachers and LWVI

This objective will address issues of how hi-tech assistive technology is used by teachers and LWVI in secondary schools, bringing out the process as discussed below:

With the use of hi-tech assistive technology, LWVI can access a wide range of resources for both academic and recreational purposes. Similarly, hi-tech assistive technology, including closed-circuit television, zoom-text and fusion formats, and Blaze ET with OCR, is put on a raised surface, and print reading material, mostly hard copies such as textbooks, past papers, or exams, and pictures are inserted in for enlargement. Most teachers and learners with low vision use it for reading. For others, particularly on smartphones, the app for zoom-text and fusion formats is installed, so the document to be read is opened through the app to be zoomed and fused for teachers and LWVI to use as a tool in teaching. Orbit readers are installed with

the software to type, store, and produce braille work by teachers and LWVI as a tool for teaching by teachers and LWVI. JAWS is installed on computers and smart phones, which gives teachers and LWVI access to all teaching material through downloads to follow the teaching process. This plays a very important role in compensating for the impairment those learners have, hence making teaching real (Hunt, 2021).

In order to improve their reading and writing skills, as well as their ability to type notes to improve communication during the teaching process in most developed countries, LWVI can therefore manipulate such equipment according to their needs to access information. However, the case for the study area has yet to be investigated.

Teachers compose notes for lessons, and then type them on computers or have LWVI type and print notes for them in both braille and large print using hi-tech assistive technology like embossers and computers. For normal lessons, teachers and LWVI keep referring to the information through reading braille, work by touch for blind learners and teachers, or enlarge on CCTV cameras during teaching. Table lamps are arranged in resource rooms where there are no lights to be utilized to provide adequate lighting so that LWVI can read their work through the compensatory devices and software (Wong, 2018). LWVI applies various hi-tech assistive technology tools and applications in a variety of contexts. For instance, in secondary schools in west and south African nations, learners use computers, orbit readers, Victor readers, clear readers, and screen readers for a variety of tasks like re-coding, writing notes during class, reading audio books and notes, listening to, and other contents available in portable document format [PDF] (Mwantimwa, 2021). Therefore, the researcher has yet to explore the condition at Madera Secondary School for the Blind in Uganda in terms of how hi-tech assistive technology is used as a tool in teaching.

Visual displays such as screen readers like JAWS, COMBRA, SUPANOVA, NVDA, and Window's Eye programs are procured and installed on desktops, computers, and radio recording devices to access audio information. This also includes note-takers and tape recorders set up in conducive learning environments by teachers and LWVI for recording and listening to notes, while the internet is considered a vital resource due to its multifunction platform to access online learning resources and/or materials in alternative formats that support their instruction through research, hence making hi-tech assistive technology a tool during teaching (Ok, 2018).

Hi-tech assistive technology provides advantages in teaching, including enabling learners to share learning resources, encouraging collaborative learning, and independent information-seeking by teachers and LWVI for educational reasons, thus promoting research for the learners. Normally, teachers distribute devices and software like orbit readers, Victor readers, and computers with JAWS to LWVI to work independently as a tool for teaching. Although many secondary schools in developing nations would desire independent operations for their teachers and LWVI, there seem to be inadequate resources to use for every learner and teacher. Particularly in Uganda, there is a rare use of hi-tech assistive technology as an educational tool but instead uses it primarily for administrative tasks because of power shutdowns and internet issues (Sikhakhane et al., 2021).

The most significant benefit of hi-tech assistive technology is access to information. Schools are required to arrange the resource rooms and ICT labs to be used for information provision. All assistive technology devices and software, when maintained and repaired, can serve as a tool for teaching for teachers and LWVI in secondary schools. Hi-tech assistive technology can compensate for impairments and improve communication when adequately provided (Rebouillat, 2022). Teachers and LWVI can access textual materials, especially books, using

PowerPoint projection. This is done through teachers sharing the soft copy documents of what they are to teach with LWVI for preparation. Also set the gadgets ready to be used by LWVI, mostly for those with low vision, such as portable electronic magnifiers, CCTV, audio recorders for blind learners for taking notes, zoom text, and fusion software; all of these things increase their reading pace. They can therefore search, retrieve, and access a greater amount of information from various sources in a timely way.

Teachers in the majority of Kenya's Special Needs Secondary Schools note that hi-tech assistive technology enriches instruction in such a way that equips the devices with software and data for the LWVI. This allows teachers and LWVI to download notes, record the teachers' lessons, read the text books in soft copies, and make groups to revise the recorded books, provide online access to learning materials, and orient LWVI into PowerPoint presentations in enlarged formats to improve the teaching of LWVI (Gitari, 2020). As a result, teachers and LWVI must embrace innovative hi-tech assistive technology in an effort to close the gap caused by visual impairment by providing adequate devices and software to the users.

Since music is primarily a visual medium, making the system of music notation accessible to musicians who are blind or visually impaired is a challenge. Basically, Braille music, talking music (which may employ the DAISY standard), and large print music are the three basic types of music LWVI uses with the help of the available hi-tech assistive technology. This can be achieved through teachers providing adequate hi-tech assistive technology to teachers and LWVI to promote teaching and learning in secondary schools. The learner can read music using specialized vision equipment that has different visual display options, such as CCTV magnification (Baker & Green, 2016).

LWVI should have opportunities to access and have physical contact with artifacts and materials as set by the school administration and, where necessary, texts in Braille and use

appropriate hi-tech assistive technology products to participate in all required subjects (Ahabwe, M., 2022). For example, the Lower Secondary Curriculum (LSC) is a competency-based curriculum (CBC) that emphasizes the active participation of learners in the learning process rather than the passive teacher-centered approach that was predominant in the old curriculum. The LSC menu comprises compulsory subjects in S1 and 2 like English, Entrepreneurship, Mathematics, Biology, Chemistry, Physics (or General Science for LWVI), Geography, History, Kiswahili, Physical Education, ICT, Religious Education, and Agriculture. At S.3 and S.4, a learner will be expected to sit in a minimum and maximum of eight and nine subjects, respectively, seven of which are compulsory and one or two electives and the reform will not affect learners at S.5 and S.6. The responsible body should provide softcopies of all the curriculum textbooks to teachers and LWVI for easy access to the copy rights and use available hi-tech assistive technology as a tool for teaching (NCDC, 2018).

In the majority of the studies, it was evident that teachers' ignorance of providing available hi-tech assistive technology had a negative impact on LWVI's use of hi-tech assistive technology devices and software (Smith et al., 2009; D'Andrea, 2009; Wong & Cohen, 2011; Wong & Law, 2016; Morash & Siu, 2016; Ajuwon et al., 2016). This implies that LWVI achievement is negatively impacted by the lack of pre-service training in assistive technology available in secondary schools. The study emphasized the importance of making assistive technology a topical focus in teacher training programs. Although it should be done, teachers and LWVI at secondary schools and higher education institutions continue to have a fundamental need for training on teaching with assistive technology. In order to use hi-tech assistive technology as a tool for teaching, more time and instruction on hi-tech equipment in the training programs should be emphasized.

In Article 4.5.1 of Uganda's ICT Policy 2014, it stated that ‘the sector's sustainability depends on the availability of a strong ICT and assistive technology infrastructure as well as equipment to use in schools or institutions’. The article continues that to use hi-tech assistive technology as a tool in teaching, a complete package of devices should be provided, for example, computers with full system units for teachers and LWVI, including JAWS (Agabirwe & Kiyingi, 2020). Utilizing hi-tech assistive technology devices and software in the creation of new services in schools requires improvement of current operations and the opening of new products as well as solutions. Uganda must create and maintain this infrastructure across all of its educational institutions. The strategies have been arranged to provide policy provisions for implementation as follows:

1. a) Enhance the infrastructure's electrical cable connectivity;

b) Expand the National Backbone Infrastructure (NBI) to the full extent of the nation in order to streamline the manner and pace of service delivery to educational institutions.

d) Implement systems for quality control in infrastructure construction;

e) Encourage Internet service providers (ISPs) to give all schools in the nation, even those in the most rural areas, access to network-based services.

The most widely used screen reader in the world is JAWS, Job Access with Speech (Erwee, 2020). It was created for computer users whose vision impairment prohibits them from seeing screen information or navigating with a mouse. For the most popular computer programs on your personal (PC) or school computer for multipurpose tasks, JAWS provides speech and braille output; therefore, to use JAWS as a tool for teaching, the purchase and installation of licensed JAWS should be done by all nations to promote education for all learners. Teachers and LWVI can use them to read emails, websites, and apps (Setiawan et al., 2020). Also, fill

out web forms easily; view any papers, including PDFs, and scan documents. Utilize the basic instructions in Daisy format, conserve time with Scan Reading and Text Analyzer, and browse the internet with web browsing inputs. Teachers help LWVI understand English by using an auditory approach and electronic material about the JAWS application (Fansury et al., 2019). Audiobooks as instructional resources for teachers and LWVI who are learning English may be provided to aid in the learning process if hi-tech assistive technology has to be used as a tool for the teaching and learning process (Susanto & Nanda, 2018). LWVI heavily relies on a variety of tools, including screen reader software like Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS), for learning English. LWVI who need to be taught using certain methodologies are typically given Braille books and auditory resources. Thus, in order to acquire secondary education level, teachers and LWVI mostly employ JAWS in the teaching and learning process (Hesti & Riski, 2017).

According to the World Health Organization (2017), the unsatisfied need for piloting hi-tech assistive technology devices for LWVI and other people with disabilities is greater in less resourced settings, such as Africa, because of individual and national poverty, environmental barriers, poor procurement systems, a lack of support services, a shortage of service providers, and insufficient training of the service providers on the piloting of the available hi-tech assistive technology before production of the devices for the teachers and LWVI.

There are seven key areas that must be addressed before providing assistive devices to users, in this case LWVI and teachers in secondary schools: assessment, procurement, technology, environment, usability, sustainability, and realization of rights around the central hub of policy (Khasnabis et al., 2015).

A significant portion of assistive devices in Africa are obtained from outside sources and are frequently of substandard quality. It is not appropriate for user needs and environmental

requirements due to insufficient pilot systems. It is therefore necessary to pilot the hi-tech assistive technology devices and software solutions so as to use them as a tool for teaching by teachers and LWVI (Gould et al., 2015). It should be noted that in areas where support services are limited, undesirable results include worsened functional and community integration, user injury, secondary problems, device breakdown, insufficient access to power, and a lack of internet connection.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This study was about the utilization of hi-tech assistive technology by teachers and learners with visual impairments at Madera Secondary School for the Blind in Uganda. The objectives that guided this study include: to examine the nature of the available hi-tech assistive technology for teachers and LWVI; to analyze the perceptions of teachers and LWVI on the use of hi-tech assistive technology; and to find out ways hi-tech assistive technology is utilized by teachers and LWVI at Madera Secondary School for the Blind in Uganda.

In this chapter, the research approach, design, study area, target population, sample and sampling procedure, research methods and instruments, data collection, data analysis, ethical considerations, limitations, and delimitations of the study are highlighted.

3.1 Research Approach

The qualitative research approach was utilized in this study. The approach is a method of investigation for comprehending a social or human issue. It is centered on creating an intricate, comprehensive image with words, reporting the opinions of participants, and taking place in a setting that is real (Creswell & Creswell, 2017). The importance of the qualitative research approach in this study was to provide an elaborate explanation of issues that numbers alone are unable to show. The natural setting in this study was the secondary school where LWVI is studying.

3.2 Research Design

The utilization of hi-tech assistive technology by teachers and LWVI in secondary schools was explored. This study used a case study design. A case study is a comprehensive, thorough

assessment of one person, group, community, or institution during which the researcher looks at extensive data pertaining to a number of different variables (Yin, 2018). A case study is defined as a qualitative research arrangement in which the researcher examines a real, contemporary, constrained system over time by collecting substantial data. The case study design in this study was considered ideal because it enabled an understanding of difficult situations within their natural contexts. It gives an update on LWVI's utilization of hi-tech assistive technology in secondary schools. It is useful to understand the perspective of participants in their environments since it may be used to create new theories or build upon current ones, criticize common beliefs, and carry out pilot research (Creswell, 2016).

3.3 Study Area

This study was conducted at Madera Secondary School for the Blind in Uganda. The school was chosen because it is an identified government-aided institution with teachers and LWVI. The government and partners have distributed a variety of hi-tech assistive technology in the school. It is a special school with teachers and LWVI as the users of hi-tech assistive devices and software.

3.4 Study Population

Population is defined as the set of all elements through which the samples are drawn (Bryman, 2016). Population means basically all items in the category of things that are being studied (Denscombe, 2017). The target population for this study was comprised of teachers and learners with visual impairments. The LWVIs were 102, with a total of 18 teachers in the school from which the sample was drawn.

3.5 Sample Size

In this study, a sample of eight (8) participants that included four (4) teachers and four (4) LWVI involved in teaching and learning at Madera Secondary School for the Blind was chosen.

The four (4) teachers were chosen because they were directly involved in facilitating the teaching process, used hi-tech assistive technology devices and software, had specialized skills and knowledge to teach LWVI, and some were responsible for the ICT resource room. The four (4) LWVI were chosen because they were in the candidate class with the necessary information to answer the research questions; some were blind while others had low vision, and they were the primary users of hi-tech assistive technology with classroom experience at Madera Secondary School for the Blind. 'A' level candidates were considered participants for this study because all other learners with visual impairments in 'O' level had left school for end-of-year holidays. Eight candidates had registered for UACE examinations, seven boys and one girl was presently participating in their A-level examinations.

A sample is a collection of persons, things, and/or objects selected from an oversized community for assessment (Bryman, 2016). The core element of sampling is that valid results can be obtained without necessitating data collection from the entire target population (Denscombe, 2017).

Table 1: Sample of study participants

SN	Category	Target population	Sample size	Degree of disability	Sample Technique
1	Teachers	18	4	2 Trs completely blind	Purposive sampling
				2 Trs with low vision	
2	LWVI	102	4	2 LWVI completely Blind	Purposive sampling
				2 LWVI with Low vision	
TOTAL		**120**	**08**		Purposive sampling

3.6 Sampling technique

The study used a purposive sampling technique in selecting the teachers and LWVI as participants. Purposive sampling is based on the idea that by concentrating on a fairly small

number of cases carefully chosen on the basis of their known characteristics, the researcher can obtain the most accurate information (Denscombe, 2017). Purposive sampling involves ‘‘hand-picking’’ the sample for the study based on their relevance and prior knowledge or experience about the study area. The sampling technique was ideal because it attempted to pick out participants based on certain qualities or standards (Creswell & Creswell, 2017).

The criteria used to select teachers were centered on five premises, including: information, communication, and technology (ICT) knowledge; hi-tech assistive technology used; ability to facilitate the LWVI in teaching and learning; being in charge of the resource room where most of the hi-tech assistive technology devices are kept; and being experienced teachers in the utilization of hi-tech assistive technology. For LWVI, the criteria of their selection were based on the level of vision loss, that is, being completely blind, and those with low vision, respective of gender, class level in this case, and considered ‘A’ level registered candidates and the knowledge to use hi-tech assistive technology. All the sampled participants met the criteria set above. At least two learners with blindness and two with low vision participated in this study, and this was applicable to the teachers selected.

3.7 Methods of data collection

In a qualitative research approach, many methods of collecting data are applied. These include interviews, document analysis, observation, archival records, and focus group discussions (Bryman, 2016). There are three core approaches, including interviews, focus group discussions, and observation, which provide researchers with rich and deep understandings (Bryman, 2016). In this study, semi-structured interviews and direct observations were used to collect data. Semi-structured interviews and direct observations gave the most precise information regarding the utilization of hi-tech assistive technology by teachers and LWVI in the area where the study took place.

3.7.1 Interviews

Interviews are an attractive idea for project researchers. There is consent to take part, the words of the participants may be written or recorded, and the researcher establishes the discussion's agenda (Denscombe, 2017). The idea of an interview is a dialogue that often takes place face-to-face involving a researcher and a participant, which includes data transfer to the researcher (Creswell, 2016). He suggested various kinds of interviews, such as one-on-one conversations with only one participant. It is useful for interviewing talkative interview participants since interviews are essentially qualitative. Creswell (2016) advises that interviewers should just ask open-ended questions.

The researcher has a defined list of topics to cover and questions to ask when conducting semi-structured interviews (Bell & Waters, 2018). In a semi-structured interview, the researcher is willing to be flexible about the sequence in which the topics are discussed and, probably more importantly, to allow the participant to express their thoughts in greater detail and develop their views. The questions are open-ended, and the participant is encouraged to elaborate on any topics of interest (Denscombe, 2017).

In this study, data was obtained through the use of a semi-structured interview that took four days to finish, as each interview took between 30 and 40 minutes during free time after attending the UACE paper and on free days without the exams. The researcher used an open-ended interview guide to give participants the opportunity to express their views and opinions in relation to the study. Three interview instruments were developed, including an interview guide for teachers and an interview guide for LWVI used by the researcher. The researcher conducted the interview with senior (S. 6) candidates in the free classroom, always used by senior ones who had already closed for holidays. Therefore, the researcher interviewed the participants one after the other to maintain the confidentiality as explained on the consent form. The interview questions were designed according to the three main themes: the nature of the

available hi-tech assistive technology for teachers and LWVI; the perceptions of teachers and LWVI on the use of hi-tech assistive technology; and how hi-tech assistive technology is utilized by teachers and LWVI in the school where the study took place in Uganda. The interview method was considered because it explored the views, experiences, and beliefs of teachers and LWVI using hi-tech assistive technology devices and software.

3.7.2 Observation

Observing is the process of acquiring free, very first data through watching people, items, and settings (Creswell & Poth, 2016). Without depending just on participant opinions, the researcher quickly observed the condition of the hi-tech assistive technology equipment and software available and the status of their use in the school. The purpose of observation is to present accurate data. Observation entails employing one's senses, particularly seeing and listening in a systematic and meaningful manner in the natural context, to allow the researcher to watch, interact with, and gain a rich picture of participants' actions. The researcher also used unstructured observation, where direct observation of the hi-tech assistive technology was done, and took notes to be used in developing the study findings. The researcher used a non-participant observation where data was mostly collected without interfering with the participants but observed the hi-tech assistive technology in existence.

3.8. Pilot Study

A pilot study is a short research study created to test several components of the procedures intended for a larger confirmation study (Lowe, 2019). Majorly, the purpose of the pilot study is to prevent researchers from starting a large-scale exploration without sufficient understanding of the specified research methods (Polit & Beck, 2017). Pre-test and pilot are often used interchangeably, but there is one critical difference between the two. In a pre-test, you only test one or a few components of the research study on a small fraction of your intended sample size, whereas during a pilot, you conduct the research study in its entirety but on a

smaller sample size. Therefore, in this study, a pilot study was carried out in another secondary school with a comparable learning environment for LWVI in central Uganda to establish the accuracy of the majority of the study methods, instruments and determine their appropriateness in gathering data. The result from the pilot study indicated few grammatical errors in the study tools and the qualitative methods were adequate for this study. Teachers had inadequate formal training, and the hi-tech assistive technology devices available were very few to use during the teaching and learning process in the school for LWVI and teachers. A suitable review of the questions in the research tool was made to enable the researcher to gain the credibility and trustworthiness of data for the large-scale study.

3.9 Data Collection Procedures

Before embarking on the study, the researcher sought:

- Approval of the research proposal by the supervisors as well as the department of Special Needs Studies (SNS) at Kyambogo University.
- The researcher got permission to conduct the study from the head of department, within which an introductory letter was given.
- The researcher then asked the school administration for permission to meet and establish rapport with the participants to identify their expectations.
- After receiving permission, the researcher personally wrote a letter requesting participants' consent and cooperation in providing the information sought.
- Interview tools were developed, and interviews were arranged and conducted with each participant.
- During the interview, the discussion was audio-recorded, and notes were taken by the researcher. The researcher also informally observed a lesson in class and saw available hi-tech assistive technology in the resource room.

3.10 Data Analysis

The raw data was transcribed from the audio records into text; themes were developed, and the data was categorized under those themes and research objectives and research questions as analyzed in Chapter four.

The transcribed data from the semi-structured interviews and observations was checked and subjected to inductive thematic data analysis to identify patterns, categories, and themes. An inductive data analysis involves careful reading of the data to ensure that all significant components of the data are fixed as well as to acquire a comprehensive understanding of what is said by the participants (Azungah, 2018). Therefore, the researcher carefully studied and coded the data in sections or paragraphs in line with the research objectives and/or questions. The research objectives and questions were used to determine the major emerging issues and themes.

Thematic analysis techniques for assessing qualitative data entailed exploring through knowledge to identify, classify, and describe recurring patterns and incorporating analysis through the selection of codes and the formulation of themes as discussed in Chapter four (Clarke & Braun, 2017). In this study, reporting information was important because it supported the taste of the initial data and assessed the researchers' views on the responses from participants, as supported by the literature reviewed in Chapter two, while codes have been used in this study to guard the identity of participants where verbatim statements from the participants were applied (Creswell & Poth, 2016). The codes used are Tr1, Tr2, Tr3, and Tr4 for teachers and LWVI 1, LWVI 2, LWVI 3, and LWVI 4 for learners with visual impairment.

3.11 Ethical Considerations

When gathering data from participants, the researcher followed the set rules to help safeguard study participants' rights, improve research relevance, and uphold systematic authenticity (Bryman, 2016).

For purposes of promoting credibility and authenticity, research moral considerations were observed in every phase of the research study. It was done by putting a specific emphasis on consent and confidentiality of data for purposes of protecting the participants' image and secrecy (Coleman, 2022). Ethically, potential participants were informed about the study's purpose, duration, and how the data collected would be used and coded. The researcher obtained participant consent and pledged confidentiality, ensuring their safety and trust.

3.12 Credibility and Authenticity

Credibility and authenticity are the accuracy or integrity of an outline, decision, clarification, understanding, or other kind of account during which the application and correctness of the approaches undertaken are true (Denscombe, 2017). He observed that credibility and authenticity provide final decisions that evaluate the inquiries to see their genuineness and correctness and make the study meaningful (Denscombe, 2017). To confirm the accuracy and trustworthiness of this study finding, instruments were designed, discussed, and confirmed by the supervisors for pretesting.

Triangulation is the process of looking at something from many angles. This could imply utilizing various techniques, data sources, or even diverse researchers in the study (Bryman, 2016). The triangulation of data collection methods in this study involved semi-structured interviews and informal observations. This helped to determine the accuracy of the data and the actual descriptions of the participants (Denscombe, 2017). The data was presented within the data analysis as a validation of what occurred in the field following the verbatim statements

from the participants as mentioned by Tr1, Tr2, Tr3, Tr4, LWVI 1, LWVI 2, LWVI 3, and LWVI 4.

3.13 Limitations of the study

During this study, the researcher encountered some limitations, and some of these are: the inability to find all students at school; this made the researcher study on only 'A' level learners. Despite the fact that the study was conducted during business hours for examinations, the researcher still had a difficult time scheduling participants because most of them were taking UACE National Examinations. The interview was deemed a disruption of one's work schedule, especially when they had to get ready for the next paper. The views from 'O' level students were not explored as learners with visual impairments at the 'O' level had closed for their end of year holidays.

Some participants were not willing to sign the consent form as they needed some payments before they could do so. This affected the study as it became expensive to acquire data from the participants. The study used only qualitative research approach. More study approaches such as mixed methods would have given different picture in the findings while using aspects like graphs and pi-charts to analyze data.

3.14 Delimitations of the study

The researcher patiently sought out participants' attention and audience and established a rapport with them, emphasizing to them the significance of their responses and the importance of setting aside time to participate.

In tight schedules, the researcher sought appointments with the respective participants, and the majority of interviews were conducted during lunch time.

The researcher had to convince participants by using titles and ensuring confidentiality for any information they gave.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

The purpose of the study was to explore the utilization of hi-tech assistive technology by teachers and learners with visual impairments at Madera Secondary School for the Blind in Uganda. Specifically, the following objectives guided the choice of research approach, study participants, and data collection methods: to examine the nature of the available hi-tech assistive technology for teachers and LWVI at Madera Secondary School for the Blind in Uganda; to analyze the perceptions of teachers and LWVI on the use of hi-tech assistive technology at Madera Secondary School for the Blind in Uganda; and to find out ways hi-tech assistive technology is utilized by the teachers and LWVI at Madera Secondary School for the Blind in Uganda.

In this chapter, the findings are presented, interpreted, and discussed under the relevant research objectives. For purposes of clarity, the presentation is structured into two sections, 'A' and 'B'. Section 'A' presents participants' characteristics, while Section **'**B' presents interpretation and discussion of the findings.

While presenting data, the verbatim of participants was provided as supporting data. In each segment, data is presented, interpreted, and discussed with reference to the literature review.

For the purpose of maintaining anonymity and confidentiality, the abbreviations 'Tr**'** and 'LWVI', respectively, refer to teacher participants and learner participants.

4.2 Section A: Participants' characteristics

The study targeted the teachers and LWVIs at Madera Secondary School for the Blind in Uganda. The total sample size of participants anticipated was 8, comprising 4 teachers and 4 LWVI, respectively. All participants sampled were interviewed as planned.

More details are shown in the table below.

Table 2: Demographic characteristics of the participants

Category	Gender		Degree of disability for Teachers & LWVI	Average age for participants	Total
	Male	Female			
Teachers	2	2	2 Trs completely blind	35 years	04
			2 Trs with low vision		
LWVI	3	1	2 LWVI completely Blind	18 years	04
			2 LWVI with Low vision		
Total	05	03			08

Source: Primary Data 2023

4.2.1 Teachers

This study targeted teachers who had spent some time with LWVI, both inside and outside classroom activities. Individual characteristics of the participants are presented below:

Tr1 is a male teacher with a Bachelor of Arts in Education majoring in RE with ICT and has 5 years of experience teaching LWVI at Madera Secondary School for the Blind. He teaches ICT from senior one to senior six. He also heads the ICT department. He has basic training in the use of most assistive technology in the school.

Tr2 is a female teacher who holds a Bachelor of Arts in Education and has taught LWVI for 13 years at this secondary school. She teaches Christian Religious Education and Physical Education (PE) at both ‘O’ and ‘A’ levels. Due to the new lower secondary curriculum, she found PE for LWVI very difficult to teach.

Tr3 is a female teacher and holds a Bachelor of Arts with Education with an experience of 20 years teaching LWVI in this secondary school. She teaches history and Christian religious education for both ‘O’ and ‘A’ level students. She is in charge of guidance and counseling at the school. She teaches S.5 and S.6.

Tr4 is a male teacher, a holder of a Bachelor of Arts with Education, and has taught LWVI in this secondary school for 20 years. He trained to teach geography and mathematics, but currently he teaches mathematics at the ‘O’ level in this secondary school.

4.2.2 Learners with Visual Impairment (LWVI)

The study targeted LWVI, both those with low vision and the blind, who utilize hi-tech assistive technology during teaching and learning in ‘A’ level classes. The learners were selected from ‘A’ level because their counterparts in ‘O’ level had left for holidays after their end-of-year examination. Only ‘A’ level students were in the school doing their UACE end-of-year national examinations. The school had seven LWVI registered, six males and one female. At least four (4) learners were completely blind, and three (3) of the seven learners registered had low vision.

LWVI 1 is a female student in senior six offering a history, economics, and literature (HEL) combination. She is from Busia and completely blind. She is registered to participate in the UACE examination in 2023 at Madera Secondary School for the Blind.

LWVI 2 is a male student in senior six, offering history, economics, and literature. He is a student with low vision who registered for the UACE 2023 examinations at Madera Secondary School for the Blind. He is a resident of Kitgum District.

LWVI 3 is a male student in senior six, offering history, economics, and divinity (HED). He is a student with low vision from Tororo. He is registered for the UACE 2023 examinations at Madera Secondary School for the Blind.

LWVI 4 is a male student in senior six, offering history, economics, and entrepreneurship. He is a student completely blind from Bugiri district. He is registered for the UACE 2023 examinations at Madera Secondary School for the Blind.

4.3 Section B: Data Presentation, Analysis and Interpretation of the findings

This section presents and discusses the data collected thematically, following the research objectives of the study.

4.3.1 The nature of hi-tech assistive technology available for LWVI and teachers

The first research question aimed at finding out the hi-tech assistive technology available for teachers and LWVI at Madera Secondary School for the Blind. The data was collected through interviews and observation guides. The raw data was interpreted and discussed. Data were presented under the following themes: hi-tech assistive technology resources available, status of hi-tech assistive technology, hi-tech assistive technology software, and subjects that are enhanced by the use of hi-tech assistive technology, as shown in table 3 below.

Table 3: The nature of the available hi-tech assistive technology for LWVI and teachers

Hi-tech assistive technology available for teachers and LWVI
Computer desktops are used by both learners and teachers who are blind and those with low vision in the school of study.
Victor readers are used by learners and teachers who are blind.
Orbit 20 readers are used by learners and teachers who are blind.
Clear readers for both blind and low-vision are used.
Closed-circuit television (CCTV) magnifiers for low vision.
Blaze ET for learners who are blind.
Laptops are used by learners and teachers who are blind and have low vision.
Omni readers are used by learners and teachers who are blind.
Optelec readers are used by learners and teachers who are blind.
Focus blue Braille displays are used by learners and teachers who are blind.
A talking scientific calculator is used by learners and teachers who are blind or have low vision.
Status of hi-tech assistive technology available
Good working condition, but few in number.
Not working well.
Still kept.
Some are in good working condition, while others are still kept.
Hi-tech assistive technology software used in teaching LWVI
Job Access with Speech (JAWS) is used by learners and teachers who are blind or have low vision.
NVDA is used by learners and teachers who are blind or have low vision.
DBT is used by both learners and teachers who are blind and have low vision.
OCR is used by both learners and teachers who are blind and those with low vision.
Subjects that use hi-tech assistive technology to enhance teaching and learning.
Literature.
English.
Christian religious education.
Divinity.
History.
Information, communication, and technology (ICT).
Mathematics.

Source: Primary Data 2023

4.3.2 Hi-tech assistive technology resources available

When participants were asked about the hi-tech assistive technologies available for use by teachers and LWVI at the school, participants (N = 8) responded that at Madera Secondary

School for the Blind, most hi-tech assistive technology devices such as computers, desktops, Victor readers, orbit 20 readers, clear readers, closed circuit television (CCTV) magnifiers, Blaze ET, laptops, omni readers, Optelec readers, and focus blue Braille displays were available. They also said that the school has a talking scientific calculator, which is currently in the head teachers' office. One of the participants said this:

> In this school, we have computers; we have assistive devices like Victor readers and an Omni reader. There is also the Blaze ET using optical character recognition (OCR) software; we have the Focus Blue Braille display; the Orbit 20 readers; and the Braille embosser, which is in the secretary's office (Tr 1).

Another participant said:

> For us here in this school, the available ones are the computers which are like fifteen, although they are not enough, we also have victor readers which are distributed in each class having two per class of which they are not also enough because we are many who need to use them ... yeah. There are also orbit 20 readers which have been introduced to the lower classes that are from senior one up to senior three and it is supposed to be for all of us but since they are not enough other classes do not use them. Then we also have a CCTV magnifier in the library that helps to enlarge letters for the print readers. There is also a clear reader that assists us in photographing if you want to read something in print, you go and put that clear reader to scan the document into software then after it reads and they are only two in this school (LWVI 1)

Similarly, one of the participants said:

> Okay thank you, currently we have a number of them like victor reader are three (3) available for the whole school, we have ten (10) laptops, we also have desktops currently working and are twenty (20) …yeah, we use for learning. UCC gave us forty (40) desktops but because of lack of space here and some do not have the system unit so we have not installed all of them... yeah and only 20 are accessed by both LWVI and the teachers as we wait for space with time. We have also what we call Optelec reader is different from an orbit reader and it is used for photographing the text materials then it reads for the user. Then we have a clear reader this one is used by learners with low vision, it is either one or two but not many so we are using them in the library it helps to enlarge words and makes learners with low vision read well. We have the orbit 20 readers we have received about one hundred and

> one (101), at first, we got forty (40) then secondly again we were given about… roughly sixty-one (61), as we talk some have broken down as LWVI keep reporting. We have also received one talking scientific calculator just recently we have not yet started using it and are told it cost 1.8 million Uganda shillings. Then we have also a computer they have installed software Non-Visual Desktop Access (NVDA) which will help us to handle issues of mathematics when it means drawing diagrams. I think so far that's what I have (Tr 4).

Similarly, views were mentioned by Tr2, Tr 3, LWVI 2, LWVI 3, and LWVI 4. They also mentioned that computers, Victor readers, orbit 20 readers, clear readers, CCTV magnifiers, Blaze ET, Omni readers, Braille embossers, laptops, focus blue Braille displays, and talking scientific calculators are among the high-tech assistive technologies used by LWVI and teachers at school.

The researcher also observed that the hi-tech assistive technologies available in the resource room were 40 computer terminals with four system units. Twenty (20) computer desktops are displayed in the resource room and are being used with adapted Job Access with Speech (JAWS). These were brought at Madera secondary school for the Blind by Uganda Communication Commission (UCC), Ministry of education and sports and AWSIP(all we see is possibility), three (3) CCTV magnifiers were seen available in the resource room, two (2) clear readers were observed being used by mostly LWVI, one Blaze ET was seen in the head teachers' office, five (5) victor readers are assigned one per class from S2 to S6, one pal Scanner available in the school, five (5) digital LCD talking calculators used during mathematics lessons for 'O' level learners, two (2) Braille embosser found in the secretaries' office , 102 orbit 20 readers where 72 were with LWVI but from S1 to S3 and 30 kept for the reasons the school knows best. The researcher also saw one talking scientific calculator well-kept and 36 computer terminals without system units. The school did not have digital recorders, I-Loview HD7, telescopes, Orbit Reader 40, or smart Braille machines.

The above findings reveal that teachers and LWVI have access to most of the hi-tech assistive technologies available in the school. These hi-tech assistive technology devices like computers with JAWS help LWVI and teachers access the information; Victor readers store recorded books and stories for LWVI and teachers to keep referring to whenever needed; and CCTV magnifiers help to enlarge the print document to be read by learners with low vision.

The findings clearly indicate that government and development partners play a significant role in distributing hi-tech assistive technology devices to secondary schools. The evidence of the distribution and supply of hi-tech assistive technology in this study included the availability of computers, Victor readers, orbit 20 readers, clear readers, CCTV magnifiers, Blaze ET with OCR software, Braille embossers, Focus Blue Braille Display, talking scientific calculators, and software like JAWS and NVDA.

The findings are related to the HAAT model when compared with its third component, called assistive technology, which refers to outside enablers like the tools and/or devices used by LWVI and teachers to participate in very specific activities where a sensory system can be replaced or enhanced by assistive technology. This includes the interface, processor, environment, and activity output. With the above hi-tech assistive technology, LWVI can work independently with the devices without the help of external support to access the information needed. The devices available process information and give the result to the users in the form of a voice or sound response to LWVI in a normal working school situation based on the assignments or activities given by the teachers at school; hence, the use of hi-tech assistive technology by LWVI increases the learning output, thus realizing learning achievement.

4.3.3 Status of hi-tech assistive technology

Participants were asked to describe the condition in which the hi-tech assistive technology was; their responses highlighted three emerging issues: good working condition but few, not

working well, and still kept. In response to the above emerging issues, participants (N = 4) responded that the school of study has some hi-tech assistive technologies in good working condition but few in number compared to the teachers and LWVI in the school. One of the participants said:

> Currently, some are in good working conditions though not all that we have works well but the challenge is they are not enough like you can imagine having one Omni reader for the whole school, five victor readers only here, there is one scientific calculator but just one to serve the whole school of at least 102 learners and 18 teachers you can see, so they are there working but few according to the available number of users in this school (Tr 1).

Another participant had this to say:

> Some are in good condition yeah but the clear readers' challenge comes in charging because there are few. There are only two clear readers so you have to wait for others to use yeah…. also lacking the headsets on these computers though they work well but make noise Um, there are some other computers which cannot give JAWS even if it is installed you find that it, fails to bring out JAWS so some working well while others not yeah… (LWVI 3)

A similar opinion was mentioned by LWVI 4 and Tr 4**.** They asserted that some hi-tech assistive technology was in good working condition but was very few in number to be used by all the LWVI and the teachers in the school.

On site observation of the resource room, the researcher saw 40 computer terminals but only four (4) system units. That means that only four computer terminals can be connected with the available four system units for LWVI to work independently, which gives evidence that they are few and may delay the learning process as most of the LWVI do line up to get access to the adapted computers with JAWS. The resource room had one central server that accommodated an additional 16 computer terminals, making a total of 20 desk tops out of the 40 that were distributed in this secondary school, implying that though they are in good working condition,

they are still few compared to the 102 LWVI and 18 teachers in the school. The researcher also saw one (1) CCTV magnifier working well, two clear readers, five (5) Victor readers, 72 orbit readers, and six (6) laptops. By analyzing the above views of the participants, it was evident that some hi-tech assistive technology was in good working condition but very few to accommodate all the LWVI and the teachers.

The findings above give the impression that the hi-tech assistive technology available in the school promotes quick access to information by teachers and LWVI, but the dilemma appears when all the LWVI have to use the same devices for different lessons and in different classes. The hi-tech assistive technology devices are available but limited which drags the work and delays the completion of the curriculum during teaching and learning.

On the other hand, participants (N = 3) said that they are in good working condition and mentioned that the school of study has some hi-tech assistive technology that is not working well. For example, one participant stated that:

> It is the orbit reader which is currently having the problem, because it is recently introduced to our school but I don't know whether it is really the charging which makes it fail to work, we are already having the problem with some orbit reader which is spoilt and we have not yet got the spare parts to put them right. Ahh… also the problem with that very orbit reader is sometimes failure to charge on time. With the laptops the problem we have is the lack of headsets we have some friends who came from America and labeled all the keyboards with braille but unfortunately, most of our computers and desktops do not have those braille labels on them that is also one problem we have with them. JAWS software inserted in the computers produce a lot of noise, everybody will be struggling to type but if we could have the headsets, it would limit it to yourself, it will not be going out of your listening to other persons' ears; it will be confined to you alone. The CCTV color makes eyes to pain (Tr 3)

Participant (LWVI 3) also, when contacted on the same issue, reported that:

> Okay, like some victor readers cannot record, yes, can't record like others actually maybe have an error from the factory yeah…. Mmm… when you press the recording button, it'll tell you that they start recording but when you keep like recording and then when you want to listen recorded work, you will find nothing is there. Computers actually have challenges with JAWS which are for demo and short leaved and disappear after 40 minutes of use. So now the challenge there is that actually the reading accent also becomes a challenge. Mmm... Yes. When reading it is difficult to understand as far as the context is concerned. The CCTV Magnifiers some colours are not favourable for some LWVI so it disturbs the sight.

The views mentioned by LWVI 1 on the condition of hi-tech assistive technology available in the school were similar to those of the above two participants and confirmed that some hi-tech assistive technology devices and software were not in good working condition.

When the researcher observed the available hi-tech assistive technology in the resource room and the head teachers' office, he confirmed that three (3) CCTV magnifiers and two (2) laptops were damaged and not in good condition. There was one pal scanner, but spoilt and two Braille embossers were found in the secretaries' office, not in use. 102 orbit readers were available in the resource room, but 30 out of the rest were declared not working well as having been mishandled by the LWVI, most especially from lower secondary. The 20 working desk tops and the 10 laptops did not have licensed JAWS but had demo JAWS, which kept disappearing during the time LWVI and teachers had to use them. The researcher also observed that out of 40 computer terminals given to the school by the Uganda Communication Commission (UCC), only four (4) had the system unit (central processing unit) with external butteries, and they were working well. 36 computer terminals did not have the system unit, so they were not being used frequently as they had to create at least one central server before using the desktops available in the school.

The findings above revealed that LWVI and teachers were not using most of the hi-tech assistive technologies available in school efficiently to simplify the teaching and learning

process, and the situation was attributed to issues such as insufficient system units for the computer terminals, a lack of licensed JAWS to be used, and rampant breakdowns created on the hi-tech assistive technology devices and software available in this school. These result from inadequate commitment from the school administration and inadequate monitoring and assessment of the hi-tech assistive technology devices from the suppliers to the school entities, as some hi-tech assistive technology comes into use with factory errors. However, given the condition described in the above findings, it is contrary to the HAAT model. Consequently, inadequate access to the available hi-tech assistive technology in the school affected the planned school activities performed by teachers and LWVI, where self-care, daily living activities, academic, occupational, recreation, and/or play activities may not be fulfilled as required by the HAAT model. LWVI can successfully access materials during the teaching process if the hi-tech assistive technology devices and software are working well, but with disappearing JAWS, noise made without headsets, and a limited number of hi-tech assistive technologies, it is impossible for LWVI to excel like their counterparts with sight.

On the contrary, participants (N = 2) responded that other hi-tech assistive technologies available in this school are still kept. One participant said:

> Some technology devices herein the school are still kept due to inadequate space at the resource room. The issue with orbit readers that not everyone has picked up seriously on the use of them but most of the learners have the orbit readers most especially the lower secondary section as well as others are kept. Actually, we have others like the magnifiers like three in number but one is the library being used by almost all learners with low vision as the other two are kept I had that they got spoilt and their colours affect the LWVI so they have been not repaired. Also, the school has one scientific talking calculator kept in the head teachers' office and we have not used it since they brought it in this school. There was also an embosser which was in a big box but I do not know where they put it so I only see one which we use and in the secretary's office where by one other is still kept either in the head teachers' office or resource room but we generally have one which is working now (Tr 2).

Similarly, participant LWVI 1 agreed with the statement that other hi-tech assistive technology devices are still kept and mentioned that some computers kept had poor network access to the internet and most of the desktops lacked the CPU, which is the system unit to be used.

On-site observation by the researcher in the head teachers' office revealed that 20 computer terminals and/or desktops were kept and had never been used since they were brought by the government in 2018, the reason being that they lacked the CPU, which is the system unit that would be the operating system. Four (4) laptops had low processing speeds. Another issue was that the space in the resource room was not enough to accommodate all the hi-tech assistive technology devices available in the school. The researcher also saw two more CCTV magnifiers kept in the library because they were damaged and the school could not afford the spare parts to repair the devices. The researcher was told that the school also received the Fusion 2021 and Zoom Text software packages for one year, and by 2022, they had expired and become non-functional.

The above finding and verbal statement showed that a number of hi-tech assistive technologies were kept and not used by both teachers and LWVI in the school for various reasons: slow processing speed, faulty devices, users not having knowledge of the new devices and software, limited space in the school, and being inaccessible by LWVI and the teachers. The statements showed that some of the hi-tech assistive technology kept has factory errors, cannot access the network, and is too complicated to be used by most LWVI and teachers. The finding additionally shows that if the hi-tech assistive technology available were functioning, LWVI would easily manipulate them to download, print, and submit their work to their classroom teachers without requiring assistance from others, especially those who are completely blind and those with low vision. These would use digital cameras or CCTV magnifiers to read printed classroom materials and simply move the digital camera to access information from the

assigned activities or notes. Based on the current situation at Madera Secondary School for the Blind, teachers and LWVI line up to use some of the available operational hi-tech assistive technology devices. While others are kept in offices, this will hinder teaching and curtail the completion of the curriculum.

4.3.4 Hi-tech assistive technology software

When participants were asked to mention the hi-tech assistive technology software they use in the school during the teaching and learning process, participants (N = 8) responded that they mostly used Job Access with Speech, abbreviated as JAWS, though it was short-lived. One of the participants had this to say: *''the software I use here is JAWS which are job access with speech but disappear most times''* (LWVI 4).

Another participant with a similar opinion said:

> Mostly, the software we use includes JAWS which we use on these computers but they keep expiring. We are also using text aloud for processing like text to audio to be played in other devices that is some audio players, we have Duxbury Braille Translator (DBT) for processing braille work ready for production by the Braille Embosser and also there is Tactile View used for creating tactile objects that can be embossed (Tr 1).

Similarly, participant Tr3 had this to say:

> Oh, we use JAWS here but the ICT teacher knows most of them that we are using here as I may not know other names but also remember NVDA. We use the JAWS, on the computers and laptops but even some of us have the JAWS like on my phone but at time they disappear when LWVI are using and there is need to be trained on how to use them to master the language that they produce because sometime I fail to understand the accent used when they talk so someone has to be very keen.

Additionally, similar views were stated by participants LWVI 1**,** Tr 2**,** LWVI 2**,** LWVI 4, and Tr 4**.** They also mentioned JAWS as the most commonly used software in the school during

teaching and learning. They also said that other software they use includes DBT, text-aloud, NVDA, and audio-to-text software.

By exploring the Hi-tech assistive technology devices and software in the resource room, the researcher observed that most of the Hi-tech devices available like the computer and laptops used JAWS, NVDA software was got on open source, DBT was used by the Braille embosser to produce the adapted print into Braille work, most of the available JAWS were Demo type, (COBRA, Dolphin and Supernova) and had expired, the school had received eight (8) licensed JAWS from Ministry of Education and Sports and 8 laptops, three (3) licenses on desktops from AWSIP (All We See Is Possibility) and out of the 20 desktops displayed in the resource room, only five were working with licensed JAWS and 15 were not using the licensed JAWS because all the 15 licenses had expired so the ICT teacher could download the Demo JAWS.

The findings show that the school uses software but struggles to make academic information accessible to LWVI since most of the hi-tech assistive technology software like JAWS expires regularly; for example, only five desktops were functional out of the 20 displayed in the resource room with the licensed JAWS. LWVIs are likely to miss out on information because they end up using Demo JAWS, which are not stable and keep disappearing even when the lesson is being conducted due to their short expiry, hence affecting LWVIs' concentration during teaching and learning. However, if the school had the most licensed JAWS, LWVI, and teachers, they could be in a position to access all information, download apps and documents, personalize the reading speed for the readable material, get closer to documents and work accurately with the software on the device, scan, browse, and read books using OCR, and perform most of the activities independently.

4.3.5 Subjects enhanced by use of Hi-tech assistive technology

When participants were asked to identify the subjects in the school that use hi-tech assistive technology to enhance teaching for LWVI, participants (N = 5) expressed themselves that literature/English, Christian religious education/divinity, history, and ICT are suitable to use hi-tech assistive technology devices and software to support teaching. Further inquiries as to why the mentioned subjects were fair to teach with available hi-tech assistive technology devices and software, they contended that these subjects did not have many illustrations, diagrams, formulae, symbols, charts, and almost no calculations, which was easily interpreted by the clear readers, Blaze ET, CCTV magnifiers, and the JAWS. One participant had this to say:

> Mmm…mostly, we use in the languages like literature, English, CRE/Divinity, History, Kiswahili and ICT subject and is applied mostly on document processing using clear readers, Blaze ET, CCTV magnifiers, JAWS and orbit readers. Generally, these subjects become easier and fair to use Hi-tech assistive technology because they are notes oriented, have no many illustrations, diagrams, formulae, symbols, charts and with almost no calculations. We are using to teach content to LWVI from S.1 to S.6 yeah (Tr 1).

Another participant said that: *''Uuuh…so really subjects starting from English, literature, mmh Kiswahili... uuhh then CRE, History, and computer itself. Those are subjects we are doing mostly with the Hi-tech assistive technology''* **(**Tr 4).

In addition to the above participants, participant LWVI 2 said:

> Actually, as far as that, is concerned, starting with the subject in my combination, HLD, is the most prominent one that is Literature, history and divinity like now I use on novels where SD card is put in the victor reader and then it just keeps any book or any chapter that I want.

In a similar belief, participants LWVI 1 and Tr 3 said most of the ARTs subjects that did not require calculations and practical sessions, such as English, History, CRE/Divinity, Kiswahili,

and Literature, fairly use hi-tech assistive technology to enhance teaching for LWVI in Madera Secondary School for the Blind in Uganda.

The above finding revealed that by using hi-tech assistive technology, most of the non-science subjects can be fairly taught to LWVI by teachers to enhance learning. It promotes integrated learning systems using unique approaches like Ed-Tech solutions like Kolibri, MyLib, Oppia, Moodle, and Google Classroom, class Dojo, and Kahoot in class activities using multimedia content and develops a learning eagerness among LWVI. There is also personalized learning, where teachers can modify the curriculum to suit LWVI in the school by allowing anytime access to education services and learning materials. Hi-tech assistive technology available, while used fairly in teaching the subjects mentioned above, will increase collaboration through communication between the teachers and LWVI. It is possible when the teachers engage LWVI as they work together to solve academic issues because the hi-tech assistive technology enhances one-to-one interaction between LWVI and the assigned activity. However, the findings still show that there is a fair use of hi-tech assistive technology, although the best solutions for these subjects are yet to be established.

4.4 Perception of Teachers and LWVI on the Use of Hi-tech Assistive Technology

The second research question that the study sought to answer was aimed at finding out the perceptions of teachers and LWVI on the use of hi-tech assistive technology in Ugandan secondary schools. In order to answer this question, the researcher used findings from the interview guide. This is reflected in the presentation and discussions of the emerging subsections, which are: training on the use of hi-tech assistive technology, repair and maintenance training, and challenges of using hi-tech assistive technology, as shown below:

Table 4: Perception of teachers and LWVI on the use of hi-tech assistive technology

The kind of training for the teachers and LWVI on hi-tech assistive technology
Teachers and LWVI in the school were perceived not have received any special formal training on the utilization of the available hi-tech assistive technology devices and software but mostly some got involved in the workshop training for at least three days.

Some of them had perceptions of never been trained on how to use the devices apart from attending ICT lessons which involve use of JAWS and NVDA to read the stored educational materials for knowledge achievement.
Teachers trained to repair and maintain Hi-tech assistive technology devices
Their perceptions show that no teacher and LWVI had skills in repairing and maintenance of the hi-tech assistive technology devices available in the school.
There were perceptions that most of the non-functional hi-tech assistive technology devices were kept because no one among the staff could sufficiently repair them. At times the school technician liaises with Enabling Services and Sense International in servicing the devices.
Challenges faced while using Hi-tech assistive technology devices and software during teaching in schools
Unstable electricity.
Chances of devices crushing and disturbing during teaching are rampant.
There were very few available hi-tech assistive technologies compared to the number of LWVI and the teachers in the school.
Most teachers and LWVI in the school are not trained to use hi-tech assistive technology.
Inadequate space to install and store the devices.
The desktops have few central processing system units (CPU) and external butteries.
Demo JAWS kept on disappearing even when in use.
Unstable network affecting internet access.
Low processing speed for hi-tech assistive technology used in the school.

Source: Primary Data 2023

4.4.1(a) Teacher training

When teachers were asked about their perceptions of the kind of training they acquired on the use of hi-tech assistive technology, participants (N = 4) replied that the teachers in the school had not received any special formal training on the use of available hi-tech assistive technology devices and software and that some had acquired the knowledge and skills in workshop training from a three-day' workshop training. Teachers confirmed that not all of them know how to use what is available in the school, apart from the ICT teacher, who explores hi-tech assistive technologies himself during his free time and thereafter transfers knowledge and skills to the rest of the participants.

One participant had this description

> Now what have helped me have been these workshops each time they call for a workshop on Hi-tech assistive technology, I ensure I attend at least to acquire the basic knowledge on the use of the assistive devices. Basically, workshops help but are not regular. I have been in this school for 20 years but have not seen a teacher here trained in these gadgets. Mmm…even we learn by doing ourselves here…we had a workshop organized by AWSIP (All We See Is Possibility) project at Kyambogo university for one day before Covid-19 lockdown to help secondary schools teach mathematics to LWVI (Tr 4)

Similarly, participants Tr 1, Tr 2, and Tr 3 revealed that they did not have any formal hi-tech assistive technology training apart from the basic knowledge and skills obtained on the use of hi-tech assistive technology devices and software during teaching and learning. This condition is perceived to contribute to the poor performance of learners with visual impairments at Madera Secondary School for the Blind in Uganda.

4.4.1(b) LWVI training

When LWVI were asked about their perception of the kind of training they acquired on the use of hi-tech assistive technology, participants (N = 4) replied that LWVI acquired skills through individual exposure to hi-tech assistive technology solutions and products but not any special training on the devices and software. In their insight, they also cited a situation where some of them had never been trained on how to use the devices apart from attending ICT lessons which involve use of JAWS and NVDA to read the stored educational materials for knowledge achievement.

One participant had this say:

> The level of training, in this school on the use of hi-tech devices actually is very low and very limited because at school here we only wait when it is time for computer lesson that is probably when we can be shown to use some and only during ICT lessons. So generally training is not there and very limited (LWVI 1).

Similarly, participants LWVI 2**,** LWVI 3, and LWVI 4 also revealed that they did not have any formal hi-tech assistive technology training apart from the basic knowledge and skills obtained on the use of hi-tech assistive technology devices and software during ICT lessons. This was gained through informal preparations such as interactions with colleagues and friends with LWVI who have a basic knowledge of the utilization of hi-tech assistive technology equipment as well as individual initiatives.

By analyzing the two narratives, it was clear that both the teachers and LWVI have never had formal training on the utilization of hi-tech assistive technologies available in their secondary school, apart from the workshops and ICT lessons. This situation is perceived to prevent teachers and LWVI from fully exploiting the available technologies, which would help in promoting academic achievement. Perception in the absence of formal training on the use of hi-tech assistive technology is observed to render most of the hi-tech assistive devices less utilized by teachers and LWVI. Scientific talking calculators, Blaze ET, Fusion 2022, and desktops had no system unit and were kept, yet teachers would independently train and practice by creating a central server to coordinate the desktops and engage the devices and software. Limited training in hi-tech assistive technologies is perceived to deter syllabus completion and content coverage, thus an academic handicap.

The findings of the teachers and LWVI above disregard the HAAT model element of "human", which states that ‘human beings’ carry out many intrinsic tasks in the physical, cognitive, and emotional spheres by exhibiting skills and abilities that successively produce an outcome. They possess abilities such as power, teamwork, length of action, stability, and/or other physical attributes. Teachers and LWVI in this case are the humans who are supposed to possess the ideas, skills, and knowledge to operate all the available hi-tech assistive technologies to deliver academic content and support each other.

4.4.2(a) Repair/maintenance skills by teachers

When participants were asked about the number of teachers and LWVI trained to repair and maintain the hi-tech assistive technology in their school, one participant (N = 4) admitted that no teacher had skills in repairing the hi-tech assistive technology devices. They further stated that damaged Victor readers, CCTV magnifiers, embossers, and some laptops were kept because no one was skilled and technical enough to maintain and repair them. Such damaged equipment waited for professional servicing by staff from Enabling Services or Sense International. One participant narrated below that:

> … That is a big challenge because we have not had any special training but in case of any breakdown of the Hi-tech assistive technology devices, we contact people outside for example we use the Enabling Services then even Sense International. The Sense International recently trained the school technician but it was generally basic training on servicing the orbit 20 readers only and he is not a teacher (Tr 1)

Other Participant Tr 2, Tr 3, and Tr 4 acknowledged that none of the teachers out of the 18 members of the staff were trained in the skills of maintenance and repair for hi-tech assistive technology in their school. For any service or repair, the school had to pay a high price for spare parts.

4.4.2(b) Repair/maintenance skills by LWVI

When participants were asked about the number of teachers and LWVI trained to repair and maintain the hi-tech assistive technology in their school, participant (N = 4) admitted that no teacher had skills in repairing the hi-tech assistive technology devices.

Another participant had this to say: *''surely, no learners are trained, and we have no idea on these repair skills''* (LWVI 2).

Other participants, LWVI 1, LWVI 3**,** and LWVI 4**,** as well, confirmed that the school did not have a LWVI trained specifically in the repair and maintenance of the hi-tech assistive technologies available in the school. For repairs and maintenance of hi-tech assistive technology devices, the school relied on Enabling Service and Sense International.

The finding above gives clear evidence that most of the hi-tech assistive technology devices are likely to get spoiled, packed, or kept on shelves and even abandoned by both the teachers and LWVI due to a lack of readily available trained teachers or learners in repair and maintenance skills services. It is therefore perceived that continuous procuring of hi-tech assistive technology devices to distribute in secondary schools without resolving the repair and maintenance issues may affect the budgetary allocation yearly and cause no value for money to provide assistive technology in Ugandan schools.

4.4.3 Challenges on using hi-tech assistive technology by teachers and LWVI

A participant was asked a question to find out their perception of the challenges they face while utilizing hi-tech assistive technology devices and software during teaching and learning. Various issues emerged. From the narratives of the participants, participants (N = 4) mentioned unstable electricity as one of the biggest challenges hampering the utilization of hi-tech assistive technology devices and software during teaching and learning in their school. This factor, they added, hinders most of the school-scheduled routines since most of the activities require constant power to run the devices and software for teachers to deliver the entire prescribed curriculum. It was also revealed that no hi-tech assistive technology can operate without the use of electricity, but the more they exist without power, the greater the chances of devices crushing and disturbing during teaching. One of the participants had this to say: *''Most of us are perceived not to teach, but the challenge is power shut down; we now cannot move further, but only one side of the resource room has the battery''* (Tr 3).

Similar views were shared by participants Tr 1**,** Tr 2, and Tr 4**,** who agreed with the narratives of the above participant. They described the power shortage in the school as one of the major problems hindering the use of hi-tech assistive technology during teaching and learning. They stated that electricity is not stable in their school, and load shading takes days or weeks. Most of the hi-tech assistive devices used in teaching depend on electricity to function, they said.

Also, participants (N = 3) had perceptions pointing to unstable electricity in their school. One of the participants had this to say:

> Actually, the first challenge is power shortage which affects us when using computers because it is not stable as we lack solar and UMEME can disappear at any time affecting our work in case we are reading or in case we are using Hi-tech devices in the lesson so, it is not stable (LWVI 4).

In a similar view, participants LWVI 2 and LWVI 3 stated that electricity is not stable in their school, yet load shading takes days or weeks, affecting the functionality of the hi-tech assistive technology devices that depend on electricity.

According to the researcher, the availability of electricity promotes assistive technology hardware and software functioning, which enhances teaching and learning. Lack of electricity or power shutdown affects the devices in terms of operation and working, leading some time to the crushing of hi-tech devices. This also affects the teaching and learning of LWVI by teachers because, at a designated time, one has to exercise his or her teaching role. A power shutdown brings all the programs to a standstill.

In another remark, participants (N = 5) pointed out that there were very few available hi-tech assistive technologies compared to the number of LWVI and the teachers using them in the school as a challenge. They also mentioned that some of the devices, though few, were not

working up to the expectations to support teaching and learning for all learners in the school. A participant had this to say:

Similar views were shared by participants Tr 1**,** Tr 2, and Tr 4**,** who agreed with the narratives of the above participant. They described the power shortage in the school as one of the major problems hindering the use of hi-tech assistive technology during teaching and learning. They stated that electricity is not stable in their school, and load shading takes days or weeks. Most of the hi-tech assistive devices used in teaching depend on electricity to function, they said.

Also, participants (N = 3) had perceptions pointing to unstable electricity in their school. One of the participants had this to say:

> Computers are few in number those which are installed with screen readers and if there could be away, the number of them could be increased. There is high competition for the few desktops installed so if the teacher wants to plan it is not easy to remove the learners who are doing their personal work (Tr 2).

The verbatim responses by Tr 1 and Tr 3 showed that the school has very few hi-tech assistive technology devices. They added that the number of these hi-tech assistive technology devices compared to the number of users does not match and does not support the approach of one-to-one training. It becomes challenging as some learners may not have hands-on experience due to the limited number of assistive devices.

LWVI 3 said: ‘*‘Uh, some hi-tech assistive technology devices like clear readers, Victor readers, and most of the others I have been mentioning are very few, only two or less in the school’’.*

A similar view was mentioned by participant LWVI 1**,** who said that hi-tech assistive devices are few in number and most of them would need to be used, but they were not enough for

LWVI to depend on, so he confirmed that they at times make lines to access and use at least one device.

In addition, participants (N = 4) stated that most teachers and LWVI in the school are not trained to utilize hi-tech assistive technology. They added that out of 18 teachers and 102 LWVI, none of them had formal training in hi-tech assistive technology skills apart from the informal trainings in workshops for less than a week. They agreed that at least three teachers went through informal training just to acquire the basic knowledge and skills to utilize hi-tech assistive technology in their school.

A participant said, ‘‘*one challenge is that our LWVI and we teachers are not yet conversant with hi-tech assistive technology use. We are moving slowly, so not all of us are knowledgeable about these technologies’’* (Tr 3)**.**

Similar opinions were mentioned by participants Tr 1 and Tr 4**.** They also confirmed that their school staff had never had formal training on the utilization of hi-tech assistive technology devices and software available in their school.

Another participant, LWVI 4**,** said, *‘‘…also, we are still having a few teachers trained who can teach us how to use hi-tech assistive technology devices, as LWVI here are very many’’*. Due to their perceptions of a lack of training, neither the teachers nor the LWVI in the school were able to utilize most of the hi-tech assistive technology that was supplied, like scientific talking calculators, Optelec readers, and OCR software, to accomplish the tasks.

The researcher, after getting the views of the participants, suggests that in order for LWVI to benefit from hi-tech assistive technology, they should undergo necessary training to enable them to work fully with the devices available in their school. This can be made possible only

if the teachers are formally trained in most assistive technology skills that they would transfer to LWVI during the teaching and learning process.

Still to note is that participants (N = 3) raised the issue of inadequate space. In their perceptions, they confirmed that the school received about 40 (forty) desk tops from UCC, and because the resource room is small, only 20 desktops have been displayed to be utilized by 102 LWVI and 18 teachers in the school. In their narratives, one of the participants had this to say:

> You know…uuhh…also, we have inadequate space because of few infrastructural setups in the school and so some of those not installed are because of lack of enough space meaning having small resource room just imagine the school here received 40 desktops but only 20 are here in the room while the balance is kept not being used and yet we are many users like 18 teachers and 102 LWVI so even some times non-teaching staff also use this machines (Tr 4).

In the same view, participants LWVI 3 and Tr 2 concurred that the school has limited space to accommodate all the hi-tech assistive technology donated and assigned to the school. Because of this, the devices are in the head teachers' office, like the scientific talking calculators and desk tops; others in the library, like the CCTV magnifiers; and others in the secretary's office, like the Braille embossers and printers.

From the findings, there is an indication that most of the hi-tech assistive technologies are less utilized due to a lack of space to house the devices in the school. LWVI and teachers mostly use what is accessible to them, and some of the LWVI and teachers showed ignorance of the existence of some hi-tech assistive technology devices found within the school.

The researcher equated the finding with the HAAT model**,** especially the component of "context" or "environment" in which the person lives, including their social, cultural, physical, and institutional contexts, which makes up the final major factor. Here, the finding shows that humans, in this case the LWVI and the teachers, can only access the hi-tech assistive

technology devices and software in a designated space available, like the resource room in a school. However, if the school does not have enough space where the assistive technology is displayed and utilized by LWVI and teachers, then there is a high risk of less utilization of the hi-tech assistive devices. Therefore, the environment plays a bigger role in the teaching and learning of LWVI if it is made available, accessible, adapted to cater for individual needs, and can accommodate all the learning resources for both LWVI and teachers.

Additionally, participants (N = 3) stated that the desktops have few central processing units (CPUs) and external butteries. They gave evidence through explanations in their narratives that when the school was given 40 computer desktops, it was accompanied by four (4) system units, meaning that by that time only four desktops were in a position to be used by LWVI and teachers in this school. One of the participants said:

> In this school somehow, we have computers but most of them do not have the CPU to put it in position to work. I was told by the ICT teacher that other computers can access JAWS but they each need a CPU or the system unit to be installed and work so now it is like we have only 20 desktops in this room but some share the CPU that is why we have some more other than using the four which came incomplete when they were given to our school (LWVI 3)

Similarly, Tr 3 and Tr 1 agreed in their verbatim statements that having few system units would make the school only utilize 20 desktops out of the 40 given to it by UCC in 2018. They added that only four system units were given to work on four desktops, but as a school, they managed to connect the 16 desktops to the four-system unit with one central server, which is why 20 desktops are in use while the rest are shelved until more system units are bought or distributed to the school by the government or any well-wisher.

Picking from the participants' narratives, the school is struggling to provide education as a right for LWVI. This is evidenced by the LWVI themselves and the teachers that only four system units were delivered in the school, meaning that at a certain point only four LWVI had to use

the desktops with JAWS while others were waiting, and yet if all the desktops distributed to the school had a complete system unit, then accessibility to information by the LWVI would be easy by using all the 40 desktops. Following the principles that guide the provision of assistive technology, it is said that availability, affordability, adaptability, acceptability, accessibility, and quality, if well implemented, can promote full utilization of hi-tech assistive technology in this school.

Another participant (N = 3) demonstrated that Demo JAWS keeps disappearing. They added that the school uses unlicensed JAWS, which only exist for between 30 and 40 minutes and disappear before a lesson is completed or even before completing revision. In their verbatim expression, one of the participants lamented that:

> Uummm there is also lack of permanent JAWS in the school apart from only for the ICT teacher. like I said all the licensed JAWS that we got from Ministry of Education and Sports and AWSIP expired so we keep downloading the Demo JAWS but cannot persist for a longer time while using during teaching and learning process, so the rate of disappearing of these JAWS are high (Tr 2).

In a similar view, LWVI 1 and LWVI 4 agreed with the rest that Demo JAWS used in the school presents a challenge to the LWVI and teachers in the school since it keeps on disappearing during teaching and learning, hence ending lessons before completing them.

From the findings above, JAWS are the software that supports and enhances teaching and learning for LWVI and teachers, and they depend on them to perform most of the academic activities, but they are expensive in terms of the amount one can afford to own on his or her personal computer, which are approximately 3.8 million Ugandan shillings each. So, due to no other option, the school depends on Demo JAWS to perform some tasks, leaving most of the work unturned. This situation in this secondary school prevents the LWVI from utilizing the technology available, as their education rights are also ruined.

Other participants (N = 3) mentioned unstable networks affecting internet access. In addition, they said that since most of the hi-tech assistive technology works with the available network, which is always on and off, it prevents LWVI and teachers from accessing information in the online library and conducting personal research on their academic areas. One of the participants had this to say:

> …and … sure we have limited accessibility to the network where some of the Hi-tech assistive technology devices that we use are displayed and this network here really affect the internet that help us to access most of the online documents (LWVI 3).

Similar views were raised by participants Tr 4 and Tr 2**,** who said that the internet network is a challenge that the LWVI and teachers go through in the school that regularly prevents them from accessing the information at the time they may need it.

The findings above show that the internet connection plays a role in processing online information. Interfacing between the LWVI and teachers' aids in promoting research for all the users of hi-tech assistive technology in the school. Any interference or disturbance with the internet network connection affects most LWVIs' learning and the operation of their school roles. Mostly, computers with JAWS, both laptops and desktops, Victor readers, Optelec readers, and many other hi-tech assistive technology devices and software require a stable internet connection for proper function, which helps to enhance teaching and learning for both LWVI and teachers in this secondary school.

A participant (N = 1) noted low processing speed for hi-tech assistive technology used in the school. Added to that, Victor Reader, orbit readers, JAWS, desktops, and laptops take a long time to be powered, open for operations, and mostly crushed due to virus infections. The participant also said that by being slow, devices also make a lot of noise due to the lack of headsets that learners use during the lesson. Another view of this participant was that even the

colors on CCTV magnifiers affect the residual vision for LWVI and make the eyes to pain. The participants' narrative also mentioned inadequate servicing, repair, and maintenance skills to affect the utilization of hi-tech assistive technology in the school. Participant LWVI 3 said:

> … the challenge I see with most of the Hi-tech assistive technology we have has slow speed like the victor readers, computer take long to show-up, make a lot of noise due to lack of headsets their colours like the CCTV magnifiers make the eye to pain, and not easily serviced as some need spare parts which are very expensive.

An expression from the above finding shows that headsets are helpful to control noise on some systems, like computers with JAWS, to create a harmonious working environment among LWVI and teachers during the teaching and learning process. The concentration rate for LWVI in the narrative above is low because of the noise produced by JAWS since every class participant has to keep pressing and working with the desktops. It is also evidenced by the finding that whenever the hi-tech assistive technology devices break down, it becomes very difficult to maintain them or resolve them to work again due to inadequate servicing, repair, and cost in terms of spares for some hi-tech assistive technology devices.

4.5 Ways hi-tech assistive technology utilized by teachers and LWVI.

The emerging issues in this section were the ways hi-tech assistive technology helps to teach LWVI, academic areas that provide difficulties in using hi-tech assistive technology, and participants' opinions on the use of hi-tech assistive technology. Each of the above findings is presented in the sections below:

Table 5: Hi-tech assistive technology utilized by LWVI and teachers

Teaching
It simplifies access to information.
Hi-tech assistive technology makes teachers and LWVI carryout research easily.
They use Hi-tech assistive technology in recording, taking notes, reading and revision of the recorded books, lessons and exercises.
They use Hi-tech assistive technology to play music during leisure time.

Academic areas that provide difficulties in using Hi-tech assistive technology devices and software
Science subjects (biology, physics and chemistry).
General science for learners with disabilities including LWVI
Mathematics due to many calculations and lack of scientific talking calculators
Geography due to maps and map reading
Economics due to (graphs, calculations, drawings and illustrations)
Opinions of the participants on the use of Hi-tech assistive technology in schools
Increasing on the number of Hi-tech assistive technologies in secondary schools would promote fair utilization of the solutions and products available by LWVI and teachers.
It would be better for teachers and LWVI to be trained on using Hi-tech assistive technology regularly
Constructing more spacious resource rooms or lab to provide space for installation of the most Hi-tech assistive technology kept in the school
There should be purchase and provision of licensed JAWS to secondary schools.
Speeding up the domestication of the Marrakesh treaty would help to access online library materials with less restriction.
The manufactures should pilot Hi-tech assistive technology solutions and products users.

Source: Primary Data 2023

4.5.1 Hi-tech assistive technology for teaching.

Participants were asked to suggest ways in which hi-tech assistive technology could help them teach LWVI in their school. A number of issues emerged, as presented and discussed below:

From the narratives of the participants (N = 5), participants stated that it simplifies access to information. The findings claimed that if the school had nothing of the available hi-tech assistive technology, then it would be very difficult for LWVI to know what happens academically. They stated that it is these hi-tech assistive technologies that have very much tried to promote access to information, like text books in soft format, reading materials like literature novels, stored documents, and adapted curriculum materials. A response from one of the participants was: ‘‘*So, it makes the curriculum accessible to LWVI other than describing what they are not utilizing, and by doing so, eases information access’’* (Tr 2). Another participant said:

> These things are very, very helpful to me in the way that they enable me to access most the information for my academic purposes most, especially the computers and the victor readers help me a lot but the problem is that the JAWS can disappear and this victor reader is very few so we some time work in shift if you need to use them like victor readers which are not enough. Yeah but I have to wait always for others to finish then I also get though it delays (LWVI 1).

Similarly, participant LWVI 3 said:

> The one, called CCTV magnifier help me as screen reader since am of low vision they expand print materials making it already accessible by my sight yeah... by enlarging digits and letter as well as sentences uuhhh… making me able to read the print.

Similar responses were given by participants Tr 1 and LWVI 2**,** who said that hi-tech assistive technology helps to simplify access to information by distributing electronic Braille work to the orbit readers, making LWVI easier to follow. They also added that devices give access to various methods of gaining information or learning, reducing the teacher's explanation from time to time.

Based on the above findings, the verbatim statements show that with the help of hi-tech assistive technology, teachers and LWVI can access information, which helps to enhance teaching and learning in their school. The challenge with the devices, though, is that they support information access but are not enough to be used by all learners and teachers at a time.

The findings are in line with the HAAT model**,** where it states that "assistive technology," in this case, hi-tech assistive technology, acts as an outside enabler like the tools and/or devices used by teachers and LWVI to participate in a very specific activity where a sensory system can be replaced or enhanced to easily access the information through an interface, processor, or environment and produce activity output. Here, LWVI discovers, explores, and participates to gain like others, even in a situation where there are no teachers to keep engaging learners,

but LWVI uses the available hi-tech assistive technology resources to read, revise, and perform various activities on their own.

A group of other participants (N = 5) mentioned that hi-tech assistive technology makes teachers and LWVI carry out research easily. They added that whenever there is internet access, they can surf online educational materials during their free time or after the lessons to discover more information related to subjects in addition to what teachers give them. One of the participants said:

> Uh…devices we have here are helpful as they facilitate learning and making research for both the teachers and the learners faster at personal level improving on our knowledge. So, i make research, and then listen to the recorded work…mmh especially in literature even in other textbooks (Tr 3).

Participant LWVI 3 said, ‘‘*we do research using the computers with JAWS, but the viruses are much and keep disturbing’’.*

Participants LWVI 1 and Tr 4 as well stated that they use hi-tech assistive technology in researching at the personal and class level for teachers and LWVI in this secondary school. In their narratives, participants pointed out that, though hi-tech assistive technology devices and software are used to carry out research, they are affected by power shortages and internet issues.

In the finding above, there is an indication that LWVI and teachers do some research using hi-tech assistive technology devices and software like computers with JAWS, Victor Readers, and Blaze ET with the help of OCR services. However, most times there is failure in the systems that end up posing challenges of inability to access information researched by LWVI and teachers due to power shutdowns, network failures, and internet failures. Therefore, the school where the study took place used hi-tech assistive technology to conduct research amidst various barriers, as mentioned above.

Another set of participants (N = 5) stated that they use hi-tech assistive technology in recording, taking notes, reading, and revising the recorded books, lessons, and exercises. They added that after lessons, LWVI retrieves all the information during personal reading to help in preparation for assessments in terms of weekly, monthly, and termly tests as well as national examinations. One of the participants had this to say: "*Yeah, we use the hi-tech devices to record, read, and revise work and assignments"* (LWVI 4).

Another participant narrated that *''Some hi-tech devices like Victor Readers are so useful in storing information as they can record it, then store it through saving and listening to it in one's free time"* (LWVI 3).

In a related statement, participant Tr1 had this to say:

> Umm… during eemmu… the class lessons as I have told you, LWVI use the devices for taking notes. Then also the audio devices I told you about are recording lessons which learners follow most especially during literature lessons, there are those books that are produced in audio using the other software I told you that text aloud so once we produce that audio, then we put in the audio players and they are able to listen to audios recorded.

Relatedly, LWVI 2 and Tr 4 observed that the hi-tech assistive technology available in the school is used for various activities by LWVI and teachers to record, read, revise, and take notes, which are used at a time when needed, but the problem is that the devices are not enough, are crushed by the virus, break down easily, and sometimes refuse to access JAWS on the computers.

The findings and statements above point out that without the use of hi-tech assistive technology, it would be very difficult for LWVI to participate, explore, and achieve academically, but with the availability of some hi-tech assistive technology in this secondary school, LWVI and teachers are able to access recorded information and use it in the future. The

researcher observed an issue of inadequate hi-tech assistive technology resources, which affect the time scheduled for the lessons, and some LWVI who do not possess the devices, for example, Victor readers, Blaze ET, and audio recorders.

Participants (N = 3) also mentioned that they use hi-tech assistive technology to play music during leisure time. They said that music is one of the motivators to learning, and after the lessons, LWVI uses Victor Readers and, at times, Blaze ET to record and play music that makes them relax and promote learning. A response from one participant was:

> Like for the case of music I use victor readers to play music during my leisure time and some like computers and victor readers I use to access internet though others may fail to access internet due to factory errors (LWVI 2).

The responses from participants LWVI 3 and LWVI 4 indicate that some hi-tech assistive technology available in the school is sometimes used to play music during the weekend for leisure and entertainment. These participants say that if the hi-tech assistive technology available, like Victor Readers, were missing, then this school would be one of the most boring areas to live in. They added that through recording, one can produce a song that can be used for business, most especially church songs, which makes LWVI relax whenever exhausted. In addition, they said that some of the hi-tech assistive technology devices have a good storage system, which makes them download and store information, including music, stories, and poems, for those offering literature at the 'A' level.

From the findings, the results show that music is one of the sports activities that promote physical fitness by boosting physical exercise among LWVI. It is therefore important for all learners to at least own a device that can be used to produce music that can be used during physical education lessons and entertainment times to make them relax after the vigorous class lessons.

4.5.2 Academic areas that provide difficulties in using Hi-tech assistive technology

From the data, participants (N = 6) mentioned that science subjects (Biology, Physics, and Chemistry), also called general science for learners with disabilities, including LWVI, mathematics due to many calculations and a lack of scientific talking calculators, and geography due to maps and map reading, are difficult to teach even with the available hi-tech assistive technology in this secondary school, so they are taught at the 'O' level in this school due to the new lower secondary curriculum, which spells out all the compulsory subjects being many for all learners regardless of their disabilities. For LWVI in upper secondary, or 'A' level, it is challenging to teach economics due to graphs, calculations, drawings, and illustrations; mathematics due to many calculations and lack of scientific talking calculators; geography due to maps and map reading; and science subjects. So LWVI in this school offers arts combinations comprising history, literature, and divinity, which they claim they can easily manipulate with the hi-tech assistive technology in the school. They added that LWVI from senior one and senior two offer 12 subjects, 11 compulsories and 1 elective, and those at senior three and four are expected to do eight and nine subjects, where seven are compulsory and one or two electives. One of the participants said:

> Now when it comes to areas or academic subjects, we have not yet explored more on science subjects that is otherwise with time we would also need teaching those pure sciences but it is very had to do with our LWVI in this school (Tr 4).

Participant Tr 1 stated:

> Umm I think the areas that are more wanting is generally on sciences and teaching science concepts are not very easily to grasped and then also in the business area like economics because I have received concerns from the economic teacher that it is not easy to teach LWVI graph with Hi-tech assistive technology devices and the drawings and illustrations mmm and here we do not generally do map reading in geography subjects, in general science like Biology, chemistry and physics in 'O' Level General science here ends in 'O' level and 'A' Level most learners have Arts combination

> which can somehow be done with the use of Hi-tech assistive technologies but also very complicated due to unstable power, Demo JAWS and being few in numbers compared to the users.

To the same question, a response from another participant was:

> Mostly I think the science subjects and here we have general science which has Biology Chemistry and Physics due to the practical done from time to time in each subject. Some of the subjects in 'O' level are compulsory as stated in the national curriculum development Centre and not ease to teach even with some of these Hi-tech assistive technology devices in this school. Also, Agriculture then Mathematics but we do not have scientific talking calculators to use in teaching the subject a part from depending on Braille yes…but also Economics because has a lot of calculations and many notes, geography because there are very many maps and map reading (Tr 3).

Furthermore, participants LWVI 1**,** LWVI 2, and LWVI 4 gave similar responses to other participants who mentioned science subjects as one of those that are not easy to teach LWVI in this school due to their nature, complications, and requirements. They also added that LWVI in this school offers only art subjects for the reasons best known to the school.

From the verbatim statements, LWVI and teachers face challenges in teaching most of the marketable subjects like biology, chemistry, physics, mathematics, geography, and economics. The whole school doesn't benefit a lot because the hi-tech assistive technology available in this school does not support appropriately full teaching of the mentioned subjects. Teachers have developed a negative attitude toward teaching the mentioned academic areas because of inadequate support for teaching and learning materials.

4.5.3 Participants' opinion on the use of Hi-tech assistive technology

When participants were asked what should be done to ensure that hi-tech assistive technology is used fairly and well in their school, many views came up, including increasing the number of hi-tech assistive technologies in the school, training teachers and LWVI on the use of hi-tech assistive technology, constructing more spacious resource rooms or labs to provide space

for the installation of the kept devices, purchasing and providing licensed JAWS, speeding up the domestication of the Marrakesh treaty, and piloting hi-tech assistive technology solutions and products before giving them to users. They are analyzed and presented below:

Participants (N = 7) suggested that increasing the number of hi-tech assistive technologies in secondary schools would promote fair utilization of the solutions and products available by LWVI and teachers. They said that the inadequate numbers of these devices hinder the participation of LWVI during teaching and learning as many are left unattended to by the teachers, hence affecting the scheduled school programs. One of the participants said:

> Actually, in my opinion, we are around a hundred plus in this school and the Hi-tech assistive technology are very few. First of all, if they can increase on them like orbit readers, victor readers, clear readers, CCTV magnifiers, laptops and computers with JAWS, Blaze ET and scientific talking calculators because we use them to read and translate books (LWVI 4).

Furthermore, another participant had this to say:

> Ok we need to make sure we add the number of most Hi-tech assistive technology devices which are very few in this school for example we have to add victor readers, the scientific talking calculators which is just one compared to 102 LWVI and 18 teachers, 10 laptops only may not be enough and eeh needs adding more at least (Tr 4).

Also, in verbatim statement, participant LWVI 3 said:

> ….Another suggestion that, uh, still on distribution mm-hmm… the government should ensure that at least a student in a school can access equipment by increasing on their numbers to avoid limit in use. Yes… so here we just struggle, for the few gadgets available in which results into other repercussions of not completing the work on time yes...

Additionally, a participant stated that:

> More of the devices and software such as CCTV, victor readers, blaze ET, permanent JAWS, can be added because what we have is a few and in small numbers compared to the number of LWVI in the school imagine the CCTV Magnifies are very few and LWVI line up to use in shifts one available and

> functioning in the school out of many LWVI, also clear readers need addition because the school has only one working out of three (Tr 2).

Based on the participants' verbal statements, participants LWVI 1**,** Tr 1, and LWVI 2 had a similar view, stating that hi-tech assistive technology should be increased to increase the number of LWVI and teachers in the school. They added that if the number of devices can be increased so that each LWVI can own at least one device to use, it would simplify the teaching and learning process in secondary schools. They also added that having more hi-tech assistive technologies will promote participation, involvement, and achievement by motivating both teachers and LWVI to teach and learn, thus improving academic performance.

The findings clearly indicate that learner participation using hi-tech assistive technology is low due to inadequate hi-tech assistive technology devices in this school. This situation reduces the LWVI attitude to learn and compete with others as the curriculum areas require. This shows that many lessons go unattended, affecting all other scheduled programs in the school due to inadequate hi-tech assistive technology resources, and yet LWVI depends on these technologies to perform all activities if they have to be independent in the school sphere.

The participants (N = 4) suggested that it would be better for teachers and LWVI to be trained on using hi-tech assistive technology regularly in the school of study. They added that training on the use of hi-tech assistive technology devices promotes self-interaction with the devices, independent living, and full utilization of the technology during the teaching and learning process for LWVI and the teachers. One of the participants had this to say:

> Mine is still on training eeeh! And change of mind set because when you are trained you will know something and you will feel okay working with the new advanced technology but if you do not know, even the strength to use what is available will go away so we need a lot of training here on all the Hi-tech assistive technology devices and software available. The training should always be done regularly like at the beginning of the term. I think CPDs should be strengthened on the use of Hi-tech assistive technologies available

> in schools for both teachers and LWVI to master on the use so that we acquire the necessary skills that will always encourage us to do the work always here and make work easier to read for the LWVI especially changing those descriptions and also the training that am talking about should aim at making all the assistive technology be used by all the users and be able to choose which device to use for which lesson to make it simplified (Tr 2).

Another participant narrated that:

> Maybe if they can continue training both our teachers and us LWVI on the use of most Hi-tech assistive technology yeah…it can make us work with a lot of ease but whenever you fail to use what is available, …one develops a negative attitude about these gadgets (LWVI 4).

Similarly, LWVI 2 and Tr 1 concurred with the statement that training for teachers and LWVI in using hi-tech assistive technology is wanted. They continued expressing their view on training and said that if all users are trained, then the teaching and learning process will be simplified and all recommended curriculum subjects will be dealt with, as every learner will be a master of himself or herself in terms of exploration and discoveries during the teaching and learning process. They also said that if the assistive technology could be part of the teacher training course, that would really help and make work easier in the use of teaching and learning with the hi-tech assistive technology devices because, in most cases, teachers who qualify do not know about assistive technology and they face it from the field wherever they go to teach.

From the findings above, training teachers and LWVI on hi-tech utilization in secondary schools plays a big role in enhancing teaching and learning, as LWVI and teachers will be able to explore the world independently and reduce the teachers' work of spoon-feeding learners. LWVI and teachers, if trained, will be able to use the hi-tech assistive technology devices and software to carry out research, download online documents, and store them for LWVI retrieval for future use with a lot of ease. Furthermore, the expressions from the finding show a negative attitude toward the utilization of hi-tech assistive technology systems due to the lack of training of both teachers and LWVI in secondary schools in Uganda.

Also, other participants (N = 3) suggested constructing more spacious resource rooms or labs to provide space for the installation of the most hi-tech assistive technology kept in the school of study. One of the participants said:

> Mmm, we need space so that some of the computers kept can be put to use imagine about 20 monitors are just kept yeah and also lack the system unit as provided by UCC who gave us 40 monitors with only four system unit rendering other devices to be kept and not in use. As you can see this school still lacks structures and even this resource room doubles as I have told you of two things, the resource room and computer lab and also act as school administration block so it is a challenge to use the gadgets fully and fairly because the space is not there (Tr 1)

Similarly, LWVI 1 and Tr 3 also mentioned the need for the construction of a more spacious resource room or lab, separating a computer lab for ICT lessons from an assistive technology resource room that may house both modern and local assistive technology devices. This is because the ICT lab is not easily accessible and locked to protect the computers, but if a room is created for the hi-tech assistive technology, then it would be freely accessible by LWVI to perform their research activities, exploit the world through reading using the devices and software, and a special network connection to aid access to the internet can be provided.

From the participants' narratives above, the researcher took a keen look at the available resource room for both computer ICT labs for ICT lessons and assistive technologies available in the school. The expressions indicated that the lab as well as the resource room were too small to accommodate all the hi-tech assistive technology devices owned in the school, and that is why some were kept non-used, for example, some orbit readers, desktops, laptops, CCTV magnifiers, scientific talking calculators, and Blaze ET.

Other participants (N = 3) mentioned that there should be the purchase and provision of licensed JAWS to secondary schools, especially Madera Secondary School for the Blind. They added that most of the JAWS used in the school are demo JAWS, which are short-lived and

keep disappearing even when a lesson is being conducted. It was also revealed that most of the licensed JAWS that the school has expired are expensive for the school to buy as there are very few financial resources that the school receives. From the verbal statements of the participants, they explained that the Demo JAWS can only be used for less than 30 minutes, and most of the lessons in the school take at least an hour, so they say such a status keeps interfering with the teaching and learning process for both the teachers and LWVI in the school. One of the participants had this to say:

> JAWS in the computer should be licensed so that they are used permanently without disappearing as we depend mostly on Demo JAWS which work for shot time and disappear shortly (LWVI 3).

Similarly, participants LWVI 4 and Tr 3 mentioned the same verbal statements that most of the hi-tech assistive technology like JAWS used in the school were not licensed, so they suggested that instead of using the demo JAWS, it would be of value to install the licensed JAWS, which are permanent to use in school for proper enhancement of the teaching and learning process for LWVI and teachers in secondary schools.

Based on the participants' ideas, LWVI in secondary schools can only achieve participation with the aid of hi-tech assistive technology hardware and installed software such as screen readers, also called JAWS, but to make the JAWS of value, most of them would be licensed JAWS, which perform tasks for a longer time without disappearing to maintain consistency during the teaching and learning of LWVI in secondary schools. Having licensed JAWS promotes positive attitudes among learners and encourages continuity in the learning and teaching process. The researcher also used one of the computers with JAWS from the resource room to type one of the verbatim statements from one of the participants in the way of transcribing the finding. The said Demo JAWS disappeared shortly before 40 minutes, and there were no headsets connected to computers in use, so there was a lot of noise produced since every LWVI was using the available computer with the Demo JAWS. Therefore, this

gave clear evidence that the participants' submissions were true. The kind of JAWS used in the school does not support continuous teaching and learning if licensed JAWS and headsets for the computers are not given to the school. This is because even the noise interferes with the smooth flow of the lesson.

A participant (N = 1) stated that speeding up the domestication of the Marrakesh treaty would help LWVI and teachers access online library materials with fewer restrictions in the area of this study. He added that restrictions on accessing soft copy materials that can be transformed into Braille or other accessible formats for easy use on hi-tech assistive technology devices remain a challenge to the teaching and learning process in most secondary schools. The participant said:

> Uaaa…one other thing is the issue of Marrakesh treaty domestication it still remains a challenge because sometimes we do not access to soft copy work. So, this process should be fastened so that it becomes easier for us to get materials because there are co-operate restrictions to accessing soft copy materials that can be transformed into Braille or other accessible format for easy use on Hi-tech assistive technology devices. The treaty can provide an open door for LWVI and teachers to access online libraries like book share (Tr 1).

According to the verbatim expression, most LWVI fail to access the reading materials in soft copy just because of the restrictions imposed on them by the publishers and other cooperate agencies. Evidence was seen during the COVID-19 error when the National Curriculum Development Centre developed education materials and made hard copies for only ordinary learners, leaving those with disabilities, particularly LWVI, without anything to access for their continued studies. The publishers failed to provide the ministry of education and sports with the soft copies on time, and the accessibility restriction could not allow LWVI and teachers to make educational materials in accessible formats for their personal study. These findings show that there are a lot of imbalances in service delivery when it comes to the education of people

with disabilities, including those with visual impairments, even when using hi-tech assistive technology to explore during the teaching and learning process.

Another participant (N = 1) suggested that the producers or manufacturers should pilot hi-tech assistive technology solutions and products before giving them to users, who are in this case LWVI and teachers in secondary schools and other learning institutions, more so at Madera Secondary School for the Blind. The participant pointed out that some hi-tech assistive technology devices are made with factory errors in them. The errors prevent them from accessing JAWS, power, and the internet network, which aid in the operation of the devices by the LWVI and the teachers in schools during the teaching and learning process. The participant said:

> Uuhhh… also most of the manufacturers of these Hi-tech assistive technology should tryout or pilot these devices and software at least with the users to check whether there are well before bringing them on market for LWVI and teachers to use in secondary schools yeah or other learning institutions because they at times have factory error preventing them from functioning, accessing internet network and power (Tr 3).

The findings above indicate that not all manufactured hi-tech products and solutions are worthy for LWVI and teachers to be used in secondary schools, but continuous testing and piloting are necessary to improve their functioning. It also shows that most of the school activities are hampered by some of the hi-tech assistive technology, which has errors at the time of manufacturing. This kind of situation affects the attitude of LWVI and teachers toward the utilization of hi-tech assistive technology devices and software available at Madera Secondary School for the Blind. Through observation, some of the Victor readers, orbit readers, and computers were corrupted with errors that could not work anymore, and this affected access to more of the hi-tech assistive technology devices, creating a state of competition for the few working ones.

CHAPTER FIVE

SUMMARY, DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

The purpose of this study was to explore the utilization of hi-tech assistive technology by teachers and learners with visual impairments at Madera Secondary School for the Blind in Uganda. In this chapter, the researcher presents the summary, conclusion, and recommendations of the findings on the utilization of hi-tech assistive technology by teachers and LWVI during teaching and learning at Madera Secondary School for the Blind in Uganda. The study objectives include: to examine the nature of hi-tech assistive technology available for teachers and LWVI; to analyze the perceptions of teachers and LWVI on the use of hi-tech assistive technology; To find out how hi-tech assistive technology is utilized by teachers and LWVI at Madera Secondary School for the Blind in Uganda.

5.2 Summary of Findings

In this section, the researcher summarized the findings following each research study objective as presented below:

5.2.1 The nature of the available hi-tech assistive technology for teachers and LWVI

After asking the participants about the most available and most utilized hi-tech assistive technology at the school where the study took place, the study discovered that computers mostly with Demo JAWS were displayed as observed in the assistive technology resource room. Only four (4) out of the 20 computer desktops were fully connected with the central processing unit; external buttery was adapted to the needs of teachers and LWVI. The remaining sixteen (16) desktops were on one central server and used Demo JAWS, which existed shortly. Other hi-tech assistive technology available but not in the resource room were: five Victor readers, 40 orbit 20 readers, two clear readers, one Blaze ET, and one scientific talking calculator kept in the head teacher's office; one CCTV magnifier was found kept in the library; as well as one embosser in the secretary's office. Twenty computer desktops in the school were also found kept in the head teacher's office on bookshelves that were not functional due to a lack of a central processing unit (CPU).

The mentioned and observed hi-tech assistive technology was not enough compared to the 102 LWVI and 18 teachers in the school. Other devices such as the Optelec focus blue Braille display, I Loview HD, pal scanner, and Omni readers were mentioned but not readily available and seen by the researcher. Furthermore, some of the hi-tech assistive technology was spoiled by the LWVI, weather conditions (moist, water, too much heat), and factory errors. LWVI and teachers mostly used hi-tech assistive technology to enhance the teaching and learning of subjects like literature, English, history, ICT, and CRE/Divinity compared to science subjects.

5.2.2 Perceptions of teachers and LWVI on the use of hi-tech assistive technology

After asking the participants about their perceptions of the use of hi-tech assistive technology at their secondary school, the views of the participants were that no teacher or LWVI was formally trained to use hi-tech assistive technology, but few teachers had informal basic training in workshops to essentially use hi-tech assistive technology devices and software

during teaching and learning in the school. For example, the ICT teacher had a qualification in CRE and history but not in ICT or a related subject, so they used the self-discovery methods of the hi-tech assistive technology explorations to instruct the LWVI during lessons. Furthermore, the researcher established that no teacher or LWVI was trained in the repair and maintenance of the hi-tech assistive technology devices available in the school. This may affect the operation of the school program in case the devices breakdown. The researcher discovered that at times the school hires repair and maintenance services from enabling services and sense international at a cost, which makes most spoilt devices unusable.

Additionally, the participants revealed that there were gaps with a power shortage that was hardly available, hindering teaching and learning by LWVI and teachers, and inadequate space, making most of the hi-tech assistive technology scattered in different offices instead of being assembled in one resource room. This affected LWVI and teachers' ability to access some of the hi-tech assistive technology that remained lying on the shelves and cupboards in offices and libraries, not being utilized. The study also revealed that the teachers and LWVI majorly depended on Demo JAWS and NVDA, an open-source program, to participate in the teaching and learning process. Demo JAWS existed for a shorter time, mostly 30 minutes, and kept on expiring since most of the licensed JAWS given to the school by the Ministry of Education and Sports, All We See Is Possibility (AWSIP), had expired two years ago; therefore, the situation posed a gap in information acquisition by teachers and LWVI in the school.

Also, the study highlighted that most of the hi-tech assistive technology had slow processing speed, powering took time for one to start working, and devices like computers with JAWS produced a lot of noise due to a lack of headsets whenever in use, thus affecting concentration.

5.2.3 Ways hi-tech assistive technology is utilized by teachers and LWVI

After asking the participants about how hi-tech assistive technology is utilized, the study revealed that by using hi-tech assistive technology, access to information by LWVI and teachers become simplified through retrieving the recorded information from the victor readers and orbit readers, carry out research easily through using the software and internet connection, record as well revise audio work and notes through use of CCTV and listening to recorded work, participate in leisure activities through playing music using hi-tech assistive devices but the problem was inadequate knowledge and skills to operate most of the hi-tech assistive technology devices and software, unstable internet connection to research information and lack of repair services. The study also established that general science subjects (chemistry, physics, and biology) were only taught to 'O' level LWVI, whereas in 'A' level, most LWVI offered arts combination just because science subjects like physics, chemistry, and biology were not easily taught by the teachers as there was a constant lack of devices like smart Braille machines, scientific talking calculators, and Duxbury Braille Translator (DBT) software, and yet the National Curriculum Development Centre (NCDC) prescribes all compulsory and elective subjects to be done by all learners. Also, the study revealed that subjects such as mathematics, geography, and economics had a lot of calculations, formulae, diagrams, illustrations, graphs, equations, maps, and map reading contents, which are not simple to teach and learn by teachers and LWVI with less knowledge and skills on the utilization of hi-tech assistive technologies available on the market. The study further revealed that increasing the number of hi-tech assistive technology in the secondary school where the study took place provides an avenue for LWVI to participate in class and after-class activities. Findings showed that hi-tech assistive devices were inadequate compared to the number of users. Imagine five Victor readers used by 102 LWVI and 18 teachers. Also, the study discovered that training teachers and LWVI formally and practically on the uses of various hi-tech assistive technology promotes

participation and makes all subjects liked and offered by LWVI at all levels. In addition, the study established that the power supply was inadequate, yet if it were constant, it would promote the proficiency of the devices, increase device life span, increase the processing speed of devices, and strengthen work efficiency by teachers and LWVI.

5.3 Discussion of results

The discussion section addressed each objective of the study separately as presented below:

5.3.1 The nature of the available hi-tech assistive technology for teachers and LWVI

These findings are in line with the literature review cited by the Royal National Institute for the Blind (RNIB, 2014), which mentioned some of the hi-tech assistive technology used by teachers and LWVI as: software for speech recognition, screen readers, and screen magnifiers; software for OCR used in Blaze ET; text-to-speech (TTS); oversized monitors; magnifiers with a CCTV; scanners; standalone reading machines; Dictaphones; Duxbury Braille Translation (DBT) software; Braille embossers; smart Braille writers; refreshable Braille displays; digital books; Focus blue Braille display; omni readers; orbit readers; clear readers; scientific talking calculators; and Victor Reader. These were seen available at Madera Secondary School for the Blind in having teachers and LWVI.

Similarly, ICT Policy (2014) Article 2 on communication, according to Makoza (2019) Section 1.1 on "Defining ICT Technologies and Disability for Uganda," listed: speech-to-text programs, screen readers, Victor readers, orbit readers, OCR programs, Blaze ET, Braille printers and embossers, mobile smart phones, internet, Automated Teller Machines (ATMs), digital systems like recorders, Merlin 20 CCTV magnifiers for learners with low vision, scientific talking calculators, computers, and laptops with JAWS as one of the hi-tech assistive technologies used by teachers and LWVI in secondary schools.

Similarly, teachers and LWVI in several African nations, including Ghana, Kenya, Tanzania, Nigeria, and South Africa, use hi-tech assistive technology available for them in schools, and efforts are made by different governments to provide quality working devices to enhance teaching and learning processes (Wachiuri, 2015). These efforts are at times hindered by financial constraints and consequently small budget allocations, affecting the purchase and distribution of hi-tech assistive technology devices, hence affecting the numbers given to secondary schools. Pilot projects based on buying different talking software versions, such as Jaws and Dolphin pens, and recycling old computers have been adopted, but the number of hi-tech assistive technology devices is still limited.

The finding is also in line with Agabirwe and Kiyingi (2020), who observed that even though the government of Uganda and its partners have continued to fairly distribute hi-tech assistive technology in secondary schools, according to reports from the Ministry of Education and Sports (2015) and UCC (2015), only 193 of the 395 computers provided have been used regularly, and out of 120 MP3 players, 32 are utilized, forty Braille embossers were provided, of which 11 are used, and of the 154 card readers supplied, 42 are used by LWVI and teachers during the teaching and learning process.

Connected to the above, Smith and Kelly (2014) say that the use of hi-tech assistive technology by LWVI is a desirable solution when having laptops, computers, and other personal assistive technology devices with an operating system, well-fixed accessibility features and settings, good processing capacity, and good storage capacity. Processing capacity is essential to play audiovisual learning material and to modify the visual appearance of texts, which enhance learning for LWVI. Further, the hi-tech assistive technology devices in use with low processing speeds may affect the usability of the accessible learning content and the attitude of the users, thus being discarded or rejected and considered less valued.

A study on the provision of hi-tech assistive technology to teachers and LWVI in Ghana revealed that LWVI find it difficult to access relevant information for academic work due to the unavailability of devices in the library, as most of them are kept because they are faulty with less response to power and internet (Mansa, 2017).

In a related account, Isaila (2014) observes that for easier accessibility of information by learners with visual impairments in educational institutions, the use of hi-tech electronic and digital assistive technologies, which include a variety of solutions like JAWs, COBRA, Dolphin Guide, Zoom Text and Fusion, Supernova, Audio to Text, DBT, tactile view, and NVDA, should be applied.

Likewise, Manduchi (2012) mentions other hi-tech assistive technology software solutions commonly used and may be of value to LWVI, including library information resources like electronic books, simulations, online PDF documents, the internet, websites, materials on storage media like flash drives and CD ROMs, e-mails, music, WhatsApp, Canva, Google Docs, zoom links, Google Slides, and Monefy solutions that, if made available, can enhance learning in sub-Saharan African schools. The discussion from the above scholar is also in line with Chandra (2021), who examined the use of screen readers in India and discovered that JAWS was the program that teachers and LWVI used most frequently. The next widely used screen reading program was NVDA, which had the advantages of being open-source, portable, and simple to use with the USB. However, given that India is a multilingual nation, concerns about language accents were anticipated to exist (Kaulu, 2019). This situation is similar to that at Madera Secondary School for the Blind in Uganda, which has a diverse LWVI using JAWS, producing a language accent not familiar to the teachers and LWVI.

The finding is in line with the study by various scholars. Setiawan et al. (2020) stated that teaching and learning for LWVI in secondary schools require the use of hi-tech assistive

technology for easier demonstration of their accessible learning subjects, mostly in English, literature, history, and Christian religious education. They also stated that by using e-text like the JAWS application and an auditory technique to assist LWVI, they promote reading English subjects easily. A similar view was discussed by Fansury et al. (2019), who revealed that realizing audiobooks as teaching media for LWVI in learning English and history could help learners in the learning process. These views also relate to Susanto and Nanda (2018), who added that a range of resources, including screen reader technology such as NVDA, JAWS, clear readers, Victor readers, and CCTV magnifiers, are significantly utilized by LWVI in their English, history, and most humanities subjects than in science subjects taught in secondary schools.

5.3.2 Perceptions of teachers and LWVI on the use of hi-tech assistive technology

The study findings are in line with Shikden (2015), who stated that teachers occasionally showed signs of high levels of anxiety when using hi-tech assistive equipment in the classroom, particularly when these gadgets are brand new. Similarly, Coleman (2016) proposes that lack of training is a factor in the utilization and potential abandonment of hi-tech assistive technology devices, particularly among teachers and LWVI, as the majority of teachers and other support staff do not receive sufficient training on how to operate hi-tech assistive technologies. This was cited by Ahmed (2018), who agreed that it could take a lot of work for LWVI and teachers to access and efficiently use some hi-tech assistive technology products and software. Furthermore, inadequate teacher training, preparation difficulties in acquiring and maintaining equipment, and time restraints. In addition to other deficiencies like handwriting, motor skills, reading, and math skills, this could be improved with the application of hi-tech assistive technology solutions.

Likewise, Hansen et al., (2014) confirm that maintenance and repair services for assistive technology, particularly hi-tech equipment for teachers and LWVIs, can be a "serious problem" that may restrict LWVIs' functional capacity. They also claim that an efficient assistive technology system must include prompt maintenance and repair of all available technology products, and they note that the repercussions of inadequate facilities for maintenance and repair go beyond how well users can perform different tasks at work. Similarly, (Borg et al., (2015), WHO (2016), Marino et al., (2015), & Chadha et al., (2014) reveal that assistive technology services are frequently in short supply and located far from the population in need, and they add that trained personnel are required to ensure the proper prescription, fitting, user training, follow-up, maintenance, and repair of assistive devices.

A report by Gallegos., Gould., & Leblois, (2021) revealed that many countries have a shortage of assistive technology and digital libraries. This shows that because of their low levels of technology and unstable power supplies, developing nations like Tanzania, Uganda, and Kenya are in a worse position to utilize hi-tech assistive technology for their LWVI and teachers in secondary schools. In a similar situation, findings in this school show a challenge with power stability hampering utilization of hi-tech assistive technology, just as it is highlighted in the report.

The finding is consistent with the scholarly study of Hunt (2021) & Watson et al., (2017), who state that one of the teachers' primary duties is to ensure that all learners, regardless of their disability, have good learning experiences enhanced by hi-tech assistive technology to accomplish tasks. The challenge is that most devices distributed in schools by the government and partners are few in number, thus preventing LWVI from using assistive technology devices fully in and out of the classroom.

The findings relate well with the UNESCO (2019); Ampratwune et al., (2016) suggestion that learners with disabilities, particularly those with visual impairments, have limited access to and awareness of the benefits of hi-tech assistive technology devices. They should be guided to have full participation through training on their utilization. Similar findings by Kisanga and Kisanga's 2019 UNESCO report on Digital Access to Information and Knowledge for Learners with Disabilities revealed that little is known about the enormous potential of hi-tech assistive technology to improve LWVI education. Another observation is that most teachers lacked the knowledge and expertise necessary to employ hi-tech assistive technology devices and that there was insufficient funding to support training in this area (Kisanga & Kisanga, 2020).

In line with the findings, Jugee and Santally (2016) asserted that across the continent, many secondary schools do not have enough room for computers and other assistive devices, lack infrastructure to enable the use of hi-tech assistive technology in the classroom, and usually teachers are not proficient in using most hi-tech assistive technology devices. They observe that the use of hi-tech assistive technological devices in schools is hampered by the absence of clean surroundings where laptops or desktops with JAWS may be utilized efficiently to avoid being damaged by dust, debris, heat, or water. LWVI and teachers are unable to utilize available technology devices because there is a lack of physical infrastructure, such as labs, during the teaching and learning process. Also, a report by (Gallegos., Gould., & Leblois, 2021) confirmed that many nations have limited accessible infrastructure, such as digital libraries and labs, and limited space for assistive technology resources in most secondary schools. The finding is in line with the situation at Madera Secondary School for the Blind, because only a few hi-tech assistive technology devices are put in the computer lab to be reached by LWVI and teachers, but the rest of the technology devices are kept in different school offices.

The findings are slightly deviating from some policy documents, such as the Persons with Disabilities Act sections 12(6) and 15(b) (2020), with the mandate that a minister in charge of communications create regulations outlining the requirements for LWVIs to have access to information and distributing a complete set or package for the assistive technology devices given to the schools in accordance with the section. Additionally, it stipulates that the government must support the use of informational assistive technology devices in accordance with the World Health Organization's (2011) joint position paper and the 1993 Standard Rules on the Equalization of Opportunities for Persons with Disabilities, including those with visual impairment. There are guidelines for the production, distribution, service provision, repair/maintenance, and use of hi-tech assistive technology devices, according to the same policy documents. It is stated that "making assistive technology available, accessible, affordable, adaptable, acceptable, and of appropriate quality requires efficient use of often limited resources." Therefore, possible production processes are frequently determined by the materials and labor that are available. The materials and production processes that can be used are determined by the service delivery systems that are available, notably for repair and maintenance. It should be noted that if the policies are well implemented, this can promote full utilization of hi-tech assistive technology in this school. Currently, according to the findings, devices are in parts not complete sets, like the computer desktops given to the school without system units, and this prevents LWVI and teachers from utilizing the devices in the school.

Ampratwumet et al., (2016) cited a similar challenge of using hi-tech assistive technology by LWVI as having unlicensed JAWS. They said that although LWVI's use hi-tech assistive technology to improve teaching and learning in secondary schools, they still struggle with using computer assistive technology effectively. It was further stated that 95 percent of LWVI have trouble utilizing Job Access with Speech, also known as screen readers. According to their investigation of JAWS, they agreed that LWVI faces difficulties in utilizing JAWS. This

unlicensed software called Demo JAWS can end its performance at any time, probably between 30 and 40 minutes (Ampratwumet et al., 2016).

The above findings correspond with De Beer et al., (2016), who stated that while some assistive technology may work offline or not rely on the internet in low- and middle-income countries, the majority of hi-tech assistive technologies need dependable internet connectivity. This is because they require more intensive processing, like image recognition or voice calling, if they are to be used sufficiently by LWVI and teachers. With reliable 4G connectivity, it is essential for smart assistive devices like phones, refreshable Braille transcribers, and smart Braille machines to work. So due to the fact that many hi-tech assistive technologies are currently only functional in places with reliable connectivity, a considerable obstacle still exists in many areas in low- and middle-income countries like Uganda, including Madera Secondary School for the Blind. Additionally, internet connectivity is an important facilitator in accessing electronic resources over a network, but the problems that contribute to limited access to hi-tech assistive technology in secondary schools include bad internet connections, a lack of understanding of how to connect products on the internet network, the lack of availability of the internet itself, high costs, a lack of experts and technical staff to navigate the available internets, and a lack of assistive technology policies (Ampratwumet et al., 2016; Kelly, 2011; Oira, 2012; UNESCO, 2019; WHO, 2016). This statement corresponds with the researchers' findings during the study, where the participants complained that the school has an unstable internet connection, affecting the teaching and learning process. These also include research into the lessons, the download of documents, and surfing to acquire new knowledge during self-discovery.

5.3.3 Ways hi-tech assistive technology is utilized by teachers and LWVI

Relatedly, Bricout et al., (2021), who say that LWVI can access a wide range of resources for both academic and recreational purposes by using hi-tech assistive technology, including closed-circuit television, zoom-text and fusion formats for enlargement, phones, particularly smartphones, JAWS, e-books, orbit readers, Blaze ET with OCR, and YouTube videos, play a very important role in compensating for the impairment that learners have. In order to improve their reading and writing skills, as well as their ability to type notes to improve communication during the teaching process in most developed countries, LWVI can therefore manipulate such equipment according to their needs to access information. Similarly, Hughes (2020; Gallegos., Gould., & Leblois, 2021) noted that the most significant benefit of hi-tech assistive technology is access to information, which also helps people communicate better and increases interest in teaching and learning. It was also added that hi-tech assistive technology helps people, including teachers and LWVI, to compensate for their impairments and improve communication. He pointed out that teachers and LWVI can access textual materials, especially books, using Power Point projection for those with low vision, portable electronic magnifiers, CCTV, audio recorders for taking notes, zoom text, and fusion software, which increases their reading pace as they search, retrieve, and access a greater amount of information from various sources in a timely way.

The findings of this study are in line with the views from the study carried out by Sikhakhane et al., (2021), who acknowledged that hi-tech assistive technology provides advantages in teaching, including enabling learners to share learning resources, encouraging collaborative learning, and independent information-seeking through research by teachers and LWVI for educational reasons. Even though many secondary schools in developing nations, particularly in Uganda, rarely use hi-tech assistive technology as an educational tool but instead use it

primarily for administrative tasks, this is due to several barriers like power shutdowns and internet issues. Similarly, the findings are in line with Ok (2018), who states that other LWVI and teachers use various alternatives to visual displays to make research with the help of screen readers like JAWS, COMBRA, SUPANOVA, and NVDA; window's eye programs to access audio information; note-takers and tape recorders for recording and listening to notes; while the internet is considered by LWVI and teachers as a vital resource due to its multifunction platform to access online learning resources and/or materials in alternative formats that support their instruction during the teaching and learning process.

The findings concur with Baker and Green (2016), who state that, since music is primarily a visual medium, making the system of music notation accessible to musicians who are blind or visually impaired is a challenge. Braille music, talking music (which may employ the DAISY standard), and large print music are the three basic types LWVI uses with the help of the available hi-tech assistive technology to promote teaching and learning in secondary schools. LWVI can read music using specialized vision equipment that has different visual display options, such as CCTV magnification. LWVI can compose and read music using audio or braille output due to specialized music software embedded in the hi-tech assistive technology devices. In the school, however, findings indicate that hi-tech assistive technology is used to play music, but not as a subject but for leisure.

The findings are in line with Ahabwe (2022), who notes that LWVI should have opportunities to access and have physical contact with artifacts and materials and, where necessary, texts in Braille and use appropriate hi-tech assistive technology products to participate in all required subjects. For example, the Lower Secondary Curriculum (LSC) is a competency-based curriculum (CBC) that emphasizes the active participation of learners in the learning process rather than the passive teacher-centered approach that was predominant in the old curriculum.

The LSC menu comprises compulsory subjects in S1 and 2 like English, Entrepreneurship, Mathematics, Biology, Chemistry, Physics (or General Science for LWVI), Geography, History, Kiswahili, Physical Education, ICT, Religious Education, and Agriculture. At S.3 and S.4, a learner will be expected to sit in a minimum and maximum of eight and nine subjects, respectively, seven of which are compulsory and one or two electives, and the reform will not affect learners at S.5 and S.6 (NCDC, 2018). From the discussion above, findings showed a discrepancy between the subjects offered in the school and the compulsory subjects as spelled out by the NCDC in Uganda. LWVI in the school mostly offers arts subjects compared to science subjects whenever it comes to 'A' level, and this means that LWVI misses out on marketable combinations like PEM, BCP, PCM, and BAG just because they do not have access to the appropriate hi-tech assistive technologies in the school.

These ideas are in line with Oira's (2016) call for schools to be equipped with more hi-tech assistive technology that is less difficult, easier, quicker, and inspiring as it promotes learning independence for LWVI. There are two advantages to equipping a resource room in schools with the proper Hi-tech assistive technology devices. LWVI will be able to complete their work on time whenever they are given tasks or assignments in the first place because they will have access to resources for assistive technology and use the time available to practice, which supplements teachers' support for them.

Agreeably (Wong & Law, 2016; Morash & Siu, 2016; Ajuwon et al., 2016; Wong & Cohen, 2011; Smith et al., 2009; D'Andrea, 2009), in their study, they stated that it was evident that teachers' ignorance of the use of hi-tech assistive technology had a negative impact on LWVI's use of technology devices and software. This implies that LWVI achievement was negatively impacted by the lack of pre-service training in assistive technology. The study emphasized the importance of making assistive technology a top focus in teacher training programs' curricula.

Although it should be done, teachers and LWVI at secondary schools and higher education institutions continue to have a fundamental need for training on teaching with assistive technology. In order to improve the teaching and learning of LWVI and teachers, there has to be more time and instruction on hi-tech equipment in the training programs. Because of this, more attention should be put on training teachers and LWVI about all of the hi-tech assistive technology that may be used to improve teaching and learning in secondary schools. Teachers and LWVI at Madera Secondary School for the Blind should be trained in using the available hi-tech assistive technology to enhance teaching and learning if the set curriculum has to be achieved.

The finding in the school is in contrary of Article 4.5.1 of Uganda's ICT policy (2014) on the use of assistive technology, which states that the sector's sustainability depends on the availability of a strong ICT and assistive technology infrastructure. Similar to this, utilizing hi-tech assistive technology devices depends on the creation of new services in the schools, like a spacious resource room, and trains the stakeholders to improve the current operations of the institution before enriching it with new assistive technology products and solutions. The advance here is that Uganda must create and maintain this infrastructure across all its educational institutions. The policy provisions have not been implemented in most of the secondary schools since evidence was observed in one city secondary school having a very small ICT and assistive technology resource room to accommodate all the available hi-tech assistive technology systems to enhance the education of LWVI during the teaching and learning process.

The findings from the statements of the participants are in line with various studies made by various scholars on the use of JAWS, as cited by Erwee (2020), that the most widely used screen reader in the world is JAWS. The JAWS are abbreviated as Job Access with Speech and

were created for computer users whose vision impairment prohibits them from seeing screen information or navigating with a mouse to provide speech and braille output. In the same study, LWVI and teachers used JAWS to read emails, websites, and apps. Also, fill out web forms easily, view any papers, including PDFs, and scan documents; utilize the basic instructions in Daisy format; conserve time with Scan Reading and Text Analyzer; and browse the internet with web browsing inputs. Other studies, such as Setiawan et al., (2020) discovered that teachers helped LWVI understand English and other subjects by using an auditory approach and electronic material with the JAWS application. Additionally, Fansury et al., (2019) suggest that using audiobooks as instructional resources for LWVI aids the learning process. Furthermore, Susanto and Nanda (2018) note that the LWVI heavily relies on a variety of tools, including screen reader software like Non-Visual Desktop Access (NVDA) and Job Access with Speech (JAWS), for learning. In short, Hesti and Riski (2017) point out that LWVI benefits from being taught using adapted methodologies with the help of Braille and auditory resources.

The finding is in line with international documents, the Convention on the Rights of Persons with Disabilities (CRPD) Articles 3 and 4 of 2006, that impose obligations on States to provide accessible information to persons with disabilities who are parties; Article 9 (b) requires States to take appropriate measures to ensure access to information, communications, and other services, including electronic services, on an equal basis with others; and Article 21 (a) grants PwDs the right to freedom of expression and opinion through access to public information (Abdelrahman, 2016). This suggests that having access to information is essential for learning and teaching in particular, and in this case, having LWVI made it possible to access curriculum activities utilizing suitable hi-tech assistive technology resources. Additionally, Article 1 of the 2013 Marrakesh Treaty was advanced by the World Intellectual Property Organization (WIPO) to ensure that literary and artistic activities in the form of text, notation, and/or related

illustrations, whether published or not, are made accessible to people with visual impairments or other print disabilities in alternative or accessible formats (Kaminiski & Yanisky, 2013).

The verbal statements from the participants concur with the study by Gitari (2020), who stated that teachers and LWVI in the majority of Kenya's special secondary schools use hi-tech assistive technology to enrich instruction in such a way that they use it to download notes, record the teachers' lessons, read the text books in soft copies, revise the recorded books, provide online access to learning materials, and use PowerPoint presentations in enlarged formats to improve the teaching of LWVI and close the gap caused by visual impairment conditions. However, the results indicate that the hi-tech assistive technology available in the school is inadequate compared to the total population of the users, thus 18 teachers and 102 LWVI are using less than five Victor readers, one Blaze ET, and unstable Demo JAWS to read, record, and take notes.

The views of the participant are in line with the findings of the World Health Organization (2017), which stated that the need for piloting hi-tech assistive technology devices for LWVI and other people with disabilities is greater in less resourced settings, such as Africa, because of individual and national poverty, environmental barriers, poor procurement systems, a lack of support services, a shortage of service providers, and insufficient training of the service providers on the piloting of the available hi-tech assistive technology before production of the devices for the LWVI and teachers.

Furthermore, Khasnabis et al., (2015) suggested that there are seven key areas that must be piloted before providing assistive devices to users, in this case LWVI and teachers in secondary schools: assessment, procurement, technology, environment, usability, sustainability, and realization of rights around the central hub of policy.

Gould et al., (2015) added that a significant portion of hi-tech assistive technology devices in Africa are obtained from outside sources, frequently of substandard quality, and are not appropriate for user needs and environmental requirements due to insufficient pilot systems. As a result, donor organizations are frequently relied upon to measure outcomes in terms of the quantity of devices delivered rather than end user function or participation. It should be noted that in areas where support services are limited, undesirable results include worsened functional and community integration, user injury, secondary problems, device breakdown, insufficient access to power, and a lack of internet connection.

5.4 Conclusion

The conclusion section addressed each objective of the study independently, as presented below in 5.3.1, 5.3.2, and 5.3.3:

5.4.1 The nature of the available hi-tech assistive technology for teachers and LWVI

During the time of study, the primary hi-tech assistive technology available at Madera Secondary School for the Blind were computers with JAWS, Victor Readers, Orbit 20 Readers, Clear Readers, and Closed-Circuit Television Magnifiers (CCTV). Some hi-tech assistive technology available but yet underutilized by LWVI and teachers includes:

Screen Readers, Closed-Circuit Television Magnification (CCTV), JAWS (Job Access with Speech), Fusion and Zoom Text Magnifier, Super NOVO, Optical Character Recognition, Non-Visual Desktop Access (NVDA), Blaze ET, Omni Readers, Braille Embossers, Focus Blue Braille Display, Optelec Readers, and Talking Scientific Calculators Participants stressed how JAWS is available at the school, but mostly Demo in nature that existed shortly, Victor readers, orbit 20 readers, and CCTV magnifiers. It was therefore concluded that the secondary school where the study took place has hi-tech assistive technology but is inadequate compared to the number of LWVI and teachers. The results showed that some of the hi-tech assistive

technology was working well; some was spoiled, whereas others were kept without a central processing unit and external butteries.

5.4.2 Perceptions of teachers and LWVI on the use of hi-tech assistive technology

The participants' perception of the utilization of hi-tech assistive technology was based on a lack of formal training to operate all the available hi-tech assistive technology resources. This was concluded that it limited the utilization of the devices and software by teachers and LWVI at the school of study, hence developing a negative attitude towards utilization. It was also perceived that a lack of repair and maintenance skills and knowledge would make the devices to be ignored with no rehabilitation for further use, hence rendering hi-tech assistive technology useless by the teachers and LWVI in the school where the study took place. There is a perception that arts subjects are taught easily to LWVI at 'A' level, leaving out science combinations. Additionally, a number of issues, including power shortages, inadequate space and infrastructure, an unstable network, and a lack of headsets, affected the secondary school where the study took place in the utilization of hi-tech assistive technology by LWVI and teachers. It is therefore concluded that training teachers and LWVI on the application and use of hi-tech assistive technology would be the basic foundation for the utilization of hi-tech assistive technology for teachers and learners. When the users are adequately trained, it becomes possible for all subjects to be taught in secondary schools, including general science for learners with visual impairments.

5.4.3 Ways hi-tech assistive technology is utilized by teachers and LWVI

The study concluded that teachers and LWVI in the secondary school where the study took place utilized available hi-tech assistive technology to access information with ease by using CCTV cameras to enlarge the print material for learners with low vision. The blind made personal research and revision to their notes by retrieving the recorded information from Victor

readers and Orbit readers. Engaged in leisure activities freely by playing music and reading novels stored on the hi-tech assistive devices. It is therefore concluded that the only way inclusive education can be achieved in Uganda, including at Madera Secondary School for the Blind, is by adequately training and providing a variety of devices to the users to utilize in the process of teaching and learning in secondary schools.

5.5 Recommendation

In light of the findings, the researcher presents recommendations following each study objective as below:

5.5.1 The nature of the available hi-tech assistive technology for teachers and LWVI

The government and partners who are directly involved in purchasing and providing hi-tech assistive technology should provide licensed JAWS for computers and desktops utilized at Madera Secondary School for the Blind, other than depending on Demo JAWS. Should also provide external butteries for power storage and ensure spacious resource rooms are in place.

Increasing the number of hi-tech assistive technology in secondary schools would promote fair utilization of these solutions and products available by LWVI and teachers at Madera Secondary School for the Blind.

Government and telecom providers should ensure that internet connectivity is available in all school premises by using USE grants on infrastructural development since it influences modern teaching and learning processes using hi-tech assistive technology.

5.5.2 Perceptions of teachers and LWVI on the use of hi-tech assistive technology

The Ministry of Education and Sports and other organizations that directly support education in terms of production and distribution of assistive technology should provide teachers in secondary schools with opportunities for training in the use of hi-tech assistive technology and

repair services to address LWVI and teachers' perceptions of the use of assistive technology in schools. This will give teachers the opportunity to use all the technological solutions available for teaching and learning in all subject areas.

The government of Uganda should speed up the domestication of the Marrakesh treaty, which would help teachers and LWVI access print materials and online library materials with fewer restrictions.

Companies producing hi-tech assistive technology devices and software should liaise with the government to pilot all their products with the users, in this case LWVI and teachers, before scaling up the distribution to the secondary school where the study took place since factory errors are only detected during the use of the hi-tech assistive technology tools and are not easy to revert back for correction. Piloting would give the companies an opportunity to correct and improve the standard for processing speed of the devices and acceptance of the internet before putting them on the market.

5.5.3 Ways hi-tech assistive technology is utilized by teachers and LWVI

The Ministry of Education and Sport should strengthen capacity building for teachers and LWVI on the use of hi-tech assistive technology in the area of study. This will encourage the teaching of all learning areas, including science subjects, using available hi-tech assistive technology resources. By having LWVI participate in science subjects in their combinations, it would be easy to compete on the job market with others.

The government should construct more spacious resource rooms or labs to provide space for the installation of the most hi-tech assistive technology kept in secondary schools, including at Madera Secondary School for the Blind.

5.6 Suggestion for future research

The researcher recommends doing a research study on both ‘O’ and ‘A’ level students using mixed research methods to explore the role of assistive technology in promoting digital inclusion for learners with visual impairments in universities in Uganda.

REFERENCES

Abubakar, S and Abdullahi, A. S. (2022). Challenges in using assistive technologies for information access by the special needs student. *Middle Belt Journal of Library and Information Science*, 20.

Abdelrahman, O. H. (2016). Use of library technology and services by the visually impaired and the blind in the University of Khartoum, Sudan. *DESIDOC Journal of Library & Information Technology, 36(3),* 93-97.

Abstract, E. (2017). Education Policy and Planning Department, Ministry of Education & Sports. *A statistical report detailing the findings of the Annual School,* 61-62.

Addis, B. M., Britton, J., & Davies, T. C. (2020). Challenges and barriers to the use and provision of assistive technology in Africa. *A systematic review.* Retrieved from https://www.resna.org/ sites/default/files/conference/2021/Internationally Appropriate

Adebisi, R. O., Liman, N. A., & Longpoe, P. K. (2015). Using Assistive Technology in Teaching Children with Learning Disabilities in the 21st Century. *Journal of Education and Practice.*, 6(24), 14-20.

Agabirwe, P., & Kiyingi, G. W. (2020, March). Utilization of Assistive Technologies Among Visually Impaired Students in University Libraries in Uganda: Users' Experiences. *In International Conference on Information* (pp. 470-479). Cham: Springer.

Ahabwe, M. (2022). Implementing the Lower Secondary Curriculum in Uganda During the Covid-19 Crisis. *African Journal of Education, Science and Technology , 7(2),* 224-235.

Ahmad, F. K. (2015). Use of Assistive Technology in Inclusive Education. *Making Room for Diverse Learning Needs, 6(2),* 62-77.

Ahmed, A. (2018). Perceptions of using assistive technology for students with disabilities in the classroom. *International Journal of Special Education, 33(1)*, 129-139.

Alharbi, R., Ng, A., Alharbi, R., & Hester, J. (2020, April). "I Am Not an Engineer": Understanding How Clinicians Design & Alter Assistive Technology. *In Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, (pp. 1-8).

Allman, C. B., & Lewis, S. (2014). ECC essentials. *Teaching the expanded core curriculum to students with visual impairments*, 15-30.

Al-Zboon, E. (2022). Assistive technologies as a curriculum component in Jordan: Future special education teachers' preparation and the field status. *Assistive Technology, 34(1)*, 20-25.

Al-Zboon, E. (2019). Assistive technologies as a curriculum component in Jordan: Future special education teachers' preparation and the field status. *Assistive Technology, 34(1)*, 20-25.

Ampratwum, J., Offei, Y. N., & Ntoaduro, A. (2016). Barriers to the Use of Computer Assistive Technology among Students with Visual Impairment in Ghana: The Case of Akropong School for the Blind. *Journal of Education and Practice, 7(29)*, 58-61.

Appiah, B., Burdine, J. N., Aftab, A., Asamoah-Akuoko, L., Anum, D. A., Kretchy, I. A., ... & Bates, I. (2018). Determinants of intention to use mobile phone caller tunes to promote voluntary blood donation: cross-sectional study. *JMIR mHealth and Health, 6(5)*, 9752.

Aziz, N., Mohamad Roseli, N. H., & Abdul Mutalib, A. (2011). Visually impaired children's acceptances on assistive courseware . *American Journal of Applied Sciences,* 1019-1026.

Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data analysis. *Qualitative Research Journal, 18* (No. 4), pp. 383-400. https://doi.org/https://doi. org/10.1108/QRJ-D-18-00035

Baguma, R. (2017). An Audit of Inclusive ICTs for Education in Uganda. *In Proceedings of the 10th International Conference on Theory and Practice of Electronic Governance*, 311-320.

Baker, D., & Green, L. (2016). Perceptions of schooling, pedagogy and notation in the lives of visually-impaired musicians. . *Research Studies in Music Education, 38(2),* 193-219.

Barbosa, I. M., Alves, P. R., & Silveira, Z. C. (2021). Upper limbs' assistive devices for stroke rehabilitation: a systematic review on design engineering solutions. *Journal of the Brazilian Society of Mechanical Sciences and Engineering, 43(5),* 1-16.

Bashir, I. W., Abdullahi, M., & Onyemaechi, N. P. (2021). Integrating assistive technology for students with learning disabilities in universities in Nigeria. . *International Journal of Scientific and Research Publications, 11(4)*, 219-225.

Baxter, S., Enderby, P., Evans, P., & Judge, S. (2012). Barriers and facilitators to the use of high-technology augmentative and alternative communication devices: a systematic review and qualitative synthesis. *International Journal of Language & Communication Disorder, 47(2),* 115-129.

Beaunoyer, E., Dupéré, S., & Guitton, M. J. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in human behavior*, 111, 106424.

Bell, E. C. (2019). Access to math and science content for youth who are blind or visually impaired. *Journal of blindness innovation and research*.

Bell, J., & Waters, S. (2018). *Ebook: doing your research project: a guide for first-time researchers.* UK: McGraw-hill education.

Bhowmick, A., & Hazarika, S. M. (2017). An insight into Assistive Technology for the visually impaired and blind people: state-of-the-art and future trends. *Journal on Multimodal User Interfaces, 11(2)*, 149-172.

Bricout, J., Greer, J., Fields, N., Xu, L., Tamplain, P., Doelling, K., & Sharma, B. (2021). The "humane in the loop": inclusive research design and policy approaches to foster capacity building assistive technologies in the COVID-19 era. *Assistive Technology*, 1-9.

Bryman, A. (2016). *Social research methods.* Oxford university press.

Chandra, P. (2021). Piracy and the Impaired Cyborg: Assistive Technologies, Accessibility, and Access. *Proceedings of the ACM on Human-Computer Interaction, 4(CSCW3)*, 1-21.

Chukwuemeka, E. J., & Samaila, D. (2020). Teachers' perception and factors limiting the use of high-tech assistive technology in special education schools in North-west Nigeria,. *Contemporary Educational Technology, 11(1)*, 99-109.

Clarke, V., & Braun, V. (2017). Thematic analysis. *J Posit Psychol, 12(3)*, 297–298.

Coleman, P. (2022). Validity and Reliability within Qualitative Research for the Caring Sciences. *International Journal of Caring Sciences, 14(3),* 2041-2045.

Connor, C., & Beard, L. A. (2015). Increasing meaningful assistive technology use in the classrooms. Universal ,. *Journal of Educational Research, 3(9),* 640-642.

Cook, A. M., & Polgar, J. M. (2008). *Cook and Hussey's assistive technology: Principles and practice.* Mosby: Baltimore (MD).

Creswell, J. W. (2016). Reflections on the MMIRA the future of mixed methods task force report. *Journal of Mixed Methods Research,* 215-219.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approach.* Sage publications.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches.* Sage publications.

Darvishy, A., Eröcal, D., & Manning, J. (2019). *Delivering together for inclusive development: digital access to Information and knowledge for persons with disabilities.* UNESCO Publishing.

Degener, T., & Koster-Dreese, Y. (1995). Standard Rules on the Equalization of Opportunities for Persons with Disabilities: Adopted and proclaimed by General Assembly resolution 48/96 of 20 December 1993. *In Human Rights and Disabled Persons. Brill Nijhoff,* pp. 285-319.

Denscombe, M. (2017). *EBOOK: The good research guide: For small-scale social research projects.* McGraw-Hill Education (UK).

Development, C. o. (2018). *Building digital competencies to benefit from existing and emerging technologies, with a special focus on gender and youth dimensions. .* Geneva, United Nations Economic and Social Council.

De Beer, J., Millar, P., Mwangi, J., Nzomo, V., & Rutenberg, I. (2016). A framework for assessing technology hubs in Africa. NYU J. Intell. Prop. & Ent. L., 6, 237.

Dominic, S., Joshua, C. E., & Eyitayo, B. A. (2020). Assessment of availability, adequacy and condition of high-tech assistive technology resources in special education schools in North-west, Nigeria. *International Journal of Research and Innovation in Social Science (IJRISS), 4(1),* 185-190.

Edyburn, D. L. (2015). *Expanding the use of assistive technology while mindful of the need to understand efficacy. In Efficacy of assistive technology interventions.* Emerald Group Publishing Limited.

Eligi, I., & Mwantimwa, K. (2017). ICT accessibility and usability to support learning of visually-impaired students in Tanzania. *International Journal of Education and Development using ICT, 13(2).*

Erwee, J. (2020). *Assistive technology that may support learners with visual impairment; Teaching Learners with Visual Impairment (Opening Eyes Volume 2).* AOSIS, Cape Town.

Fansury, A.H., Lutfin, N., & Arsyad, S.N. (2019). Audio Books as Teaching Media to Blind Students in Learning EFL. Klasikal. *Journal of Education, Language Teaching and Science, 1(1),* 1–9. https://doi.org/https://doi.org/10.31219/osf.io/8r2m3

Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Assistive technology for the inclusion of students with

disabilities: a systematic review . *Educational technology research and development*, 1-20.

Gallegos, H. L., Gould, M., & Leblois, A. (2021). Global Trends for Accessible Technologies in the Developing World. Accessible Technology and the Developing World, 58.

Gamble, M. J., Dowler, D. L., & Hirsh, A. E. (2020). Informed decision making on assistive technology workplace accommodations for people with visual impairments. *Work*, *23*(2), 123-130.

Giesbrecht, E. D. (2013). Application of the Human Activity Assistive Technology model for occupational therapy research. *Australian Occupational therapy journal, 60(4)*, 230-240.

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

GOU. (2020). *The Persons with Disabilities Act:*. Kampala: Uganda.

Gould, M., Leblois, A., Cesa Bianchi, F., & Montenegro, V. (2015). Convention on the rights of persons with disabilities, assistive technology and information and communication technology requirements: where do we stand on implementation? *Disability and Rehabilitation: Assistive Technology, , 10(4)*, 295-300.

Habulezi, J., Batsalelwang, K. P., & Malatsi, N. M. (2017). Factors influencing the poor academic performance of learners with vision impairment in Science Subjects in Kgatleng District in Botswana. *International Journal of Learning, Teaching and Educational research, 16(11)*, 28-44.

Hughes, J. M. (2020). Constructing a united disability community: The National Council on Disability's discourse of unity in the deliberative system around disability rights. *Journal of Deliberative Democracy*, 12(1).

Hunt, P. F. (2021). Inclusive education: The case for early identification and early intervention in assistive technology. *Assistive Technology, 33(sup1)*, S94-S101.

Isaila, N. (2014). The assistive software, useful and necessary tool for blind student's abilities development. *Procedia-Social and Behavioral Sciences*, 116, 2189-2192.

Jamali-Phiri, M., Ebuenyi, I. D., Smith, E. M., Kafumba, J. A., MacLachlan, M., & Munthali, A. (2021). Socio-demographic factors influencing the use of assistive technology among children with disabilities in Malawi. *International Journal of Environmental Research Public Health, 18(3062)* , 2-12.

Johnson, D. (2011). Why is assistive technology underused? *Library Hi Tech News, 16(6)*, 15.

Jones, B. A., Rudinger, B., Williams, N., & Witcher, S. (2019). Training pre-service general educators in assistive technology competencies for students with visual impairments. *British Journal of Visual Impairment, 37(1)*, 29-39.

Jordaan, D. B. (2014). Computer science students' perceptions of mobile technology in the classroom. *Mediterranean Journal of Social Sciences, 5(21)*, 353-353.

Jugee, S., & Santally, M. I . (2016). The tablet PC initiative in Mauritius-A situational analysis. IJAEDU. *International E-Journal of Advances in Education, 2(4)*, 14-22.

Kamei-Hannan, C., & Lawson, H. (2012). Impact of a braille-note on writing: Evaluating the process, quality, and attitudes of three students who are visually impaired. *Journal of Special Education Technology, 27(3)*, 1-14.

Kaminski, M. E., & Yanisky-Ravid, S . (2013). *The Marrakesh Treaty for visually impaired persons: Why a treaty was preferable to soft law. 75, 255.* U. Pitt. L. Rev.

Kaulu, J. (2019). *Efficacy of assistive technology on the visually impaired learners' grasping of library information resources: a case of Zambia library, cultural and skills centre for the visually impaired in (Doctoral dissertation).* Lusaka-Zambia: The University of Zambia.

Khasnabis, C., Mirza, Z., & MacLachlan, M. (2015). Opening the GATE to inclusion for people with disabilities. *The Lancet, 386(10010)*, 2229-2230.

Khumalo, S., & Hodgson, T. F. (2017). *The right to basic education for children with disabilities. The Basic Education Rights Handbook: Education rights in , 104-127.* Pretoria: South Africa.

Kisanga, D. H., & Kisanga, S. E. (2021). Access to Assistive Technology among students with visual impairment in higher education institutions in Tanzania: challenges and coping mechanisms. *University of Dar es Salaam Library Journal, 15(2)*, 137-151.

Kisanga, S. E. (2020). Coping with educational barriers in Tanzanian inclusive education settings: evidence from students with sensory impairment. *Current Psychology*, 1-10.

Kisanga, S. E., & Kisanga, D. H. (2022). The role of assistive technology devices in fostering the participation and learning of students with visual impairment in higher education institutions in Tanzania. Disability and Rehabilitation. *Assistive Technology*, 791-800.

Koch, K. (2017). Stay in the box! Embedded Assistive Technology improves access for students with disabilities. *Education Sciences, 7(4)*, 82.

Lamond, B., & Cunningham, T. (2020). Understanding teacher perceptions of assistive technology. *Journal of Special Education Technology, 35(2)*, 97-108.

Lawson, N., Maia, M., Hennen, L., Wolbring, G., Bratan, T., Kukk, P., ... & Mordini, E. (2018). Assistive technologies for people with disabilities–Part II: Current and emerging technologies. *Technical Report, European Parliamentary Research Service, Scientific Foresight Unit (STOA)*.

Lowe, N. K. (2019). What is a pilot study? *Journal of Obstetric, Gynecologic & Neonatal Nursing, 48(2)*, 117-118.

Lucky, A.T. & Achebe, N.E . (2012). "Information service delivery to the visually impaired: case study of hope for the blind foundation in Wusasa, Zaria (Nigeria)". . *Research Journal of Information Technology*, 18-23.

Mahony & Quinlivan. (2020). Voice-controlled smart assistive device for visually impaired individuals. IEEE. *In 2016 12th IEEE international symposium on electronics and telecommunications (ISETC)*, 186-190.

Makoza, F. (2019). National ICT policy challenges for developing countries: a grounded theory informed literature review. *International Journal of Technology Policy and Law, 3(2)*, 107-130.

Manduchi, R. (2012). Mobile vision as Assistive Technology for the blind: An experimental study. Springer. *In International Conference on Computers for Handicapped Persons* (pp. 9-16). Berlin: Heidelberg.

Manjari, K., Verma, M., & Singal, G. (2020). A survey on assistive technology for visually impaired. *Internet of Things*, 11, 100188.

Mansa, A. E. (2017). Provision of assistive technologies in academic libraries to students with visual impairment in Ghana: A case study of the University of Education,

Winneba, Ghana. *Library Philosophy and Practice (e-journal, 1679.*(https://digitalcommons. unl.edu/lib philprac/1679).

Meeks, L. M., Herzer, K., & Jain, N. R. (2018). Removing barriers and facilitating access: increasing the number of physicians with disabilities. *Academic Medicine, 93(4),* 540-543.

Miyauchi, H., & Paul, P. V. (2020). Perceptions of Students with Visual Impairment on Inclusive Education: A Narrative Meta-Analysis. Human: . *Journal for Interdisciplinary Studies*, 10(2).

Modisi, R. (2019). The implementation of inclusive education by teachers of learners with visual impairment (Doctoral dissertation,). Pretoria: University of Pretoria.

MoICT. (2014). *Ministry of Information and Communications Technology . Kampala.*

Morelle, M. (2016). Challenges experienced by learners with visual impairment in two mainstream primary schools in Klerksdorp, Dr. Kenneth Kaunda District , University of Liberia. *master's thesis*.

Mukhopadhyay, S., Moswela, E., & Habulezi, J . (2021). Experiences of learners with visual impairments in Botswana primary schools. *International Journal of Inclusive Education*, 1-18.

Mulvenna, M., Hutton, A., Coates, V., Martin, S., Todd, S., Bond, R., & Moorhead, A. (2017). Views of caregivers on the ethics of assistive technology used for home surveillance of people living with dementia. *Neuroethics, 10(2),* 255-266.

Mwantimwa, K. (2021). Exploring usage of assistive technology resources by students with disabilities. *Journal of Disability Studies, 7(1),* 38-47.

O'Brolcháin, F. (2018). Autonomy benefits and risks of assistive technologies for persons with intellectual and developmental disabilities. *Frontiers in public health*, 6, 296.

Odeke-Nato, J. (2021). Information and Communication Technology (ICT) in Teacher Education. *Towards facilitating conducive learning environments for learners with visual impairment*, 10.

Ok, M. W. (2018). Use of iPads as assistive technology for students with disabilities. *TechTrends, 62(1),* 95-102.

P. M. Ajuwon, M. K. Meeks, Griffin-Shirley, N., & Okungu, P. A. (2016). Reflections of teachers of visually impaired students on their assistive technology competencies. *Journal of Visual Impairment & Blindness, 110(2),* pp. 128-134.

Polit, D. F., & Beck, C. T. (2017). *Nursing research: Generating and assessing evidence for nursing practice (10th ed.).* Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins.

Rebouillat, S. (2022). IP & Innovation, within the Context of Frontier Technologies; A Matter of Accessibility with “Open” Questions. *Intelligent Information Management, 14(3),* 93-103.

Reddy, K. S. (2020). Facilitating Instruction for visually impaired children. *Editorial Board, 9(1),* 132.

Sah, P. K. (2013). Assistive Technology Competencies: Need, Outlook, and Prospects (With Reference to Special Educators for Children with Visual Impairment). *American Journal of Disability , 200(15),* 22- 35.

Senjam, S. S. (2021). The current advances in human–smartphone user interface design: An opportunity for people with vision loss. *Indian Journal of Ophthalmology, 69(9)*, 2544.

Setiawan, W.A.J., Adnyani, L.D.S., & Suprianti, G.A.P. (2020). Strategies in Teaching Reading to Visually Impaired Students. *Journal Pendidikan Bahasa Inggris Undiksha, 8(2)*(65). https://doi.org/https://doi.org/10.23887/jpbi.v8i2.28663

Shay, A. (2019). The accommodation System: Environment . Academic Press. *In Assistive Technology Service Delivery*, 45-53.

Sikhakhane, M., Govender, S., & Maphalala, M. C. (2021). South African teachers' perspectives on using the computer as a tool for teaching and learning. *International Journal of Education and Practice, 9(1),* 93-104.

Siu, Y. T., & Morash, V. S. (2014). Teachers of students with visual impairments and their use of assistive technology: Measuring the proficiency of teachers and their identification with a community of practice. *Journal of Visual Impairment & Blindness , 108(5),* 384-398.

Smith, D. W., & Kelly, S. M. (2014). Assistive technology for students with visual impairments: A research agenda. *International review of research in developmental disabilities*, 46, 23-53.

Susanto, S., & Nanda, D.S . (2018). Teaching and Learning English for Visually Impaired Students: An Ethnographic Case Study. English Review. *Journal of English Education, 7(1)*(83). https://doi.org/ https://doi.org/10.25134/erjee.v7i1.1530

UNESCO. (2019). *Delivering together for inclusive development: Digital access to information and knowledge for persons with disabilities.* Paris: UNESCO.

UNICEF. (2019). *Technology for development report: accelerating results for children with technology and digital innovation.* Unicef.

V. S. Morash & Y. T. Siu. (2016). Social predictors of assistive technology proficiency among teachers of students . *International Journal for Infonomics (IJI), 13*(1, March 2020).

Wachiuri, R. N. (2015). *Effect of assistive technology on teaching and Learning of integrated English among visually Impaired learners in special secondary schools in Kenya (Doctoral dissertation).* Nairobi: University of Nairobi.

Wandera, S. O., Ntozi, J., & Kwagala, B. (2014). Prevalence and correlates of disability among older Ugandans: evidence from the Uganda National Household Survey. *Global Health Action, 7(1),* 25686.

Watson, A. H., Ito, M., Smith, R. O., & Andersen, L. T. (2017). Effect of assistive technology in a public-school setting. *The American Journal of Occupational Therapy, 64(1),* 18-29.

Weerasinghe, I. E., Fonseka, P., Dharmaratne, S. D., Jayatilake, J. A., & Gielen, A. C. (2015). *Barriers in using assistive devices among a group of community-dwelling persons with lower limb disabilities in DCIDJ,* (Vol. 26(1). Sri Lanka.

WHO. (2014). Joint position paper on the provision of mobility devices in less-resourced settings. *a step towards implementation of the Convention on the Rights of Persons with Disabilities (CRPD) related to personal mobility*.

WHO. (2017). Global priority research agenda for improving access to high-quality affordable assistive technology.

WHO. (2022). *Global report on assistive technology.*

Williamson-Henriques, K. M. (2013). *Secondary teachers' perceptions of assistive technology use for students with learning disabilities* . Carolina : University of North Carolina at Greensboro.

Wong, M. E. (2018). Guiding teachers of students with visual impairments to make assistive technology decisions: Support for Learning. *Preliminary experience using the Wisconsin assistive technology initiative, 33(4),* 429-439.

Wong, M. E., & Law, J. S. (2016). Practices of Assistive Technology implementation and facilitation: Experiences of teachers of students with visual impairments in Singapore. *Journal of Visual Impairment & Blindness, 110(3),* 195-200.

Yin, R. K. (2018). *Case study Research and applications. Design and methods (6th edition).*

Zhou, L., Parker, A. T., Smith, D. W., & Griffin-Shirley, N. (2013). Assistive technology for students with visual impairments: Challenges and needs in teachers' preparation programs and practice. *Journal of Visual Impairment & Blindness, 105(4),* 197-210.

APPENDICES

Appendix i: Interview Guide for Teachers

I am Sanya Jackson Obale, a student at Kyambogo University pursuing a Master's degree ***in*** *Special Needs Education. I am undertaking a research study titled* ***''Utilization of hi-tech assistive technology by teachers and learners with visual impairment at Madera Secondary School for the Blind in Uganda''.*** *The study explores the utilization of hi-tech assistive technology by teachers and LWVI at Madera secondary schools for the blind in eastern Uganda. You have been purposefully selected to participate in this study because it is assumed that you will provide reliable information about the utilization of hi-tech assistive technology in secondary schools.*

(i). Background information about the teachers including;

Gender, subject, classes taught while using hi-tech assistive technology and teaching experience to LWVI.

(ii) The nature of the available hi-tech assistive technology for teachers.

1. Which hi-tech assistive technologies are available for use by teachers in your school?
2. What status are the hi-tech assistive technology resources your school uses during teaching for teachers?
3. Which hi-tech assistive technology software do you use during teaching teachers in your school?
4. Which subjects in your school use hi-tech assistive technology to enhance teaching?

(iii) The perceptions of teachers on the use of hi-tech assistive technology.

1. What kind of training do you have in using hi-tech assistive technology for teaching teachers?
2. Are teachers trained in hi-tech assistive technology repair and maintenance skills in your school?
3. What challenges do you face while using hi-tech assistive technology devices and software during teaching in your school?

(iv) Ways hi-tech assistive technology is utilized by teachers.

1. In what ways does hi-tech assistive technology help you teach in your school?
2. Which academic areas provide difficulties for you while utilizing hi-tech assistive technology to teach at your school?
3. What should be done, in your opinion, to ensure that hi-tech assistive technology is used fairly and well at your school?

THANK YOU FOR YOUR COOPERATION

Appendix ii: Interview Guide for LWVI

I am Sanya Jackson Obale, a student at Kyambogo University pursuing a Master's degree ***in*** *Special Needs Education. I am undertaking a research study titled* ***''Utilization of hi-tech assistive technology by teachers and learners with visual impairment at Madera Secondary School for the Blind in Uganda''.*** *The study explores the utilization of hi-tech assistive technology by teachers and LWVI at Madera secondary schools for the blind in eastern Uganda. You have been purposefully selected to participate in this study because it is assumed that you will provide reliable information about the utilization of hi-tech assistive technology in secondary schools.*

(i). Background information about LWVI including:

Gender, subjects learn and class.

(ii) The nature of the available hi-tech assistive technology for LWVI.

1. Which hi-tech assistive technologies are available for use in your school?
2. What status are the hi-tech assistive technology resources your school uses during learning?
3. Which hi-tech assistive technology software do you use during learning in your school?
4. Which subjects in your school use hi-tech assistive technology to enhance learning?

(iii) The perceptions of LWVI on the use of Hi-tech assistive technology.

1. What kind of training do you have in using hi-tech assistive technology for learning in your school?
2. Are LWVIs trained in hi-tech assistive technology repair and maintenance skills in your school?
3. What challenges do you face while using hi-tech assistive technology devices and software during learning in your school?

(iv) Ways hi-tech assistive technology utilized by LWVI.

1. In what ways does hi-tech assistive technology help you learn in your school?
2. Which academic areas provide difficulties for you while utilizing hi-tech assistive technology to learn at your school?
3. What should be done, in your opinion, to ensure that Hi-tech assistive technology is used fairly and well at your school?

THANK YOU FOR YOUR COOPERATION

Appendix iii: Observation Guide

Aspect to observe	Expected Items	Available	Remarks
Assistive Technology available in the school.	Assistive Technology resource room.		
	Hi- Tech Assistive Technologies		
	CCTVs (Merlin 20)		
	Digital recorders		
	Clear readers		
	Screen Readers (JAWs) COBRA, Dolphin Guide, Supernova.		
	Blaze ET		
	Fusion 2022 (Jaws and Zoom Text)		
	Victor reader stream		
	Pal Scanner		
	Digital LCD talking Calculators		
	I-Loview HD 7		
	Braille embosser		
	Orbit Reader 20		
	Orbit Reader 40		
	Telescopes		
	Laptops/computers		
	Smart Braille Machines		

Indicate any other hi-tech assistive technology available but not mentioned above in the school;

Appendix iv: Introductory Letter

KYAMBOGO UNIVERSITY

P. O. BOX 1, KAMPALA
FACULTY OF SPECIAL NEEDS & REHABILITATION
Tel: 0414-286237/285001/2 Fax: 0414-220464
DEPARTMENT OF SPECIAL NEEDS STUDIES

21st November 2022

To whom it may concern

Dear Sir/Madam,

SUBJECT: INTRODUCTORY LETTER FOR DATA COLLECTION

This is to introduce the bearer SANYA JACKSON DRALE **Reg. No:** 20/U/GMSN/13102/WKD who is a bonafide student of Kyambogo University in the Department of Special Needs Studies. As partial fulfillment of the requirements for the award of the Masters of Special Needs Education, s/he is required to undertake a research on the approved area of study.

The purpose of this letter is to request you to allow him/her to collect data for his/her research study.

Kyambogo University will be grateful for any assistance rendered to the student.

Sincerely,

Dr. Okwaput Stackus

HEAD OF DEPARTMENT

Kyambogo University
21 NOV 2022
P.O.Box 1, Kyambogo
Department Of Special Needs Studies

Appendix v: Letter to the School Administration

KYAMBOGO UNIVERSITY

FACULTY OF SPECIAL NEEDS AND REHABILITATION

DEPARTMENT OF SPECIAL NEEDS STUDIES

P.O BOX 1, KYAMBOGO

Tel 0414-286237/8/285584, 222935, Fax 0414-222961

Letter to the School Administration

THE HEAD TEACHER

MADERA SECONDARY SCHOOL FOR THE BLIND

Dear sir/madam/Sr;

RE: REQUEST TO CARRY OUT DATA COLLECTION FROM YOUR SCHOOL

I hereby submit my request to your office as indicated in the reference above. I am a student of Kyambogo University pursing a master's degree in Special Needs Education tenable in the department of special needs studies. Currently, I am conducting a study on **'*Utilization of hi-tech assistive technology by teachers and learners with visual impairment at Madera secondary school for the blind in Uganda*'** and I have embarked on data collection exercise as a requirement for the award of that degree. My study is targeting Secondary Schools in eastern Uganda and in particular the teachers and LWVI. This School has been chosen because it has LWVI. Thus, your institution is expected to have relevant information to answer the research questions for the study.

My study is purely qualitative and I am using interviews to collect data but I also request to be allowed to observe the resource room where LWVI learn from. The purpose of this letter therefore is to request your office to grant me permission to get information for my study.

I will be a grateful if my request meets your kind consideration. Attached are copies of my university identity card, introductory letter and admission letter from Kyambogo University.

Thank you

Yours sincerely

SANYA JACKSON OBALE

jackson.sanya@education.go.ug / 0773335521

Appendix vi: Letter to the Participant

KYAMBOGO UNIVERSITY

FACULTY OF SPECIAL NEEDS AND REHABILITATION

DEPARTMENT OF SPECIAL NEEDS STUDIES

P.O BOX 1, KYAMBOGO

Tel 0414-286237/8/285584, 222935, Fax 0414-222961

Letter to the Participant

Dear participant,

Re: Request to participate in the research study

I write to you as per the reference above. I am a student of Kyambogo University pursuing a master's degree in special needs education tenable in the department of special needs studies

Currently, i am conducting a study entitled ''***Utilization of hi-tech assistive technology by teachers and learners with visual impairment at Madera secondary school for the blind in Uganda***'' and your college has been identified as an entity for data collection. The purpose of this letter is therefore to humbly request you to be a participant in this study. The information you will provide is strictly for academic purposes only and as such will be treated confidential. You are free to withdraw if you feel uncomfortable to proceed with the participation.

I will be very grateful if you positively consider my request. I thank you.

Yours sincerely

SANYA JACKSON OBALE

jackson.sanya@education.go.ug / 0773335521

Appendix vii: Consent Form

KYAMBOGO UNIVERSITY

FACULTY OF SPECIAL NEEDS AND REHABILITATION

DEPARTMENT OF SPECIAL NEEDS STUDIES

P.O BOX 1, KYAMBOGO

Tel 0414-286237/8/285584, 222935, Fax 0414-222961

CONSENT FORM

Dear participant,

I am a student of Kyambogo University pursuing a Master's Degree in Special Needs Education. I am carrying out a research study on ***'Utilization of hi-tech assistive technology by teachers and learners with visual impairment at Madera secondary school for the blind in Uganda'***. Its hoped that the findings of the study will help to enlighten the educators on how hi-tech assistive technology can be utilized by LWVI during their learning in secondary schools and provide useful information to ministry of education and sports as well as other stakeholders for policy formulation, planning, developing and providing appropriate hi-tech assistive technology research in secondary schools in Uganda.

You have been identified as one of the participants who can inform the study through an interview. The interview will focus on study objectives. The interview is likely to last 25-30 minutes. The purpose of this letter is to request you to participate in the study. Whatever information you provide will be used for the purpose of the study and academics only and will be kept confidential. You will also be free to withdraw from the study in case you fill uncomfortable to proceed with the participation.

Thank you very much for your support and cooperation in advance.

Yours sincerely

SANYA JACKSON OBALE

Confirmation of acceptance

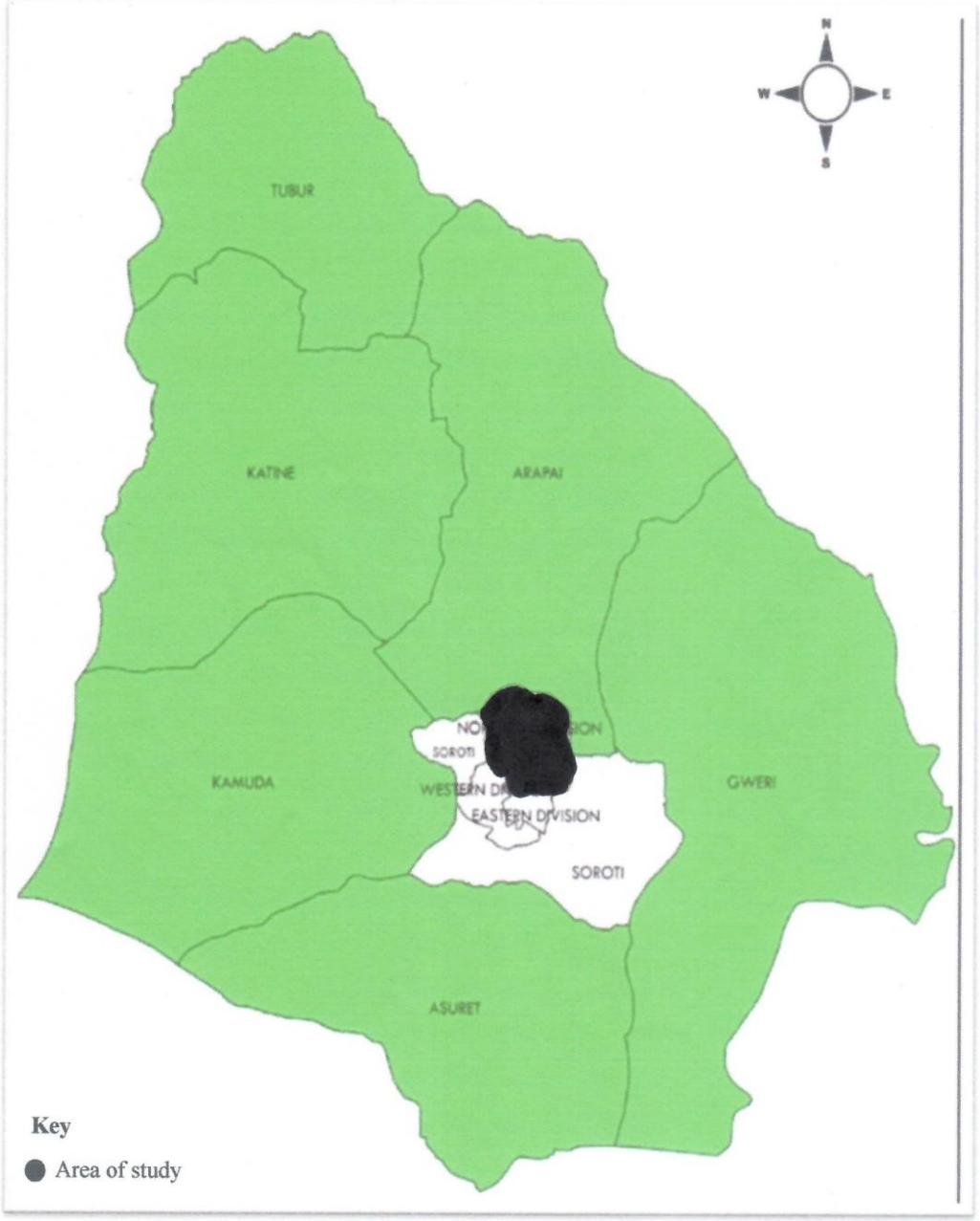
I have read and understood the purpose of the study and I hereby consent to participate.

Signature…… Date ……

Appendix viii: Map of Uganda showing Madera SFB in Soroti City

Source: Uganda Bureau of Statistics April, 2017

Appendix ix: Map of Soroti City showing Area of study



Source: Uganda Bureau of Statistics April, 2017