

**UTILIZATION OF ASSISTIVE TECHNOLOGY IN IMPROVING ACADEMIC PERFORMANCE IN PRIMARY SCHOOLS FOR LEARNERS WITH HEARING CHALLENGES IN MERU AND THARAKA NITHI COUNTIES, KENYA**

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**A Thesis Submitted to the School of Education and Social Sciences in Partial Fulfilment of the Requirements for the Conferment of the Degree of Doctor of Philosophy in Leadership and Education Management of Kenya Methodist University**

**AUGUST 2022**

## DECLARATION AND RECOMMENDATION

### **Declaration**

This thesis is my original work and has not been presented for the award of a degree or any other award in any other University.

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### **Recommendation**

We confirm that the candidate carried out the work reported in this thesis under our supervision.

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## **DEDICATION**

To my husband Murithi Mutea, our son Sam Kim, Dan Mutuma and our daughter lisa Nkirote.

## **ACKNOWLEDGMENT**

I sincerely thank God for his love and provision throughout my course of study. I am grateful to my supervisors Dr. Severina Mwirichia and Prof Paul Gichohi for their professional guidance and encouragement that led to the development of this document. My special thanks also goes to Dr. Kibaara, Dr Muchiri, Dr Kanyi and Dr. Lucy Ikiara among others for their guidance and support which led to the completion of this document.

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## ABSTRACT

Through the Ministry of Education, the government of Kenya has put in place legal frameworks and policies to support children's education with special needs. It has implemented measures such as training and employing teachers to deliver special needs quality education and increasing budgetary allocations for the same. Despite these efforts, academic performance in primary schools for students with hearing impairments has been dismal, falling below the national average of 250 points. This study aimed to assess the utilization of assistive technologies towards improving the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties, Kenya, and determine the moderating effect of learner's attitude in the hypothesized relationship. The study's key objectives were to investigate the impact of listening assistive technology, augmentative and alternative assistive technologies, and alerting assistive technology on academic achievement in primary schools for students with hearing impairments. The last objective looked at how learners' attitudes influenced the hypothesized relationship. The cause and effect theory, capacity theory, and social cognitive theory drove the study. It adopted the pragmatism philosophy and applied a mixed-methods approach. It utilized correlational and descriptive survey research designs. The three primary schools for students with hearing impairments were the target audience, and information was contributed by students, teaching and non-teaching personnel, head teachers, and County Educational Directors of Education. The learners, teaching and non-teaching personnel were selected using simple random, however the three head teachers and two County Educational Directors of Education were chosen on purposively. Data were collected using questionnaires, focused group discussion and an interview guide. Piloting enabled the checking of the reliability and validity of instruments. The quantitative data were analyzed using SPSS. The mean, mode and percentages were computed, while correlation and regression analysis helped to test hypotheses. Thematic analysis was used to assess the qualitative data. Tables, graphs, and identified themes were used to present the findings. The study confirmed that the academic performance in the three primary schools was poor. The schools had few assistive technology devices, which were poorly maintained and limited in variety; hence, their utilization in class and during examinations was conspicuously very low. Moreover, the learners lacked enough skills, while the schools lacked clear guidelines regarding their utilization. The government's support was also negligible. Nevertheless, the three assistive technology devices were statistically significant in influencing the academic performance in primary schools for learners with hearing impairments. The learner's attitude moderated the hypothesized relationship in this study. The study recommends that the Ministry of Education not only purchase all the requisite assistive technology devices but also allocate some funds for repair and maintenance. It should come up with training schedules for learners on assistive devices. Policy was needed to foster the use of assistive technology devices in classes and during examinations. The Teacher Service Commission should liaise with the government to ensure that all the teachers posted to primary schools for learners with hearing impairments are well trained in using the assistive technology devices. Findings have implications on curriculum, funding, and teaching practices of the hearing impaired learners.

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## **LIST OF ABBREVIATIONS & ACRONYMS**

ABR	Auditory brainstem
APA	American Psychological Association
ASHA	American Speech-Language and Hearing Association
CHC	Center for Hearing and Communication
FGD	Focus Group Discussion
GATE	Global Cooperation on Assistive Technology
IDEA	Individuals with Disability Education Act
IQ	intelligence quotient
KCPE	Kenya Certificate of Primary Education
KeMU	Kenya Methodist University
LCD	Liquid Crystal Display
LOI	Language of Instruction
MADHS	Michigan Association for Deaf, Hearing and Speech Services
NACOSTI	National Commission for Science Technology and Innovation
NGOs	Non-governmental Organizations
NIDCD	National Institute on Deafness and Other Communication Disorders
NIDCD	National Institute on Deafness and Other Communication Disorders
NIDCD	National Institute on Deafness and Others Communication Disorders
NIH	National Institute of Health
OCALI	Outreach Center for Deafness and Blindness
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
USA	United States of America
WHO	World Health Organization

# CHAPTER ONE

## INTRODUCTION

### **1.1 Background of the study**

Education is instrumental in fostering the social-economic development of an individual and community. In all countries, education is considered a basic human right. Equalizing education opportunities for all learners is therefore paramount. It guarantees equal academic achievement for all. For learners with a hearing challenge, equal opportunity for academic achievement has implications on teaching methodologies, instructional media, learning environment, classroom management and handling of examinations (Mcclain-Nhlapo et al., 2017; Marschark et al., 2015; Su et al., 2020).

Hearing challenges assimilates to a temporal or permanent condition of partial, moderate, severe to conductive, sensory neural diminish or complete hearing loss that may be in one year, unilateral or both ears resulting from malformation, malfunctioning or damage of the outer ear, middle ear, inner ear or the hearing control center in the brain (Musonda & Phiri, 2017; WHO, 2021). The phrase 'hearing challenges' has been used in this study interchangeably with 'hearing impairment' and 'hearing loss. This study adopted hearing challenges. Hearing challenges are quickly noticeable when individual experiences diminished hearing sensitivity to sound, which is usually indicated by the level of sound detection, commonly referred to as the hearing threshold (WHO, 2021).

Hearing challenges are usually classified into three types; sensorineural hearing impairment, conductive hearing impairment, and mixed hearing loss. Sensorineural hearing challenges come

with ageing, injuries, excessive noise exposure, stroke, meningitis, and viral infectious diseases such as mumps and measles. It can be hereditary or resulting from hypertension and diabetes. At the same time, conductive hearing challenges come from wax build-up, foreign objects in the ear canal, ossicles, otosclerosis and tumours (The National Institute of Health [NIH], 2021; Wein, 2014). Over 700 million individuals will have hearing problems by 2050, according to the World Health Organization [WHO] (2021). According to the Globe Federation of the Deaf, there are 70 million deaf persons in the world, with 56 million receiving just basic education, primarily in poor nations (Mcclain-Nhlapo et al., 2017).

Globally, there has been increasing emphasis and conventions on education for all, resulting in many countries enacting policies on inclusive education. Access to education is linked to academic achievement. Education achievement for all learners (with or without disability) is critical in shaping their future destiny and success (Kun-man, 2017; Su et al., 2020; Sambu et al., 2018). For learners with hearing challenges, the academic achievement indicates that the learners have adequate resources and other support systems in the form of teachers, assistive technology, facilities and equipment. In the current study, the performance of learners with the hearing challenge is assessed with respect to the utilization of assistive devices, facilities and technologies that facilitate learning in primary schools.

The Individuals with Disabilities Education Act [IDEA] of 2004 in the United States defines assistive technology as any item, piece of equipment, or product system, whether purchased commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities. It goes on to say that assistive technology

services are any services that directly help a person with a disability choose, acquire, or utilize assistive technology equipment (Individuals with Disability Education Act [IDEA], 2004; Wairimu, 2015; National Institute on Deafness and Other Communication Disorders [NIDCD], 2021). In the context of this study, the definition provided by the USA Individuals with Disability Education Act will be adopted.

Numerous technologies assist people with hearing challenges. The same is broadly classified into three; listening assistive technology, augmentative and alternative assistive technologies and alerting assistive technology (National Institute on Deafness and Others Communication Disorders, 2021; Ashton, 2002; Wein, 2014). The choice of one kind over another is dependent on specific needs or attributes, and it may change over time or in different situations. LaPlante et al. (1992), Wein (2014), and Ashton (2002), argues that assistive technology gives people with disabilities the independence to execute things that they formerly had difficulty or were unable to complete by providing enhanced abilities. They offer alternative ways of accomplishing tasks, actions, and activities, as well as assisting persons with disabilities in reaching their full potential, such as achieving educational goals (LaPlante et al., 1992; Ashton, 2002; Wein, 2014).

Academic success of students with hearing difficulties is often defined by a learner's ability to spell correctly, communicate well, and improve in subjects studied. The performance can be measured through education assessment tools, such as academic scores in examinations such as KCPE (Marasinghe et al., 2015). The performance of a hearing impaired learner depends on many factors such as psychosocial factors, age, degree of hearing loss, as well as the extent to which one is able to use assistive device. Basically, the education of learners with hearing challenges has been facilitated by the incorporation of sign language and the adoption of an inclusive learning

strategy that entails incorporating assistive devices. Examples of such devices include computers with software for persons with special needs, hearing aids and text phones for the deaf (The National Needs Education Policy Framework, 2009; Sambu et al., 2018; Kun-man, 2017). A recent development from China indicates that the teaching and learning of this special group of learners have been facilitated through oral approach, auditory and speech training with minimal emphasis on sign language training (Su et al., 2020).

Globally, the academic performance of students with hearing impairments is critical and cannot be overstated.. Many countries have established policy and regulatory frameworks guiding the education of special groups. These include policies addressing inclusive education, commissioning rehabilitation of various forms of impairment and special need acts. The Committee on Care and Rehabilitation of the Disabled, Totally Integrated Quality Education and Training, and Task Force on Exceptional Needs are three current efforts and advocacy groups that support the education of persons with special needs (Kalya, 2020; Jitolee, 2016; Masayi, 2020; Mugisa, 2017; Alshutwi et al., 2020). In China and Australia, the academic failure of learners with the hearing challenge is perceived as a long-standing issue that is yet to get amicable solutions. Despite that, it is documented that the difference in achievement in China and Australia tends to widen as the learners go to the next academic level of education (Kun-man, 2017; Su et al., 2020).

In America, academic achievement for learners with hearing challenges is influenced by several factors. These include the student hearing levels and threshold, language and communication issues, the parents' level of education, family's socioeconomic status, and the school environment (Marschark et al., 2015). The same factors were also evident in the findings of Su et al. (2020) in Australia. Furthermore, the type of school for learners with hearing challenges matters a lot. A conspicuous difference exists between the learners with a hearing challenge in special schools and



those in inclusive public schools. Specifically, the learners in inclusive schools do poorer academically than those in special schools (Musonda & Phiri, 2017; Alshutwi, 2020).

Kun-man (2017) noted that in China, this was mainly because, in inclusive schools, the deaf and the people with mild hearing challenges were not easily accessing information and were not participating in the class activity equally; hence, they were outdone by their aggressive hearing peers. This was also evident in America, where Marschark et al. (2015) observed that students in regular schools and state-sponsored special schools performed dismally and differently in examinations. Undoubtedly, children born with this particular form of impairment continue to be feared and shown superstitious reactions; hence are hiding worldwide (Sambu et al., 2018; Kalya, 2020; Mwanyuma, 2016; Mwoma, 2017; Murithi, 2014)). This kind of stigmatization is likely to affect the way they perform. However, in Malaysia, learners with hearing challenge performed better in inclusive schools than in special schools since their self-esteem beefed up unlike the others, who felt they had a problem; no wonder was in special schools (Alshutwi et al., 2020).

Low academic achievement of students with hearing impairments is commonly related to communication criteria and methodology used in imparting information, not to mention the manner in which assessments are administered. Other determinants include the literacy level of both the instructors and the hearing challenged learners and factors related to the curriculum (Musonda & Phiri, 2017). Moreover, the absence of resources, lack of sign language practitioners and specialists, low awareness and exposure to the assistive devices among staff and teachers largely contributes to the academic achievement of learners with hearing challenges.

Learners' academic performance with both mild and profound hearing is of great concern and requires global and local solutions. For this reason, developed countries have sought solutions to

fight the causes of the underperformance. Strategies employed by America, Australia, China and India include sign language and inclusion of learners in regular schools (Hrastinski & Wilbur, 2016; Marschark et al., 2015; Kun-man, 2017; Su et al., 2020).

Regionally, the developing countries such as the African countries, for example, Ghana, Nigeria, Ethiopia, Kenya, Tanzania and South Africa, are also reporting poor academic performance of learners with hearing difficulties (Addi, 2017; Cobbina et al., 2017; Musonda & Phiri, 2017; Desalegn & Worku, 2016). Some of these countries, such as South Africa, Ethiopia, and Kenya, emphasize special education frameworks (Bell et al., 2016; Kalya, 2020; Sambu et al., 2018; Desalegn & Worku, 2016). Moreover, education for the hearing challenged learners has been supported through actionable statutory policies and legal frameworks; for instance, South Africa adopted inclusive educational policies (Bell et al., 2016). That notwithstanding, studies on the performance of learners with mild and hard of hearing concerning the utilization of assistive technologies are scanty. Most studies have focused on the challenges, factors and causes of underperformance and sign language issues (Desalegn & Worku, 2016; Rishaelly, 2017; Alshutwi et al., 2020; Addi, 2017; Alshutwi et al., 2020).

The situation in Ethiopia is not very different from that of developed countries. Common challenges affecting learners with hearing challenges include the absence of resource centers, teachers' lack of sign language skills, low awareness by the stakeholders and little commitment towards implementing inclusive policies (Desalegn & Worku, 2016). In Zambia, Ghana, Tanzania, and arid and semi-arid nations, low academic performance among learners with the hearing challenge has been attributed to the communication inconsistencies and methodologies employed in giving class instructions, methods of testing and administration of the same, lack of teachers who are skilled in sign language, literacy levels of learners, and the lack of assistive facilities

(Musonda & Phiri, 2017; Addi, 2017; Cobbina et al., 2017; Rishaelly, 2017; Chizingwa, 2018; Alshutwi et al., 2020; Desalegn & Worku, 2016; Rishaelly, 2017; Chizingwa, 2018; Bell et al., 2016).

Locally, the Republic of Kenya promulgated a new constitution in 2010 where learners with disabilities were accorded the right to access institutions of learning and facilities (Constitution of Kenya, 2010, p. 37). Consequently, there are notable efforts by the government which are aimed at promoting equity of access to education and learning facilities. Various conventions, declarations, and policies have supported this, such as Vision 2030, the second Millennium Development Goal (MDG) on Universal Primary Education (UPE), which aims to reach children with special needs and marginalized communities; and the adoption of Free Primary Education (FPE) in 2003, which helped to actualize the Education For All (EFA) (Kalya, 2020).

Kenya emphasizes the relevance of special needs education in achieving its objective of achieving Education for All (EFA) by 2015. Notably, Kenya is among the African countries on the frontline in providing special education facilities and services needed by a variety of special groups. This has been supported by a robust legal framework where various laws, policies, acts have addressed learners with various disabilities. The robust legal framework includes the 2010 constitution, article 53 (1) part (b), which insists that every child has a right to basic education and should have equal educational and training opportunities, irrespective of any disabilities. This was regularized by the passing of the basic education Act (No. 14 in 2013. Another notable development is the implementation of free and compulsory basic education for all, including those with physical and mental challenges (Kalya, 2020; Mwanjuma, 2016; Nyabere & Okello, 2021; Owour et al., 2020);

as well as Vision 2030's second Medium Plan Term and the Policy Framework for Education and Training (Rights to education Project, 2014).

Other contributions geared towards the achievement of education for the hearing challenged learners are the acceptance of sign language as a medium of communication and instructions and the continuous review and amendment of various legislations addressing the rights of people with special needs. Furthermore, special institutions such as Maseno University, Kenyatta University and Kenya Institute of Special Education are mandated to offer courses to teachers to build capacities to handle learners with special needs (Kalya, 2020).

There is also evidence of deliberate efforts by the government of Kenya to implore enrollment to schools through creating awareness and putting emphasis on inclusive education in regular primary schools. Some of the measures taken include Salamanca Statement and Framework for Action of 1994, the building of more schools for learners with hearing challenges, allocation of funds to special schools to secure equipment and assistive technology, as well as the developing programs in universities and colleges where this special group attain skills and knowledge, up-to masters levels (Kalya, 2020; Nyabere & Okello, 2021). This outrightly explains the massive increase in enrollment of learners with hearing difficulties in both primary and high school levels (Nyabere & Okello, 2021; Mwanyuma, 2016).

For the above reason, learners with special needs are expected to perform equally well in examinations, just like their counterparts who don't have any challenges. However, despite these measures, poor academic performance continues to be recorded for learners with hearing challenges even in the national examinations. When learners with mild, profound hearing difficulties are ranked in regular schools, they fall at the five bottom positions with mean scores

ranging from 100 to 200 marks (Kayla, 2020; Mwanyuma, 2016); Nyabere & Okello, 2021). It is worth noting that even in specialized schools, where students have specialized teachers, resources, assistive technology and services, the learners have continued to post poor academic performance results (Kalya, 2020).

Notably, the low academic performance of students with hearing impairments is connected to the same reasons discussed above. The additional is the demotivation among teachers, socio-cultural factors, rigid curriculum, lack of guidance and counselling services, poor medical attention, lack of implementation of quality standards assurance, and inadequate instructional resource (Sambu et al., 2018; Kalya, 2020; Mwangi, 2013; Mwanyuma, 2016; Kayla, 2020). Efforts directed towards addressing the challenges of academic underperformance among these particular learners in Kenya include the investment in inclusive education settings and the procurement of assistive technologies through government interventions (Owour et al., 2020; Alshutwi et al., 2020; Desalegn & Worku, 2016; Rishaelly, 2017; Chizingwa, 2018; Bell et al., 2016).

Empirical research indicate that learners with hearing challenges perform poorly in Meru and Tharaka Nithi Counties. The drawback is attributed to teachers who largely lack professional development, inadequate resources and learning materials, and lack of regular inspection by quality assurance and service delivery auditing bodies (Muiti, 2010; Muguna, 2011; Mwoma, 2017; Mpaku, 2019; Murithi, 2014).

It is worth mentioning that most studies have focused on the impact of sign language, the hindrances that cause little performance for learners with hearing challenges and the effects of inclusion criteria (Muiti, 2010; Muguna, 2011; Mwoma, 2017; Murithi, 2014; Mpaku, 2019; Muguna, 2011). Specifically, the influence of using assistive technology on the performance of

students with hearing impairments has yet to be investigated. Also unexplored is the role of learners' attitudes in affecting the utilization of assistive technology.

Concerning the preceding discussion, the study found a landing ground to bridge the gap by assessing the utilization of assistive technology (listening assistive technology, augmentative and alternative assistive technologies and alerting assistive technology) to improve academic performance for learners with hearing difficulties Meru and Tharaka Nithi County in Kenya. It further assessed the moderating role of learners' attitudes in affecting how they utilize assistive technology.

## **1.2 Statement of the Problem**

The Kenyan government has made remarkable efforts to enhance equity of access to learning and education facilities. Notably, the government has put up legal frameworks and policies to support education for children with special needs. These are, the Persons with Disabilities Act of 2003, the Integrated Quality Education Act of 1999, and the Special National Needs Education Policy Framework of 2010. (Elder, 2015; Jitolee, 2016; Kalya, 2020; Masayi, 2020; Mugisa, 2017). Further, the special needs section was developed under the Ministry of Education, where specialists were employed to train teachers in universities to deliver special needs quality education. Moreover, there have been increased budgetary allocations for special needs schools (Jitolee, 2016; Masayi, 2020; Mugisa, 2017). These steps are projected to boost academic attainment for all students, including those with hearing impairments

Despite the aforesaid measures and devotion, the academic performance of primary school students with hearing impairment has been dismal, falling short of the average aggregate mark of

250 in national examinations. That is, when learners are ranked together; the regular normal, and those from special schools, the learners with the hearing challenge are last with a mean score ranging between 100-200 marks (Musonda & Phiri, 2017; Masayi, 2020; Mugisa, 2017; Jitolee, 2016). An earlier report from the Ministry of Education of 2009 had attributed this to poor infrastructure, inadequate specialized facilities and equipment, insufficient resources for disability mainstreaming and non-inclusivity in primary classrooms, and few specialized trained teachers. Studies such as Masayi (2020) and Mugisa (2017) has noted the indispensable need for specialized facilities and equipment in determining the academic success of learners with hearing impairment.

The utilization of specialized equipment such as assistive technology in the classroom and during examinations is essential. However, there have been few studies that have proven a link between the use of assistive technology and the academic achievement of students with hearing impairments. The existing researches such as Su et al. (2020); Kun-man (2017); Marschark et al. (2015); Owour et al. (2020); Alshutwi et al. (2020); Desalegn & Worku (2016); Rishaelly (2017); Chizingwa (2018); Bell et al. (2016); Sambu et al. (2018); Kalya (2020); and Mwanyuma (2016) have primarily focused on challenges facing learners with a hearing challenge, inclusive education, socialization sign language, and academic performance. This exposes a gap in literature since little is known regarding the utilization of assistive technology (listening assistive technology, augmentative and alternative assistive technologies, alerting assistive technology) and how it affects the academic performance of learners that have hearing challenges. This presented a need for the this study, which further explored how the hypothesized relationship is moderated by pupils' attitude within primary schools in Meru and Tharaka Nithi Counties. If the problem is not addressed, the low academic performance of students with hearing impairments will endure and

have long-term economic and social effects (Musonda & Phiri, 2017; Masayi, 2020; Mugisa, 2017; Jitolee, 2016).

### **1.3 Purpose of the Study**

The goal of this study was to evaluate the utilization of assistive technologies towards improving the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties, Kenya, and determine the moderating effect of learner's attitude in the hypothesized relationship.

### **1.4 Objectives of the Study**

The specific research objectives was to:

- i. Assess the effect of utilization of listening assistive technologies on the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.
- ii. Examine the effect of utilization of augmentative and alternative assistive technologies on the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.
- iii. Determine the effect of utilization of alerting assistive technologies on the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.
- iv. Determine the moderating effects of learners' attitudes towards assistive devices on the relationship between the utilization of assistive technology and academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.



### **1.5 Research Hypotheses**

The study had these hypotheses:

- i. HO<sub>1</sub>: The utilization of listening assistive technologies does not significantly affect the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.
- ii. HO<sub>2</sub>: The utilization of augmentative and alternative assistive technologies does not significantly affect the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.
- iii. HO<sub>3</sub>: The utilization of alerting assistive technologies does not significantly affect academic performance of learners with hearing challenges in specialized primary schools in Meru and Tharaka Nithi counties.
- iv. HO<sub>4</sub>: Learners' attitude does not moderate the relationship between the utilization of assistive technology and the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.

### **1.6 Significance of the Study**

In Kenya, there has been limited study on the usage of assistive technology among students with hearing impairment. Therefore, this study was justified considering the poor academic result of learners with hearing difficulties in primary schools for the hearing impaired in Kenya. The study was significant because it would help the government realize its objectives in providing education for all; without discriminating learners with the hearing challenge. It would provide critical information that would go a long way in supporting disability mainstreaming, especially regarding access to learning facilities.

Academic success of students with hearing impairments is critical. This evaluation will reveal the implementation of inclusive education by clearly addressing assistive technology and establishing how they are used in primary schools for the hearing impaired in Meru and Tharaka Nithi Counties. The outcomes of the same were expected to inform the necessary measures to address the identified gaps. When these gaps would be addressed the learners with hearing challenges would benefit and be in a position to compete fairly with other learners.

This study was very significant to both the inclusive and the special education primary schools. It was expected to provide critical information that would improve learners' academic performance with hearing challenges in the Meru and Tharaka Nithi Counties. Other stakeholders, such as the government, would get information that would be particularly important in informing the revision of policies on special needs education. The study was also significant in informing budgetary allocations, awareness programs and training needs for learners and teachers. The teachers who are involved, would find the study very relevant since improved academic performance of learners heightens their morale and commitment.

The learners would benefit from this study since the effective utilization of assistive technology would build confidence and instill self-esteem, self-confidence, and self-worthiness critical in academic pursuit. Teachers will ultimately enjoy the availability of assistive technology, which can be integrated into delivering classroom instructions and adopted during the examination. This will eventually boost the academic results of students with hearing challenges. The knowledge creation anticipated in this study would progress debates and continuous discourse and discovery in inclusive education and disability mainstreaming.

### **1.7 Scope of the Study**

The study's objective was to evaluating the use of assistive technology in primary schools for the hearing impaired in Meru and Tharaka Nithi Counties, Kenya, to improve the academic performance of learners with a hearing challenge. The specific constructs include listening assistive technology, augmentative and alternative assistive technologies, alerting assistive technology and attitudes of primary school learners with the hearing challenge. Data for this study was collected from the head-teachers, primary school teachers and learners with hearing challenges from primary schools for the hearing impaired in Meru and Tharaka Nithi counties. The study negated views from the learners with other forms of impairments. Moreover, the teachers' attitude towards the utilization of assistive technology was not be covered in this study.

### **1.8 Limitations of the Study**

This study was limited to Meru and Tharaka Nithi County. The results reported were based on the respondent's opinions and experiences, a situation that limited the elimination of individual biases. The study addressed this gap by urging respondents to be sincere, honest, and truthful in their responses to the data collection tool's inquiries. Another limitation was methodological, considering that the study was cross-sectional. Conducting a longitudinal study was to take several years, outside the required completion period for the degree sought.

### **1.9 Assumptions of the Study**

This study presumed that the targeted primary schools for learners with hearing challenges have the assistive technology in place but is not optimally utilized by learners. It also assumed that both Meru and Tharaka Nithi Counties have adopted assistive technology in the classrooms and during examinations. The study further believed that technical know-how inhibits effective utilization of assistive technologies in primary schools for hearing impaired; hence, learners with hearing challenges have poor academic performance. The attitude of learners was assumed to be negatively

affecting effectiveness in utilizing assistive technologies. Finally, the success of this study believed that the targeted respondents would co-operate and provide reliable responses willingly.

## 1.10 Operational Definition of Terms

<b>Academic performance</b>	Academic performance refers to a learner's accomplishment in their studies, which is mostly judged by the learner's ability to spell correctly, speak appropriately, and progress in areas other than language (Marasinghe et al., 2015). It also involves educational assessment of academic performance in tests such as the KCPE via various scores.
<b>Alerting assistive technologies</b>	Alerting assistive constitutes devices, systems, and equipment that enable the hard of hearing individuals perceive the environment just as the obverse does (Hermawati & Pieri, 2020).
<b>Assistive technologies</b>	These are mechanical aids, supportive tools and equipment which substitute for or enhance the function of hearing the ability that is impaired, which include voice synthesizers, computer systems (Winfred, 2017).
<b>Attitudes</b>	Comprise positive or negative feelings towards a person or something (Marasinghe et al., 2015).
<b>Augmentative and alerting technology</b>	Augmentative and alerting technology is a category of assistive technology where pathologists and audiologists compensate, facilitate and enhance both hearing and communication abilities of individuals with either permanent, temporary, severe hearing challenges by implementing aids, devices and techniques (The American Speech-Language and Hearing Association [ASHA], 1992; Shroyer & Chapel, 2020)

<b>Deaf</b>	This refers to a kid, adult, learner, or anybody who has a hearing impairment and is unable to communicate via oral-aural modalities with or without sound amplification (Winfred, 2017).
<b>Hard of hearing</b>	This refers to a low level of hearing loss associated with residual hearing, which can easily be fixed with an assistive auditory device such as a hearing aid (Nguyo, 2015).
<b>Hearing aids</b>	Constitute equipment and devices which amplify or increase the intensity of sounds (Kalya, 2020).
<b>Hearing Challenge</b>	A temporal or permanent condition of partial, moderate, severe, conductive, sensory neural diminished or complete hearing loss resulting from damaged outer, middle, inner or hearing control centre in the brain (Musonda & Phiri, 2017).
<b>Inclusive education</b>	Is a situation where all children learn together in the same institution and even class irrespective of the different diversities and are attended to according to their needs (Mwanyuma, 2016)
<b>Learners with hearing impairment</b>	This refers to pupils that have the inability to hear well, which is mainly associated with residue hearing, which is often linked to a particular level of hearing loss, ranging from mild to total deafness and hard of hearing (Nguyo, 2015).
<b>Listening assistive technologies</b>	Listening assistive technologies refers to the equipment and devices that amplify, moderate and avail sound to enhance the hearing ability of an individual especially alerting when there is background noise (Heckendorf, 2009).

**Sign language**

This is a language system where an individual utilizes gestures, body movements, lip movements, written communication to express and convey meaning (Mwanyuma, 2016).

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter presents a survey of empirical literature conducted by prior researchers and scholars on the study's major constructs. The chapter starts by discussing academic performance for learners with hearing challenges. After that, literature is reviewed on the utilization of listening assistive technology, augmentative and alternative assistive technologies, and alerting assistive technology while demonstrating the linkage between each of the constructs with the academic performance of learners with hearing challenges. Following immediately is a review on the attitudes of learners with the hearing challenges in primary schools, which is the moderating variable between the assistive technology and the academic performance of learners. Lastly, the chapter concludes by presenting both theoretical and conceptual frameworks.

#### **2.2 Academic Performance for Learners with Hearing Challenge**

Learners' academic performance is described as the sum of their achievements in terms of knowledge, abilities, and competencies when examined by an examiner via tests, practicals, assignments, and even national examinations (Brown et al. 2018; Addi, 2017). Learners are usually assessed to determine their academic performances. Regardless of one's deformities or challenges, all learners in a school ought to be assessed without discrimination and without providing due advantage to some and not to others. There are different types of evaluations available to determine the academic performance of students with special needs. Screening tests, IQ tests, academic achievement tests, adaptive behavior scales, behavior rating scales, curriculum-based assessments, and end-of-grade alternative examinations are among them (Rose et al., 2008). In an ideal situation, the academic performance of learners with a hearing challenge can be assessed using optoacoustic



emissions (OAE) tests, Auditory brainstem (ABR) tests, tympanometry tests, tuning fork tests, speech and word recognition tests; acoustic reflex measures, and pure-tone audiometry tests (Hearing Centre, 2021). The hearing impairment mentioned here relates to a temporal or permanent condition of partial, moderate, severe, conductive, sensory neural diminished or complete hearing loss resulting from damaged outer, middle, inner or hearing control center in the brain (Musonda & Phiri, 2017). This section addresses academic performance difficulties for kids with hearing impairments.

The academic performance of learners with either mild or severe hearing challenges are characterized by a demonstration of knowledge, improved literacy and auditory skills, high-grade scores in tests, assignments and or the final examination results (Brown et al., 2018; Alshutwi et al., 2020; Addi, 2017). In many countries, academic achievement for students with hearing challenges has been facilitated by establishing a solid legal and regulatory framework that supports special needs education. The legal framework comprises the constitution, educational policies, legislations such as disability acts, integration/inclusion policies, special education acts and education and training policies (Khalid & Asghar, 2021; Mariella et al., 2015; Alshutwi et al., 2020; Kun-man, 2017; Hrastinski & Wilbur, 2016). These legal measures and regulatory frameworks foster integration, inclusion, use of sign language, and provision of special education, hence the increased number of children with special needs joining schools (Desalegn & Worku, 2016). One outstanding gap from these empirical studies was the aspect of the utilization of supportive technology in a classroom and examination settings to which the proposed study is set to address.

Despite having the existing legal measures and regulatory frameworks, the academic achievements for learners with impairment are influenced by factors such as intrinsic expressive and receptive language modalities and abilities; hearing thresholds, family features, and environmental factors (Marscharket et al., 2015). Other influential factors are social factors, parents' low income, lack of hearing devices, and absence of appropriate textbooks, negative community perception, discrimination, low motivation, traumatization, and segregation (Yabbi, 2015).

Numerous empirical studies have observed poor academic results of students with hard of hearing complications (Brown et al., 2018; Hrastinski & Wilbur, 2016; Kun-man, 2017; Musonda & Phiri, 2017; Desalegn & Worku, 2016; Marscharket et al., 2015; Su et al., 2020). These scholars attribute academic underperformance of learners with hearing challenges to the inadequacy of instructional and learning resources, unsupportive community, family and the school environment. Several other scholars such as Hrastinski and Wilbur (2016), Kun-man (2017), Musonda and Phiri (2017), Desalegn and Worku (2016), Marscharket et al. (2015), and Su et al. (2020) have explored the challenges affecting learners with special needs. The majority of these studies identified challenges such as the school environment, the community, lack of inclusive setting, and teachers' perceptions of learners with hearing difficulties. The presence of these challenges can be attributed to the poor performance of learners with hearing challenges worldwide.

To address this challenge, many developed countries have instituted various measures. In America, for example, sign language is considered a key criterion for enhancing reading skills among hard of hearing kids in English subjects. Hrastinski and Wilbur (2016) compared the levels of proficiency in reading and comprehension skills among learners. They discovered that the schools which had adopted American Sign Language at an early age, their learners performed well academically. In concurrence, Hrastinski and Wilbur (2016) and Kun-man (2017) respectively

attributed the low academic achievement for learners with hearing challenges to the poor adoption of sign language. The study by Kun-man (2017) specifically advocated for adopting sign bilingualism in Hong Kong to improve the academic underperformance of learners with hearing challenges. Kun-man's study identified other determinants for poor academic performance that included the lack of special schools. The findings by Khalid and Asghar (2021) and Yun et al. (2017) seemed to disagree with Kun-man (2017) on special schools. They observed that the learners who had attended traditional school settings had good speaking fluency, scored high in tests, and performed well in examinations. Therefore, they stressed the need to implement inclusive education, noting that it fosters an environment where learners feel accepted in society. That notwithstanding, the findings on performance by Hrastinski and Wilbur (2016) were, however, limited in that the authors used reading skills as the only academic performance outcome; hence, other methods of academic performance outcomes for learners with hearing challenges were not covered. This study aimed to bridge the gap left by Hrastinski and Wilbur (2016) through a holistic view of learners' performance.

Besides the factors discussed above, other factors are believed to be crucial in improving the academic success of students with mild to severe hearing impairments. These include the environment, communication criteria and family support (Marscharket et al., 2015; Khalid & Asghar, 2021; Yun et al., 2017; Su et al., 2020). Another element of previous empirical research from industrialized nations is demographic factors and academic achievement among students with hearing impairments. Here, the academic performance of both genders was compared. Two studies, Su et al. (2020) and Yun et al. (2017), discovered statistically significant disparities in the performance between male and female disabled learners in Nigeria and China, respectively. The findings indicated that male learners scored poorer as compared to their females' counterparts. It

was also clear that performance deteriorated more with the increase in the age of an individual learner. This finding did not put into context the aspect of utilizing the assistive technology, that is, whether gender factor had a role in the utilization of assistive technology. Additional factors which were detrimental to excellence in academic performance across hearing challenged learners was social-economic background learners. However, the extent to which the social-economic background affected the adoption and utilization of assistive technology was not covered, hence the need for this study.

In Africa, education for all children is highly recognized, as evidenced by various conventions, legislations and policies in most countries (Marriela et al., 2015). Notably, studies have underpinned the academic achievement for learners with mild, profound and even those with severe hearing challenges. Examples of the studies that have addressed the performance of learners with hearing challenges are Kumatongo et al. (2021), Khomera et al. (2020), Cobinna et al. (2017), Alshutwi et al. (2020) and Chizigwa, 2018). Specifically, the academic achievement of learners with hearing challenges has been explored concerning the contributory factors, as noted in the subsequent discussion.

Notably, the underperformance of the mild, profound and deaf students in Zambia was linked to the teacher factor and other institutional-based factors such as unfriendly curriculum in special schools, inappropriate modes of communication technology (Mundo & Penda, 2019; Musonda & Phiri, 2017). These weaknesses are similar to those reported by Marscharket et al. (2015) and Su et al. (2020) in the developed nations. The studies by Mundo and Penda (2019); and Musonda and Phiri (2017) traced the underperformance in Zambia to policy matters. Mundo and Penda (2019) specifically recommended a need for a policy that allows special format modes of assessing learners with hearing challenges as opposed to concentrating on formative scores, which appear to

favour the regular students. The recommendation for a profound policy is welcome and most appropriate. However, a gap exists in that the recommendation did not include aspects of utilizing assistive technology when undertaking the special assessments. This study bridges the gap by addressing the utilization of assistive technology to improve the academic performance of students with hearing impairments.

Similar challenges were observed in Ethiopia by Desalegn and Worku (2016). The key ones were the absence of resources, lack of sign language teachers, elaborate policies, and the segregation gap among staff and teachers. In Tanzania, Rishaelly (2017) found similar constraints undermining academic achievement among special needs learners. In addition, Rishaelly reported a shortage of infrastructure, facilities, and books. Although the potential findings implicated immediate government intervention in addressing these challenges, the generalization of results faced limitations considering that the study was based on one school in Tanzania. A year later, Chizigwa (2018) bridged this gap by widening the scope to include other schools in Dodoma. The results by Chizingwa linked the underperformance to curriculum inconsistencies that were offered in the inclusive schools.

Furthermore, teachers attending to the special students were the same and lacked competencies and pedagogical training for handling special needs children; many more lacked knowledge in utilizing special devices used by the special group. The study by Chizigwa (2018) differs significantly from the current one in that the variables of observations are different. The other thing is that Chizigwa focused on learners with special needs from inclusive schools, while the proposed study will focus on the special schools.

The use of sign language in the classroom is crucial, and it helps to improve the academic achievement of students who have hearing impairments. The findings of Chibwe (2015), Hrastinski and Wilbur (2016), and Kun-man (2017) clearly illustrated this phenomenon. The establishment of sign language clubs and the distribution of sign language dictionaries were recognized as important in supporting strong academic achievement of students with hearing impairments in Zambian schools.

Another contribution to addressing low academic achievement among learners is the investment in cooperative learning among learners with hearing challenges. This idea was permeated in the findings of Chinaka and Osisanya (2020). They discovered that collaborative learning in the classroom had a great potency to improve the scoring of students with hearing challenges in Nigeria. Ezechinyere et al. (2021) as well stressed the idea. They added that learner engagement in both cooperative and cognitive engagement games with cards and macula board-seed games recorded better performance than the control experiments. However, both studies were limited in the sense that performance was gauged from the quasi-experiment groups majorly in one subject alone, which might not be the case for other subjects. This limits the conclusions that were arrived at.

Studies such as Desalegn and Worku (2016), Chizigwa (2018), Rishaelly (2017), Musonda and Phiri (2017), Marscharket et al. (2015), and Su et al. (2020) have noted that the achievement in academics for students with hearing difficulties is directly proportional to the level of self-acceptance, identity, disclosure and self-esteem. These aspects have a direct link with one's attitude. Bell et al. (2016), Kumatongo et al. (2021) and Matiku (2015) also support this argument saying that the learners who hid their hearing inconsistencies were relatively affected academically, and this ultimately affected their performance. Matiku stressed the need for

developing positive attitudes for both teachers and the learners, saying that it improves learners' level of acceptance. An oral method of communication was deemed necessary Kumatongo et al. (2021) and Matiku (2015), with the application of other procedures which could give impaired students a conducive environment to expose their hearing needs. Both studies, however, did not recommend actions for fostering learners' openness and a change of attitude. The researchers also collected data from a small sample size, that is, seven respondents, which largely limits the generalization of the findings.

The attitude of learners and instructors determine the liking of a subject. Olukotun and Aderibdigbe (2021), Kumatongo et al. (2021), and Khomera et al. (2020) demonstrated that both learners and teachers' attitudes impacted the academic performance of kids in an inclusive setting in Zambia and Malawi, respectively. However, the studies were limited to the generalization of the findings in that the researchers solicited data from one school each hence a small sample of 7 respondents.

The academic achievement of students with hearing impairments varies according to gender and personality. The studies by Chinaka and Osisanya (2020) and Si et al. (2020) in Nigeria reported that gender influenced learners' performance to some extent. In some inclusive settings, girls performed better academically and were more creative than boys, while in other countries, it was vice versa.

There are other solutions sought and implemented by different countries to address the low academic achievement of students with hearing impairments: the rehabilitative approach (Chinaka & Osisanya, 2020; Marriela et al., 2015; Bown et al., 2018; Hrastinski & Wilbur, 2016). Osei et al. (2018) notably suggested the introduction of screening at an early age for children, which may help identify the level of hearing loss, detect the cause of the challenge, and prevent this pandemic

through appropriate medication and measures. Hrastinski and Wilbur (2016) noted that hearing challenges were preventable, and therefore, the best remedy was the application of preventive measures such as audiometric screening tests. The prevention and rehabilitative efforts covered by these studies were very significant. However, they did not explore how the identified cases were fairing in examinations and how they utilized the assistive technology in class and during examinations.

Most previous studies employed a quantitative approach and adopted a descriptive study design in exploring challenges for the poor performance of learners with hearing challenges. Cobinna et al. (2017) and Addi (2017), on the other hand, employed a qualitative study technique to examine the academic accomplishment of completely deaf learners in Ghana. The research established that the low academic achievement emanated from self, family and institutional environment barriers, inadequate infrastructures, and insufficient resources. Similar challenges were reported in Malawi by Khomera et al. (2020).

In Kenya, the intention to support learners with hearing challenges is evidenced by the endorsement of Kenya sign language as official communication and the adoption of inclusive schooling systems as discussed by Kathare (2020), Sambu et al. (2018), Nyambere and Okello (2021), Kalya et al. (2020), and Owour et al. (2020). Despite these efforts, the inclusive settings have suffered drawbacks due to a shortage of staff who lack proficiency in handling hearing challenges. In addition to the above endorsement, there is great emphasis on education for all, However, studies on the use of assistive technology on academic achievement of students with hearing impairments remain largely unexplored. A few empirical studies on academic achievement for learners with mild, severe and total hearing challenges exist. They include Yabbi (2015), Mwanyuma (2016), Nyambere and Okello (2021), Owour et al. (2020) and Kalya (2020), which



have focused on sign language and inclusive education as key factors influencing academic performance. The causes for the poor performance of these learners have also been investigated. They include attitudinal stereotypes, negative perception, un-comprehensive curriculum, infrastructure inadequacy, and learning resources (Kathare, 2020; Nyambere, 2019; Mwanyuma, 2016; Yabbi, 2015; Owour et al., 2020). The key recommendation noted from these studies is the need for intervention measures by the government by equipping and financing the special schools.

The approach and the issues under investigation in most of the above studies necessitated soliciting information from parents. Moreover, the studies have examined performance concerning one subject, for example, mathematics. This indicates a point of differentiation of these studies with the current one. Considering the utilization of assistive technology and academic performance are the variables under investigation, teachers and learners themselves are the most appropriate respondents. This current study also considered academic performance in national examinations in all subjects.

Kathare (2020), Owino et al. (2018), and Nyambere (2019) appear to concur that teacher-related factors have a considerable impact on learner performance. Some essential aspects of a teacher factor include attitudes, experience, and handling of special students, pedagogy, gender and professional expertise. To remedy this challenge, Mwanyuma (2016), Nyambere and Okello (2021), Owour et al. (2020), Kathare (2020), and Nyambere (2019) recommended the employment of specially qualified teachers who had background training in special education.

Undoubtedly, the reviewed empirical studies have explored the construct of academic performance for learners with the hearing challenge. However, low academic performance continues to recur despite the adoption of inclusive education, endorsement of Kenyan sign language and the

investment in special education systems. This necessitated the need to explore assistive technologies to improve the academic results of primary school students with hearing challenges in Meru and Tharaka Nithi Counties.

### **2.3 The Utilization of Listening Assistive Technology by Learners with the Hearing Challenge**

Listening assistive technologies are equipment and gadgets that amplify, moderate and avail sound to enhance the hearing ability of an individual especially alerting when there is background noise (Heckendorf, 2009; Individuals with Disability Education Act [IDEA], 2004; National Institute on Deafness and Others Communication Disorders [NIDCD], 2021; Masayi, 2020). Listening assistive technologies are meant to qualify sound by eliminating background noise, attaining attention and intelligent the desirable sound. The idea here is to improve the level of independence of the hearing challenged child through attentiveness and enhanced speech to ease access to information (Heckendorf, 2009; Ashton, 2002; National Institute on Deafness and Other Communication Disorders [NIDCD], 2021).

Listening assistive technology fall under a significant group of technologies commonly known as hearing technology, where personal amplification devices and listening assistive are most essential. According to Heckendorf (2009), an audiologist, assistive listening devices can be used by a single person or a large number of people with or without the assistance of specialist experts. For personal amplification devices, the choice of a device is directly proportional to the specific need a wearer wishes to address while being guided by the level of hearing threshold, which in this case, a speciality audiologist must attend to them (Zirzor, 2019; Heckendorf, 2009; NIDCD, 2021).

The assistive listening technology used depends on how severe the condition is; for example, in the situation where the inner ear remains intact while dire otitis media damage the middle ear (National Institute on Deafness and Others Communication Disorders, 2021; Heckendorf, 2009). Once the hearing challenge is confirmed in an individual, depending on the intensity of the impairment, the technology ranging from individual hearing aids, sound amplification systems, frequency-modulated systems, loop induction systems, cochlear implants and vibrotactile aid are some of the listening assistive that can be considered to boost the hearing ability (NIDCD, 2021; Individuals with Disability Education Act [IDEA], 2004; Heckendorf, 2009). In a classroom, frequency modulation [FM] setting, induction loop, sound field systems and group hearing aids are better placed to enable a learner to receive sound (NIDCD, 2021; IDEA, 2004; Heckendorf, 2009; Zirzor, 2019; Zanin & Rance, 2016).

Apart from the level of severity consideration, other factors are considered when choosing the specific listening assistive technology, a learner is expected to wear. These include sensory and environmental concerns (Heckendorf, 2009). The environment encompasses noise, room acoustics, distance, visual access, lighting, and the availability of technology. Other featured aspects are the tasks a student can accomplish, such as learning, group discussion, and the student's abilities (Zanin & Rance, 2016; Wagner-Skinner, 2018).

Globally, utilization of listening assistive technology goes beyond having the devices readily available to the presence of expert audiologists and technicians to monitor the hearing levels and ensure the functionality of the listening devices (Zirzor, 2019; Wagner-Skinner, 2018; The American Speech-Language and Hearing Association [ASHA], 2016). The presence of training and education to enlighten learners and teachers on using these devices also ensure full exploitation and utilization (Zirzor, 2019; Wagner-Skinner, 2018).

Hearing loss has numerous implications for a learner. It negatively impacts language and literacy development, social and emotional development, participation in frivolous activities, and the academic achievement spectrum of the child (IDEA, 2004; Wagner-Skinner, 2018). This was well illustrated in the findings of Wager-Skinner (2018), who reported that learners with hearing loss could not participate in activities their counterparts engaged in. This was noted as having the ultimate effect on their performance in academics. Zanin and Rance (2016) bridged this gap by suggesting the application of remote microphones and sound field systems as listening assistive in the classroom setting. However, the scope of the study by Zanin and Rance was limited to two assistive listening technologies, which were only applicable in a classroom setting. The current study investigated numerous types of listening assistive devices that foster both communication, attentiveness and hearing ability for learners with hearing challenges in multidimensional environmental systems.

The study acknowledges the existence of several directives aimed at addressing the adverse impacts experienced by learners with hearing challenges. Key initiatives include the conduct of needs assessment, enactment of policies, procurement of relevant equipment, and capacity building to enable children with variety of hearing challenges (Dyre, 2016; The Outreach Center for Deafness and Blindness [OCALI], 2021; Lyton & Borg, 2019; All-Tayar et al., 2019; Lee, 2019; Khan, 2019; Zanin & Rance, 2016).

The demand for assistive listening technology grows high with increment in the age of individuals. In Europe, All-Tayar et al. (2019) surveyed Denmark, Spain, Armenia, and Ukraine. They revealed that hearing needs were more prevalent among the various forms of disabilities in these nations with different levels of severity. The demand for listening assistive technology grow higher and higher with the increment in the age of disabled individuals. However, it was clear that among the

nations, the government could cater to the needs of disabled individuals by providing the most needed 15 assistive technologies. These studies identified research gaps, including the lack of conformity and standardization in the procurement of assistive devices, especially from the private sector. There was a great need to provide quality services and devices to the impaired individuals through the enactment of standards guiding both the private and public service providers.

The utilization of assistive technology is beneficial to learners with hearing challenges. Systematic reviews by McNicholl et al. (2019), Dyre (2016) and Downs et al. (2000) highlighted several benefits such as communication abilities, social and psychological satisfaction. Because of the important role these two variables play in creating a good learner-tutor connection and the entire learning process, communication abilities and psychological happiness can be connected to academic success of these learners. Ebras (2017) seems to support the findings of McNicholl et al. (2019) by explicitly elaborating that listening assistive technologies available to hard-of-hearing learners enabled them to participate more in the classroom activities than the situation before the administration of listening devices. It was clear that both studies investigated the relationship between assistive devices and learners' academic performance but in inclusive school settings. The purpose of this study was to look into the impact of listening assistive technology on the academic performance of hard of hearing students in special education settings.

In India, the utilization of listening assistive devices and equipment by learners with hearing challenges was deemed a strategy to foster inclusive education (Erbas, 2017; Downs et al., 2000). In both studies, teachers availed assistive listening technologies to learners in inclusive schools. This enabled them to participate in activities just as the hearing counterparts did actively. The survey by Ebras relied on the data from teachers in addressing the research objectives. This points

out a departure where the current study would include learners' views to develop more precise and comprehensive inferences.

Several studies on the use of assistive technology by students with hearing issues have been conducted in Asian nations, particularly in Pakistan and India (Farooq et al., 2015; Lee, 2019; Khan, 2019; Lyton & Borg, 2019). It was revealed that in these nations, the adoption of assistive technology in learning faced severe limitations, including negative stigma and stereotypes among learners in the school environment. It was also clear that lack of adequate budget derailed the procurement of hearing devices (Farooq et al., 2015; Lee, 2019; Khan, 2019; Lyton & Borg, 2019). An aerial view indicates that these studies were set out to establish the hindrances to the use of assistive technology in schools; hence it differs from the approach adopted in the proposed study where the utilization of assistive technology will be assessed to ascertain the extent to which it aids in the academic achievement of students with hearing impairments in special primary schools. The use of listening assistive technological devices is dependent on the learners' attitudes towards them (Rekkedal, 2014; Wagner-Skinner, 2018). Both Rekkedal (2014) and Wagner-Skinner (2018) studies reiterated that listening devices for primary and secondary school learners were influenced by the attitudes of learners and teachers towards the technologies. It was also clear that the learners who had severe hearing loss appreciated what the listening assistive offered, and for that case, they were more satisfied in using them, although their impacts on academic performance was not ascertained. The most common listening assistive technology was the frequency modulation systems, whose demand was high in lower grade and high school settings. Rekkedal (2014) study specifically investigated the teachers' perception in influencing learners' ability to use the listening technologies. The results were affirmative to the proposition.

In contrast, Farooq et al. (2015) found out that attitudes towards the adoption of listening devices as a note issue; instead, the financial constraint was described as the main challenge. The quasi study by Wagner-Skinner (2018) relied on previously reviewed literature to come up with generalizations mainly based on the conclusions arrived at by other scholars. This study collected primary data from learners and teachers to understand the underlying situation and appropriate inferences.

There is limited research in Africa that explore the usage for students with hearing impairments. an empirical study indicates that, the majority of research have studied the issues experienced by learners in inclusive settings, as well as teacher attitudes toward learners with hearing challenges. Maaga (2016); Ngonyani and Mnyanyi (2021); Chibuzer (2017); Masayi (2000); Langatang (2016). The studies focusing on the use of assistive technology towards improving academic performance are very scarce. The few studies have blamed the limited use of listening assistive technologies on the inadequate expertise to help learners utilize the devices, little awareness on the importance of using listening assistive and social-cultural factors (Chibuzer, 2017; Langtang, 2016; Soetan et al., 2020; Soetan et al., 2021; Ngonyani & Mnyanyi, 2021; Maaga, 2016).

In Nigeria, the limited use of assistive technology was attributed to factors such as high costs of procuring the devices, little professional experts and teachers who assist learners in utilizing the devices. Moreover, there lacked a clear policy guiding the importation of assistive technologies for learners in inclusive settings (Chibuzer, 2017; Langatang, 2016). The findings of Chibuzer and Langtang (2016) were based on assistive devices for all forms of disabilities in inclusive settings. Soetan et al. (2020) bridged the gap left by Chibuzer and Langtang (2016), who focused on hard of hearing students. Soetan et al. (2020) noted that assistive technology was essential in enhancing student self-efficacy, and therefore the utilization of specialists who attend to students was deemed

necessary. This study focused on learners with hearing impairment but concentrate on utilizing listening assistive technologies to improve academic performance. A significant difference exists between Chibuzer (2017) and Soetan et al. (2020) and the current research in terms of the constructs under study and the population settings. Unlike Cibuzer (2017), who used respondents from an inclusive system, the proposed research will be based the special schools.

Assistive technology was deemed necessary in Tanzania for fostering better educational achievement, as Ngonyani and Mnyanyi (2021) noted. The study indicated that learners with hearing were provided with listening technologies, although they were not enough. However, gainful utilization of these devices was derailed by a lack of staff with the technical expertise necessary to provide assistive technology services such as repairing and maintaining. It was also clear that the rare training for the learners and teachers were based on older technology, and hence they did not suffice the current needs of the wearers. The study, however, focused on multiple forms of disabilities among University of Dar el Salaam students. The population and differences in the investigation construct point to a departure from the current study where the assistive listening technology for the hearing challenged learners in special primary schools is the context.

Another aspect of assistive listening technology from the previous studies is the learners' attitudes towards the utilization of assistive technology. In Amesi and Yellowe (2018) findings, the utilization of technological devices in teaching and learning promoted a lot of independence. This advantage attracted the liking of the technological devices. They also boosted learners' morale which was critical in developing positive attitudes towards assistive technology. Nevertheless, the findings were based on inferences drawn from regular learners other than those with disabilities. Three years later, Soetan et al. (2021) bridged this gap by focusing on hearing-impaired students' attitudes towards the utilization of listening assistive.



In Kenya, research into the relationship between the use of assistive technology and academic achievement among hard of hearing students is likewise scarce. Most empirical studies have focused on the challenges that lead to poor academic achievement for learners with various disabilities. Still, the role played by assistive technologies in realizing good academic performance has not been investigated. Some of the challenges faced by learners with hearing difficulties are elaborated by Masayi (2020), who noted that learners with hearing difficulties lacked the required technologies in facilitating their learning. Furthermore, findings unearthed the dismal academic performance of these learners. They linked it to an interplay of factors ranging from hearing aids being noisy to, unavailability of expert technicians to fix and fine-tune the listening devices. Other factors include economic factors, incomprehensive policies and inability to use the listening devices due to a lack of expert teachers who can connect, modify and manage the devices (Kigotho, 2016; Mwatsaka, 2020; Joel, 2013).

It is also clear that the listening assistive technological devices are expensive hence the need for subsidies or adequate budget. This concurred with the situation found in Nigeria by both Chibuzer (2017) and Langatang (2016), who linked the underutilization to similar constraints. Maaga (2016) also reckoned that the lack of modern technology hampered the academic achievement among learners to a very great extent. Maaga stressed the need for local technical expertise to troubleshoot, maintain and manage assistive technology. Although For Maaga's study was conducted in a similar special schooling setting, there exists a difference from the proposed study where data was collected from a secondary school setting. In contrast, this study collected data from the primary school setting.

Koweru et al. (2015) seem to back up the idea of Maaga (2016) by clearly exposing a pivotal role played by assistive technologies in realizing educational outcomes in both internal and external examination for learners with hearing challenges. Koweru et al. (2015) clarify the relationship between the utilization of assistive technologies and learners' performance. However, their study focused on the visual form of disability among secondary school going students.

One of the solutions sought in the Kenyan setting towards solving the issue of poor academic scoring for learners with hearing impairment is through the investment in information communication technology to foster learning. Considerable investment in inclusive education is also evident where the government intervenes by resourcing regular schools and special schools; and adopting international policies and standards, all of which aim to assist children with disabilities. Another noticeable improvement is partnering with donors, religious bodies and international organizations, some of which occasionally fund the education for learners with disabilities (Mwatsaka, 2020; Kigotho, 2016; Maaga, 2016; Koweru et al. 2015; Joel, 2013).

Despite the efforts indicated above to improve the academic results of pupils with hearing disabilities, primary school-aged children with hearing disabilities continue to do poorly in their academics. Furthermore, empirical research supporting the use of assistive listening devices in the academic performance of hard of hearing learners in primary schools are insufficient. This study investigated this construct and established how utilization of listening assistive technology would help the special primary school to improve the academic performance of hearing challenged learners.

## **2.4 Utilization of Augmentative and Alerting Assistive Technologies by Learners with Hearing Challenge**

Augmentative and alerting technology is a category of assistive technology where pathologists and audiologists compensate, facilitate and enhance both hearing and communication abilities of individuals with either permanent, temporary, severe hearing challenges by implementing aids, devices and techniques (The American Speech-Language and Hearing Association [ASHA], 1992; Shroyer & Chapel, 2020; National Institute on Deafness and Other Communication Disorders [NIDCD] (2021) ). According to the Individuals with Disabilities Education Act (IDEA) and The California Special Education Law, the augmentative and alternative assistive technology is comprised of items, equipment and systems acquired commercially or customized through modification to enable grip attention, alert, maintain and improve communication abilities in learners with the hearing challenge.

The Rehabilitation Engineering Research Center on Communication Enhancement [AAC- RERC] (2020) describes augmentative and alternative communication technology which may either be electronic or non-electronic devices that boost individuals with communication disabilities or hearing loss to speak. Unlike assistive listening devices that are effectively applied in a classroom group system, the augmentative and alternating communication technologies are suited for face-to-face interaction for hard of hearing learners in the classroom (Shroyer & Chapel, 2020). According to the National Institute on Deafness and Other Communication Disorders [NIDCD] (2021), augmentative and alternative communication enables deaf and hard of hearing learners understand and communicate with others.

Augmentative and alternative technologies comprise communication devices, software and equipment such as communication boards, speech synthesizers, modified typewriters, head

pointers, text to voice software, picture boards, touch screen devices, keyboards, display panels and speech-generating devices (Shroyer & Chapel, 2020; National Institute on Deafness and Other Communication Disorders [NIDCD], 2021).

It is one thing to have assistive technology. It is different to utilize the same optimally (The United Nations Convention on the Rights of Persons with Disabilities [UNCRPD], 2008; Winfred, 2017).

To encourage optimal utilization of the augmentative assistive technology, the Los Angeles Unified School District Policy has revamped the assistive technology service to include humanitarian services rendered directly to students with impairment. These range from activities relating to the selection, evaluation, designing, maintaining, repairing, replacing the device, acquisition, training on its use, and providing other technical assistance (The United Nations Convention on the Rights of Persons with Disabilities [UNCRPD], 2008; Winfred, 2017).

Globally, the utilization of augmentative and alternative technology is seen as a foundation for the development of speech and fluency in language among learners. This is evidenced in the study by Maine (2001) in New Jersey, who found that an eight-year-old male with apraxia of speech could communicate with fluency, improved oral speech and master of vocabulary throughout the case study. A lot of competencies, including improved social and communication interaction, was also observed. Augmentative and alternative technology was deemed a necessity in enabling and improving expressive behavior. The study recommended procuring, training and awareness creation to the society to appreciate the use of this technology. However, the findings were based on one eight-year-old participant who was interviewed, observed and tested over the case study period, out of which conclusions were arrived at. This study bridged the gap by involving an adequate number of male and female learners to arrive at a clearer generalization.

Augmentative and alternative assistive technology utilization has the potential to contribute to how a learner performs academically. For example, Maine (2001) and Santoso et al. (2020) in New Jersey and Bandung, respectively, found that the use of augmentative technologies improved the communication and comprehension abilities of learners with hearing abilities. These two aspects are critical in understanding evaluation tests and examinations for learners with the hearing challenge. This is because most assessments require phonology, morphology, syntax and linguistics skills. Although the two studies mentioned herein lacked clarity and specificity on the specific equipment, devices and other technologies, they are very instrumental in elaborating the relationship between assistive technology and communication. Erdem (2017) attempted to close the gap in the Turkish context by developing specific alternatives and augmentative technologies such as aided and unaided symbols, high technology electronic systems, picture boards, picture books, eye gaze frames, speech-generating devices, text-based devices with speech synthesis, and picture exchange communication systems. Erdem, however, investigated technologies geared towards addressing the needs of learners with communication difficulties alone and not precisely the hearing challenges. This study clearly elaborated on the utilization of augmentative and alternative technologies in improving learners' academic performance with hearing challenges in the primary special schooling system.

The study noted that the utilization of augmentative and alternative technologies in improving academic performance has a connection with one's self-esteem. In Oman, Al-Ani et al. (2020) noticed that learners who had positive attitudes towards the augmentative technology developed good self-esteem among their peers in inclusive settings. This powerful driver tremendously enabled them to participate in activities that they could not engage in before. Furthermore, technology led to learning outcomes, motivation, and better communication and nurtured free

interaction with the hearing counterparts in the university inclusive settings. The findings seem to agree with those of Santoso et al. (2020) and Alasmari (2021), who reiterated that the academic achievement of learners with hearing difficulties was directly proportional to the level of self-acceptance, positive attitudes by both the individual utilizing the device as well as positive peer, public and family image portrayed towards the wearer. The studies mentioned above focused on teachers' perceptions and attitudes towards learners with hearing complications. In this study, the learners' attitudes were investigated in relation to the utilization of augmentative and alternative technologies in special schools, unlike the case in the study by Al-Ani et al. (2020), who solicited inferences from inclusive schooling systems.

Despite their importance, the effective utilization of augmentative and alternative technologies can be inhibited by incomprehensive policy, economic factors, and social-cultural implications (Rohwerder, 2018; Hock & Lafi, 2011; Borg, 2011; Alasmari, 2021). A study by Rohwerder (2018) reiterated that in the US, assistive technology designed particularly for the deaf was limited in quantity and quality and encountered paucity distribution in the rural areas. Furthermore, low use is associated with high acquisition prices, limited availability, a lack of awareness, insufficiently qualified speciality skills, and minimal government engagement. This agrees with Alasmari (2021) study in Florida, where training was a great challenge that implicated the access of assistive technology.

In Malaysia and Bangladesh, Hock and Lafi (2011) and Borg (2011) reported how augmentative communication technologies improved communication independence among special hearing learners, although its utilization was poor. The poor utilization was attributed to cultural, social, economic and government policy implications. While Borg majored in the utilization of assistive technology to foster poverty eradication and dependence, Hock and Lafi study was clearer in

detailing the situation on the utilization of augmentative and alternative communication technologies for a variety of forms of disabilities. This study was different in the essence that the forms of assistive technology (listening, alerting, augmentative and alternative) were assessed in relation to learners with hearing difficulties.

Few researches have been conducted in developed nations to evaluate the approaches for addressing the underutilization of augmentative and alternative. Some studies such as MacLachlan and Scherer (2018) and Alasmari (2021) noted several measures that include the enactment of systems approach across 10ps that connotes people (users), policies, products, personnel (well trained to do maintenance and training), provision (strategic funding drivers), procurement, place, pace, promotion and partnership where all of them are geared at creating availability, accessibility, usability and affordability of augmentations. Other measures include the embracing of modern assistive technology policies in the education sector, which address the specific needs of the special groups (McPherson & Clark, 2017; MacLachlan & Scherer, 2018).

Regionally, the utilization of augmentative and alternative technologies to boost the communication ability of learners with hearing challenges is greatly emphasized (Rohwerder, 2018; McPherson & Clark, 2017). This is because their utilization not only boosts the learner's communication and educational outcomes but also plays a crucial role in eradicating economic development alleviates bottlenecks and contributes to the accomplishment of the Sustainable Development Goals [SDGs]. (Tebbutt et al., 2016). Augmentative and alternative technologies also form the critical gateway to the pursuit of inclusive education by enabling the special learners to realize their rights (Cockburn et al., 2017; Visagie et al., 2016; Tebbutt et al., 2016).

It is worth mentioning that access to augmentative and alternative technologies in developing countries has been gaining support from government health services agencies, international humanitarian aids, charity and religious organizations, the private sector and NGOs. Since augmentative and alternative assistive are expensive, middle and low-income level countries are bridging the gap of paucity distribution through efforts and intervention that include collaboration with Global Cooperation on Assistive Technology (GATE) and the World Health Organization [WHO] Priority Assistive Products List, WHO Funding and Partnerships of international governmental organizations, governments and NGOs (Rohwerder, 2018; Matter & Eide, 2018; Visagie et al. 2016).

However, the majorities of empirical studies from developing nations report underutilization of augmentative and alternative technologies and other associated communication technologies. They have also elaborated major drawback to their utilization which includes social, economic, legislative factors, limited availability, lack of knowledge, and a shortage of appropriately educated staff (Cockburn et al., 2017; McPherson & Clark, 2017; Matter & Eide, 2018; Hock & Lafi, 2011; Rohwerder, 2018; Tebbutt et al., 2016; Visagie et al., 2016). The limited supply of services and equipment is mainly due to inadequate policies addressing the same, limited funding from the government, little logistics, lack of research, strict customs and high import exercise charges on assistive technology (Rohwerder, 2018; Matter & Eide, 2018; Visagie et al. 2016).

In South Africa, Visagie et al. (2016) investigated the utilization of assistive technology. They found out that the devices were not being maintained by experts but individual wearers and family members at home. It was also clear that users and the teachers lacked adequate skills since training was scarce. These challenges are also featured in Rohwerder (2018) findings, who found out that low-income countries experienced difficulties due to a lack of training, awareness, and



development programs for helping learners with disabilities. Similarly, Eide (2018) found that the growing unmet demand for assistive technology resulted from inadequate funding, limited training and participation by the government, and diminished partnership with global institutions in procuring assistive technology for all forms of disabilities. The findings of Visagie et al., The studies by Rohwerder (2018) and Matter and Eide (2018) were based on multiple forms of disabilities hence failed to cover one aspect exhaustively. The exhaustivity on the use of augmentative and alternative technology will be realized by investigating ways to improve the academic performance of learners with hearing issues in special primary schools.

The situation in North Africa is not what was observed in South Africa. Children with disabilities cannot live independently because of problems emanating from social stigma, inadequate devices due to funding inadequacies and training issues (Khalil & Yasmeen, 2020). Similar findings have also been reported in Tanzania, where a shortage of skilled and well-trained experts was eminent (Ngonyani & Mnyanyi, 2021; Winfred, 2017).

The central theme in this study is the connection between augmentative and alternative technology utilization and the educational performance of learners with hearing challenges. Although there are no specific studies that have taken this approach, the multiple forms of disabilities were assessed in the studies of Ngonyani and Mnyanyi (2021) and Winfred (2017) in Tanzania, who reported that visually impaired, physically impaired, the speech impaired and hearing-impaired learners who had access to these technologies performed their academic tasks better, were more independent, communicated with fluency and hence achieved better in academics than those without. Another study by Adebisi et al. (2015) in Nigeria hinted at the possibilities of assistive technology impacting on academic achievement of students with the hearing challenge. However, the studies did not uncover how assistive technology such as augmentative and alternative

technologies were utilized during examinations. The other issue is contextual in nature, considering that a study by Ngonyani and Mnyanyi was based in a university setting while both studies solicited data from learners with a variety of forms of disabilities. This study was based on the hearing-impaired special primary schools based in Meru and Tharaka Nithi counties.

The setbacks to the utilization of augmentative and other assistive technologies for the hearing challenged learners have been addressed through the inception and emphasis on inclusive education in nations such as South Africa, Nigeria, Kenya, Tanzania and Cameroon (Ramaahlo et al. 2018; Cockburn et al., 2017; Ahmed, 2015; Ngonyani & Mnyanyi, 2021). Also noted is mileage in the development of comprehensive policies and partnership with international organizations such as WHO and GATE, who donate equipment, provide funding and research training aimed at addressing the challenges in the use of the assistive technology in learning institutions (Matter & Eide, 2018; Visagie et al. 2016; Winfred, 2017). Another unique solution towards addressing the challenge faced by hearing challenged learners in sub-Saharan nations is adopting a home-based intervention mechanism that involves modifying assistive technology to suit a user's needs and procurement locally made low-tech materials (Bunning et al. 2014).

Locally, studies detailing the aspect of augmentative and alternative technologies and learners' performance with hearing challenges are limited. The few ones have majored in descriptive research survey design to investigate the matter. Bunning et al. (2014) used a pre-test post-test design to investigate the teacher perceptions towards learners with hearing challenges concerning the use of augmentative and alternative technologies. Teachers' perception was found to be positive in terms of attitudes towards the learners wearing augmentative and alternative technologies. It was also observed that learners utilizing the devices socialized with others freely and were able to communicate. Bunning et al. however, used observation method to solicit data

from respondents over a period of time with the absence of a control group. This study adopted a unique approach in that it would include interviews to investigate the attitudes of learners with hearing impairment about the use of augmentative and alternative technology. Kathare (2020) and Owino et al. (2018) also agree that teachers' attitudes, expertise, and perceptions towards special students when handling them pose repercussions on their achievements.

Masayi, (2020) conducted a study that focused on the association between the use of assistive technology and academic attainment. Masayi found out that the high availability of assistive hearing and communication technology for the hard of hearing and even the deaf possessed a dialectal relationship with utilization in one hand, and on the other hand, positively impacted learners' academic achievement. This study differs from the previous research of Masayi in the essence that the methodologies and context of the study are entirely different. Nevertheless, Masayi (2020) demonstrated clearly that the academic performance of learners with hearing impairments differs with gender and personality. The study found that male learners performed better academically when compared with female learners with hearing complications. The reason for the same were empirically investigated.

There are noticeable efforts to address the worrying phenomena of poor academic achievement among special learners in Kenya. Such efforts include the use of sign language as official communication, the creation of inclusive schooling systems, and engagement with international organizations and faith-based institutions (Winfred, 2017; Kathare, 2020; Sambu et al., 2018).

Undoubtedly, there are scanty studies detailing the construct of augmentative and alternative assistive technology in addressing the poor academic performance of students with hearing impairments despite the adoption of comprehensive policies, inclusive education systems, and

partnerships of developing nations with international organizations and donors GATE Initiatives, WHO and NGOs. This necessitated the investigation of the use of augmentative and alternative assistive technology to improve the academic performance of children with hearing issues in special primary schools in Meru and Tharaka Nithi Counties.

## **2.5 Utilization of alerting assistive technology by learners with the hearing challenge**

The alerting assistive constitutes devices, systems, and equipment that enable the hard of hearing individuals perceive the environment just as the obverse does (APA Dictionary of Psychology, 2020; Hermawati & Pieri, 2020). According to The Center for Hearing and Communication [CC] (2021) and Hermawati and Pieri (2020), alerting assistive refers to a broader range of equipment that creates attention, awareness and perceptions towards what is happening in the immediate and general environment and through which a hard of hearing individual can respond quickly with ease just as their counterparts do. It entails the grabbing of attention on a daily basis life through the utilization of wearable, network and mobile devices (Hermawati & Pieri, 2020; Bragg et al., 2016). The intention here is to achieve environmental sound awareness and localize it accordingly through the impact of the good intent, such as smoke detected by a fire alarm, a child crying, and door bell (APA Dictionary of Psychology, 2020; The Center for Hearing and Communication, 2021).

According to the American Speech-Language and Hearing Association [ASHA] (2015) and The National Institute on Deafness and Other Communication Disorders [NIDCD] (2019), commercially available alerting assistive technologies and devices include doorbells, smoke detectors, alarm clocks, phone alerting devices, smoke alarm devices, baby-crying or room-to-room sound alerting systems, vibrating clock alarms, paging systems, and watch alarms and smoke detectors. For instance, after the fire alarm rings and maybe a profound or hard of hearing

individual fails to bandwagon because he/she did not hear, it blinks intensively to create attention to that particular individual (ASHA, 2015; CHC, 2021; Hermawati & Pieri, 2020; Bragg et al., 2016; APA Dictionary of Psychology, 2020). Other systems and technologies used in different environments are wireless sensitive sensor networks, iterative user-centred design, mobile alert devices (vibe), PiCam (for alerting a hard of hearing about a visitor), sound and music detectors, mobile applications for detecting sounds from the environment and detecting sound systems (CHC, 2021; Bragg et al., 2016; Kumari et al., 2015; Hermawati & Pieri, 2020).

Globally, the area of alerting assistive technology is indubitably a typical phase of interest with the core aim of providing independence and equal opportunities. This is evidenced by the earnest deposit of energy directed towards seeking solutions for profound, hard of hearing and deaf learners in various settings. This is achieved through the development of systems, mobile application software, devices, policies, acts and equipment that enable individuals to quickly perceive, detect acoustic from the environment and localize with ease (Bragg et al., 2016; Kumari et al., 2015; Hermawati & Pieri, 2020; Daoud et al., 2015; Marschark et al., 2015); Mordini et al., 2018).

The study by Daound et al. (2015) addressed the independence and detection needs of hard-of-hearing learners by developing a wearing device in the form of a belt that utilized microphone arrays to deliver haptic feedback to the wearer. In the same year, Kumari et al. (2015) came up with a PiCam system with a transmitter and a wearing device. The transmitter was placed strategically at the door, which detected the coming of a visitor while the wearer responded through the signals that they felt while wearing the device. The findings essentially contributed to the hearing of the impaired independence, although their working undoubtedly depended on the individual to wear the belt and the device at all times. Moreover, the devices lacked universality

as they addressed a particular need for wear, which could not be employed in a classroom setting to foster any form of learning. The purpose of this study was to evaluate the influence of alerting assistive technology on the academic performance of hearing-impaired students.

Other iconic pioneers who solved the problem of hearing challenges during emergencies are Bragg et al. (2016). They came up with a mobile-based application software where the wearers detect and perceive various sounds from the environment. Advantageously, the mobile software enables one to see specific sounds and directs one to undertake a particular course of action since it provides a platform for recording and later recognizing familiar sounds. Despite this, the mobile application did not specify the direction of the sound. This gap was solved by Mielke and Bruck (2016) in their invention of a smartwatch that detects a sound from the learner environment whether, home, and field, at school, in town or conference settings and specified the direction of the sound. These great achievements are geared towards creating satisfaction among hard of hearing learners. This was different in that alerting assistive technology utilization is assessed regarding the impact it possesses on the learners' academic achievement.

In the United Kingdom, Hermawati and Pieri (2020) provide a list of alerting devices that existed and what currently needs to be done to foster severe and hard of hearing quality of life. The findings reiterate that devices ranging from doorbells, smoke detectors, alarm clocks and smoke detectors easily guide the hearing impaired. Hermawati and Pieri identified the strides made in the industry towards fostering of independence of individuals with a hearing challenge. However, they did not clarify the current development in terms of alerting devices. A connection of the same with examination outcomes was not covered. This study was interested in the available range of alerting assistive technologies, as well as examining the use of this specific equipment and its impact on the academic attainment of students with hearing disability.

The utilization of alerting assistive technology has numerous benefits and enhances the experience of the affected individuals. The studies by Marschark et al. (2015), Mordini et al. (2018) and Farooq et al. (2015) noted how the alerting assistive technology enhances speech development, enables learners to grab attention. This led to improved interaction in frivolous activities and satisfaction by both the learners and their parents. Kim and Lee (2016) endorse these findings and further call for informed policies to guide learners' utilization of specific technologies. Another advantage is the development in communication. This is because alerting technology enables children to respond quickly to situations as precipitated by alert systems, speech enhancement, recognitions and learning applications and telecommunication systems (Dhanjal & Singh, 2019). The studies mentioned herein are contextually different from the proposed considering that they were based on secondary and college settings. This study focused on primary school as respondents.

However, the utilization of alerting assistive technologies is hampered by the technological, economic, social, educational and awareness divide (Kaye et al., 2010; Farooq et al., 2015; Marschark et al., 2015; Chava et al., 2012; Kim & Lee, 2016; Mordini et al., 2018). Kaye et al. (2010) alluded that utilization of technology and devices to alert individuals may be resulting from the scarcity of technology and equipment for this particular form of disability. The study by Kaye and colleagues was based on multiple sub-dimensions of disabilities with dominance on mental health issues. A similar observation was made in Pakistan by Farooq et al. (2015), who noted that hard of hearing learners did not have access to alerting technologies due to their unaffordability. Apart from the economic constraint, Marschark et al. (2015) identified individual characteristics, family background, and experiences inside and outside the school environment as critical antecedents for underutilization and underperformance of learners with difficulty in hearing. Other

issues that hampered the adoption of alerting assistive technology were the learners' perceptions of their particular condition. The attitudes towards assistive technology were also a key determinant (Aranda-Jan et al., 2020; Danjal & Singh, 2019).

There are interventions available to help students with hard and severe hearing impairments overcome the difficulties they face. These include the investment in counselling and rehabilitative care units, investing in accommodation in education systems, investing in technologies aimed at augmenting learners abilities, integration and inclusion criteria and the enactment and implementation of policies and disability acts (Bat-Chava et al., 2012; Kim & Lee, 2016; Mordini et al., 2018). Hearing handicap difficulties are specifically addressed in Michigan through the Michigan Association for Deaf, Hearing, and Speech Services (MADHS), which provides soft loan funds for the purchase of alerting equipment (Michigan Department of Labor & Economic Growth Rehabilitation Services, 2005).

Studies undertaken in medium and low-income nations in the region's periphery show a substantial growth in the number of people with hearing problems (Desalew et al., 2020; World Health Organization African Region Report, 2021; Borg et al., 2011; Bradley, 2011; Marasinghe et al., 2015). According to the World Health Organization African Region Report (2021), the incidence of moderate and severe impairment is predicted to be 15.6%, with a population of 400 million by 2050. Hearing and cognitive aids are estimated to be used by 0.5% to 15% of the world's population of one billion people (Desalew et al., 2020; WHO African Region Report, 2021). It is also worth mentioning that there is a shortage in literature expounding the construct of alerting assistive technologies and the learning outcomes of individuals. Existing literature covers general assistive technologies for the disabled, emphasizing visually impaired learners (Okonji & Ogwezzy, 2018; Ysusuf et al., 2019).



Access to alerting assistive technologies is severely limited. This is exacerbated by the rapid growth in population, including the ageing population and the lack of required essential services in developing countries (Borg et al., 2011; Bradley, 2011; Marasinghe et al., 2015). According to the WHO African Region Report (2021), the scarcity and underutilization of assistive devices for hearing-impaired students is ascribed to the weak governance systems for implementing frameworks for the disabled, the inadequate funding which jeopardizes the acquisition of the devices inadequate regulatory systems, where medical products have yet to be extended to include assistive devices; limited procurement systems hence the overreliance on international procurement and donations; shortage of skilled workforce, poor service supply as a result of lax policies and procedures; lack of readiness for health emergencies like the COVID 19 pandemic. Most critically, there is a significant knowledge gap as a result of little or no research. These challenges show less commitment towards supporting the acquisition of hearing assistive technology in the African region (Desalew et al., 2020).

Bell and Swart (2018), Aranda-Jan et al. (2020) and Mapepa and Magano (2018) also blamed the uncomprehensive curriculum in the inclusive settings as well as the lack of awareness of the accommodation needs of hearing challenged learners; failure to understand the uniqueness of such learners' teaching needs, staff in competencies, poor professionalism, attitudinal barriers and inadequate of financial and human resources. The presence of the challenges mentioned above ultimately affects the academic achievement of hearing challenged learners.

The situation reported by Bell and Swart (2018) and Mapepa and Magano (2018) is similar to the one noted by Rishaelly (2017) in Tanzania, where there is limited curriculum support in special schools and inadequate teaching and learning devices. Rishaelly's study locale was based on the

inclusive secondary school system. This study differs acutely from Rishaely's since it collects data from primary school hard of hearing learners in special schools.

Winfred (2017) and Kisanga et al. (2018) investigated the influence of assistive technology use on academic performance of students with impairments.. A dialectical relationship between the availability of assistive technology and utilization was reported on one hand. On the other hand, the improvement has been hinted at, although the linkage is sketchy. Although the study did not focus on specific assistive devices, Winfred's study proved that access to assistive technology favorably influenced the academic performance of primary school students. Kisanga et al. (2018) examined specific assistive tools but based their study on vocational institutions. This study looked at how alerting assistive technology affected the academic achievement of students with hearing impairment in special primary schools.

However, the study by Ndlovu (2020) done in South Africa contrasted the findings of Winfred (2017) and Kisanga et al. (2018). Ndlovu (2020) did a de-colonial perspective of students with disabilities and found out that although assistive technology-facilitated learning and independence among learners, it did not show improvement in the performance of such learners, especially in an inclusive setting. A year later, Ndlovu (2021) utilized a critical disability theory to establish assistive technologies and devices. They noted that the provision of assistive devices and systems was limited, although learner academic performance seemed to improve with their utilization. Nevertheless, the availability and provision of assistive devices was a major drawback. This was linked to economic and unsupportive government constraints. However, in both case studies, data were solicited from university students with hearing challenges and from inclusive schooling settings.

The interventions measures noted for addressing the challenges facing hard of hearing learners regarding the assistive technologies utilization in the African context include the investment in multispectral and synergistic partnerships involving both public and private steering; developing and acting of evidence-based policies and interventions, use of comprehensive primary healthcare approaches, advocacy for equity of human rights, government ownership of the procurement responsibility for listening and alerting technologies (WHO African Region Report, 2021; Rohwerder, 2018; Aranda-Jan et al., 2020). Other rehabilitative approaches implemented include the investment in-ear screening for little children for possible causes of hearing impairment, including otitis, abnormalities, cerumen and perforation of the tympanic membrane and henceforth remedy or resolve the conditions through prevention, adaptive and treatments for treatable risk factors (Ertzgaard et al., 2020; Desalew et al., 2020; Mapepa & Magano, 2018).

Locally, according to the national census, 1.0 million to 2.2% of the 47.6 million populations have a form of disability (The Clinton Health Access Initiative [CHAI], 2021). This was observed to be more prevalent among poor women, older persons, children, and adults, as well as those impacted by wars and disasters (WHO African Region Report, 2021). Few empirical studies exist on alerting assistive technology and academic achievement. Most have focused on the utilization of sign language, parental involvement, availability of assistive technologies, and strategies for enabling learning deaf, hard of hearing learners in schooling settings (Mwololo, 2017; Makewa & Mutie, 2018; Wawire & Namunga, 2019; Oira, 2016). The area of hard of hearing learners is scarcely studied in Kenya except for physically challenged and visually impaired learners (Fred, 2020; Aranda-Jan et al., 2020; Ndlovu, 2020).

Despite the equalizing that is fostered through the wearing of alerting technologies to enable learners to perceive the environment positively, the hard, profound and deaf learners have

continued to face challenges concerning the use of this technology (Mwololo, 2017; Makewa & Mutie, 2018; Wawire & Namunga, 2019). Among the most pressing issues in Kenya were a lack of appropriate staff training and support procedures, negative learner, societal, staff, and family attitudes toward special learners, inadequate investment in assessment, appraisal, performance, and planning processes, limited fiscal resources, and poor equipment maintenance (Mwololo, 2017; Makewa & Mutie, 2018; Wawire & Namunga, 2019). Other problems are multifaceted, the fact that health centers and access points for rehabilitative treatments are not equitably dispersed, adequately staffed, or well equipped (CHAI, 2021).

Kenya seems to have adopted assistive technology policy, measures and standards from the western nations. Some of the conventions include the United Nations Convention on the Rights of Persons with Disabilities [UNCRPD], the declaration of Astana on primary health care and the Decade of Healthy Ageing 2020–2030 (WHO African Region Report, 2021; Makewa & Mutie, 2018; Wairimu, 2012; Kirongo et al., 2018). Some measures are specifically meant to address the challenges experienced by learners with hearing challenges which entail the application of rehabilitative services and pursuance of partnerships with NGOs and international organizations (CHAI, 2021). The apparent research gap arising from this discussion is the scarcity of empirical studies linking alerting assistive technology with academic performance, hence the need for the this study.

## **2.6 The Learners' Attitude towards the Utilization of Assistive Technology**

In the context of this study, learners' attitude comprises of beliefs, feelings, opinions, perceptions and behavioural tendencies towards the use of assistive objects, devices, technologies or towards people attending to them as well as the learning environment (Primadi et al., 2017; Veresova &

Mala, 2016; Sanchal, & Sharma, 2017). According to Veresova and Mala (2016), attitudes of learners may be affective feelings a learner has towards the device, conative connoting to how the feeling towards the object causes a learner to behave and cognitive which entails the learners' school of thought, knowledge and beliefs towards the utilization of assistive devices.

Learners' attitudes towards the utilization of assistive technologies may be positive or negative. Positive attitudes towards wearing assistive devices by a learner are promoted by the severity of the hearing loss and the quality of sound the devices avail to the wearer (Lartz et al., 2008; Alegre de la Rosa & Villar Angulo, 2019; Rekkedal, 2012; Soetan et al., 2021). The utilization of assistive technologies may be promoted by very severe hearing loss, positive attitudes possessed by the wearer, enthusiastic people surrounding the child, and the hearing aid's sound quality (Rekkedal, 2012; Soetan et al., 2021). It is further contended that learner's ability to utilize assistive hearing devices is dependent on the responsiveness of the environment, which comprise of its ability to accommodate the wearer and the acceptance of the underlying cause of the hearing impairment condition (Jorgensen & Messersmith, 2015; Soetan et al., 2020; Soetan et al., 2021). That is to say, where a learner is liked and appreciated by the parents, fellow pupils and the teachers, they are likely to embrace the device.

Positive attitudes towards hearing devices for learners directly impact their utilization (Tony, 2019; Soetan et al., 2020; Soetan et al., 2021). The attitudes of learners towards the utilization of assistive technologies may be influenced by the absence of trained staff who maintain the devices, lack of acceptance of disability condition by a learner, especially a root cause if not born with; inadequacy of policies addressing the procurement of assistive, negative stigma and stereotyping; inadequacy of ability assessment for the wearers, the inappropriateness of recommended device resulting from poor need assessment and cost implications of hearing technologies (Khairuddin, 2019; Jorgensen

& Messersmith, 2015). According to Johnson (2021), learners' attitudes can further be caused by the lack of adequate disability data; hence the matter has remained unchallenged globally. This implies that people are still unaware of the needs and what needs to be done to individuals living with disabilities. These issues form the source of stigma and isolation facing individuals living with disabilities, hearing challenges included.

Moreover, learners' positive attitudes towards utilizing assistive technologies can be boosted through actionable strategies, including motivation procedures, seminar and education programs, special education systems, inclusivity in schools, research and development and establishment of accommodating environments which, create a sense of belonging (Wapling, 2016; Soetan et al., 2020; Tony, 2019; Miles et al. 2018; Khairuddin, 2019). Students' attitudes, according to Alegre de la Rosa and Villar Angulo (2019), can also be boosted through family involvement, especially in the use of assistive technologies, investing in inclusion centers, communication, good partnering with medical specialists and regular assessments of technologies to improve their functionality through incorporating user feedback.

Globally, studies have focused on the teachers' perception, the efficacy of assistive technology and factors influencing the accomplishment of students with hearing impairment (Tony, 2019; Wood et al., 2017; Ahmed, 2015; Ahmed, 2018; Kundu et al. 2020; Al-Moghyrah, 2017). There is no literature that addresses all aspects of hard of hearing learners' attitudes and the link between assistive devices and academic achievement.

Some studies, such as Tony (2019), Al-Moghyrah (2017) and Ahmed (2015) focused on teachers' perception and attitude. These studies reported that teachers' perception had a role in impacting learners' effective utilization of assistive technologies. The presence of teachers having positive

attitudes toward. Therefore, the technologies, therefore, acted as a factor of influence in fostering. It was also argued that teachers' attitudes towards children with hearing challenges in utilizing assistive technologies were influenced by age, average grade points, and income status. Moreover, teachers lacked were rarely updating their competency and proficiency in steering the implementation of wearable and appropriate technologies. The research urged for teacher training and growth in order to promote learning. The study, however, was concerned with the teachers' perspectives rather than the students' attitudes. Ahmed (2018) bridged the gap left by the above studies by specifically investigating on the learners' attitudes towards utilizing assistive technologies in the US. Ahmed discovered that challenged students had good attitudes concerning the usage of electronic gadgets in inclusive educational settings. In Ahmed's study, only 7% of the respondents were learners with hearing challenges while the rest, 93%, were normal counterparts.

The utilization of assistive technologies is predisposed to affecting the academic performance of learners. In meta analytics and systematic reviews, Sung et al. (2016), Ahmed (2018), Khairuddin (2019) and Miles et al. (2018) revealed that the use of mobile phones, hearing aids, text magnification software, mobility enablers and other assistive software for learners with disabilities, actually increased their participatory in the classroom setting, improved learner attention, boosted their communication and writing skills which are termed as key in alleviating the intricacies of poor academic achievements. The procurement of assistive technology devices, as well as advocacy in enhancing awareness of the same, were among the proposed recommendations. Unlike the studies mentioned above, which adopted a meta-analytic systematic review, this study was descriptive. It used both qualitative and quantitative approaches to investigate the link between the use of assistive technology and academic achievement, while taking learners' attitudes into account as moderating factors. Further, the study is different from

the preceding ones because it specializes in the hearing type of impairment among learners in primary schools.

Several researches focused on the attitudes of students with hearing impairments toward the usage of assistive technology. They include Lartz et al. (2008), Alegre de la Rosa and Villar Angulo (2019) in America and Spain, respectively. Lartz et al. reported that learners with hearing impairment portrayed mixed reactions towards a variety of hearing devices. In particular, learners had a good perception towards hearing aids, frequency modulation systems, interpreters, overhead projectors, LCD projectors, sidekicks and computers. It was further unveiled in both studies that the immense utilization of the loved devices was due to the wide range of information availed to them, the quality of sound they received and the strong awareness created through research, seminary, webinars and teacher training which enabled increased communication and enhanced inclusivity. The findings agree with those of Johnson (2021), who emphasized exploring the needs and causes of poor attitudes towards assistive technology by learners with hearing impairment. Lartz et al. (2008) utilized 9 participants as primary respondents for data collection who were videotaped. Important details such as their names, experiences, age were gathered, while the approach used by Alegre de la Rosa and Villar Angulo (2019) was based on inclusive education. This study engaged a large group of respondents while utilizing questionnaires and interview schedules to solicit data. Confirmatory information was also gathered from teachers through interviews.

The situation in India is not different from what has been reported in America and France. It is also clear that there is little research on the phenomena. The studies such as Tony (2019), Al-Moghyrah (2017), and Ahmed (2015) seemed to blemish teachers' attitudes on poor utilization of assistive technology by learners with hearing challenges. This argument is supported by Kundu et



al. (2020), who reported teachers having mixed reactions to assistive technologies. This was attributed to the inadequacy of teacher knowledge, squat implementation of policies and little awareness among learners and parents. The existence of these problems may explain why students with hearing impairment perform poorly in school. However, the moderating factor of learners' attitude was not covered, hence the gap that this study addresses.

Individuals' opinions regarding the usage of assistive technologies may change depending on their gender. Kundu et al. (2020) reported differences in that males showed high levels of knowledge and high awareness output. The female learners were noted to have embraced assistive technology disabled learners better than their counterparts in an inclusive secondary school setting. The context of this study was different considering that units of analysis will comprise learners from primary school with hearing challenges.

Regionally the attitudes of learners have been assessed concerning the gender of a disabled individual. There is the exposure of utilization differences between male and female learners with hearing challenges. Notably, most studies that measured attitude are biased to the teachers and not the learners' attitude (Soetan et al., 2020; Soetan et al., 2021; Adenkule, 2017; Onevihu et al., 2017; Amurani, 2019; Ndlovu, 2021; Onivehu et al., 2017; Jamali-Phiri et al., 2021). Mainly, Soetan et al. (2020) established that self-efficacy and utilization of assistive technologies differed with the gender of the user. Similar results were observed by Kundu et al. (2020) in India, where a significant difference existed between males and females. Adenkule (2017) also reported a lack of any significant relationship between male and female learners in utilizing information communication technology tools in inclusive settings. However, Onevihu et al. (2017) found that, aside from a lack of proper training and understanding on assistive technology, gender and experiences had no effect on teachers' views about the use of assistive technology.. These studies

were, however, based on learners with hearing impairment drawn from universities. These findings may not apply in the primary school setting considering the age and learning environment differences.

The academic performance of hard and deaf learners is propositioned as being directly influenced by the learners' attitudes (Soetan et al., 2021). In Sweden, Wood et al. (2017) and Tony (2019) discovered that the use of assistive technology had a high potential for meeting learners' educational needs. They argued that the utilization contributes to independence in thinking, which is ultimately reflected in the learners' academic performance with hearing challenges. Other comparable studies were reported in Rwanda by Amurani (2019) and Ndlovu (2021) in South Africa. Positive views regarding the use of assistive technologies by the disabled were found to have an influence on academic attainment in the research. Specifically, Amurani argues that the use of technologies boosts learners' ability to participate in more interactive activities, which boost the learners' performance in the long run. Through an experimental design, the academic outcomes of learners were monitored between the control and working experiment group for multiple forms of disabilities. However, it was based on a college setting. This research intended to maneuver through this area by engaging primary school learners with hearing impairment, excluding other disabilities.

Moreover, the findings from studies done in Sweden and Arab as reported by Tony (2019) and Ahmed (2015), respectively, stressed that positive teachers' perceptions and views towards the implementation of technology in the inclusive setting encouraged learners to mingle freely, engage in more challenging engagements and this improved their academic scoring in tests. These studies focused on the self-efficacy and effectiveness of hearing devices on hard of hearing learners. This

study examined the link between the use of assistive technology and academic achievement of hearing-impaired students, as well as attitudes as a moderating variable.

Learners' attitudes towards the use of assistive technology are deemed to fluctuate with age advancement as noted by Jamali-Phiri et al. (2021) in Malawi. The data collected using question modeling technique unveiled high percentages of unmet needs among learners between ages 2-9 especially those living in urban areas. The modelling trend was reported to impact the learners' attitudes towards the device, primarily negative based on past experiences. This study was different in that it solicited information from the respondents through interview schedules and questionnaires.

Learners' attitudes were identified as the biggest problems for learners with hearing impairment in elementary schools in Malawi (Wezzie et al., 2020; Jamali-Phiri et al., 2021). This was particularly attributed to the community perceptions, family treatments and overlooked needs of such children. Other obstacles to hard of hearing students' academic progress included a teacher shortage, insufficient financing, a lack of transportation facilities, and desertion by parents and relatives. Similarly, Mutanga (2017) reported a myriad of challenges in South Africa with special emphasis on attitudinal barriers, focusing on university education. Wezzie et al. (2020) called for financial interventions from the government. The findings by Mwantimwa (2021) in Tanzania admitted that the usage of assistive technologies by students with disabilities is influenced by, first and foremost, their attitudes. Other drawbacks noted by Mwantimwa include technophobia, low knowledge and skills on the usage of assistive technologies. The study recommended special units and libraries to conduct sensitization workshops.

Locally, there is a scarcity of research examining learners' perceptions of the relationship between the use of assistive technologies and academic achievement of students with hearing problems. A few studies that exist have focused on the obstacles faced by learners with hearing impairment, stakeholder readiness in the use of assistive technology, and variables influencing the use of assistive technologies. (Wairimu et al., 2018; Ejore, 2019; Kathare, 2020; Kigotho, 2016; Murunga, 2017; Kayere et al., 2016; Njeri, 2015; Awori et al., 2010).

Few studies such as Wairimu et al. (2018), Kochung et al. (2013), Njeri (2015) and Ejore (2019) established that the utilization of assistive technologies for standard seven and eight learners was linked to administration and teachers' negative attitudes towards the devices; inflexible curriculum; high cost of acquiring and maintaining the devices; unavailability of the devices and incompetency incapacities evidenced by the instructors during teaching and learning. Key recommendations include government interventions in procuring assistive technologies and regular supervision of classrooms to ensure maximum utilization of assistive devices. However, in both experiments, the learners with visual impairment were given special attention. The present study included students who had hearing impairment.

Kigotho (2016) and Murunga (2017) specially established the factors that deterred the academic achievement of learners with disabilities. Significant barriers included; noisy classrooms, the inability of teachers to tune in the assistive devices and social challenges, which led to loneliness and isolation in the school setting. Such stigma made learners feel excluded, and this influenced their achievement negatively. These observations also featured in the findings of Njeri (2015). Kigotho's (2016) findings further revealed a positive relationship between learners' attitudes and academic performance. Differences, however, still exist since Kigotho and Murunga solicited data

from learners from an inclusive university situation. At the same time, the current study was based on primary schools with hearing challenges learners.

Kayere et al. (2016) and Njeri (2015) established that a link existed between utilization of assistive technologies and learners' performance, while Awori et al. (2010) opined that self-confidence, attitudes and self-esteem directly informed the academic achievement of secondary school learners with disabilities. However, this was not achieved in the inclusive setting since teachers lacked expertise in both pedagogy and technical expertise in handling learners' devices. The comparative research design of Kareye et al. recommended the investment in education and training to improve education service delivery to pupils with disabilities. The study by Kayere et al. (2016) restrained accessing the relationship using one type of device. This study was diverse through accommodating listening, augmentative and alternative and alerting assistive technologies while introducing learners' attitudes as a moderating factor.

There is a distinct absence of empirical research that investigate the moderating influence of learners' views on the link between assistive technology use and learners' academic performance with hearing impairment, according to the reviewed literature. Few studies have identified learners' attitudes is critical in determining the outcomes of an examination process. However, the moderating role of the same has not been investigated. This indicated a need for this study considering that Learners with hearing impairments continue to do poorly in national exams despite an emphasis on inclusive education and the adoption of policies addressing the purchase of assistive technology (Awori et al., 2010; Kareye et al., 2016; Njeri, 2015). The extent of the moderating role of learners' attitudes on utilization of assistive technology is therefore deemed

essential in proving appropriate solutions and creating new knowledge to influence practices and relevant policies.

## **2.7 Theoretical Framework**

The cause and effect theory, capacity theory, and social cognitive theory led this investigation. The cause-and-effect theory underpins the dependent construct, while capability theory and social cognitive theory guide the independent variables.

### **2.7.1 The Cause-and-Effect Theory**

Peb Jourdan developed the cause-and-effect theory in 1919, while Aristotle improved it in 2006. Peb hinged on the premise that everything happening possesses a cause in every enveloped fact. This was based on the supposition that an effect is inevitably developed when suitable conditions accompany a cause.

The main point of argument by the theorist is that the effect produced by a particular cause becomes the cause of another phenomenon, which, in turn, results in the cause of a third phenomenon and the cycle repeated itself. Peb (1919) noted that the sequence of recurring phenomena or a set of actions led to the development of a causal or a chain of causality, which mainly meant that any one event in the chain caused the next event. This made Peb conclude that there is the cause for each problem: the reason for the condition, the consequence or the effect resulting from the cause, and finally, the causal chain. Therefore, the theorist was stimulated to find the root causes of a challenge by digging deep through their causes, the effects they bring, and the causal chain of a confronting challenge to arrive at amicable solutions.

Although the theory evidence weaknesses including lacking clear procedural criteria for understanding the root cause of a challenge and the fact that it negates the solution part of the problems realized, the theory of cause and effect is very significant in informing this study. It helps to demonstrate the relationship between poor academic performance and the root causes. It also aids in demonstrating the relationship between the dependent variable (low academic performance) and the moderating variable (attitude of learners with hearing challenges). In this case, the schematic representation denotes that low academic attainment among learners with hearing impairment may be caused by the underutilization or lack of use of assistive technologies, which may result from the lack of devices, incompetence in utilizing the technologies and unsupportive technical attendant. The same may be traced to the inadequate financial resources and attitudinal barriers, for example, the attitude of learners with hearing challenges, which may similarly have adverse effects on both the learner and society if they are unaddressed.

### **2.7.2 The capability theory**

The formulation of capability theory is originally traced to Amarta Sen, who developed it in the 1980s. The theory was later improved by Tobobso (2011) by introducing it with linkage the information communication technology capabilities. Amarta Sen observed that personal characteristics resulting from disabilities impacted the person's capabilities.

Tobobso (2011) articulated an evaluation of disability in Sen's opine that individual learner abilities and sense functioning techniques such as hearing could be boosted through the use of information and communication technology. The theorist further noted that the essence of diversity in the functioning capabilities of learners with disabilities required the inclusion of assistive technologies to enable their navigation in their daily undertakings.

Based on that view, the argument of this theory seems to suggest that the utilization of technologies and devices to improve learner engagement, involvement, the element of accessibility and inclusion be considered in order to attain the intended goals, such as the rights and equitable opportunities for people with disabilities.

However, the theory lacks the space of users' attitudes requiring the amplified functionality requirements in the sense that it assumes that users readily accept and view the capability enablers positively. Despite this weakness, the theory is still applicable in our study since it accepts the utilization of assistive tools in fostering learner learning and performance, which is the key aspect of this study.

The capability theory is of great relevance in this study. It advocates the need for learners with disabilities to make use of technologies. With the argument that capabilities are products of accessibility and usability, it will be utilized in this study to address how utilization of listening, augmentative and alternative and alerting assistive devices enable students with hearing impairments to fulfill their educational and intellectual goals.

### **2.7.3 The Social Cognitive Theory**

In 1986, Albert Bandura proposed the social cognitive theory. Bandura contends that self-belief was an important factor in human existence that influenced behavior and motivation. Bandura believes that social behaviors and attitudes toward circumstances and individuals encourage this negative outlook

The social cognitive theory's core argument is that self-efficacy beliefs are the foundation for human motivation, well-being, and personal successes; hence, without an individual believes in



themselves, they have very little reason to act, persevere, or achieve feasible results. Based on Bandura's argument, individual self-efficacy and attitudinal beliefs can emerge from mastery experience, vicarious experience, social persuasion and physiological reactions. For mastery experience, high performance can easily be realized when an individual sticks to his goal, enjoys good parenting and learns from failure. The vicarious experiences may, in this case, entail the keen observation of other accomplishments by others. The verbal messages and social perceptions learnt from other people through observation, whether intentional or accidental, also affect a child's self-efficacy.

Learners with hearing impairment can improve their attitudes towards the utilization of assistive technologies by investing in their self-efficacy. Bandura pointed out that self-beliefs proved a weapon for children to work harder, persist longer, persevere and imitate individuals who record good performance and greater optimism. Therefore, from this dispensation, learners with hearing impairment can expressly adopt Bandura's argument. Since by nature, these learners would view themselves as lesser, too dependent, hence suffering from low self-esteem. This factor is purported to deter academic performance to a greater extent.

Despite this, Bandura's theory lacks specific motivational ways of addressing individual self-efficacy development strategies. However, this does not limit the theory from its application in this study since it underpins learners' attitudes.

The social cognitive theory informs the attitudes of learners with hearing impairment. It substantiates the need to cultivate positive attitudes toward learners with hearing challenges towards utilizing assistive technology, which is postulated to affect their academic performance in the long run. Since self-efficacy is a critical determinant for learners choosing to use assistive

technologies, the urge for utilization should be stimulated through motivation. This can be achieved by ensuring ready technical assistance in utilizing the devices.

#### **2.7.4 Miller's Learning Theory**

This theory was coined by Miller in 1957. The theorist argument informs that effective learning results from applying four factors. These factors include motivation, cue, response and reward. According to Miller (1957), every learner has a hereditary motivating factor, and therefore, a learner goes to school based on the drive of that particular motivation.

Therefore, learners need to be motivated externally apart from the inborn motivation, which entails learners being able to notice what is happening in the environment. At the same time, for a response, this may be a response to stimuli or instructions outplayed. The fourth principle is about reward, and both intrinsic motivations promote this.

For learners with hearing impairment, this particular self-interest to attend school can be sustained if not energized by using assistive hearing devices in the classroom setting, when being taught and when taking part in other engagements outside the classroom. It is point blank that learners with hearing impairment need to learn. They can only access instructions fully by utilizing assistive hearing devices like hearing aids which makes them understand what the teacher and other learners say.

For cue, learners must notice what is happening in the classroom and in their environment; hence apart from sight, the sense of hearing is the second in importance as far as getting cues from the environment is concerned. Sound cues can only be acquired through the sense of hearing; thus, this sense must be stimulated to get instructions which are only done through the utilization of

assistive hearing devices. Assistive devices are essential in improving the learners' response to instructional materials. The response principle entails that the learner has to do something for learning to occur, and one of the essential elements in learning is responding to instructions. The fourth principle in Miller's theory is a reward, which comes in the learners' achievements and, specifically, for hearing impaired ones, with assistive technologies. This boosts the learners' confidence, and the effectiveness of instruction of the learner is satisfied.

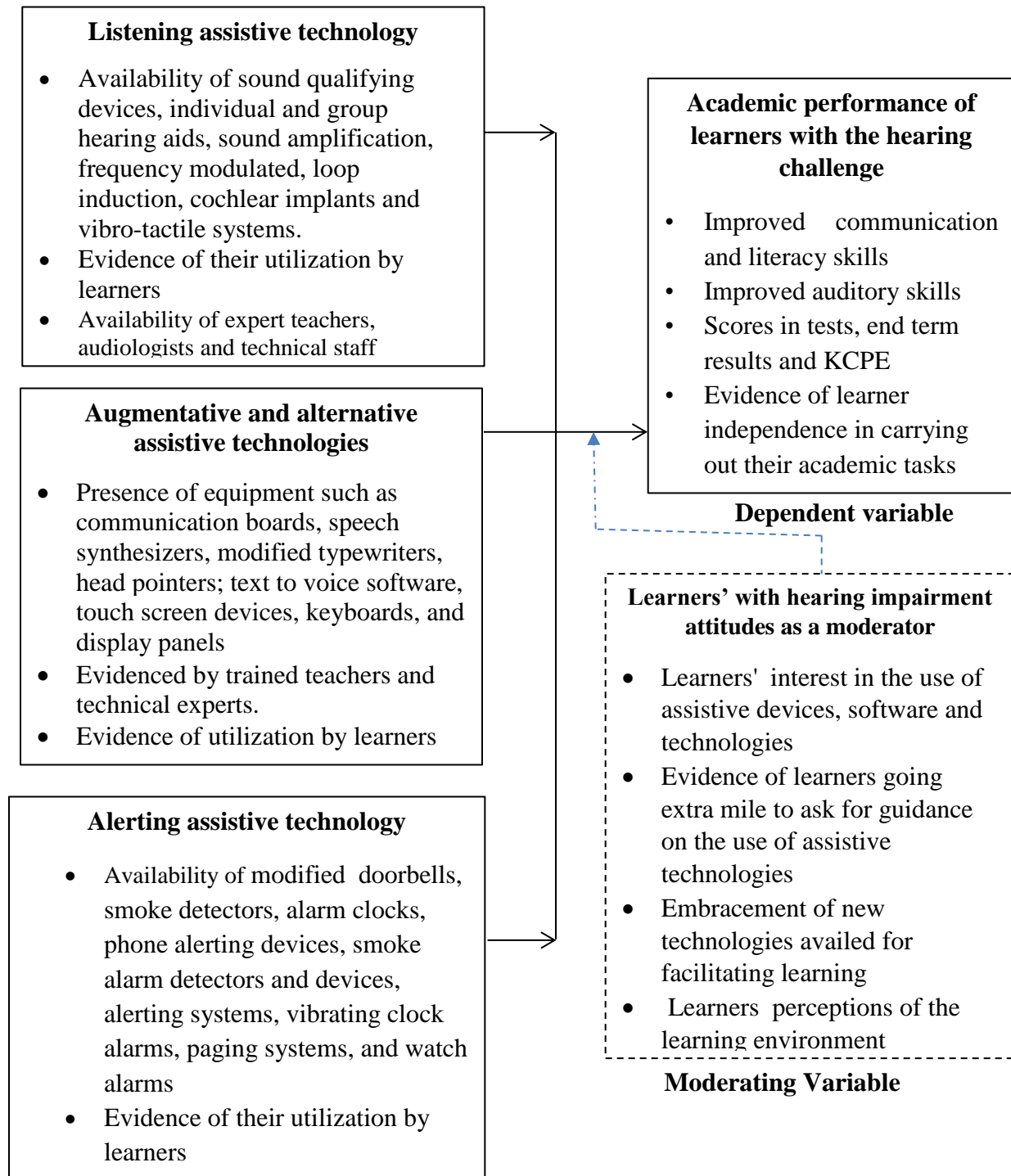
It can be contemplated that if a learner with hearing impairment goes through the four stages as purported by Miller, they can achieve highly at the reward stage. Although the theory heavily relies on self-interest and intrinsic motivation while negating extrinsic motivation for learners, the theory is highly relevant for its ability to link well the relationship between the assistive technology (listening assistive, augmentative and alternative assistive and alerting devices) utilization and learners' academic achievement.

## **2.8 Conceptual Framework**

The conceptual framework depicts the interrelationship of the independent, moderating, and dependent variables.

**Figure 2. 1**

*Conceptual Framework*



**Independent variables**

## **Description of Variables in the Conceptual Framework**

Figure 2.1 shows the relationship between the factors hypothesized in this study. The assistive technologies, listening assistive, augmentative and alternative and alerting assistive technologies entail the independent variables purported to influence the academic performance of pupils with hearing challenges in primary schools in Meru and Tharaka Nithi counties.

The availability of listening assistive technology and corresponding devices ranging from individual hearing aids, group hearing aids, sound amplification, frequency modulated, loop induction, cochlear implants and vibrotactile systems will be established. Their utilization will further be indicated by the availability of experienced and competent expert teachers, audiologists and technical staff, who are expected to provide humanitarian support services ranging from selection, evaluation, designing, maintaining, repairing, and replacing the device and training on its use to foster the use of the augmentative technologies. Evidence of their utilization by learners will be obtained and analyzed accordingly.

Augmentative and alternative assistive technologies was evidenced by equipment, devices, and software such as speech synthesizers touch screen devices, speech synthesizers, modified typewriters, head pointers, text to voice software, communication boards, keyboards, display panels, etc. availability of assistive technology humanitarian services. Evidence of their utilization by learners will be obtained and analyzed accordingly.

Alerting assistive technologies was determined by the availability of modified doorbells, smoke detectors, alarm clocks, phone alerting devices, smoke alarm detectors and devices alerting systems, vibrating clock alarms, paging systems, and blinking watch alarms or correspond

uniquely after the emergency sound is made ringing and available technical expertise. Evidence of their utilization by learners will be obtained and analyzed accordingly.

The dependent variable in this study was the academic performance of students with hearing impairments, which was predicted to be modified favorably or adversely by the use of listening, augmentative and alternative, and alerting assistive technologies. The academic performance was measured by assessing communication, literacy and auditory skills; test scores, end term exam results and KCPE results. In addition, the independence of the hearing-impaired learners in carrying out their educational tasks will be observed accordingly.

The hearing-impaired learners' attitude was hypothesized to be a moderating variable in this study. It is expected that hard of hearing learners' attitudes will moderate the extent of the utilization of assistive technologies (listening, augmentative and alternative and alerting technologies) and the hard of hearing learners' academic performance in Meru and Tharaka Nithi special primary schools. The attitudes of learners with the hearing challenge can strengthen or weaken the extent of utilization of the assistive technology. The attitudes of learners with the hearing challenge will be evidenced by their interests, perceptions, behavior, opinions, views, and feelings about using assistive devices, software, and technologies. Moreover, the evidence of learners going the extra mile to ask for guidance on the use of assistive technologies will be noted. Another element of attitude is the issue of learners' perceptions of the learning environment.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter describes the details regarding the locale of the study, the research design and the target population. Also described are the sampling techniques, the tools for soliciting data, data quality strategies that was applied and the method that was used to analyze the collected data. Finally, the chapter closes with a description of the ethical issues that were used to implement the proposed study.

#### **3.2 Location of the Study**

The current study was carried out in Meru and Tharaka Nithi special elementary schools. Meru County, which covers 6,936 square kilometers, is located on the eastern slope of Mount Kenya. At the same time, Tharaka Nithi County, which is approximately 2,564 square kilometers in size, borders Embu, Kitui, and Meru County to the north and northeast. Meru County is divided into eleven sub-counties: Imenti South, Meru Central, Imenti North, Igembe South, Igembe North, Igembe Central, Tigania East, Tigania West, Tigania Central, Buuri West, and Buuri East.. The Tharaka Nithi county has five sub-counties; Tharaka North, Tharaka South, Chuka, Igambango'mbe and Maara. The two counties have a total of three primary schools for the hearing-impaired learners; out of which two schools are in Meru County and one is in Tharaka Nithi.

Meru and Tharaka Nithi counties were chosen as the research region owing to the low academic performance of learners with hearing impairments, despite lobbying for inclusive education, special education, and frameworks created to achieve education and equity for everyone. As a result, the study sought to assess the use of assistive technology, including listening assistive

technology, augmentative and alternative assistive technologies, alerting assistive technology, and learners' attitudes toward improving academic achievement in primary schools for learners with hearing difficulties in Meru and Tharaka Nithi Counties. Table 3.1 lists the special elementary schools together with their corresponding counties.

### **3.3 Research Philosophy and Approach**

A research philosophy refers to how one sees the world and makes sense out of it. It is about how a researcher understands the truth and knowledge, which plays a key role in shaping one's views and thoughts about the world (Creswell, 2018). Understanding the basis for certain propositions and stance is essential, which other guides interpret and conclude (Kivunja & Kayuni, 2017). The utilization of assistive technologies by hearing challenged pupils requires understanding clearly to inform key policy formulation. Therefore, the use of one research approach is not sufficient in soliciting the required information. The current study proposed using a multimethod in collecting data using qualitative and quantitative approaches.

In that connection, the study proposed using the pragmatism philosophical paradigm to understand the status in the identified special schools. Pragmatism is associated with flexibility in investigating phenomena, applying qualitative and quantitative techniques in fact-finding, interpretation, and concluding (Creswell, 2018). Pragmatism is usually associated with multiple methods of soliciting solutions to predetermined research questions and underlying hypotheses (Kivunja & Kayuni, 2017).

By adopting the mixed-method approach, the current study collected quantitative data regarding the nature of facilities and technologies in use. The information was solicited using a questionnaire administered to learners with the hearing challenge. Because the study's major goal was to examine



use, qualitative data was crucial in revealing insight. The probing methods were utilized in obtaining information from head teachers through a face-to-face interview. A focused group discussion by teachers was beneficial in coming up with well-thought solutions. Qualitative and quantitative data were both important in this investigation

The narratives, together with explanations from the head teachers and the teachers, were significant in explaining why and how learners utilize the assistive technology during teaching, learning and examination moments. The situation is complex; hence, adopting one strategy was not sufficient. The appropriateness of the mixed methods approach was also anchored on its strength in overcoming threats of validity that are associated with the use of qualitative or quantitative. According to Walliman (2018), the mixed methods approach fosters enhanced validity of methods and the research findings hence good in promoting scientific practices. Moreover, the study has four research objectives where some are well measured using qualitative data, while others are better measured using quantitative data (Bryman & Bell (2011)).

### **3.4 Research Design**

According to Obwatho (2014), a research design is a strategy used to carry out a study in order to attain defined goals. It contains the specific strategy, plan and structure of a study. It describes how data is collected, measured and analyzed (Babbie, 2014). The proposed study was a cross-sectional study that used a descriptive survey research methodology to analyze the use of assistive technology in enhancing the academic performance of primary school learners with hearing problems in Meru and Tharaka Nithi Counties. This study used a descriptive survey research design to determine the extent to which the use of assistive technology (listening assistive, augmentative and alternative technologies, and alerting assistive) affects the academic

performance of primary school learners with hearing impairment in Meru and Tharaka Nithi Counties in Kenya.

The descriptive survey design was preferred for use in this study due to its appropriateness in obtaining opinions attitudes. It further helped describe the scenario in the targeted schools and establish an underlying relationship between those assistive technologies and utilization. Furthermore, since the study would not control other factors fostering or causing the refraining from the utilization of assistive technologies, a descriptive survey research design was better in this position with the assumption of the availability of assistive technologies .Previous comparable studies, such as Addi (2017), Bunning et al. (2014), and Cobinna et al. (2017), employed a descriptive survey study approach.

### **3.5 Target Population**

The study targeted the special public primary schools in Meru and Tharaka Nithi Counties in Kenya. There are a total of three special public primary schools in Meru and Tharaka Nithi Counties. Meru County has 2 namely Kaaga primary school for hearing impaired and Njia primary school for hearing impaired which is in Igembe central, while Kamatungu primary school for hearing impaired is in Tharaka Nithi County. The research sample included 249 primary school students with hearing impairment and 42 instructors. Each school has one head teacher. This gives a total of 3 head-teachers while the support staff ware 29. Two County Educational Directors of Education from both Meru and Tharaka Nithi Counties also participated in this study. County Educational Directors of Education explained government efforts to enhance academic achievement of students with hearing impairment in primary schools in their counties. This study focused on students who had hearing difficulties. They provided information on their experience on the use of assistive technology in learning and in doing the examinations. Their views helped

to address the underperformance of such learners in national examinations. The teachers are expected to not teach but also ensure that learners are using the assistive technology in class and when doing examinations. The support staff are expected to work very closely with teachers and learners to provide necessary technical assistance during learning, teaching and when doing examinations. Their views and observations were therefore very critical in fulfilling the aims of this study. The head teachers are also very important in providing policy issues and general challenges affecting learners in such schools. Table 3.1 provides a breakdown of the target population.

**Table 3. 1**

*Target population*

Category of target population	Kaaga primary school for hearing impaired in Meru County	Njia primary school for hearing impaired in Meru County	Kamatungu primary school for hearing impaired in Tharaka Nithi County	Total
1. Head teachers	1	1	1	3
2. Teachers	17	15	10	42
3. Technical support staff	11	12	6	29
4. Learners with hearing impairment	106	59	77	242
5. County Educational Director of Education		1	1	2
Total target population	136	87	95	318

### **3.6 Sample Size and Sampling Techniques**

A sample is a subset of the researcher's population that is meant to reflect the entire target population (Mugenda & Mugenda, 2003). In this study, the researcher used the purposive sampling approach to identify elementary schools for hearing challenged students in both Meru and Tharaka Nithi Counties. In both counties, the number of special public primary schools with hearing impaired learners is three. Since the study focused on the utilization aspects, then, the hearing-impaired learners will be the units of analysis. As a result, the number of learners who participated was estimated using the 30% approach proposed by Mugenda & Mugenda (2003). The same 30% was applied in coming up with the number of teachers and technical support staff.

A simple random sampling technique was utilized in selecting participants from learners, teachers and technical support staff. The method provides equal chances of participants being included in the study; something that promotes objectivity. All the three head teachers and all the two county directors (census) were purposively requested to participate in this study. The resulting number of study participants were computed proportionally to come up with the actual number of teachers and technical support staff from each school. A detailed summarized sample size of each category of respondent is present in Table 3.2.

**Table 3. 2***Sample Size*

Category of target population	Kaaga primary school for hearing impaired in Meru County	Njia primary school for hearing impaired in Meru County	Kamatungu primary school for hearing impaired in Tharaka Nithi County	Total
1) Head teachers	1	1	1	<b>3</b>
2) Teachers	5	5	3	<b>13</b>
3) Technical support staff	3	4	2	<b>9</b>
4) Learners with hearing impairment	39	23	29	<b>91</b>
5) County Educational Director of Education		1	1	<b>2</b>

**3.7 Research Instruments**

Data was solicited using questionnaires, interview guide, focused group discussion and document analysis. Each of these tools is described below.

**3.7.1 Questionnaires**

Due to their capacity to ensure anonymity, questionnaires are best suited in this study to gather data from learners freely. This is because questionnaires enable data to be collected from a large sample size quickly and within a short time. They are also easy to design, quantify and analyze data in SPSS. The questionnaire was composed of close-ended questions on a Likert scale ranging from 1 to 5. The sentiments were arranged in sections according to the study's objectives. Section A covers the biographic data of the respondents. In contrast, sections B, C and D covers the study's independent variables, which are the forms of assistive technologies available for learners with

hearing impairment. Section E contains sentiments on the learners' attitudes. The last section, F, covers sentiments on the dependent variable construct: academic performance for students with hearing difficulties in Meru and Tharaka Nithi Counties. These specific questions or sentiments were derived from the previously reviewed literature in chapter two. The conceptual framework also heavily informed the coming up with specific sentiments. For the questionnaire instrument, see appendix II and III, respectively.

### **3.7.2 The Interview Guide**

Secondly, the interview guide was utilized to collect information from the two County Educational Officers and principals. This offered the researcher an avenue to ask supplementary questions while seeking more clarification on the responses regarding policy issues on the phenomena of the study. The interview guide questions mainly contained open-ended non-structured questions, which required the respondents to give brief descriptions. During the interview, the respondents provided information verbally, whilst the researcher recorded the given information by writing and at the same time using an electronic device after consent has been granted. The interview schedules which were used in this study are provided in appendix IV.

### **3.7.3 Description of the Focus Group Discussion**

This refers to an organized, simple and small discussion comprising a leader who acts as a moderator specifically collecting data and a group of individuals bearing similar characteristics (Prasad & Garcia, 2017). In this study, a focused group discussion involved the teachers who teach learners with hearing challenges. Another focus group discussion involved the technical staff who offer support to students with hearing difficulties. The researcher guided the sampled teachers taking part in the debate through lead questions covering all the study variables. Specifically, the

questions covered all the independent and dependent variables of the study. Other questions were probed depending on responses gotten from the teachers. A focused group interview is provided in appendix IV.

#### **3.7.4 Document Analysis**

The academic achievement of learners with hearing problems in three selected primary schools in Meru and Tharaka Nithi Counties was at the heart of this study. As such data regarding their academic the learners' performance in national examinations, the Kenya School of Primary Education (KCPE) was critical. This was because the learners' performance in this national examination determined the academic progression of learners irrespective of the disabilities. As a result, the researcher created a form (see Appendix V) to assist in soliciting the real KCPE performance of the three primary schools in Meru and Tharaka Nithi Counties for learners with hearing impairments. In this study, the researcher considered the KCPE performance for the last six years. Specifically, the study considered the KCPE mean scores for year 2015 to 2021 apart from the results for 2020 which was left out because of covid-19 pandemic. The past KCPE performance records were obtained from the concerned schools.

#### **3.8 Piloting of Research Instruments**

This was carried out purposely to identify and rectify inconsistencies in the design, content and suitability of the language of the instruments to achieve a high level of clarity, accuracy and comprehensiveness. Furthermore, insightful responses would inform decisions relating to modifying the content in the tools. Furthermore, piloting the research instruments aids in testing the validity and reliability of the instruments (Kothari, 2004).

In this research, the pre-testing of the instruments was done in Isiolo primary school for the hearing-impaired learners. This area of piloting has been selected for since it exhibits similar characteristics to those in Meru and Tharaka Nithi counties in terms of the learning environmental conditions as applied to special primary schools. The schools are also similar in the aspect of underperformance of the learners with hearing impairment. During the pilot, 1 head-teacher, 3 teachers, 3 support staff and 10 learners were engaged.

### **3.9 Validity of Research Instruments**

Research instrument validity usually tests whether a research instrument meets the research objectives by ensuring soundness and accuracy in the tools. In this study, the content validity for this study was established through the advice of the supervisors. Specifically, the content validity was determined by experts who judged, critiqued, commented and rated the instruments to ensure that they met the requirements in terms of the content. At the same time, the previous literature reviewed in chapter two on each construct of the study was consulted while coming up with the specific sentiments addressing both the dependent and the independent constructs. The face validity was ensured by incorporating both expert judgment and piloting the research instruments to a different group of participants with similar characteristics, whereafter, any grey areas and inconsistencies was addressed. For construct validity, the questionnaire instrument was subdivided into several sections, where each section addressed the sentiments of a particular objective.

### **3.10 Reliability of Research Instruments**

Instrument reliability refers to consistent outcomes across time for a high level of replicability. The questionnaires were distributed to pre-test groups by the researcher. In this study, the data collected during the pre-test stage was input into the statistics package for statistical sciences



(SPSS) version 26 to compute a Cronbach alpha value. An alpha value of 0.7 and above would be sufficient to satisfy the instrument reliability (Bryan, 2014). Necessary modifications were done accordingly to the questionnaire to achieve a high level of reliability thereafter.

### **3.11 Data Collection Procedures**

The researcher received a research clearance letter from the university, which she used to apply for a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI). With the permit at hand, a letter of authorization was sought from County Education Office from Meru and Tharaka Nithi to collect data from public special primary schools. In addition, consent to participate in the study was sought from individual respondents. Respondents of the study were asked to sign a consent statement provided in the appendix 1. Once this was granted, the researcher visited the data collection targeted schools, where they made arrangements on an agreed convenient date to undertake the exercise as described below.

#### **3.11.1 Procedure for administering questionnaires**

The researcher hired three research assistants and taught them on how to distribute research equipment, behave themselves ethically in the field, and treat respondents with respect while explaining the purpose of the study. The three research assistants explained the goal of the study and assured the respondents confidentiality before obtaining data before delivering the questionnaires. Hence, the questionnaires were administered and picked later. The completed questionnaires were collected and numbered chronologically before the sorting exercise.

#### **3.11.2 Procedures for conducting the interview**

Upon agreement, phone contacts were done with the two head teachers and the two Education Officers. The researcher personally administered the interview at the venues agreed upon with a

particular participant. The researcher made a phone call a day before the actual day of the interview to remind the appointment and time. Before the interviewing exercise, the researcher sought consent for the audio recording of the conversation from each participant. The audio recording was done using a smartphone. In addition, the researcher made quick short notes in a notebook for each section of the interview guide. Thank you, cards, and oral appreciation of all officers was done at the end of the interview.

### **3.11.3 Procedures for conducting the focus group discussion**

All participants were notified via phone. Teachers and technical support workers who consented to engage in the focus group discussion were asked to join a WhatsApp group. The focus group discussion was two FGD in each school; one for teachers and another one for technical support staff. The two-focus group discussions were held on the same day at one school, but one was completed before going to the other school on a separate day. The exercise took place in a local hotel where the researcher catered for the facilitation. This was expected to motivate students' participants.

Upon assembling in a pre-booked hotel, the researcher called the meeting to order and moderated it accordingly. A lead question was first posted to the group to pave the way for deliberations as guided in the questions derived from each construct of the study. The researcher was assisted by two research assistants who were doing the recording and taping. Before commencing the discussion, all participants were informed that the deliberations would be video-recorded. At the conclusion of the focus group session, the researcher ensured that it had acknowledged all participants. In addition, the researcher bought internet bundles for each student's participation as tokens of appreciation.

### **3.11.4 Procedures for carrying out document analysis**

Upon obtaining the authorization from the County Directors of Education and from the County Commissioners from both Meru and Tharaka Nithi Counties to collect data the three schools, the researcher approached the head teachers and requested the permission to peruse through the KCPE performance for the past six years, 2015 to 2021. It is imperative to state and acknowledge that the three schools had kept good record on the KCPE performance of the school. To collect the needed data, the KCPE mean performance scores, 2015 – 2021 for each of the three primary schools for learners with hearing impairments in Meru and Tharaka Nithi Counties were noted and compared with the county mean scores for the same period. Data were recorded in a special data collection form which is provided in appendix VI. The data acquired aided in understanding the trend in academic performance of learners with hearing impairments in national tests when compared to county average performance scores.

### **3.12 Data Processing and Analysis Procedures**

This study gathered both quantitative and qualitative data, the techniques for analyzing each are detailed below

#### **3.12.1 Quantitative data analysis procedures**

The chronologically serialized questionnaires were first checked for completeness. The data from the well-completed surveys was input into the Statistical Package for Social Sciences (SPSS) version 26 statistical analysis computer program. This enabled the computation of the descriptive statistics; mean, mode, median, percentages, and standard deviation. This shed light on the utilization status of independent variables of the study: listening, augmentative and alternative and the alerting assistive technologies. Furthermore, the association between the attitudes of students with hearing impairments and their academic achievement was examined. The data collected

through the analysis of the past KCPE examination records were tabulated and the mean scores were computed accordingly. The Microsoft Excel was used in the computation.

The SPSS software was also utilized to test the study's research hypotheses using correlation and regression analysis. Multiple linear regression assisted in determining the overarching goal of the study.. The following function shows the relationship between variables in a multiple regression model.

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + e, \text{ Where:}$$

Y= Academic performance of learners with hearing impairment

$\beta_0$  = Constant

$\beta_1, \beta_2, \beta_3$  = regression coefficient weights for  $x_1, x_2, x_3$  as shown below:

$X_1$  = listening assistive technology

$X_2$  = augmentative and alterative assistive technology

$X_3$  = alerting assistive technology

$\varepsilon$  = is the estimated error of the model.

The diagnostic was first carried out to test the assumptions of regression analysis to ascertain the extent to which assistive technology utilization impact the academic attainment of students with hearing difficulties in Meru and Tharaka Nithi Counties. Most quantitative data was presented using tables.

The few present open-ended questions in the questionnaire were analyzed thematically. Study findings were presented using descriptive tables and figures. Appropriately, applicable narrations were brought on board to understand the results quickly.

### **3.12.1 Qualitative data analysis procedures**

The recorded data, which was solicited through the interview schedule, open-ended questions in the questionnaire and focus group interview, was analyzed thematically. The identified themes were categorized into patterns. This was done through a combination of deductive and inductive analysis techniques (Creswell, 2012). In some cases, narrations was used to elaborate on a point.

### **3.13 Ethical Considerations**

The researcher was granted permission to do study by KeMU, which was granted permission by the National Commission for Science, Technology, and Innovation (NACOSTI). Before collecting data from the special public elementary schools on the proposed dates, permission from the Educational Officers of Meru and Tharaka Nithi counties would be obtained. Thereafter, a cover letter outlining the title of the research and the purpose of undertaking the study was availed to the respondents. To allay any fears of ulterior motives other than academic purposes, it was explained. Respondents partaking in the exercise were requested to volunteer information to succeed in the study.

The collected data was treated with a lot of confidentiality and privacy. The participants were not required to identify themselves in any way. Ethics of involving children was observed as guided by Berman, et al. (2016). Data was analyzed with utmost honesty and all the reviewed works and scholarly publications was cited and referenced appropriately using the 7th edition manual of the American Psychological Association Publication Manual. Freedom of undertaking the exercise was also guaranteed by granting respondents an opportunity to fill the questionnaire in their free

time and be collected in agreement. Participants were also allowed to withdraw from the study if they wish.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

This chapter discusses the results of the data analysis. The findings have been organized in accordance with the main variables derived from the objectives of the study. The presentation of the results has been followed by appropriate interpretation and discussion. The study had three main variables; that is, independent, moderating and dependent variables. The three independent variables were based on assistive technology used by learners who have hearing impairments. They were: listening assistive technology, augmentative and alternative assistive technologies, and alerting assistive technology. The dependent variable was academic achievement of students with hearing impairments, whereas the moderating variable was student attitudes toward students with hearing impairments.

The results based on quantitative data were first presented. To enhance interpretation and shed more lights on the status of utilization of assistive technology, the findings based on the qualitative data gathered during interview and focused group discussions were consolidated and incorporated in the discussion. Before the inferential results were presented and discussed (correlation analysis and multiple linear regression analysis), the study first covered the results on diagnostic tests. The researcher employed correlation analysis to evaluate hypotheses, while multiple linear regression analysis was performed to examine the main goal of the study and to determine the moderating impact of learners with hearing impairment's views. In the first instance, the chapter offered the findings of the data dependability, response rate, and background information on the respondents

## 4.2 Findings on Reliability Test

Before the data were used in the analysis, the researcher checked their correctness and relevancy by assessing their reliability. This was achieved by computing the correlation coefficients of items in the variables which gave the Cronbach Bach alpha values for each key variable of the study. The reliability results showing the Cronbach Bach alpha values are presented in Table 4.1.

**Table 4. 1**

*Reliability result based on the main variables of the study*

Main constructs of the study (N = 86)	Cronbach's Alpha
Listening assistive technology (X1)	0.771
Augmentative and alternative assistive technologies (X2)	0.741
Alerting assistive technology (X3)	0.848
Attitudes of learners with hearing impairment (Moderator, M)	0.713
Academic performance of learners with the hearing impairment (Y)	0.862

Table 4.1 is showing the Cronbach's Bach value which was greater than 0.7, ( $\alpha < 0.700$ ) for each main variable of the study. According to Bryman and Bell (2011), this meant that the data were reliable to be used in the analysis.

## 4.3 Response Rate of the Study

In this study, the researcher had administered 91 questionnaires to learners with hearing impairment and all of them were returned. However, out of the 91 returned questionnaires, 5 were defective (had many incomplete answers) and were therefore not included in the analysis. Only 86 (94.5%) valid questionnaires were used in the analysis. As for the head teachers, the study had intended to interview 3 members, and all of them, (100%) were available for the interview session. The same applied to the two County Directors of Education who were also available for the



interview. As for the teachers and technical staff, the study had invited twenty-two (22) to a Focused Group Discussion, but only 18 (81.8%) turned up for the meeting. The overall response rate was therefore 94%. This was a very good response rate which was attributed to cooperation of teachers and learners. The findings were in agreement with Mugenda and Mugenda (2003) on response rate who said that a return rate of 70% and above is an excellent representation. Kumar (2010) also acknowledged that such a response is adequate. The high response further shows that the strategies employed by the researcher to collect data were very effective. It also implied that the targeted respondents were willing to share out information regarding the phenomena of the study, hence willing to participate in the data collection exercise. Studies such as Mugisa (2017), Sambu et al. (2018) and Kalya (2020) who investigated academic performance and sign language of learners with special needs also attributed a high response reported in their study to adequate preparation before the data collection exercise. The replies of the students were tabulated further per school, as shown in Table 4.2.

**Table 4. 2**

*Pupils' responses from each school*

Name of School	Frequency	Percent
Njia primary school for hearing impaired in Meru County	25	29.1
Kamatungu primary school for hearing impaired in Tharaka Nithi County	26	30.2
Kaaga primary school for hearing impaired in Meru County	35	40.7
Total	86	100.0

The Kaaga primary school for hearing impaired in Meru County had the highest number of learners with hearing impairment, 35 (40.7%). The second one was Kamatungu primary school for hearing impaired in Tharaka Nithi County, 26 (30.2%) followed by Njia primary school for hearing impaired in Meru County, 25 (29.1%). The hearing-impaired learners were all in school hence the

high response rate. According to Jitolee (2016), the Kenya National Special Needs Education Report, there is a favorable increase in attendance of school by the learners with various forms of disabilities and those that have special needs as informed of the motivational efforts channeled by non-governmental organizations, the community-based organizations, care for the learners, provision of facilitates and conducive school environments. This good return rate of the questionnaire tool was very significant in this study. The information gathered helped to reveal the actual status on the utilization of assistive devices in elementary schools for students with hearing impairments, allowing the researcher to propose informed suggestions for changing policies put in place by government for supporting inclusive education, and equal access to education by all learners. The information gathered further helped to reflect on the provisions of the Kenyan constitution and the vision 2030 pillars by articulating efforts and achievements made in promoting human development (Jitolee, 2016).

#### **4.4 Background Characteristics of Respondents**

In this section, the key background information of respondents is provided. The respondents of this study were learners with hearing challenges from primary schools of learners with the hearing impairments. Also include were the head teachers, teaching and non-teaching staff and two Country Directors of Education.

##### **4.4.1 Background characteristics of learners with hearing impairment**

The background information sought from pupils was on gender and academic level of a learner. This helped to understand the composition and dynamics of the study. It further helped the researcher to make objective interpretation of perspectives and other observations made in the

study. The study first inquired about the gender of a learner and the information was presented in Figure 4.1.

**Figure 4. 1**

*Gender of learners with hearing challenges at Meru and Tharaka Nithi Counties*

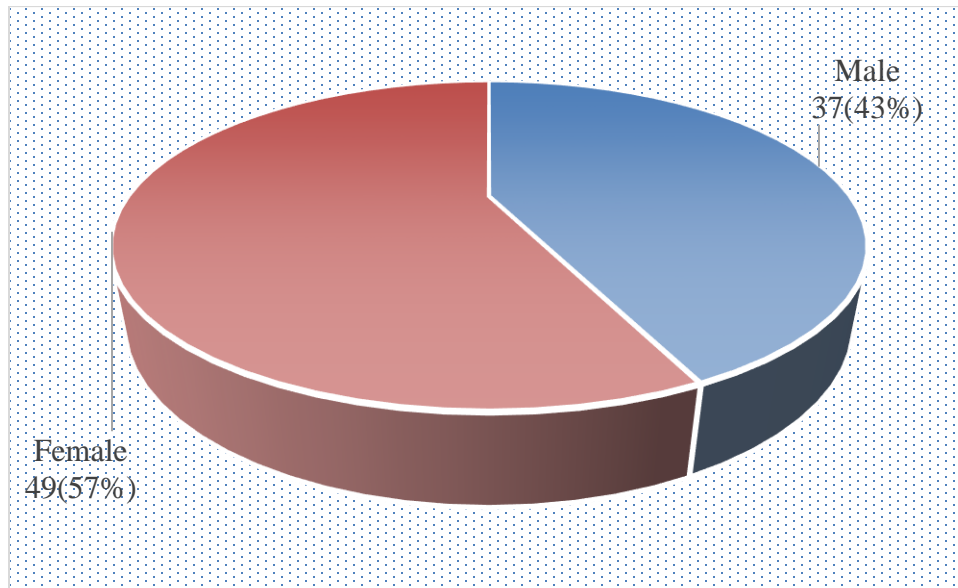


Figure 4.1 shows that there are more female pupils with hearing impairment than male students in the two counties. The data represent the status in most primary schools in Kenya where, one finds more girls than boys enrolled in primary schools. According to Masayi (2020), learners enrolled in the school for the deaf in Kakamega County were dominated by the female gender than the male. Yabbi (2013) also found a similar trend which seemed to agree with the Kenya National Census (2009) report. Masayi (2020) and Yabbi (2013) linked the observed trend on gender disparity among pupils to poor enrolment, cultural practices and prejudices.

The other aspect sought about hearing-impaired learner was on academic level. Table 4.3 summarizes and presents information on the academic level of hearing-impaired students.

**Table 4. 3*****Level of hearing-impaired learners***

Class level of the hearing-impaired learners in the three schools	Frequency	Percent
Class eight	29	33.7
Class seven	21	24.4
Class six	26	30.2
Class five	10	11.6
Total	86	100.0

The three schools had more hearing-impaired learners in class eight and in class six. The lowest number of hearing-impaired learners were in class five. It appeared like the number of learners with hearing impairment was increasing with class level, such that, the lowest number was in lower class level while the highest number was in higher level. Addi (2017) also found a similar situation among Ghanaian schools on the number of learners at different class levels. Contrary to these findings was the study by Chizingwa (2018) which stated that the number of disabled students in Tanzanian schools decreased with the ascending levels of education; such that the last grade had the fewest pupils as compared to the lower grades. Chizingwa (2018) linked the decreased number of pupils in the upper grades to the poor pedagogical methods of giving instructions, poor attendance in the inclusive classrooms, lack of required facilities and professional skills. Regardless of the class level of a hearing-impaired learners, it was expected that one performs well in examination. Similarly, it was important for these learners to know how to utilize the assistive technology devices which are meant to help overcome the learning challenges.

#### **4.4.1 Background Characteristics of other Respondents**

As noted in chapter three, teaching and non-teaching staff participated in a focused group interview. As for the teaching staff, all of them had P1 Certificate. Actually, 90 percent of teachers had P1 Certificate while the rest (25%) had Diploma. The P1 Certificate is the minimum qualification required for a primary school teacher; hence they were all qualified. Most teachers indicated that they had worked in a special needs school between six and 20 years, while three had worked over 20 years. This shows that the teachers from the three schools were experienced in handling learners with the hearing impairments. Sambu et al. (2018) underscored wide experience arguing that the teaching staffs for students with special needs are expected to have a wealth of professionalism, knowledge, skills, competencies and experiences. Owour et al. (2020) also noted that teaching staff with good professionalism and wide range of experiences in handling pupils with special needs had direct influences on the learner's achievement, improved enrollment and raising the figure of candidates sitting for examinations.

The majority of the non-teaching staff (75%) said that they had KCSE Certificate while the rest (25%) had KCPE Certificate. They were also experience considering that all of them had worked in a special school for over six years. Concerning the argument for having literate and experienced guardians, Addi (2017) also appreciated the importance of having an environmental surrounding comprising of knowledgeable individuals including the parents, since they enabled learners with special needs to overcome socio-cultural barriers. The nature of experience noted in both teaching and non-teaching staff was regarded adequate and gave the researcher confidence that the information provided by respondents was reliable and can be depended upon in determining solutions to the problem under investigation.

The head teachers were regarded as administrators and chief officers in schools for learners with hearing challenges. According to information received from the three principals, all of the teachers held a P1 qualification, while some had advanced to the Diploma level. The County Directors of Education from the two County were also qualified. With least qualified being a master's degree. The three principals and two County Directors of Education each had more than 20 years of expertise. Their wide working experience in the education sector was critical in the current study. Their replies during the interview were thus highly important in informing on the measures that may be put in place in primary schools for students with hearing issues to ensure the use of assistive technology, which was expected to lead to an improvement in students' academic performance. Owour et al. (2020), Kalya (2020) and Sambu et al. (2018) argued that knowledgeable and experienced educational stakeholders were better placed to know the needs of pupils; for example, the assistive devices required and the skills of teachers they look for during recruitment. Addi (2017) linked high academic achievement in schools to adequate knowledge and experience of teachers.

These above findings indicate that the County Directors of Education, and the teaching staff had the minimum qualifications required to manage and to teach in primary school level respectfully. The study noted that the government of Kenya had no standard qualification for support staff who work in a school for learners with the hearing impairments.

#### **4.5 Results on Listening Assistive Technology and Academic Performance of Learners**

The concept of listening assistive technology was founded on the study's first objective. This concept was evaluated to identify the extent to which learners with hearing impairments used

listening assistive technology. The main aim was to establish how the utilization of the listening assistive technology helped to improve their academic performance. The utilization was sought regarding the equipment and devices that amplify, moderate and avail sound to enhance the hearing ability of an individual. Examples of equipment examined were devices for individual or group hearing aids, sound amplification, frequency modulated, loop induction, cochlear implants and vibro-tactile systems; where, evidence of their utilization by learners with hearing impairment was sought. The other aspect sought was about the availability of expert teachers, audiologists and technical staff to assist learners in the utilization of the aforementioned assistive technology devices.

The use of assistive technology devices was assessed by posing several sentiments to learners with hearing impaired learners. In a focused group discussion, teachers and technical staff were invited to discuss challenges about listening assistive technology. The head teachers and county directors of education were interviewed about the same topics, and their responses were assessed and integrated into the discussion. The sentiments to pupils were in a 5-level Likert scale requiring the hearing-impaired learners to mark their level of agreement with each assertion in a table. The rating for each sentiment was coded in SPSS, where, 1 represented strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 was coded to represent strongly agree. In interpreting and reporting the results from hearing impaired learners, the total number that agreed and those who strongly agreed was summed up to represent the agreement status, while the total number that disagreed and those who strongly disagreed was summed up to represent the disagreement status. The mean score for each sentiment in a table was computed to help visualize the average value of the responses out of a ranking of 5 points in a Likert Scale. Table 4.4 provides a summary of the replies received.

**Table 4. 4*****Utilization of Listening Assistive Technology***

Sentiments on listening assistive technologies (N = 86)	SD(1)	D(2)	N(3)	A(4)	SA(5)	Mean
• I have enough skills on how to use listening assistive technologies	34 (39.5%)	20 (23.3%)	13 (15.1%)	16 (18.6%)	3 (3.5%)	2.23
• Our school have enough listening assistive devices	7 (8.1%)	40 (46.5%)	14 (16.3%)	17 (19.8%)	8 (9.3%)	2.76
• Our school have variety of listening assistive devices	22 (25.6%)	29 (33.7%)	21 (24.4%)	11 (12.8%)	3 (3.5%)	2.35
• The school has provided the required support to enhance maximum utilization of listening assistive technologies	12 (14.0%)	25 (29.1%)	23 (26.7%)	24 (27.9%)	2 (2.3%)	2.76
• Learners utilize listening assistive devices in class	18 (20.9%)	17 (19.8%)	24 (27.9%)	25 (29.1%)	2 (2.3%)	2.72
• Our school has clear guidelines regarding using of listening assistive	26 (30.2%)	23 (26.7%)	24 (27.9%)	9 (10.5%)	4 (4.7%)	2.33
• Learners utilizing the listening assistive technologies are recognized at our school	22 (25.6%)	29 (33.7%)	21 (24.4%)	11 (12.8%)	3 (3.5%)	2.35
• The listening assistive devices are repaired in timely manner	29 (33.7%)	17 (19.8%)	14 (16.3%)	20 (23.3%)	6 (7.0%)	2.50

Table 4.4 is showing that there was a generally high disagreement with all the statements posed to learners regarding the utilization of listening assistive technologies, where, the mean was around 2.5. On adequacy of listening assistive devices, the study found that they were not enough as indicated by 47 (54.6%) of learners with the hearing impairment. Only 25 (29.1%) of learners who



termed the devices as adequate, while, 14 (16.3%) were neutral. Because listening assistive technology devices vary in type, the study attempted to determine if the school has a variety of devices for treating various levels of hearing impairments. The results show that 51 (59.3%) of learners disagreed, but, 14 (16.3%) agreed while 11 (12.8%) were neutral. The study's findings agreed with other researchers' results, such as Okutoyi et al. (2013), Soetan et al. (2020), and Chibuzer (2017), indicating special schools and those in inclusive settings confront the same difficulty of insufficient teaching and learning resources. Mwatsaka (2020) also presented a disparity that apart from the inadequacy; schools were also suffering from the lack of variety of devices to cater for various academic needs. According to Kigotho (2016) and Mwatsaka (2020), the availability and proper use of assistive technologies is a crucial factor of academic performance for learners with impairments. According to the responses gotten from the teaching and non-teaching staff, head teachers and County Directors of Education through focused group discussion and interviews, the listening assistive technologies expected in elementary schools for hearing challenged students include hearing aids, cochlear implant, tape audiograms, group hearing and loop induction, acoustically treated classes for classes near the roads, audiometers, and radios.

The research also sought to know if the students with hearing impairment were using the few available listening assistive technology devices in class. Surprisingly, 35 (40.7%) disagreed with the sentiment, but, 27 (31.4%) agreed, while 24 (27.9%) were neutral. The findings revealed that there were few listening assistive technology devices in the three schools that took part in the study. The devices further lacked varieties of such devices, something that shows that the learners who would require some specialized devices due to the nature of their hearing challenge were suffering or were getting little assistance. Lantang (2016), Kigotho (2016) and Mwatsaka (2020) also reported an alarming scenario of dismal availability of required devices for learners with

disabilities. Moreover, most learners confessed that they were not utilizing the listening assistive technology devices in their classroom. This indicates that the rate of non-utilization of listening assistive technology devices was high in the schools and hence their non-utilization would affect their level of listening and understanding of the contents being taught. This would definitely affect their academic performance. The study by Chibuzor (2017) was consistent in the argument that, not all assistive technologies available were utilized by the special need pupils in the school. Non utilization was blamed on the lack of required guidance on the use of assistive devices by the teaching and non-teaching staff in the schools. Alnahdi (2014) gave an illustration that learners were less interested in utilizing high-tech and expensive devices which were viewed as less appealing.

From the results provided in Table 4.4, the causes for the limited utilization of listening assistive technology devices in the three schools were deduced. In the first instance, 54 (62.8%) of learners confessed that they did not have enough skills on how to use the listening assistive technologies. Only 19 (22.1%) had the requisite skills. The inability to employ specialist listening assistive technology equipment might be a significant disadvantage to the utilization as noted by Chibuzor (2017) and Lantang (2016). In the second instance, the study noted that three schools had not provided the required support to enhance maximum utilization of listening assistive technologies as indicated by 37 (43.1%) of students with hearing challenges. The other thing was that the three schools did not have clear guidelines regarding the using of listening assistive; 47 (56.9%) disagreed, while 13 (15.2%) answered in affirmative. May be, the lack of these guidelines further affected the manner in which the listening assistive technology devices were maintained. This is because, more than half, 46 (53.5%) disagreed that the listening assistive devices were repaired in a timely manner. The presence of technical experts such audiologists, speech therapists

and otolaryngologists employed in the school was considered by Zirzor (2019) and Wagner-Skinner (2018) as very critical decision towards ensuring learners get immediate help and technical expertise assistance in utilizing assistive technologies devices. Chibuzor (2017) findings also demonstrated that pupil's guidance and the usage of accessible technological gadgets for increasing the hearing capacities of the afflicted students was directly related to directionLantang (2016) found a direct association between the academic performance of learners and adequacy of assistive technologies.

The fact that the above findings have indicated that there were inadequate hearing assistive devices, lack of varieties and poor maintenance of the few that were available, indicated that, either there was lack of funds, poor management or there was lack of the needed goodwill and support from the school management and or from the government. Information gathered from head teachers during interview indicated the primary schools for learners with hearing challenge provide support by buying batteries for hearing aids, and sometimes availing funds for repairing non-functioning hearing aids, buying videos sometimes depending on availability of funds, and allowing teachers to attend workshops and seminars. The teaching and non-teaching staff also acknowledged support from the school administration in that there were computer labs, T.V room, spacious classrooms, electricity, projector, watches alarm, laptops / computers, internet, photo copier machines and phone. They also acknowledged that the head teacher ensures that classes are painted regularly, broken windows are repaired immediately and chalkboard maintained. Maaga (2016) also acknowledged the importance of securing local technical expertise to troubleshoot, maintain and manage assistive technology. However, one head teacher lamented, *“Our school have very few hearings assistive devices, so we are doing nothing”* According to County Directors of Education, the government had provided tablets and laptop computers and planned to build

acoustically treated classrooms. One Officer noted that the Ministry of Education had provided free internet to the school for learners with hearing impairments. The Ministry of Education recognised its responsibility in educating and inducting teachers in the use of assistive technology devices, as well as monitoring their use for quality control and improvement and giving policy guidelines. The results agree with the observations by Kigotho (2016), Maaga (2016), Koweru et al. (2015) and Joel (2013). These studies reported that inclusive and even special education systems need to have both own source revenue streams and strong support from NGOs, CBOs, international organizations and the national government in order to eradicate the issues of inadequacy, illiteracy and expertise by facilitating training, acquisition and maintenance of the needed technologies. This is because the technologies required are costly, while others are not readily available in the country; hence, need to be imported. Similarly, Eide (2018) and Rohwerder (2018) findings proposed on building organizational partnerships, collaborative trainings and government and global institutions interventions in procuring assistive technology for all forms of disabilities.

#### **4.6 Results on Augmentative and Alternative Assistive Technologies and Academic Performance of Learners**

The second goal of the study was to evaluate the use of augmentative and alternative assistive technology in primary schools for the hearing impaired in Meru and Tharaka Nithi counties to improve academic performance of learners with a hearing issue.

The augmentative and alternative assistive technologies are mostly used for face-to-face interaction for hard of hearing learners in the classroom. The augmentative and alternative assistive technology devices comprise communication devices, Communication boards, speech synthesizers, customized typewriters, head pointers, text to voice software, picture boards, touch screen devices, keyboards, display panels, and speech-generating devices are examples of software

and hardware. (Shroyer & Chapel, 2020; National Institute on Deafness and Other Communication Disorders [NIDCD], 2021). These devices usually compensate, facilitate and enhance both hearing and communication abilities of individuals with either permanent, temporary, severe hearing challenges by implementing aids, devices and techniques. When a learner uses these devices, one is able to compensate the hearing hence able to understanding the content taught in class and from group discussions.

The utilization of augmentative and alternative assistive technology devices was measured by posing several sentiments to learners with hearing impaired learners. Teachers and technical personnel were requested to participate in a focused group discussion about augmentative and alternative assistive technology. The school heads and county directors of education were interviewed about the same topics, and their responses were assessed and integrated into the discussion. The sentiments to pupils were in a 5-level Likert scale requiring the hearing-impaired students were to make the level of their agreement with each assertion in a table. The rating for each sentiment was coded in SPSS, where, 1 represented strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 was coded to represent strongly agree. In interpreting and reporting the results from hearing impaired learners, the total number that agreed and those who strongly agreed was summed up to represent the agreement status, while the total number that disagreed and those who strongly disagreed was summed up to represent the disagreement status. The mean score for each sentiment in a table was computed to help visualize the average value of the responses out of a ranking of 5 points in a Likert Scale. Table 4.5 is a summary of the replies received.

**Table 4. 5*****Utilization of Augmentative and Alternative Assistive Technologies***

Statements on augmentative and alternative assistive technologies (N = 86)	SD(1)	D(2)	N (3)	A(4)	SA(5)	Mean
• We utilize a variety of augmentative and alternative assistive devices in our school	20 (23.3%)	41 (47.7%)	8 (9.3%)	14 (16.3%)	3 (3.5%)	2.29
• We have adequate augmentative and alternative assistive devices in our school	13 (15.1%)	46 (53.5%)	11 (12.8%)	11 (12.8%)	5 (5.8%)	2.41
• Our school has clear guidelines assistive devices	15 (17.4%)	27 (31.4%)	22 (25.6%)	18 (20.9%)	4 (4.7%)	2.64
• Learners are sensitized to use devices	14 (16.3%)	35 (40.7%)	7 (8.1%)	21 (24.4%)	9 (10.5%)	2.72
• Learners utilize augmentative and alternative assistive devices in classroom	22 (25.6%)	21 (24.4%)	19 (22.1%)	19 (22.1%)	5 (5.8%)	2.58
• Our school has instituted measures on utilization assistive devices	33 (38.4%)	16 (18.6%)	12 (14.0%)	16 (18.6%)	9 (10.5%)	2.44
• The augmentative and alternative assistive technological devices are repaired in timely manner	26 (30.2%)	32 (37.2%)	11 (12.8%)	11 (12.8%)	6 (7.0%)	2.29
• I have the skills to use augmentative and alternative assistive devices	22 (25.6%)	21 (24.4%)	19 (22.1%)	19 (22.1%)	5 (5.8%)	2.58

Table 4.5 is showing that there was a generally high disagreement with all the statements posed to learners regarding the utilization of augmentative and alternative assistive technology devices,

where, the overall mean was 2.49. On adequacy of augmentative and alternative assistive technology devices, the study found that they were not enough as indicated by 59 (68.6%) of learners with the hearing impairment. Only 16 (18.6%) of learners who termed the devices as adequate, while, 11 (12.8%) were neutral. The augmentative and alternative assistive technology devices are also of different nature, hence, the research wanted to know if the school had different types of hearing aids for different levels of hearing impairment. The results show that 61 (71%) of learners disagreed, but, 17 (19.8%) agreed while 8 (9.3%) were neutral. Rohwerder (2018) and Masayi (2016) also lamented that assistive technologies for all forms of disabilities were limited in quantity, quality, availability and paucity distribution among the schools. The limited variety of assistive according to Alasmari (2021) was a dominant observation among junior and high schools. It was undisputable that the dismal availability of some devices was linked to poor academic attainment among the learners with special needs. Bunning et al. (2014) also concurred with the study findings on the availability of inadequate and limited variety of devices; hence, a suggestion on adopting a home-based intervention of modifying assistive technology to suit a user's needs.

The research also sought to see if the students with hearing impairment were using the few available augmentative and alternative assistive technology devices while in class. According to the results presented in Table 4.5, half of the learners, 43 (50.0%) disagreed with the sentiment, 24 (27.9%) agreed, while 19 (24.4%) were neutral. According to the findings, there were few augmentative and alternative assistive technology devices at the three schools that took part in the study. The devices further lacked varieties of such devices, something that shows that the learners who would require some specialized devices in the classroom due to the nature of their hearing challenge were suffering or were getting little assistance. This indicates that the rate of non-utilization of augmentative and alternative assistive technology devices was high in the schools

and this would affect their level of listening and understanding of the contents taught in class. It also had the potential to affect their participation in group work. This would ultimately affect their academic performance. Other alarming scenarios were presented by MacLachlan and Scherer (2018) and Alasmari (2021) who noted stances of non-use and under-utilization of assistive technologies for learners with multiple forms of disabilities. MacLachlan and Scherer (2018) findings opined that the dismal use was caused by little know-how and irregular maintenance of the devices by technical experts. According to Masayi (2016), the availability and utilization of assistive technologies had significant impact on the academic achievement of visually, mentally, physically and hearing-impaired learners. Several measures that include the enactment of policies, purchasing of products, employing competent personnel, conducting training for the already employed technical personnel and scheduling regular maintenance for the augmentative and alternative assistive devices were laid out by MacLachlan and Scherer (2018) and Alasmari (2021). The measures suggested by these studies were also adopted in this study.

Considering that augmentative and alternative assistive technology devices largely assist a learner while in class, the low utilization of the devices was disturbing, and reflected unequal opportunities to learning. Apart from inadequate number of augmentative and alternative assistive technology devices, other reasons for the low utilization were attributed to learners lacking the required skills. This was due to the fact that 43 (50.0%) of the students with hearing disability admitted to lacking the ability to use augmentative and alternative assistive technology devices. MacLachlan and Scherer (2018) associated the underutilization of available assistive technologies for learners in educational premises to dismal training on how to wear, use and operate the devices. Other researchers such as Chibuzor (2017) and Lantang (2016) likened the dismal utilization assistive devices to the lack of technical assistance, socio-cultural aspects and fear of stigmatization. It is



also worth noting that the dismal underutilization observed was associated with non-appealing results on communication fluency and poor examination scoring among the learners (Mwatsaka, 2020).

The learners lacking skills to utilize the augmentative and alternative assistive technology devices raised a concern that whether the teachers themselves possessed the said skills. The question regarding the skills that a teacher ought to have been posed to head teachers, teaching and non-teaching staff as well as the County Directors of Education. The responses given were securitized and common themes were identified. This led to a few skills which were regarded critical for both teaching and non-teaching staff. They included:

- Repair and maintenance of the assistive technologies
- Operating and fitting the technological devices e.g. audiometer
- Computer literacy skills
- Assessing knowledge of levels of every child
- Sign language skill
- Digital literacy skills
- Knowledge / skill to measure hearing loss
- Safety of the devices
- Communication skills

The other thing that stood out from the results was that the schools did not have measures / guidelines to foster the utilization of augmentative and alternative assistive devices. This was indicated by 49 (57%) of learners. It was also clear that the augmentative and alternative assistive technology devices were rarely repaired once they break down. These aspects may explain the low utilization of augmentative and alternative assistive technology devices by learners in the three schools. This situation would undoubtedly have an impact on the academic achievement of students with hearing impairment. Chiubzor (2017) and Lantang (2016) discovered that

elementary and secondary schools with students with disabilities misused the equipment and services available to them owing to a lack of technical help. These negative trends are against the declarations made by The United Nations Convention on the Rights of Persons with Disabilities of 2008 that utilization of assistive was not only supported by their availability but most importantly also by the availability of competent humanitarian services rendered directly to learners with disabilities. Winfred (2017) opined that technical experts are meant to; maintain, repair, replace, adjust, repackage and train marginalized children on the devices' use. In agreement, Mwatsaka (2020) reported a significant and positive relationship between utilization and the learners' class achievements.

#### **4.7 Results on Alerting Assistive Technologies and Academic Performance of Learners**

The third goal of the study was to evaluate the use of alerting assistive technology in primary schools for the hearing impaired in Meru and Tharaka Nithi counties to improve academic achievement of learners with hearing challenges. The alerting assistive technologies mostly enable the hard of hearing individuals perceive the environment just as others do. This assistive technology comprise equipment that creates attention, awareness and perceptions towards what is happening in the immediate and general environment and through which a hard of hearing individual can respond quickly with ease just as their counterparts do (Hermawati & Pieri, 2020). These devices are usually utilized to achieve environmental sound awareness and localize it accordingly through the impact of the good intent, such as smoke detected by a fire alarm, a child crying, and door bell and others.

The utilization of alerting assistive technology devices was measured by posing several sentiments to learners who had hearing impairment. In a focused group discussion, teachers and technical staff

were asked to explore difficulties concerning alerting assistive technology tools.. The head teachers and County Directors of Education were interviewed regarding the same aspects and their responses were analyzed and incorporated in the discussion. The sentiments to pupils were in a 5-level Likert scale requiring the hearing-impaired learners to mark the level of their agreement with each statement in a table. The rating for each sentiment was coded in SPSS, where, 1 represented strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 was coded to represent strongly agree. In interpreting and reporting the results from hearing impaired learners, the total number that agreed and those who strongly agreed was summed up to represent the agreement status, while the total number that disagreed and those who strongly disagreed was summed up to represent the disagreement status. The mean score for each sentiment in a table was computed to help visualize the average value of the responses out of a ranking of 5 points in a Likert Scale. Table 4.6 provides a summary of the replies received.

**Table 4. 6*****Utilization of Alerting Assistive Technology***

• Sentiments on alerting assistive technologies (N = 86)	SD(1)	D(2)	N(3)	A(4)	SA(5)	
• All building in our school are fitted with alerting devices which can notify us in case of an emergency	49 (57.0%)	14 (16.3%)	17 (19.8%)	1 (1.2%)	5 (5.8%)	1.83
• I have the skills to use alerting assistive technology devices	35 (40.7%)	23 (26.7%)	9 (10.5%)	16 (18.6%)	3 (3.5%)	2.17
• Our school has clear guidelines on the utilization of alerting assistive technology devices	28 (32.6%)	25 (29.1%)	8 (9.3%)	18 (20.9%)	7 (8.1%)	2.43
• The alerting assistive devices are repaired in timely manner	26 (30.2%)	33 (38.4%)	8 (9.3%)	14 (16.3%)	5 (5.8%)	2.29
• Learners are sensitized to use alerting assistive technology devices	38 (44.2%)	26 (30.2%)	8 (9.3%)	7 (8.1%)	7 (8.1%)	2.06
• We have adequate alerting assistive devices in our school	40 (46.5%)	21 (24.4%)	7 (8.1%)	11 (12.8%)	7 (8.1%)	2.12

Table 4.6 is showing a high disagreement on all the statements regarding the alerting assistive technology devices that were posed to learners, mean was 2.15. On adequacy of alerting assistive technology devices, the study found that they were not enough as indicated by 61 (70.9%) of learners with the hearing impairment. These responses were confirmed by the first statement where 63 (73.3%) of learners said that all the building at their school were not fitted with alerting devices

which can notify them in case of an emergency. This indicates high level on non-compliance with safety measures recommended by the National Institute on Deafness and Other Communication Disorders [NIDCD], 2021).

The results further indicated that the few alerting assistive devices that were available were rarely repaired / maintained as noted by 59 (68.6%) of learners across the three schools. It was also clear that 58 (67.4%) of learners indicated that they lacked skills to utilize the few alerting assistive technology devices. The sensitization level of learners on hearing impairment also seemed to be low, where, only 14 (16.2%) said that they had been sensitized on the use of alerting assistive technology devices. Notably, the majority of students, 64 (74.4%), stated that they had not been educated on the usage of alerting assistive technology gadgets. Probably, this was due to the fact that most alerting assistive devices were few or not available in the school. The other reason could be due to the lack guidelines from the school. Actually, most learners, 53 (61.7%) indicated that their school did not have clear guidelines on the utilization of alerting assistive technology devices. In the contrary, Hermawati and Pieri (2020) reported a highly improved quality of life for children with hearing impairment due to the presence of a wide list of alerting devices that ranged from doorbells, smoke detectors and alarm clocks. Kim and Lee (2016) concurred with the findings on poor utilization which they reported to be as a result of the limited availability and technical know-how. The findings by Kim and Lee on the aspect of emphasizing a need for enactment of appropriate policies to guide learners' utilization and acquisition of specific technologies. The World Health Organization African Region Report (2021) attributed the inadequate availability and underutilization of assistive technologies devices on the weak governance systems for implementing frameworks for the disabled and inadequate funding which jeopardized their acquisition and maintenance of the same.

The findings are showing that the three schools did not have adequate alerting assistive devices. The few available ones were poorly maintained and most learners lacked skills to utilize them. This situation was regarded to affect the learning environment of learners in the school compound and had potentials to affect their academic performance. Winfred (2018) also found that poor utilization of assistive technological devices had negative impact on the academic achievement of learners with disabilities. Winfred in addition noted that some schools were in possession of some valuable devices which could be utilized to enable the learners with disabilities perceive the school environment positively and respond to learning needs with ease. However, these devices were rarely utilized. These was largely because, the majority of them were obsolete, very old, rarely repaired. Moreover, there was lack of technical non-teaching experts to guide the wearers. In a common view, Ng'etich (2018) found that maximum utilization of assistive technologies for the visually impaired learners improved their quality of life, contributed to their independency and eliminated learning barriers which characterized important attributes of quality education. However, the academic achievement of learners was hindered by the inadequacy of the needed assistive as well as the stigmatization in the school and in the society.

The research also sought to know if students with hearing impairment were using the few alerting assistive technology devices that were offered in class. According to the results presented in Table 4.4, half of the learners, 43 (50.0%) disagreed with the sentiment, 24 (27.9%) agreed, while 19 (24.4%) were neutral. According to the findings, there were few alerting assistive technology devices at the three schools that took part in the survey. The devices further lacked varieties of such devices, something that shows that the learners who would require some specialized devices in the classroom due to the nature of their hearing challenge were suffering or were getting little assistance. This indicates that the rate of non-utilization of alerting assistive technology devices

was high in the schools and this would affect their level of perception to the environment just as others do. It also had the potential to affect their participation in group work. This would eventually have an impact on their academic achievement. According to Ng'etich (2018), the poor and unacceptable performance of learners with disabilities was discovered to be due to a lack of training for both the learners and the personnel who were assisting the students. It was clear that the lack of enough funds allocated to procure devices regularly acted as a serious drawback. Similarly, other researchers such as Danjal and Singh (2019) and Aranda-Jan et al. (2020) linked the little achievement of learners with disabilities in academics to negative attitudes towards the technologies. Other issues mentioned by these studies were the lack of adequate technical support and stigmatizing environment.

Considering that alerting assistive technology devices largely assist a learner while in class, the low utilization of the devices was disturbing, and reflected unequal opportunities to learning. Apart from inadequate number of alerting assistive technology devices, other reasons for the low utilization were attributed to learners lacking the required skills. This was due to the fact that 43 (50.0%) of the learners with hearing disability admitted to lacking the ability to use alerting assistive technology devices. According to the World Health Organization African Region Report (2021), the limited availability and underutilization of assistive technologies for hearing-impaired students is due to weak governance systems for implementing frameworks for the disabled, insufficient funding, which jeopardizes device acquisition, and insufficient regulatory frameworks. However, Marschark et al. (2015) and Aranda-Jan et al. (2020) findings were different from the study findings; where, it was identified that individual characteristics, family background, and experiences inside and outside the school environment were among the critical antecedents for underutilization of assistive by learners with difficulty in hearing. Other factors deterring the

utilization of alerting assistive technology devices were the immediate environment, which was described as critical in shaping the learners' perceptions of their special condition. The attitudes towards assistive technology were also a key determinant (Aranda-Jan et al., 2020; Danjal & Singh, 2019).

#### **4.8 Attitudes of the Hearing-Impaired Learners towards Assistive Technologies**

The fourth goal of the study was to examine the moderating effects of learners' views on the link between the use of assistive technology and academic achievement of learners with hearing challenges in Meru and Tharaka Nithi counties' primary schools for the hearing impaired. The researcher argued that the attitudes (positive or negative) of the hearing-impaired learners towards assistive devices directly impact their utilization. The information for this variable was acquired from teachers and technical personnel who were requested to participate in a focused group discussion about attitudes of learners with hearing impairment toward assistive technology technologies. The head teachers and County Directors of Education were interviewed regarding the same aspects and their responses were analyzed and incorporated in the discussion. Information was also acquired from the study's main respondents, namely the students with hearing impairments; where, the attitude was a latent variable; meaning that, respondents were asked to identify their views in response to various sentiments. The summation of the responses helped to gauge the attitude that learners had towards the assistive technologies. The sentiments posed to respondents were about beliefs, feelings, opinions, perceptions, acceptance of the hearing impairment condition and behavioral tendencies towards the use of assistive technology devices.

The feelings of hearing-impaired learners were expressed on a 5-level Likert scale, with the hearing-impaired learners marking their level of agreeing with each sentence in a table. The rating for each sentiment was coded in SPSS, where, 1 represented strongly disagree, 2 for disagree, 3



for neutral, 4 for agree and 5 was coded to represent strongly agree. In interpreting and reporting the results from hearing impaired learners, the total number that agreed and those who strongly agreed was summed up to represent the agreement status, while the total number that disagreed and those who strongly disagreed was summed up to represent the disagreement status. The mean score for each sentiment in a table was computed to help visualize the average value of the responses out of a ranking of 5 points in a Likert Scale. Summary of the responses gotten is presented in Table 4.7.

**Table 4. 7*****Attitudes of Learners with Hearing Impairment towards Assistive Technologies***

Sentiments (N = 86)	SD(1)	D(2)	N(3)	A(4)	SA(5)	
• I like wearing the assistive devices	22 (25.6%)	26 (30.2%)	13 (15.1%)	14 (16.3%)	11 (12.8%)	2.60
• I enjoy utilizing assistive devices.	17 (19.8%)	37 (43.0%)	11 (12.8%)	16 (18.6%)	5 (5.8%)	2.48
• Wearing the hearing assistive devices has made me perform well in examinations	9 (10.5%)	32 (37.2%)	13 (15.1%)	15 (17.4%)	17 (19.8%)	2.99
• Using listening, devices have made me get with activities	20 (23.3%)	38 (44.2%)	12 (14.0%)	9 (10.5%)	7 (8.1%)	2.36
• My teachers make me feel encouraged to wear the assistive devices	18 (20.9%)	34 (39.5%)	16 (18.6%)	4 (4.7%)	14 (16.3%)	2.56
• The availability of devices boost my morale	19 (22.1%)	36 (41.9%)	12 (14.0%)	11 (12.8%)	8 (9.3%)	2.45
• I don't like wearing the devices	8 (9.3%)	49 (57.0%)	11 (12.8%)	12 (14.0%)	6 (7.0%)	2.52
• Learners only ask for the devices when the teacher is in the class	22 (25.6%)	36 (41.9%)	14 (16.3%)	5 (5.8%)	9 (10.5%)	2.34
• learners rarely were devices due to mockery	20 (23.3%)	36 (41.9%)	9 (10.5%)	12 (14.0%)	9 (10.5%)	2.47
• The hearing assistive devices are user friendly,	9 (10.5%)	32 (37.2%)	13 (15.1%)	15 (17.4%)	17 (19.8%)	2.99

The results are showing the nature of attitudes that learners with hearing impairments had towards the assistive technology devices. According to the results in Table 4.7, it is evident that more than

half of learners with hearing impairments, 48 (55.8%), dislike wearing assistive technological equipment on a regular basis; only 25 (29.1%) agreed to the attitude that was positively stated. This discovery demanded an investigation on the attitudes of students with hearing impairment about the use of hearing aids. On the friendliness aspects of assistive technology devices, the results indicated that 41 (47.7%) of the learners with hearing impairment don't perceive them being user friendly, 32 (37.2%) agreed; meaning, they perceive them as user friendly, while 13 (15.1%) were neutral.

The above answer may explain why a high number, 54 (62.8%) of learners with hearing impairment said that they don't enjoy utilizing assistive devices inside the classroom and outside the school environment. The perception towards the use of equipment affects the manner in which one enjoys the expected benefits. Wairimo et al. (2018) supported the study findings in their views which pointed out that learners' attitudes towards assistive technologies were among the discovered significant variables that affected the utilization of available gadgets apart from the skills and knowledge on how to wear and utilize them. Moreover, Wairimu et al. deduced that the negative attitudes towards the devices were featuring in their ultimate academic results characterized by dismal achievements. Ejore (2019) also noted that students in Turkana failed to use the available assistive devices for various forms of disabilities due to poor sensitization strategies for eliminating the negative views and perceptions towards wearing alternative devices in the inclusive settings. The findings appeared to stress on the need to come up with implementation strategies which impact positive attitudes towards assistive technologies in and outside school premises. Furthermore, Okutoyi et al. (2013) also elaborated those learners with hearing impairment faced four major challenges where attitudes were second in rank in the list of

predisposing factors. The other drawback was; communication, inadequate access to resources and inadequate competent personnel.

The act of not liking to use the hearing assistive devices may also be attributed to stigma in the school and from the immediate environment. Table 4.7 shows that in this investigation, 56 (65.2%) of the results show that there were cases reported on learners wearing the hearing assistive devices facing stigma, criticism and mockery from hearing counterparts in our school as was indicated by 56 (65.2%). This shows that there were evidence of stigma, criticisms and mockery on learners putting on hearing assistive devices emanating from the immediate environment. These treatments create a feeling of rejection, self-pity and exclusion (Primadi et al., 2017), hence, learners with hearing impairments may stop using the devices to avoid stigmatization, criticisms and mockery. The resulting attitudes may lead to the nonuse of the hearing assistive devices, hence, negating the benefits thereof. The continual nonuse may affect how one performs academically. In concurrence, Khairuddin (2019) and Johnson (2021) clearly stipulated that the learners' attitudes towards utilizing assistive was shaped by the surrounding, stakeholder, environmental, social, peer and family among other factors. This meant that the people surrounding an individual who has some marginalized characteristics contributed to their liking or disliking of the device, wearing or negating wearing the device, utilizing it consistently or at sometimes or fearing to be associated with the hearing aid. Along the same vein, Khairuddin (2019) and Jorgensen and Messersmith (2015) argued that attitudes of learners towards the utilization of assistive technologies may be influenced by lack of acceptance of disability condition by a learner and negative stigma and stereotyping from the immediate family members or the society. Similarly, Ahmed (2015) reported that teachers' perception had a role in impacting learners' effective utilization of assistive technologies in the school premises and even outside.

The failure to see the value and benefit of hearing assistive devices by learners may explain why the 41 (47%) said that the wearing of the hearing assistive devices does not make them perform well in examinations. Only 32 (37.2%) admitted to have performed well in examinations for using hearing assistive devices, while, 13 (15.1%) were neutral. This shows that learners with hearing challenges do not perceive the assistive device as being helpful towards improving academic performance. This could be attributed to poor attitude towards utilization of hearing assistive devices. A similar opinion was presented by Wairimu et al. (2018) whose study findings reported a significant relationship between negative attitudes and poor academic success of students with hearing problem in mathematics subject. Kayere et al. (2016) too admitted that positive perceptions on assistive device use translated to positive results on the learners' academic performance. Ejore (2019) acknowledged that the use and the un-use of available devices significantly depended on the stakeholders and individual perceptions. For this reason, Ejore suggested ways towards instilling a positive image on using assistive devices by learners with hearing impairment, which, was termed as a strong pillar to address utilization issues.

The attitudes of students with hearing impairments regarding assistive devices may have been influenced by the availability of equipment and the sort of assistance received while using them. The results in Tables 4.3, 4.4, 4.5 and 4.6 indicate that hearing assistive devices were not adequate and this was lowering the morale of learners with hearing impairments as was reported by 55 (64%). However, there were a few cases (18, 21%) where teachers were encouraging the learners to wear the assistive devices. One encouraging thing was that there were people to assist the learner to fix the hearing assistive devices when help was needed. This may explain why Rekkedal (2012) and Soetan et al. (2021) concluded that an environment comprising of enthusiastic people who

offer readily required help to a hearing marginalized child impacted positive attitudes towards wearing the assistive device. Soetan et al. (2020) also appreciated the place having technical experts who offer immediate help on request by learners for example in repairing, rectifying, tuning and modifying the assistive devices. The findings concur with the report by Ahmed (2015) which appreciated the efforts of the immediate community, especially the teachers, in helping learners wear assistive technology devices. Teachers' positive attitudes were reported to influence the marginalized group by developing positive perception towards utilizing the available assistive devices. This was indicated by approximately two third (57, 66.3%) of learners.

The above findings demonstrate how learners with hearing impairments' attitudes might deter them from using assistive equipment. This indicates the need to address the situation by establishing measures that would helpful in imparting positive attitudes in hearing impaired learners. In that connection, teaching and non-teaching staff, head teachers, the County Directors of Education, were asked during interview and focused group discussion to state what they thought should be done to improve the attitudes of learners towards using assistive technology.

The study received several suggestions which were examined critically; first, inductively with an aim to identify common themes and statements. The identified themes and phrases were cross-examined with a view to identity broad themes or categories. This involved a rigorous qualitative approach which enabled the researcher to hence deductively narrow down to four categories of solutions to address the learners' attitudes towards hearing assistive devices. The four common broad thematic categories were in inform of support which included home-based support, community-based support, school-based support, and government-based support. The four

thematic categories were enumerated with a view to showing the specific solutions under each of them as stipulated below.

### **Home-based support**

These were need to sensitize and educate parents on importance of using hearing assistive devices. Train / show parents how to use hearing assistive devices so that they can support their affected children while at home; parents to embrace and encourage the affected children to use hearing assistive devices while at home; parent should be encouraged to have their children wear hearing aid even at home and other public gathering places. Parents to teach and sensitize the deaf child so that one doesn't ask why a child is using hands, why are they wearing a hearing aid.

### **Community-based support**

There is need to encourage the use of assistive technology devices in public locations such as churches, mosques, and other places of worship. Increase community awareness regarding hearing impairments, teachers of hearing-impaired learners to sacrifice by interpreting communication during church services, public gathering and other public places, and community to be sensitized to using sign language. The sensitization can take places in public places such as church, education institutions, and public barazas, among others.

### **School-based support**

Support by sensitizing and educating learners on importance of using hearing assistive devices. Also, exposure learners to places where the hearing assistive devices are used, for example, radio & T.V stations, parliament and other places; teachers to ensure that information in the hearing assistive devices is attractive, friendly and interesting to learners; Teachers to ensure that the

hearing assistive devices are fitted well to avoid discomfort to the learners; schools to introduce rewarding programs for the learners who continuously use their hearing assistive devices; the schools to provide functional and reliable assistive technology devices to avoid bad impression or discouragement, the schools to come up with programs that reduce stigma on the use of assistive technology.

Other are, the schools to introduce and train peer counselors among learners themselves, provide psychological counselling sessions to learners with hearing the impairments regarding embracing and using hearing assistive devices, expose learners to mentors who have gone through school for hearing impaired and are successful in life, encourage the hearing-impaired learners to be using the hearing assistive devices in their normal communication, sensitize learners on the importance of using assistive devices in school for improving their academic performance and even outside the school compound; and training the learners with the hearing impairments on how to take care of their own devices and how to wear them correctly.

### **Government-based support**

Government to establish centers in all sub-counties where all interested person can be trained on sign language, Government to provide funding for training parents in different regions of the counties on hearing impairments and related assistive devices, the government will implement a regulation requiring all teacher colleges to include sign language as one of their courses; government to lobby for more deaf education programs be initiated via TV and radio stations; Government to ensure a patron in education institutions to serve as an advocate for persons with hearing impairments; and government to establish affirmative actions in learning institutions and employment for hearing impaired persons.



The above nature of support which were suggested as solutions for addressing the attitudes learners with the hearing impairments towards the assistive devices indicate a need for a centered effort. The efforts spread from home to school, community and to government. This points out to the need for sensitization and education of all the involved stakeholders. Wairumu et al. (2018) noted the power of sensitizing the concerned stakeholders in the Ministry of Education to undertake their specific contributory roles in shaping up learners' attitudes towards utilizing assistive technological devices. These findings are indicating on the need for government to fund, train, employ and avail a budget for assistive devices, while, the teachers and fellow pupils need to be sensitized so as to accommodate learners with unique characteristics in the inclusive schooling set up and even in specialized schools. Kayere et al. (2016), Okutoyi et al. (2013), and Ejore (2019) stressed the importance of training and awareness campaigns in advocating for equality and inclusion. In a similar vein, Alegre de la Rosa and Villar Angulo (2019) highlighted the importance of family members and engagement in instilling good attitudes toward children with special needs. They termed the role played by the immediate family as very fundamental in determining receptivity of other pieces of advice received in the school.

#### **4.9 Academic Performance of Learners with the Hearing Impairments**

The dependent variable in this study was the academic achievement of students with hearing impairments. This study's reference to academic success means the totality of outcomes in terms of knowledge, skills and competencies that a learner exhibits when tested by an examiner through tests, practical, assignments and even national examinations (Brown et al. 2018). The learning and examination systems put in place ought to promote fairness regardless of one's deformities. The learners in a school ought to be assessed without discrimination and without providing due advantages to some and not to others.

The information regarding academic performance was gathered from the teachers and technical staff who were asked to discuss issues affecting the academic performance of learners with hearing impairment in a focused group discussion. The head teachers and County Directors of Education were also interviewed regarding the same aspects and their responses were analyzed and incorporated in the discussion. Information was also acquired from the study's major respondents, namely the students with hearing impairment; academic achievement was evaluated as a latent variable; meaning, various sentiments were posed to respondents requiring them to indicate their responses. The summation of the responses gotten helped to gauge the academic performance of learners from the three primary schools for hearing impaired in Meru and Tharaka Nithi counties. The sentiments posed to respondents were about demonstration of knowledge, improved communication, literacy and auditory skills; scores in tests, end term results and KCPE, as well as statements regarding learner's independence in carrying out academic related tasks.

The sentiments to learners with hearing impairment were expressed on a 5-point Likert scale, with the hearing-impaired learners needing to mark their degree of agreement with each statement in a table. The rating for each sentiment was coded in SPSS, where, 1 represented strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 was coded to represent strongly agree. In interpreting and reporting the results from hearing impaired learners, the total number that agreed and those who strongly agreed was summed up to represent the agreement status, while the total number that disagreed and those who strongly disagreed was summed up to represent the disagreement status. The mean score for each sentiment in a table was computed to help visualize the average value of the responses out of a ranking of 5 points in a Likert Scale. Table 4.8 provides a summary of the replies received.

**Table 4. 8*****Academic Performance of Learners with Hearing Impairments***

Statements regarding academic performance	SD(1)	D(2)	N(3)	A(4)	SA(5)	
Utilization of a listening, augmentative and alternative and alerting devices has enabled me to improve my academic performance.	19 (22.1%)	32 (37.2%)	10 (11.6%)	15 (17.4%)	10 (11.6%)	2.59
Using assistive technology has made me perform better in the continuous assessment tests	21 (24.4%)	23 (26.7%)	21 (24.4%)	11 (12.8%)	10 (11.6%)	2.60
Using assistive devices has made me to perform better in end of term examinations	18 (20.9%)	33 (38.4%)	12 (14.0%)	13 (15.1%)	10 (11.6%)	2.58
My attitudes towards the utilization of assistive technologies negatively affect my academic performance	20 (23.3%)	39 (45.3%)	12 (14.0%)	11 (12.8%)	4 (4.7%)	2.30
Using assistive technologies has boosted my communication abilities	12 (14.0%)	36 (41.9%)	11 (12.8%)	16 (18.6%)	11 (12.8%)	2.74
Using assistive technologies have made me respond quickly to questions in class	18 (20.9%)	28 (32.6%)	6 (7.0%)	20 (23.3%)	14 (16.3%)	2.81
The use of hearing assistive devices has enabled me to remain active in class	18 (20.9%)	33 (38.4%)	12 (14.0%)	13 (15.1%)	10 (11.6%)	2.58
The use of assistive technologies has boosted my ability to participate in group discussions	19 (22.1%)	36 (41.9%)	9 (10.5%)	15 (17.4%)	7 (8.1%)	2.48

The results on academic results of learners with the hearing impairment indicate the extent to which the non-utilization of hearing assistive technologies was affecting learning activities inside and outside the class. According to the findings in Table 4.8, the majority of learners with hearing impairments, 46 (53.5%) said that the using of assistive technologies had not enabled them to

respond quickly to questions in class. Only 34 (39.6%) of learners with hearing impairment said that using of assistive technologies had enabled them to respond quickly to questions in class. Similarly, a low number of learners, 23 (26.7%) also agreed that the use of hearing assistive devices had enabled me to remain active in class, while, 51 (59.3%) disagreed. A high level of disagreement was also noted in the use of assistive technologies in group discussions, where, 55 (64%) said that the utilization of assistive technology had not boosted their ability to participate in group discussions. Moreover, 48 (55.9%) indicated that the use of hearing assistive technologies had boosted my communication abilities.

The hearing assistive devices, when used appropriately, are expected to enhance the extent to which a learner is able to participate in learning activities such as being active in class by asking and answering questions and by being active in groups' assignments. It also expected to enable one interact well with people and enhance one's communication. In that conjunction, Marschark et al. (2015), Farooq et al. (2015) and Mordini et al. (2018) endorsed that assistive technology devices utilization for hard of hearing had numerous benefits to the affected individuals. Examples of the benefits were; speech development, grabbing attention, alerting and perceiving and communication development. Kim and Lee (2016) and Dhanjal and Singh (2019) correlated these benefits to learners' improvement in their academics. The study by Ahmed (2018) and Khairuddin (2019) revealed that the use of mobile phones, hearing aids, text magnification software, mobility enablers and other assistive software for students with special needs, increased their participatory in the classroom setting, improved learner attention, boosted their communication and writing skills which were termed as key in alleviating the intricacies of poor academic achievements.

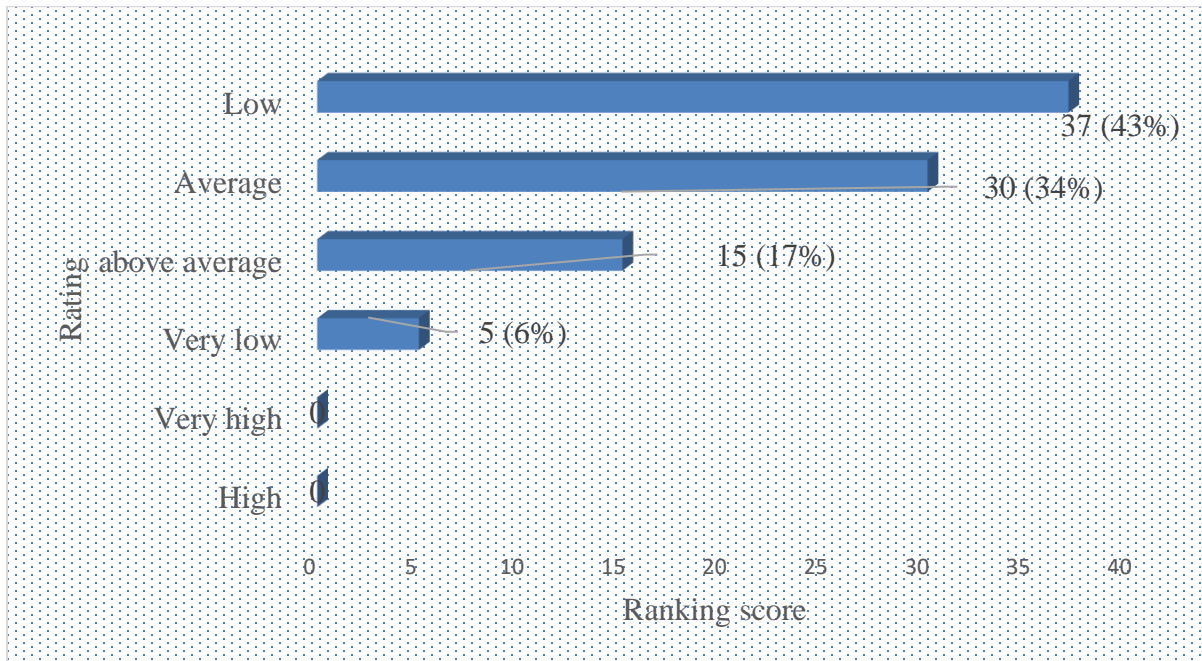
It was hypothesized that the use of listening, augmentative and alternative, and alerting technologies would impact the academic performance of students with hearing disabilities. When

asked about this, learners responded by disagreeing to the sentiment. The results show that 51 (59.3%) disagreed that the use of the hearing assistive technologies had enabled them to improve their academic performance. Only 25 (29%) had a contrary opinion. The study also wanted to know how the usage of hearing aids influenced performance on continuous assessment tests and end-of-term exams. The results are showing that a high number disagreed where, 44 (51.1%) said that the hearing assistive devices had not helped them to improve continuous assessment tests and, 51 (59.3%) in end of terms examinations. The results are showing that, the learners with hearing impairments did not feel the benefits of using hearing assistive devices towards improving their academic performance across the three schools. In disagreement, Sung et al. (2016), Ahmed (2018), Khairuddin (2019) and Miles et al. (2018) findings noted that the employment of assistive devices had a positive impact on learners' academic progress. Specifically, Sung et al. (2016), Ahmed (2018), Khairuddin (2019) and Miles et al. (2018) revealed that the use of mobile phones, hearing aids, text magnification software, mobility enablers and other assistive software for learners with disabilities; increased their participatory in the classroom setting, improved learner's attention, boosted their communication and writing skills which are termed as key in alleviating the intricacies of poor academic achievements.

The replies given above led to an examination of the data indicating how students with hearing problems perceived their academic achievement. The students with hearing problems were asked to assess their academic performance on a 6-point Likert scale (see results in Figure 4.2).

**Figure 4. 2**

*The learners' self-rating on their academic performance*



The results in Figure 4.2 are showing a low academic performance by majority of learners with hearing impairments. Surprisingly, 37 (43%) admitted that their academic performance was low, while, 30 (34%) said that it was at average. The findings also indicated that 5 (6%) of learners rated their academic performance as very low. Only 15 (17%) who said that their academic performance was above average. The researcher went ahead to confirm the academic performance by analyzing the KCPE results for the last six years (2015 to 2021) apart from 2020 which was exempted because of covid-19 pandemic. Table 4.9 contains an analytical summary.

**Table 4. 9*****KCPE Performance of primary schools for learners with hearing challenges in Meru and Tharaka Nith Counties***

Year	2015	2016	2017	2018	2019	2021
Njia Primary School - KCPE Mean Scores	177.1	193.5	177.3	149.1	86.7	210.5
Kaaga Primary School - KCPE Mean Scores	201.7	169.5	148.6	138.6	178	159.1
Meru County - KCPE average mean scores	248.7	241.3	244.1	245	242.1	253.5
Kamatungu primary school - KCPE Mean Scores	217.2	219.9	164.14	167. 9	167.5	172
Tharaka Nithi County - KCPE average mean scores	252.6	253.7	246.5	256.3	247.5	256.6

The KCPE data shown in Table 4.9 indicates that the academic performance of the three primary schools for learners with hearing impairments has been very low as compared to the county average performance scores for the year 2015, 2016, 2017, 2018, 2019, and 2021. As evidenced by the data, the performance for both Njia and Kaaga Primary Schools has been 165.7 and 165.9 respectively as compared to the Meru County average scores of 245.8; while, the performance for Kamatungu primary school has been slightly higher at 184.8, although low as compared to the Tharaka Nithi County average scores of 252.2. A similar low academic performance was reported in the study by Mwanyuma (2016), where, a mean score of 131, 151 155 was reported in KCPE of 2012 at Kuja, Maseno and Mumias schools for the deaf. Primary schools' poor academic achievement for students with hearing impairments noted at Njia, Kaaga and Kamatungu Primary Schools for the last six years is worrying and indicates an urgent need for a remedy. The equality of access to education and related opportunities as stated in the 2010 Kenya Constitution must be

seen by students with hearing problems. Poor academic results in the three schools were depriving students with hearing impairments chances for educational progress and related advantages.

The reasons that contribute to low academic performance of students with hearing impairments are numerous, thus there was a strong need to explore the potential risk factors in the three primary schools. In a qualitative study of Munali Secondary School in Zambia, Kaindu et al. (2021) noted that the curriculum used was unfriendly hearing impaired students, inadequate sign language information resources and that teachers' lack of proficiency in using sign language in the classroom. The use of assistive technology devices, which were believed to have had a role in leading to low academic achievement among students with hearing disability, was central to this study. The low academic attainment of students with hearing problems had also been reported at Kasarani Primary School in Nairobi County by Ndei (2008) and in Tanzania by Rishaelly (2017). The two studies were however carried out in an inclusive primary school as compared to the current study which focused on primary schools for students who are deaf or hard of hearing. Teachers who took part in Rishaelly's (2017) study complained about the constraints of employing both verbal and sign languages when teaching in an inclusive context due to the pressure to complete the curriculum. Consequently, the teachers had the tendencies of not the sign language in class. In such scenario, the underperformance in national examinations by the hearing-impaired learners was understood. The current study was expecting different reasons for poor academic performance considering that the three primary schools had hearing impaired learners only.

A closely related study by Muguongo (2016) found poor performance in math for students with hearing problems in Meru County from 2007 to 2014. According to Muguongo (2016), the poor performance in mathematics by learners with hearing challenges in Kaaga and Njia primary schools were due to negative attitudes towards mathematics, the pedagogies for teaching



mathematics, poor auxiliary services and inadequate resources. Muguna (2011) also examined the issue of academic performance at Kaaga primary school for learners with hearing challenges but focused on pre-school children. The overall purpose of the study by Muguna, assessed the perception that pre-school learners had on factors for good academic performance such as the learning materials, sign language, prejudices and the training skills with a view to determine remedial measures at early stage of growth of a child. Muguna attributed the poor performance of pre-school learners to the attitudes of both teachers and learners towards sign language, inadequate learning resources, and prejudices.

Similar concerns on low academic performance of learners with hearing challenges were also expressed by scholars such as Musonda and Phiri (2017), Masayi (2020), Mugisa (2017) and Jitolee (2016) who attributed this trend to poor infrastructure, inadequate specialized facilities and equipment, insufficient resources for disability mainstreaming and non-inclusivity in primary classrooms. Masayi (2020) and Mugisa (2017) noted the indispensable need for supply and deployment of specialized facilities and equipment to boost the academic results for students with hearing challenges.

The school head teachers, as well as the teaching and non-teaching personnel, were asked to recommend what they thought should be done to improve the academic performance of hearing-impaired learners at their schools. The responses gotten emphasized the need for government to provide more funds in schools for hearing challenges to acquire assistive technology devices and to pay for the non-teaching staff as well. Head teachers' number three said that the Ministry of Education should devise a system of footing the pay bill for the non-teaching staff. This head teacher further remarked, *"I have 16 non-teaching staff how do I pay them"*. The head teachers noted that the amount of funds channeled to special schools by government is very little such that,

it is very difficult to meet all the operational costs. Consequently, most non-teaching staff are underpaid, hence their motivation is low. Responding to this challenge, the County Directors of Education underscored the need for better remuneration of teaching and non-teaching staff who deal with special needs learners. In addition, they urged the head teachers to lobby for donor funding from different organizations to supplement the government funding. In agreement, Wairumu et al. (2018) encouraged the government to take action through the Ministry of Education and undertake their specific contributory roles in shaping up learners' attitudes towards utilizing assistive technological devices by leveraging funding, conducting training, employing and availing a budget for devices. Other scholars' perspectives as Kayere et al. (2016), Okutoyi et al. (2013) and Ejore (2019) advocated for the adoption of sign language in teaching saying that it is a contributor to the alleviation of low academic results of learners with hearing challenges. The findings of Chibwe (2015), Hrastinski and Wilbur (2016), and Kun-man (2017) also insisted on increasing the allocation of funds which will cater for repairs, maintenance, management and purchasing new required assistive to eliminate inadequacy.

Another measure suggested by head teachers for improving the academic results of students with hearing impairments was about training of teachers so that hearing impaired can be handled in a regular setting. The head teacher number one noted, *“Some learners here can be taught in a regular school as long as the teachers have knowledge. This helps to avoid segregation & labeling”*. Stigma, segregation and labeling were also identified by Khairuddin (2019) and Jorgensen and Messersmith (2015) as serious drawback to children with special needs.

Sensitizing and educating parents was noted by head teachers as a key strategy towards improving the academic attainment of students with hearing impairments. During the interview, the head

teacher number one quoted a common question which is heard from several parents, “*how will a person with deformity help me?*” The head teacher number two further said that many parents who have children with some disabilities are usually the last ones to be taken to school. That the parents are heard saying, “*I don’t have money; I have paid for the other children*”. This shows serious discrimination and a wrong attitude by parents which may affect how the affected children perform in academically. Comparably, Alegre de la Rosa and Villar Angulo (2019) noted that charity began at home and therefore, learners’ attitudes were mostly influenced to be negative by the people in the immediate surroundings of children. They cause stigmatization, seclusion, low motivation, traumatization, segregation and discrimination. For this very reason, family members were a key player in insinuating positive attitudes to students with special needs, hence, Rosa and Villar Angulo emphasized on the need for parents to be made aware through trainings, campaigns, seminars and workshops on the importance of appreciating disabilities and the wearing of assistive technology devices.

One county director of education emphasized the importance of community sensitization initiatives in changing parents' and society's views about students with hearing impairments. The head teachers suggested need for a special program where the government provide conducive learning environment for hearing impaired learners in addition to buying equipment and paying teachers. Examples of special program include providing basic needs such as water, electricity, food in all schools for students with hearing challenges. The establishment of conducive and accommodating school environment with adequate resources, devices and facilities was also appreciated by Wapling (2016), Soetan et al. (2020) and Tony (2019). These studies also underscored a friendly atmosphere which they said can be characterized by arrangement of items; color used on the buildings, the language used in the environment and the behavior other people

in the compound. One County Directors of Education said that the government should fully finance the education of learners with the hearing impairments.

Learners require encouragement and motivation from peers and other people in the environment in order to perform well in examinations. However, the learners with hearing impairment lacks examples from colleagues who have excelled right from lower classes to higher education despite the hearing challenges. Lack of role models and absence of mentors who have personally excelled academically and in life despite hearing challenges, usually discourage learners from putting effort in their academic pursuit. The head teacher number two noted, *“Most learners with hearing impairment don’t continue with education after primary school and this discourage other children from attending or performing well in school”*. This indicates need for measure by government to encourage the hearing-impaired learners who completed primary to continue with education for example transit to secondary and vocational training institutions, and other institutions of higher learning. These practices are common in most African countries, however, countries such as South Africa and Nigeria (The Master Card Foundation, 2018) have well supported transition programs for learners with the hearing impairments.

The head teachers together with the teaching and non-teaching staff indicated the need for adoption of a curriculum for hearing impaired and full implementation of the Individualized Education Program (IEP). This idea was also supported by the County Directors of Education who noted a need to revise the curriculum to incorporate the hearing-impaired learners. This has implications on the number of teaching and non-teaching staff engaged. Also noted was the need for policy changes to ensure that all subjects in the schools for hearing challenged learners are taught and examined in sign language. This implies need for hiring interpreters during examination. For

lessons delivery, the teachers recommended that the lessons taught should be transformed or recorded in visual format to foster better understanding.

Another issue emphasized by teaching and non-teaching staff was need to embrace use of assistive technology in class and during examinations. This implies need for increased funding to purchase the required equipment. It also implies need for incorporating special needs teachers in the process of setting examinations. This program would also necessitate raising community knowledge about the usage of assistive technology. In addition, the government should ensure that the education and other program in TV are deaf friendly. This was seen as crucial in terms of increasing inclusion and would go a long way toward boosting the academic performance of students with hearing impairments. Kathare (2020), Sambu et al. (2018), Nyambere and Okello (2021), Kalya et al. (2020) and Owour et al. (2020) further supports the endorsement of Kenya sign language as official communication and the adoption of inclusive schooling systems as modalities of effecting education equity. The current study's findings, together with those published by previous research, speak to the necessity for a dramatic change in the usage of sign language in schools and teaching institutions. The findings also are also pointing out implications on the curriculum.

Kalya et al. (2020) and Owour et al. (2020) opined that in the inclusive settings, the government should chip in by providing funding to cater for procurement of devices, remunerating teaching staff, employing more teaching staff and conduct trainings and in-service professional development programs. The county Director of Education urged the head teachers and the Ministry to regularly assess the situation to determine the progress and hence institute timely corrective measures. This clearly stipulates that the interventions have great pressure on financial obligations by the government.

Concerns were also raised by teachers and non-teaching during focused group discussion regarding examination invigilation and supervision, where, the meeting noted the need to ensure that the time allocated for examination be increased for learners with the hearing impairments. This was to allow time for translation. Along the same vein, they recommended that the examination supervisors and invigilators be fully conversant with the sign language to avoid confusion. The findings by Khalid and Asghar (2021), Yun et al. (2017) and Kun-man (2017) also recommended on the adoption of sign language, special education and inclusive education. In Kenya specifically, concerns on exacerbating undesirable academic achievement for the learners with hearing impairment is dominated by issues of adopting Kenya sign language as official communication. The same has featured in the studies by Kathare (2020), Sambu et al. (2018), Nyambere and Okello (2021), Kalya et al. (2020), and Owour et al. (2020). The County Directors of Education attributed this to lack of adequate qualified personnel to handle the hearing-impaired learners. They therefore need to change policy to encourage more teachers to pursue special education. They also noted the need for regular capacity building of the teachers who deal with learners with hearing impairments. This had implication on policy to support such initiative.

#### **4.10 Relationship between Utilization of Assistive Technology and the Academic Performance of Learners with a Hearing Challenge**

The data offered in the preceding sections gave information on the use of listening assistive technology, augmentative and alternative assistive technologies, alerting assistive technology, learner attitudes, and academic achievement. Empirical evidence regarding these constructs have been provided which also suggested a possibility in which one variable affect the other one. However, the relationships between variables needed to be performed to validate the postulated relationship. In this regard, the study took a step to evaluate the hypothesized relationship in order to determine the extent to which the presumed predictor variables (the use of listening assistive

technology, augmentative and alternative assistive technologies, and alerting assistive technology) accounted for the academic attainment of students with hearing challenges.

In order to test the level of prediction, the study first carried out diagnostic tests to help in deciding the appropriate statistical test to be adopted. The study intended to use regression analysis and therefore, the assumption of this statistical test had to be carried out. The assumptions tested were normality, autocorrelation, multicellularity, heteroscedasticity and linearity of the data. The findings on these tests are found in sections 4.9.1.

#### **4.9.1 The test on normality of the data**

In social sciences, the survey studies usually assume that data is drawn from a normally distributed population. In this study, the normality of the data was the first diagnostic test to be assessed. In the first instance, the P-value was used to assess the normality of the data, after which the Kolmogorov-Smirnov and Shapiro-Wilk tests were computed. The population of the study was small and hence, the Shapiro-Wilk P-values were adopted and interpreted accordingly (Cooper & Schindler, 2011). The study used 0.05 as the level of significance for P-values. This meant that, any P-value below 0.05 signified that data was not normally distributed and the vice versa was true. The normality requirement was further tested by inspecting the histograms, Q-Q plots, and box plots to establish the amount of the skewness. Table 4.10 displays the findings of the P-values based on the Kolmogorov-Smirnov and Shapiro-Wilk tests.

**Table 4. 10*****Tests of normality on main variables of the study***

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
X1	.105	77	.134	.960	77	.117
X2	.110	77	.023	.979	77	.221
X3	.111	77	.019	.951	77	.005
M	.128	77	.003	.907	77	.000
Y	.119	77	.009	.978	77	.193

a. Lilliefors Significance Correction

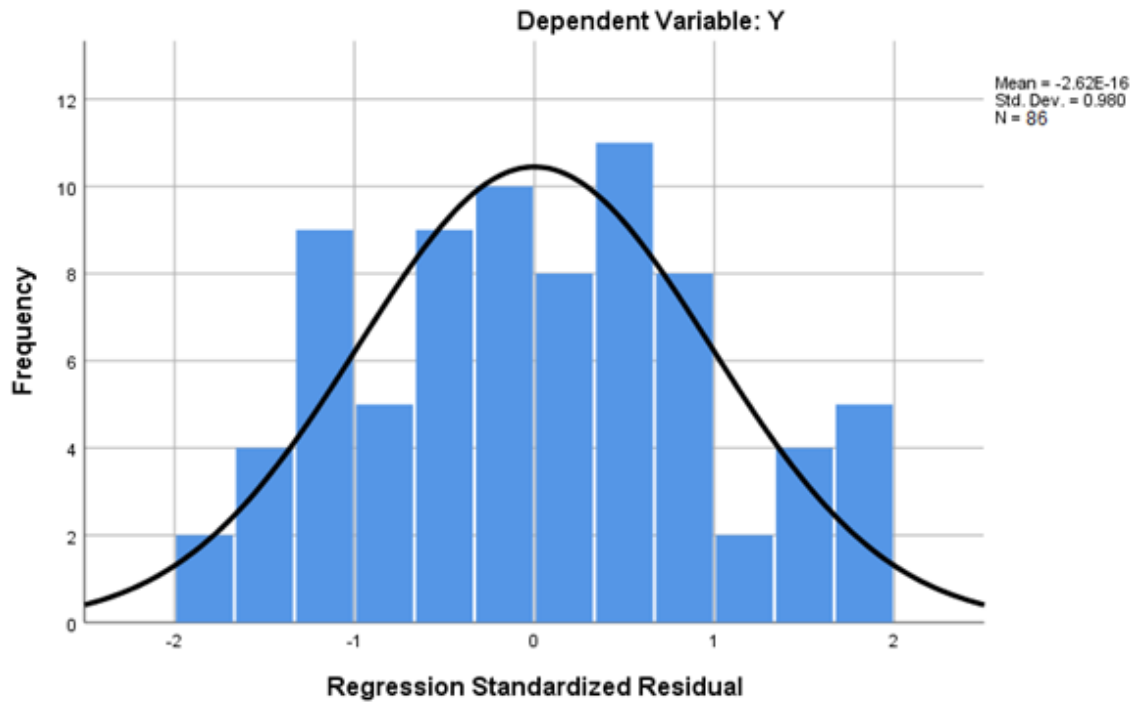
Table 4.10 displays the results that the P-values (both the Kolmogorov-Smirnovtest and Shapiro-Wilk) are insignificant for some variables, P-value is more than 0.05 level of significance (Y= .193; X<sub>1</sub> = .117; X<sub>2</sub> = .221; X<sub>3</sub> = .005; P < 0.05). In this case normality was observed in Y, X1 and X2. Preference was given to the dependent variable hence the researcher observed that data was normally distributed.

In order to counter-confirm the extent of normality of the data, the graphical methods was adopted. This was checked especially for the dependent variable. The outcome based on the dependent variable is shown in Figures 4.3, 4.4 and 4.5 respectively.



**Figure 4.3**

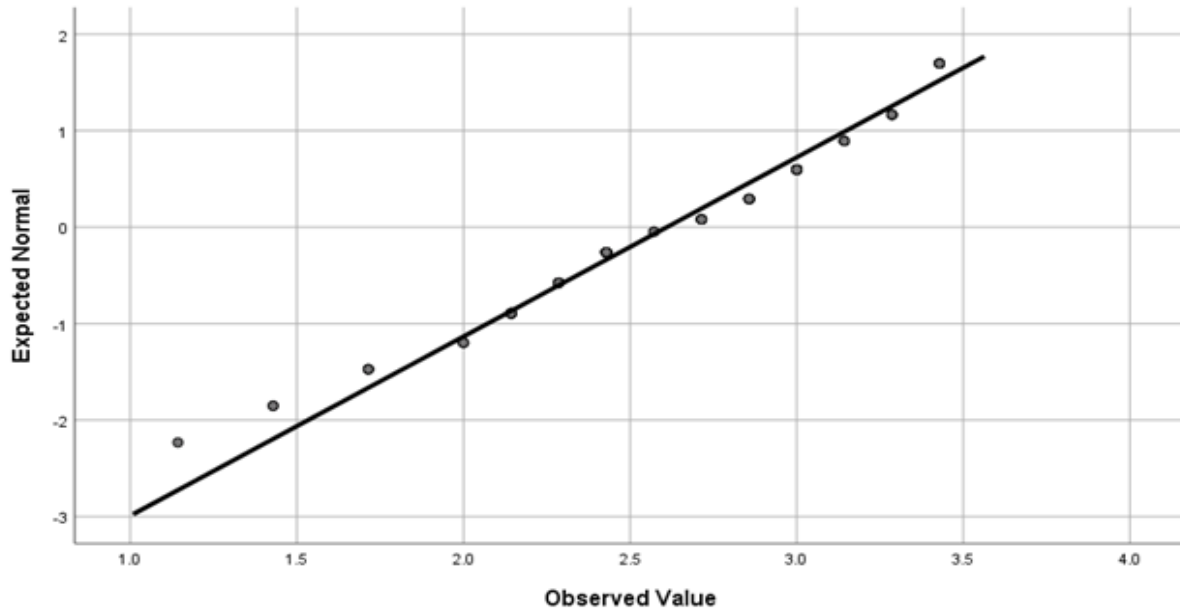
*Histograms: The academic performance of learners with hearing impairment*



According to the findings in Figure 4.3, there is a negligible skewness in the manner in which the data is distributed, hence, the study concluded the data does not show significant deviation from normality. The standard Q-Q plots were further generated to provide a clear visualization of the status of the normality condition. The Q-Q plots are presented in Figure 4.4.

**Figure 4. 4**

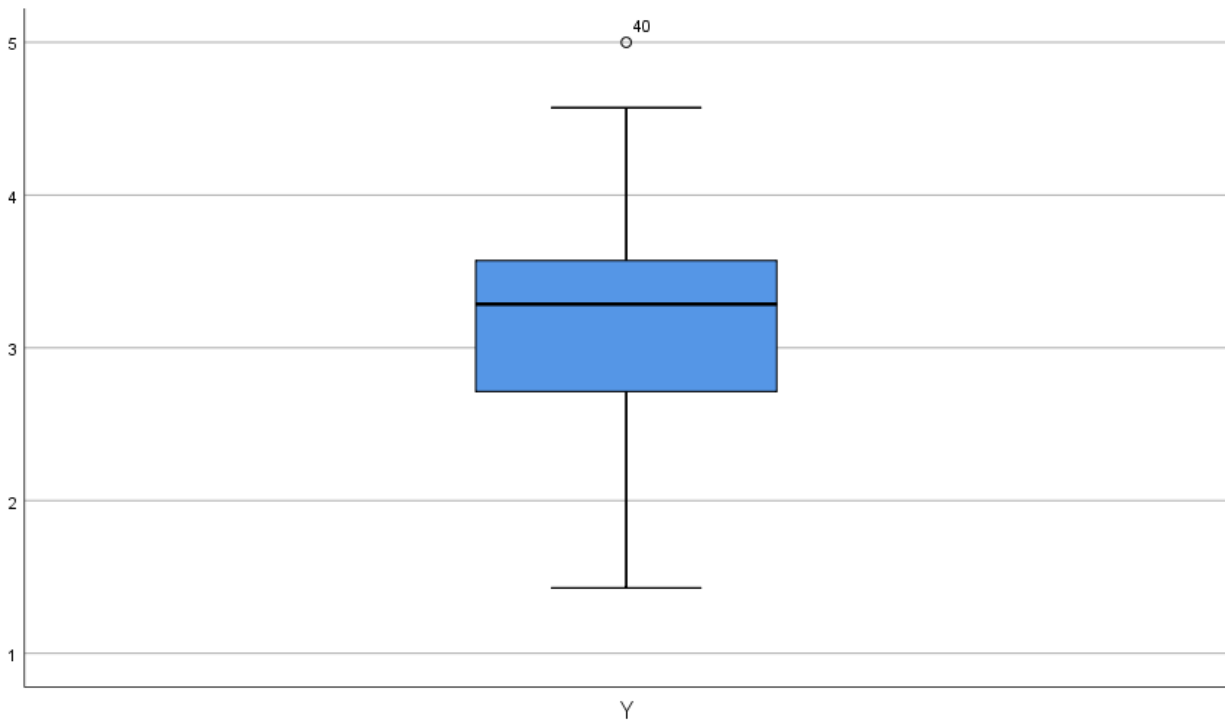
*Q-Q on the academic performance of learners with hearing impairment*



The Q-Q plot results in Figure 4.4 reveal that there are extremely few points of the Q-Q plot that are not fitted along the line of the best fit, hence a good linearity of the data was noticed. This led to a conclusion that there was a normal distribution in the data. A box plot was also generated with a view to check full compliance to the normality assumption condition. The results are shown in Figure 4.5.

**Figure 4. 5**

*Box plot on the academic performance of learners with hearing impairment*



The whickers in the box plot presented in Figure 4.5 are showing a slight skewedness in the data. However, the skewedness does not show significant deviation of whiskers; hence, data was normally distributed.

The preceding results proved the data's normality and linearity, implying the use of parametric tests in the investigation of the predicted link between the dependent and independent variables. Considering that the study wanted to use correlation and multiple linear regression analysis, it was important to first check whether data exhibited problem of heteroscedasticity, autocorrelation, and multicollinearity. Table 4.11 displays the results of the autocorrelation and multicollinearity tests.

**Table 4. 11**

*Autocorrelation and multicollinearity on hearing assistive technologies*

Variables	R square change	Durbin-Watson	VIF
X1	.155	1.860	2.763
X2	.106	1.737	2.770
X3	.101	1.928	1.057

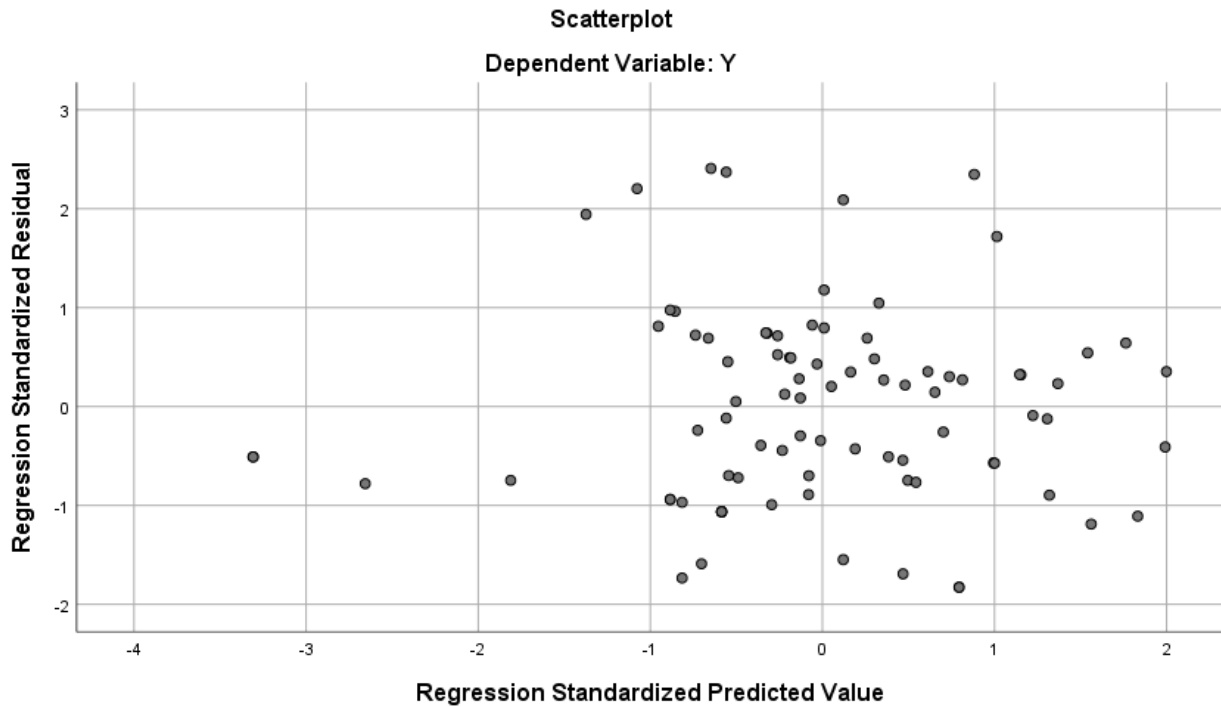
The Durbin-Watson values were used to check the autocorrelation, that is, establishing whether items of predictor variables were had a correlation across several observations. Table 4.11 displays the results showing Durbin-Watson values, where,  $X_1 = 1.860$ ;  $X_2 = 1.737$ ;  $X_3 = 1.928$ . The Durbin-Watson value is around 2 for each study variable. This meant that the data had no autocorrelation problem.

The next assumption of regression analysis to be tested was multicollinearity problem. In this study, the multicollinearity condition was tested by computing the Variance Inflation Factor (VIF). The VIF values between 1 and 5 show absence of multicollinearity problem, while, the VIF values above 5 indicate a multicollinearity problem (Cooper & Schindler, 2011). According to the findings in Table 4.11, the VIF values for predictor variables are,  $X_1 = 2.763$ ;  $X_2 = 2.770$ ;  $X_3 = 1.057$ . The VIF values are showing that there was no multicollinearity problem in the data.

Another condition tested was the heteroscedasticity problem. In checking for heteroscedasticity condition in the data, a scatter graph was generated using standardized predicted residuals and mean standardized residuals. In the scatter graph, the points were checked whether they formed an established pattern. The output was presented in Figure 4.6.

**Figure 4. 6**

*Heteroscedasticity test on the academic performance of learners with hearing impairment*



The findings are showing scatter points that are dispersed without any form of established pattern as one moves from left to right. This implies the absence of heteroscedasticity problem in the data. In order to counter-check this condition, the predictor variables were regressed on the squared residuals values with underlying null hypothesis stating that, data is heteroscedastic. Results are presented in Table 4.12.

**Table 4. 12**

*Heteroscedasticity Test: ANOVA results on the squared residuals values*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.185	3	.728	.310	.818 <sup>b</sup>
	Residual	439.693	187	2.351		
	Total	441.878	190			

a. Dependent Variable: Square residuals

b. Predictors: (Constant), X3, X1, X2

Table 4.12 shows a P value larger than 0.05;  $P = 0.818$ ; hence, the investigation failed to reject the null hypothesis that the data is heteroscedastic. This led to a conclusion that there was no heteroscedasticity problem in the data. Considering that the data did not show violations of the aforementioned conditions, (normality, linearity, autocorrelation, multicellularity and heteroscedasticity), the parametric statistical tests were therefore adopted in testing the proposition of this study and in assessing the overall purpose of the study. The proposition of this research was assessed as guided by research hypotheses.

#### **4.9.2 Testing Hypotheses of the Study**

Following the findings on diagnostic tests reported in the preceding section, a Pearson correlation analysis was used to analyze the impact of using hearing assistive technology on learners' academic achievement. Pearson correlation analysis was used to evaluate the first three research hypotheses, while regression analysis was utilized to assess the fourth research hypothesis as well as the study's overall aim. The correlation analysis was done with the level of significance for correlation coefficients set at  $P 0.05$ . The results of a Pearson correlation analysis for the first three research hypotheses of the study are presented in Table 4.19, while, the interpretation and discussion on the same follows subsequently.

#### 4.9.2.1 Testing of Hypothesis One

The first null hypothesis stated: *The utilization of listening assistive technologies does not significantly affect the academic performance in primary schools for pupils with hearing challenges in Meru and Tharaka Nithi counties.* A Pearson correlation analysis was performed to evaluate the null hypotheses, and the findings are shown in Table 4.13.

**Table 4. 13**

*Correlations analysis on utilization of hearing assistive technology and the academic performance of learners with hearing impairment*

		X1	X2	X3	Y
X1 (listening assistive technologies)	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	86			
X2 (augmentative and alternative assistive technologies)	Pearson Correlation	.787**	1		
	Sig. (2-tailed)	.000			
	N	86	86		
X3 (alerting assistive technology)	Pearson Correlation	-.038	.293**	1	
	Sig. (2-tailed)	.745	.010		
	N	86	86	86	
M	Pearson Correlation	-.326**	.041	.306**	
	Sig. (2-tailed)	.004	.724	.007	
	N	86	86	86	
Y	Pearson Correlation	.237*	.084	.109	1
	Sig. (2-tailed)	.038	.466	.345	
	N	86	86	86	86

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

\*\*. Correlation is significant at the 0.01 level (2-tailed).

The findings regarding correlation analysis shown in Table 4.13 indicate the Pearson correlation value for the first predictor variable (X<sub>1</sub>) which shows,  $r = .237^*$  and a P value that is less than 0.05. The P-value shows a statistically significant ( $r = .237, P = .038$ ) influence of listening assistive technologies on academic attainment of students with the hearing challenges. This led to the

conclusion that listening assistive devices had a statistically significant influence on the academic achievement of pupils in primary schools for the hearing impaired in Meru and Tharaka Nithi counties. In similar accord, Ebras (2017) and McNicholl et al. (2019) also noted a positive association between the utilization of listening assistive technology by secondary school students and their academic performance in their inclusive setting scope. This was denoted by the explicit elaboration that listening assistive technologies available to hard-of-hearing learners enabled them to participate more in the classroom activities than before the administration of listening devices. The positive association between the two variables implies that an increase in the predictor variable (listening assistive technologies) causes an increase in the outcome variable (the academic performance of learners in primary schools for the hearing challenged in Meru and Tharaka Nithi counties).

#### **4.9.2.2 Testing of Hypothesis Two**

The second null hypothesis stated: *The utilization of augmentative and alternative assistive technologies does not significantly affect the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.* The result regarding correlation analysis shown in Table 4.13 indicate the Pearson correlation value for the second predictor variable ( $X_2$ ) which shows,  $r = .084^*$  and a P value which is more than 0.05. The P-value shows a statistically insignificant ( $r = .084$ ,  $P = .466$ ) influence of augmentative and alternative assistive technologies on academic attainment of students with the hearing challenged. This led to the conclusion that augmentative and alternative assistive technologies was not statistically significant in influencing the academic performance of learners in primary schools for the hearing impaired in Meru and Tharaka Nithi counties. The study findings do not support the conclusions of Maine (2001) and Santoso et al. (2020) who culminated that the use of augmentative technologies improved learners' academic achievement by boosting their communication, comprehension abilities and understanding evaluation tests and examinations for learners with the hearing challenges. These two aspects are critical. This meant that, when all factors are held



constant, an increase in the predictor variable (augmentative and alternative assistive technologies) does not alone causes an increase in the outcome variable (the academic performance of Learners at Meru and Tharaka Nithi counties' primary schools for the deaf).

#### **4.9.2.3 Testing of Hypothesis Three**

The third null hypothesis stated: *The utilization of alerting assistive technologies does not significantly affect academic performance of learners with hearing challenges in specialized primary schools in Meru and Tharaka Nithi counties.* The findings regarding correlation analysis shown in Table 4.13 indicate the Pearson correlation value for the third predictor variable ( $X_3$ ) which shows,  $r = .109^*$  and a P value which is more than 0.05. The P-value indicates that alerting assistive devices have a statistically negligible ( $r = .109$ ,  $P = .345$ ) effect on academic achievement of learners with hearing impairment. This led to the conclusion that alerting assistive technology had no statistically significant impact on the academic achievement of pupils in Meru and Tharaka Nithi counties' primary schools for the hearing impaired. The conclusions herein disagree with those reached by Kisanga et al. (2018) who observed that specific assistive tools influenced the academic performance of learners in Tanzania vocational training institutes. Otherwise, Ndlovu (2020) agreed with the current conclusions that the utilization of assistive technologies did not have a big impact on learners' academic performance although, assistive technology-facilitated learning and independence among learners in an inclusive setting. This meant that, when all factors are held constant, an increase in the predictor variable (alerting assistive technologies) does not alone causes an increase in the outcome variable (the academic performance of learners in primary schools for the hearing challenged in Meru and Tharaka Nithi counties).

#### **4.11 Assessing the Overall Purpose of the Study**

The goal of this study was to evaluate the use of assistive technologies to improve the academic performance of learners with hearing impairment in specialized primary schools in Meru and Tharaka Nithi counties in Kenya, as well as to determine the moderating effect of learner attitude in the hypothesized relationship in order to suggest remedial measures. In the previous sections,

the findings on the prediction of the independent variables based on the first three research hypotheses has been provided. The overall purpose as well as the conceptual framework in chapter two indicated an indispensable need for three predictors. To test this hypothesized relationship, a multiple linear regression analysis was conducted, where, the dependent variable (the academic performance of learners with a hearing challenge in primary schools for hearing impaired in Meru and Tharaka Nithi counties) was therefore regressed on the three independent variables (the utilization of assistive technologies) in a combined model to determine the prediction capacity.

In this study, the coefficient of determination (R-Square value) was used to determine the nature of the variance that was accounted by the three predictor variables (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) (Saunders et al., 2009). The R-value represented the strength of the link between the use of assistive technology and the academic achievement of learners with hearing challenges in Meru and Tharaka Nithi counties' primary schools for the hearing impaired. The statistical values in the ANOVA table were helpful in determining whether the model was statistically significant and valid to be used in the analysis. In this study, the alpha level of significance was,  $P = \leq 0.05$ . The regression coefficients were employed in order to show the lowest beta value of each predictor variable when all of them, (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) are combined in one model. Therefore, the regression weights help to show the effect of change in the academic achievement of students with the hearing challenges as compared to one unit change in the corresponding independent variables (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies), while, all other factors in the combined model were held constant. Tables 4.14, 4.15, and 4.16 show the results of a multiple linear regression.

**Table 4. 14*****Model summary results on hearing assistive technology***

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.389 <sup>a</sup>	.151	.120	.74626

a. Predictors: (Constant), X3, X1, X2

b. Dependent Variable: Y

Table 4.14 shows that when the three variables (listening assistive technologies (X1), augmentative and alternative assistive technologies (X2), and alerting assistive technologies (X3)) are assessed in a single model, they show a positive correlation with the dependent variable (academic performance of learners with a hearing challenge); the R-value is 0.389. The data also reveal that the three predictor variables have an R-square value ( $R^2 = 0.151$ ), indicating that the three predictor factors explain for 15.1% of the variation in the outcome variable. The ANOVA results in Table 4.15 aided in determining the model's validity.

**Table 4. 15*****ANOVA results on the hearing assistive technology***

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.138	3	2.713	4.871	.004 <sup>b</sup>
	Residual	45.666	82	.557		
	Total	53.804	85			

a. Dependent Variable: Y

b. Predictors: (Constant), X3, X1, X2

The findings on model validity, as shown in ANOVA Table 4.15, reveal that the model is an excellent match to the data; ( $F(3,82) = 4.871, P.005$ ). This meant that the three predictor variables (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) generated a statistically significant model for explaining variances in the

academic performance of learners with a hearing challenge in Meru and Tharaka Nithi counties' primary schools for the hearing impaired. The regression coefficients were estimated to indicate how changes in the independent variable caused changes in the dependent variable. The regression weights for each predictor variable in the combined model are shown in Table 4.16.

**Table 4. 16**

*Regression weights results on the hearing assistive technology*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.289	.483		4.737	.000		
	X1	-.705	.247	-.484	-2.861	.005	.362	2.763
	X2	.855	.277	.523	3.091	.003	.361	2.770
	X3	.142	.104	.142	1.359	.178	.946	1.057

a. Dependent Variable: Y

The results of the regression coefficients (see Table 4.16) for each predictor variable in the model, shows the unstandardized B-coefficient values of .2.289, -.705, .855 and .142 for X<sub>1</sub>, X<sub>2</sub> and X<sub>3</sub> respectively. The results indicate that the P-values for X<sub>1</sub> and X<sub>2</sub> were significant, but the one for X<sub>3</sub> had an insignificant P-value. The study considered and interpreted the unstandardized B-coefficient values since the constant value was statistically significant and considering that is, P<0.05, and also due to the fact that the measuring scale was similar for all variables. The results are showing that although the three predictor variables are jointly statistically significant in the combined regression model, it is the listening assistive technologies and the augmentative and alternative assistive technologies that exert more influence on the changes in the academic performance of learners with a hearing challenge in primary schools for the hearing impaired

in Meru and Tharaka Nithi counties. The third predictor (alerting assistive technologies) cease to be significant in the combined model ( $P>0.05$ ).

Consequently, the initial regression model was confirmed. That is,

$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + e$ , where:

Y= the academic performance of learners with a hearing impairment

$\beta_0$  = Constant

$\beta_1, \beta_2, \beta_3$  = regression coefficient weights for  $x_1, x_2, x_3$  as shown below:

$X_1$  = listening assistive technologies

$X_2$  = augmentative and alternative assistive technologies

$X_3$  = alerting assistive technologies

$\epsilon$  = is the estimated error of the model.

The resulting multiple linear regression model is:

The academic performance of learners with a hearing impairment =  $2.289 - .705X_1 + .855X_2 + .142X_3 + e$

The resulting multiple linear regression model shows that academic performance of hearing impaired learners in primary schools in Meru and Tharaka Nithi counties =  $(-.705X_1 \text{ listening assistive technologies}) + (-.855X_2 \text{ augmentative and alternative assistive technologies}) + (.142X_3 \text{ alerting assistive technologies}) + 2.289$ ). In this model, 2.289 is the threshold value which is linked to the independent hearing assistive technologies. This implies that 2.289 is the same for each

hearing assistive technologies indicator. The findings show that all the three hearing assistive technologies, that is, listening assistive technologies ( $X_1$ ) augmentative and alternative assistive technologies ( $X_2$ ), and alerting assistive technologies ( $X_3$ ) when combined together, forms a model that is statistically significant in determining the academic performance of learners with a hearing challenge in primary schools for the hearing impaired in Meru and Tharaka Nithi counties. However, in the combined model, it is the listening assistive technologies and the augmentative and alternative assistive technologies that are statistically significant ( $X_1$ ), ( $\beta_1 = -.705$ ,  $p = .005$ ) and  $X_2$  ( $\beta_2 = .855$ ,  $p = .003$ ). The alerting assistive technologies, ( $X_3$ ), ( $\beta_3 = .142$ ,  $p = .178$ ), become statistically insignificant in the model.

The above results have underscored the unwavering importance of the three-hearing assistive (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) in influencing the academic achievement of students with hearing problems. It suggests that the three assistive technologies work together to improve the academic achievement of students with hearing impairment. It follows that primary schools for students with hearing impairments that fail to build and promote the three assistive technologies would have students underperform academically. However, the implementation of the three assistive technologies should first emphasize on listening assistive technologies and the augmentative and alternative assistive technologies since these two showed prominences in the combined model. According to Brown et al. (2018), Alshutwi et al. (2020) and Addi (2017), the utilization of assistive technologies contributes to improved academic achievement. This is because the alerting, tuning in and augmentation of learners' sense of hearing contribute towards the demonstration of knowledge, improved literacy and auditory skills, high-grade scores in tests, assignments and or the final examination results (Brown et al., 2018; Alshutwi et al., 2020; Addi, 2017).

Since the utilization of the three hearing assistive technologies (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) were shown to be crucial in boosting the academic performance of learners with hearing impairment, it was critical for primary schools to be adequately equipped with the necessary equipment and facilities for learners with hearing impairments.

In view of this, the County Directors of Education, head teachers, teaching and non-teaching staff were asked during interview and focused group discussion to state the nature of support that the National or County government provide to the school towards supporting the utilization of assistive technologies. From the responses gotten, it was clear the government provides financial support in various forms. These were personnel, County government employs ECED teachers while TSC employs other teachers, provide text books, provide teaching materials (Kenya Sign Language), provide computers and tablets and laptops, provide projectors, constructed classrooms, though not acoustically treated, training of teachers on ICT, free internet, and pay for electricity power used in the school for photocopying exams.

According to the data shown above, national and county governments provide little assistance to primary schools for students with hearing impairments. Because students with hearing impairments are a particular population, assistance from the national and county governments is critical. Absence of the needed support will continue to affect the academic performance of learners. The World Health Organization African Region Report (2021) also showed the need for the government to chip in among African countries by developing and enacting systems for implementing frameworks for the disabled, by funding, by being mediators who will advocate the

inclusion of assistive devices as part and parcel of medical products and also bridging the gap associated with very long procurement procedures and systems for assistive technology.

Both teaching and non-teaching personnel require enough assistance in order to carry out their teaching responsibilities efficiently. Notably, the teaching and the non-teaching staff from primary schools for learners with hearing impairments usually deal with learners who require special attention and patience due to their special conditions. Information gathered from the County Directors of Education, head teachers, teaching and non-teaching staff during interview and focused groups discussions indicated that the teaching and the non-teaching staff receive minimal support. The little support was largely on training aspects, where, the staff indicated that they were trained on using laptops and projectors. The head teacher number two indicated to have attended a school management training which was on how to hire non-teaching staff, and to procure materials and equipment, which included how to acquire the hearing assistive devices. The head teacher number one however pointed that there have been no seminars or workshops related to SNE saying such development programs had been kept aside by the government. Moreover, the teaching and the non-teaching staff revealed that there were no professional development programs at primary school level for teachers and support staff with reference to the hearing assistive technologies. This was also confirmed by head teachers during interview. The head teacher number one noted, *“Teachers were only trained in KISE during their two years training”*

When asked how they inspire teaching and non-teaching personnel, the head teachers and county directors mentioned the training that the government provides through the Kenya School of Special Education. The same was confirmed from the teaching and non-teaching staff during focused group discussion. Their response was clear that there were neither special motivational programs, nor professional development programs in the school. This indicates poor support for teaching and



non-teaching staff from school and government. Lack of appropriate support for staff may curtail their commitment to serving the hearing-impaired learners, and this may affect the utilization of assistive technological devices. If the situation is not addressed, it will have an impact on how students with hearing problems perform academically in school. This was also recognized by Okutoyi et al. (2013) who concluded that support services were needed in inclusive schools which had learners with different forms of disabilities. The common services recommended was the employment of competent teacher trainer who will undertake regular in-service training and professional development forums for the teaching staff. According to Winfred (2017), developing nations need to adopt specific strategies stipulated in some foreign policies such as the Los Angeles Unified School District Policy which revamped the assistive technology service to include humanitarian services. These humanitarian services will cater for selection, evaluation, designing, maintaining, repairing, acquisition, training, remuneration, provision of technical assistance and sensitizing the surrounding environment on the importance of utilizing assistive technologies. (The United Nations Convention on the Rights of Persons with Disabilities [UNCRPD], 2008; Winfred, 2017). Furthermore, these findings support the cause and the effect, capability, social cognitive and millers learning theories that underpinned the study. This is based on the fact that learners with hearing impaired need support for then to attain independency which may be in the essence of adopting assistive technologies. Moreover, the theories have provided a well ground approach of coming up with solutions (the adoption of assistive technologies) out of assessing the underlying problem poor academic achievement of learners with hearing impairments. For this to be practically met, staff role cannot be overlooked hence the call for motivation through fair remuneration, equipping them with skills and competencies an also creating an enabling friendly

school environment that foster assistive technology utilization since it is the major solution to the challenges of poor academic achievement.

When contacted during the interview, the County Directors of Education acknowledged a lack of government assistance for schools serving students with hearing impairments. They did, however, state that the administration intended to start exchange programs with other local international organizations in order to share ideas. The government was also planning to conduct training of trainers (TOT) with a view to reaching out parents and guardians for children with the hearing impairments. Two County Directors of Education however noted a need to develop a training program policy for staff working in primary schools for learners with hearing impairments. This clearly, underpin that the government had a central role to play if learners with hearing impairment are to be treated equally and, hence, improve in their academics. Desalew et al. (2020) and WHO African Region Report (2021) recommended strong government commitment and taking up of the burden since it is better placed at developing and implementing appropriate policy frameworks for learners with hearing impairment, at mediating and collaborating with suppliers and international organizations when securing assistive, most importantly is the provision of adequate funds for acquiring devices, employing staff and conducting trainings and creating public awareness. This also implicated on the theories that underpinned the study, in succinct, the findings agree with the stipulated theories on the basis of improving the attitudes of both learners and the other stakeholders such as parents, fellow pupils, teaching and the non-teaching staff through awareness programs, workshops, seminars and trainings on the essence of appreciating the use of assistive technologies for learners with hearing impairments.

For improvement purposes, the County Directors of Education, head teachers, teaching and non-teaching staff were asked during interview and focused group discussion provide suggestions on

what should be done to improve the utilization of assistive (listening, augmentative and alternative and alerting) technologies in learning and during examinations. Various suggestions were given which were scrutinized for the purpose of identifying commonality. The respondents provided suggestions that included, need to increase the assistive devices in the schools, building of acoustically treated classes in the schools, the government to provide alert watches and electric bells for hard of hearing learners, the Ministry of Education to adapt curriculum for the hearing impaired, the Ministry of Education should include sign language in the standard curriculum so that all instructors may teach it, the teachers Service Commission to provide enough teachers who are sign language compliant, ensure that all teachers teaching the primary schools for learners with hearing impairments have gone through the technical training institutes where they are trained how to handle hearing assistive devices. This will enable them to assist learners to operate those devices. They also said that the teaching and examinations in the primary schools for learners with hearing impairments to be in audio – visual format, ensure that the personnel who invigilate examinations are trained in the sign language, and need to increase time for examinations as compared to the regular learners.

The preceding guidelines are extremely important and should be considered in all elementary schools for students with hearing problems. However, the proposed solutions have ramifications for finance, teaching techniques, assessment modes, and administration procedures, as well as primary school professional development programs for students with hearing impairments. In concurrence the studies by Desalegn and Worku (2016), Rishaelly (2017), Mwanyuma (2016), Nyambere and Okello (2021), Owour et al. (2020), Kathare (2020), and Nyambere (2019) advocated for the procurement of learning and teaching resources, adoption of sign language, recruitment and hiring of competent teachers in the specialty of hearing impairments, introduction

of special education, introduction of inclusive education and the development and overseeing the implementation of elaborate policies which all of them called for government intervention through funding and budgetary strategies. This meant that actionable plans towards eradicating the problem influence the encounter of huge costs.

#### **4.12 Moderating effect of Learners' Attitudes towards Hearing Assistive Technologies**

The fourth research hypothesis stated, *“Learners’ attitude does not moderate the relationship between the utilization of assistive technology and the academic performance in primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties.* The Moderated Multiple Regression (MMR) model was employed to test this null hypothesis. This allowed the study to first assess the combined impact of the three-hearing assistive technology on the academic achievement of learners with hearing impairment in primary schools for the hearing impaired in Meru and Tharaka Nithi counties. This was referred to as model one.

Secondly, the moderator variable, that is, the attitudes of learners with hearing impairments towards assistive technology was added to the first model. The outcome constituted the second model. Thirdly, an interaction term, herein referred to as the interaction term of the moderator was added to the second model, hence coming up with the third model. It is in the third model that the researcher was able to determine the moderation effect sought in this study.

The R square change statistics from the summary of the moderated multiple regression model were considered and interpreted in determining the moderation effect of the attitudes of learners with hearing impairments towards assistive technology, while the P-value were used to indicate the statistical level of significance of the model's interaction term, to conclude on the moderation effect hypothesized in this study. The MMR model employed in this investigation is depicted below.

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_jZ_j + \beta_{ij}X_iZ_j + \varepsilon$$

The same was broken down into three models as described below;

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \varepsilon \dots\dots\dots (i)$$

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_zZ_j + \varepsilon\dots\dots\dots (ii)$$

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_jZ_j + \beta_{ij}X_iZ_j + \varepsilon\dots\dots\dots (iii)$$

Where:

Y is the academic performance of learners with a hearing challenge in primary schools for the hearing impaired in Meru and Tharaka Nithi counties.

$\beta_0$  is the constant,

$\beta_1, \beta_2, \beta_3$  represent coefficients of hearing assistive technologies

$X_1, X_2$  and  $X_3$  are the predictor variables (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies)

$Z_j$  is the moderating variable, the attitudes of learners with hearing impairments towards assistive technology.

$\beta_j$  is the coefficient of the moderator as a predictor

$X_iZ_j$  is the interaction term between variable  $X_i$  ( $i = 1, 2, 3$ ) and moderating variable

$\beta_{ij}$  is the coefficient of the interaction term.

$\varepsilon$  is the error term.

The first model evaluated in a combined model was the connection between predictor factors (hearing assistive technology) and academic achievement of learners with a hearing difficulty in primary schools for the hearing impaired. The second model included a moderating variable ( $Z_j$ , attitudes of learners with hearing impairments toward assistive technology) in the multiple

regression model, whereas the third model included interaction terms ( $X_i*Z_j$ ) and features from the second model. The moderation findings are reported in section 4.12.1 below.

#### 4.12.1 Moderating effect of attitudes of learners with hearing impairments towards assistive technology

The findings on the moderating effect of the attitudes of learners with hearing impairments towards assistive technologies on the relationship between and academic performance of learners with a hearing challenge in primary schools for the hearing impaired in Meru and Tharaka Nithi counties were generated and presented in Tables 4.17, 4.18 and 4.19, and thereafter discussed accordingly.

**Table 4. 17**

*Moderation effect of the attitudes of learners with hearing impairments: Model validity*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.138	3	2.713	4.871	.004 <sup>b</sup>
	Residual	45.666	82	.557		
	Total	53.804	85			
2	Regression	17.026	4	4.256	9.375	.000 <sup>c</sup>
	Residual	36.778	81	.454		
	Total	53.804	85			
3	Regression	20.400	5	4.080	9.771	.000 <sup>d</sup>
	Residual	33.404	80	.418		
	Total	53.804	85			

a. Dependent Variable: Y

b. Predictors: (Constant), X3, X1, X2

c. Predictors: (Constant), X3, X1, X2, Moderator

d. Predictors: (Constant), X3, X1, X2, Moderator, Moderater\_interaction\_factor

For model one,  $F(3, 82) = 4.871$ ,  $P.05$  is shown in Table 4.17. This shows that the model is statistically significant and so suitable for further investigation. When attitudes of learners with hearing impairments toward assistive technologies were included as a predictor variable in the second model, the F statistics,  $F(4, 81) = 9.375$ ,  $P.05$ , revealed that the second model was also

statistically significant in influencing the academic performance of learners with a hearing challenge in Meru and Tharaka Nithi counties. The results for the third model were  $F(5, 80) = 9.771, P.05$ , indicating that the model was still valid (statistically significant) when the interaction term (Moderator interaction factor) was incorporated. The findings indicated that the three variables included in the model were statistically significant in determining the academic achievement of learners with a hearing difficulty in Meru and Tharaka Nithi counties' primary schools for the hearing impaired

The study required to assess the data in the model summary table to identify the influence of the moderating variable on the hypothesized relationship after establishing the prediction capability and validity. Table 4.18 summarizes the findings.

**Table 4. 18**

***Moderation effect of the attitudes of learners with hearing impairments: Model Summary***

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F	df1	df2	
1	.389 <sup>a</sup>	.151	.120	.74626	.151	4.871	3	82	.004
2	.563 <sup>b</sup>	.316	.283	.67383	.165	19.575	1	81	.000
3	.616 <sup>c</sup>	.379	.340	.64618	.063	8.080	1	80	.006

a. Predictors: (Constant), X3, X1, X2

b. Predictors: (Constant), X3, X1, X2, Moderator

c. Predictors: (Constant), X3, X1, X2, Moderator, Moderator\_interaction\_factor

d. Dependent Variable: Y

According to the data in Table 4.18, all three hearing assistive devices account for 15.1% of the overall variance in academic achievement of learners with a hearing difficulty in primary schools for the hearing impaired ( $R^2 = .151$ ). When attitudes of students with hearing impairments toward assistive technology (the moderator) were added to the second model, the  $R^2$  value improved by 16.5 percent, and the model became statistically significant ( $R^2 = .316, P = .000$ ). This meant that

even after controlling for the moderator (the attitudes of learners with hearing impairments toward assistive technologies), the model was still statistically significant in influencing the academic performance of learners with a hearing challenge in primary schools for the hearing impaired.

The next step involved introducing the interaction factor of the moderator, ( $Z1 * Xi$ ) into MMR model number three to help ascertain the moderating effect. In the resulting model number three, the R square increased by 6.3% to 37.9% (R-square change = .063, and the P-value of model three was statistically significant, ( $R^2 = .379$ ,  $p = .006$ ). This meant that when the interaction terms of the moderator (moderation factor) were introduced into the model, it led to an increase in the R square value, while the P-value shows that the model was statistically significant. Therefore, the study concluded that attitudes of learners with hearing impairments towards assistive technologies was statistically significant moderator between the hearing assistive technologies and the academic performance of learners with a hearing challenge in primary schools for the hearing impaired. In view of this finding, the study went ahead to interpret the regression coefficients whose results are shown in Table 4.19.



**Table 4. 19*****Moderation effect of the attitudes of learners with hearing impairments: Regression weights***

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics
	B	Std. Error	Beta	t		
1 (Constant)	2.289	.483		4.737	.000	
X1	-.705	.247	-.484	-2.861	.005	.362
X2	.855	.277	.523	3.091	.003	.361
X3	.142	.104	.142	1.359	.178	.946
2 (Constant)	1.316	.489		2.694	.009	
X1	-.302	.241	-.207	-1.253	.214	.310
X2	.400	.270	.245	1.479	.143	.309
X3	.033	.097	.033	.338	.737	.885
Moderator	.435	.098	.468	4.424	.000	.754
3 (Constant)	-2.387	1.385		-1.724	.089	
X1	.152	.281	.104	.542	.002	.210
X2	.934	.320	.572	2.917	.005	.202
X3	.523	.196	.525	2.668	.009	.200
Moderator	1.599	.420	1.720	3.806	.000	.038
Moderater_interaction_factor	-.462	.162	-1.629	-2.843	.006	.024

a. Dependent Variable: Y

According to the findings in Table 4.19, listening assistive technologies, as well as augmentative and alternative assistive technologies, are statistically significant in predicting academic performance of learners with a hearing challenge in primary schools for the hearing impaired, whereas alerting assistive technologies are statistically insignificant. In model two, all the three hearing assistive technologies were insignificant, but the attitudes of learners were significant. The model was still relevant according to the findings in Table 4.14. This meant that the attitudes of learners with hearing impairments towards assistive technologies had a very strong

impact in influencing the academic performance of learners with hearing impairment. Actually, when the interaction terms were introduced in step three, model number three remained statistically significant ( $\beta_1 = -.2.387$ ,  $P <.000$ ); and coincidentally, all the hearing assistive technologies (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) when combined in one model together with the interaction terms became statistically significant. This indicates that attitudes of students with hearing impairments toward assistive technologies had very strong moderation effects in the model, influencing the influence of the three hearing assistive technologies on the academic performance of students with hearing challenges in primary schools for the hearing impaired. These findings support the conclusion that learners with hearing impairments' attitudes toward assistive technologies moderate the relationship between hearing assistive technologies and academic performance of learners with a hearing challenge in Meru and Tharaka Nithi counties' primary schools for the hearing impaired.

The resulting moderated multiple regression model was generated using the unstandardized coefficients because the scale used were similar and that the constant had a significant P-value.

The model was:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_jZ_j + \beta_{ij}X_iZ_j + \epsilon, \text{ hence,}$$

$$\text{Marital satisfaction of couples} = -2.387 + .152X_1 + .934X_2 + .523X_3 + 1.599Z_j + -.462Z_j + \epsilon.$$

The resulting moderated multiple regression model shows that the marital satisfaction = (.152X<sub>1</sub> listening assistive technologies) + (.934X<sub>2</sub> augmentative and alternative assistive technologies) + (.523X<sub>3</sub> alerting assistive technologies) 1.599 attitudes of learners with hearing impairments towards assistive technologies) -.462 interaction terms -2.387). In this model, -2.387 is the baseline

value which is linked to the predictor variables. This implies that -2.387 is the same for each hearing assistive technologies in the moderated multiple regression model. These results are showing that the relationship between hearing assistive technologies and the academic performance of learners with a hearing challenge in primary schools for the hearing impaired is moderated by the attitudes of learners with hearing impairments towards assistive technologies. The available literature was scanty in addressing a complete facet of hard of hearing learners' attitudes and the relationship between assistive technologies and their academic performance. Available research studies position that academic performance of hard and deaf learners is directly influenced by the learners' attitudes (Soetan et al., 2021). Moreover, studies by Wood et al. (2017) and Tony (2019) underpinned that the utilization of assistive technologies due to their potential in enabling the learners to fulfill the educational needs. Other comparable studies by Amurani (2019) and Ndlovu (2021) noted positive attitudes towards the utilization of assistive devices which in the long run was described as having impacts on the learners' academic achievements although the moderating facet of attitudes did not feature in the constructs of these studies.

The model's findings and demonstration show that attitudes of learners with hearing impairments toward assistive technologies strongly moderate the relationship between hearing assistive technologies and academic performance of learners with a hearing challenge in Meru and Tharaka Nithi counties' primary schools for the hearing impaired. This meant that an increase in the utilization of assistive technologies by learners with hearing impairments would improve their academic performance, however, the learners' attitudes towards these technologies determines the strength of the impact of utilization and subsequent academic performance. This implies that the attitudes of learners with hearing impairments towards assistive technologies affect the utilization, and this, ultimately affect their academic performance. The results have underscored the strong

effects of the attitudes of learners with hearing impairments towards assistive technologies in the utilization of the hearing assistive technologies to which this study has proved that if addressed can significantly contribute towards improving the academic performance of learners with a hearing challenge in primary schools for the hearing impaired in Meru and Tharaka Nithi counties. Amurani (2019) and Ndlovu (2021) also underscored the need to work on learners' attitudes by addressing the environmental inhibitors, social and cultural deterrents in order to achieve high utilization of assistive technologies which their use was associated with academic achievement. Positive attitudes towards hearing devices for learners directly impact their utilization. Tony (2019) Soetan et al. (2020) and Soetan et al. (2021) also advocated for the cultivation of strong positive attitudes towards utilization of assistive technologies by learners with hearing impairment but ensuring there are trained staff who maintain the devices. They also emphasized on the need for learners to be counseled to accept the disability condition. Other recommendations made were need to develop adequate policies for addressing the procurement of assistive devices, sensitization of parents, pupils, teachers and other stakeholders in order to eliminate negative stigma and stereotyping which inhibit self-esteem, and acceptance of coping mechanisms.

## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

This chapter provides an overview of the study's conceptualization, followed by a highlight of the findings. Then, a synopsis of the conclusions and recommendations of the study are presented. Also covered is a summary of how the study's findings impact the theories, practices and policies. The chapter concludes by suggesting issues and aspects that can be considered for further studies.

#### 5.2 Summary of Conceptualization of the Study

Kenya's government has established legislative frameworks and policies to facilitate the education of students with special needs. Various measures have also been put in place that includes training and employing university teachers to deliver special needs quality education. The government has also increased the budgetary allocations for special needs schools. These measures are expected to support the academic achievement of all learners, including those with hearing challenges. However, the academic performance of primary school learners with hearing impairments has been poor and below the average marks of 250 in national examinations. The purpose of this study was to evaluate the use of assistive technology in primary schools for learners with hearing issues in Meru and Tharaka Nithi counties in Kenya, as well as to investigate the moderating role of learner attitude on the hypothesized relationship

The study's particular aims were to investigate the influence of using listening assistive technology, augmentative and alternative assistive technologies, and alerting assistive technology on the academic performance of learners with hearing problems. It also looked at how learners' attitudes influenced the link between the use of assistive technology and academic achievement in students with hearing impairments. The study was guided by the cause and effect, capability, and social

cognitive theories. It adopted the pragmatism philosophy and applied a mixed-methods approach. It utilized correlational and descriptive survey research designs. Primary school students with hearing impairment, teaching and non-teaching personnel, head teachers, and County Educational Directors of Education formed the target audience. Participants were chosen using a simple random sample approach among learners, teaching and non-teaching staff: three head teachers and two County Educational Directors of Education. Questionnaires, focused group discussions, and an interview guide were utilized to collect data. Piloting allowed for the verification of instrument dependability and correctness. SPSS was used to examine the quantitative data, and descriptive and inferential statistics were employed to summarize information and test hypotheses, respectively. Thematic analysis was used to assess the qualitative data.

### **5.3 Summary of the Major Findings**

In this study, the overall response rate was 94%. The summary of the major findings has been presented systematically according to the study's main factors. The study variables include the academic performance in primary schools for learners with hearing challenges and assistive technologies (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies). A synopsis of the key findings is provided in the sections that follow.

#### **5.3.1 Summary of Results on background characteristics of learners with hearing impairment**

In the three primary schools in Meru and Tharaka Nithi counties, there were more female than male students with hearing impairment. Njia primary school for the deaf in Meru County, Kamatungu primary school for the deaf in Tharaka Nithi County, and Kaaga primary school for the deaf in Meru County all had more hearing-impaired students in class eight and class six.

Notably, in the three primary schools, the number of students with hearing impairment rose with class level.

Ninety per cent of teachers in the three primary schools had a P1 Certificate, while the rest (25%) had a Diploma. Most non-teaching staff (75%) had KCSE certificates, while the rest (25%) had KCPE certificates. The three head teachers and the two County Directors of Education had over 20 years of work experience, and most had Bachelor's Degree in Education and above. Most teachers had worked in a special needs school for six and twenty years. The study noted that the government of Kenya had no standard qualification for support staff who work in schools for learners with hearing impairments.

### **5.3.2 Summary of Results of Listening Assistive Technology**

The use of listening assistive devices for students with hearing impairments was extremely low in the three elementary schools. The information gathered from learners, staff and head teachers indicated that few listening assistive technology devices in the three primary schools for learners with hearing challenges participated in the study from Meru and Tharaka Nithi Counties. The results indicated that few available ones were poorly maintained. In the first instance, the assistive listening devices were not adequate. In the second instance, the school lacked varieties of listening assistive devices. The study noted that the learners who would require specialized listening assistive devices due to their condition and nature of the hearing challenge were suffering or were getting little assistance. The findings showed that the learners were not utilizing the listening assistive technology devices in their classroom and rarely used them during examinations.

The results identified essential listening assistive devices needed in primary schools for learners with hearing challenges, including hearing aids, conciliar implants, tape audiograms, group

hearing and loop induction, and acoustically treated classes for classes near the roads audiometers, and radios. These assistive listening devices require that the learner is familiar with them to use them gainfully. However, most learners (62.8%) confessed that they did not have enough skills to use assistive listening technologies. The study further noted that none of the three schools had clear guidelines regarding using listening assistive. The lack of clear guidelines was affecting how the listening assistive technology devices were maintained.

The utilization of listening assistive devices requires good support from the school and the government. The findings have shown that the support from the government and the schools was negligible and limited in diversity. The government's support included establishing computer labs, TV rooms, spacious classrooms, electricity, a watches alarm, laptops/computers, internet, photocopier machines and phone. This was not uniform in all schools for the learner with hearing impairment. The support from schools included buying batteries for hearing aids, sometimes availing funds for repairing non-functioning hearing aids, buying some videos, and allowing teachers to attend workshops and seminars. The head teachers further ensure that classes are painted regularly, broken windows are repaired immediately, and chalkboards are maintained. However, the lack of funds to buy all the required listening assistive devices featured as a key drawback. The study noted that the aforementioned state of affairs was affecting the utilization of listening assistive devices by learners. Despite the aforesaid limitations, they found that listening assistive devices had a statistically significant impact on academic achievement in primary schools for students with hearing difficulties.

### **5.3.3 Summary of Results on Augmentative and Alternative Assistive Technologies**

The study noted that when assessed alone, the augmentative and alternative assistive technologies were not statistically significant in influencing the academic performance in primary schools for



learners with the hearing challenge in Meru and Tharaka Nithi County. However, the information gathered from learners, staff, head teachers and County Directors of Education agreed that there were few augmentative and alternative assistive technology devices in the three primary schools for learners with hearing challenges that participated in the study in Meru and Tharaka Nithi Counties. The few available augmentative and alternative assistive technology devices had a poor maintenance program as across the three primary schools. There were also very few varieties of augmentative and alternative assistive technology devices. This situation had implications on the rate of utilization of augmentative and alternative assistive technology devices by learners.

The augmentative and alternative assistive technology devices are mostly used in class; hence, the lack of variety of devices hindered the utilization and affected the learners' participation in group work activities. This was negatively affecting the learners since they were missing opportunities to acquire group and cooperative learning skills, and this was affecting their academic performance.

The survey also found that a lack of skills among instructors and students limited the use of the few available augmentative and alternative assistive technology devices. The following are some of the important abilities highlighted in the usage of augmentative and alternative assistive technology devices; skills to carry out simple repair and maintenance of the assistive technologies, skills to operate and fit the technological devices, for example, audiometer; computer literacy skills, skills to assess the knowledge levels of every child; sign language skill, digital literacy skills, knowledge/skill to measure hearing loss; skills to assess the safety of the devices, and communication skills.

#### **5.3.4 Summary of Results on Alerting Assistive Technologies**

The study's findings indicated that, when assessed alone, the utilization of the alerting assistive technology devices did not statistically influence the academic performance in the three primary schools for learners with hearing impairments in Meru and Tharaka Nithi Counties. Concerning the sufficiency of alerting assistive technology devices, 70.9% of students reported that such equipment was scarce in their classrooms. The majority of the buildings in the three main schools for students with hearing impairments lacked alerting equipment that might inform them in the event of an emergency or a change in program. This showed a significant level of noncompliance with safety precautions advised by the National Institute on Deafness and Other Communication Disorders [NIDCD]. According to the information acquired, the few existing alerting assistance devices were also seldom repaired/maintained throughout the three primary schools.

Moreover, 58 (67.4%) of learners indicated that they lacked the skills to utilize the few alerting assistive technology devices. The study also noted that learners' awareness of assistive alerting technologies was poor. This is because 74.4% said they had not been sensitized to the use of alerting assistive technology devices. In addition, the study noted that none of the three primary schools had clear guidelines on using alerting assistive technology devices. This situation explained why there was low utilization of alerting assistive technology devices in the three primary schools for learners with hearing challenges.

#### **5.3.5 Summary of Results on Attitudes of the Hearing-Impaired Learners towards Assistive Technologies**

The attitudes of the hearing-impaired learners towards the assistive technology devices affected how they were utilizing the devices in learning, examination and social life. The study learnt that

55.8% of the hearing-challenged learners across the three primary schools didn't like wearing assistive technological devices daily. A sizeable number also (47.7%) did not perceive the hearing assistive devices as user-friendly. Learners' attitudes toward hearing assistive devices were largely attributed to stigma and mockery. Results show that 65.2% of learners with hearing challenges said they were facing stigma, criticism and mockery from their hearing counterparts in the school. The negative attitude reported herein was affecting the gainful utilization of the hearing assistive devices, hence, negating the benefits of utilizing the devices. This had a bearing on learners' academic performance with the hearing challenge, where dismal performance was witnessed across the three primary schools in Meru and Tharaka Nithi Counties.

One way of addressing the negative attitude that learners had towards hearing assistive devices was through the nature of help provided to learners at school, at home and in society. According to the County Directors of Education, head teachers, and teaching and non-teaching staff, the nature of support mitigation strategies for addressing the attitudes of learners with hearing impairments towards the assistive devices demand support from the home of the affected learner and then from school, community and government. Results show that they were receiving moderate assistance from school in fixing the hearing assistive devices and encouragement to wear the assistive devices.

### **5.3.6 Summary of Results on the academic performance of primary schools for learners with hearing challenges**

The findings suggest that academic performance (as measured by mean scores from 2015 to 2020) in the three primary schools for learners with hearing issues was insufficient when compared to the county average performance scores in the Kenya Certificate of Primary School Education

during the same time. The findings indicate that the academic performance of students with hearing impairments was below expectations, which is cause for worry. Only 15 (17%) learners said their academic performance was above average. Thirty-seven (44%) admitted their low academic performance, while 30 (34%) said it was average. The decline in academic performance of learners with hearing impairment is an issue of concern and indicates a great need to address the trend.

The study noted that the utilization of listening, augmentative and alternative and alerting devices affected learners' academic performance with hearing impairments. Notably, the majority (over 50%) of learners with hearing challenges said that using assistive technology devices had neither enabled them to respond quickly to questions in class nor boosted their communication abilities. They also noted that the devices had not helped them to improve their performance in the continuous assessment tests and in the end-of-term examinations.

The inadequacy of assistive devices in the three primary schools was obviously noted. This was attributed to little funding from the government. The study noted the amount of funds channeled to special schools by the government was very little such that it was very difficult to meet all the operational costs and buy the required assistive devices. Consequently, most non-teaching staff were underpaid; hence their motivation was low, and only a few assistive devices were purchased and maintained.

Another reason for poor performance was due to lack of mentors. The respondents pointed out that the lack of role models and absence of mentors who have personally excelled academically and in life despite hearing challenges usually discourage learners from putting effort in their academic pursuits.

### **5.3.7 Summary of Results on the Relationship between Utilization of Assistive Technology and the Academic Performance of Learners with a Hearing Challenge**

When the three predictor variables (listening assistive technologies, augmentative and alternative assistive technologies, and alerting assistive technologies) were regressed together, they produced a statistically significant model for explaining variances in academic performance in primary schools for learners with hearing impairments in Meru and Tharaka Nithi counties. However, in the composite model, assistive listening technologies and augmentative and alternative assistive technologies had the greatest impact on improvements in academic performance in primary schools for learners with hearing impairments in Meru and Tharaka Nithi counties.

The attitudes of students with hearing impairments toward assistive technology devices were found to be statistically significant in moderating the relationship between hearing assistive technologies and academic performance in primary schools for students with hearing impairments in Meru and Tharaka Nithi counties in this study.

## **5.4 Conclusions of the Study**

The findings reported in this research were cross-examined to enable the researcher to come up with major conclusions. To enable better comprehension and flow, the conclusions generated from the data were categorized according to the study's primary factors.

### **5.4.1 Conclusion on the Listening Assistive Technologies**

The rate of non-utilization of listening assistive technology devices was high in primary school for learners with hearing challenges. The failure to utilize these devices affected the learners' level of listening and understanding of the contents being taught. This was impacting negatively on their academic performance. This situation was affecting the learning environment of learners in the

school compound and had the potential to affect their academic performance. The low utilization of listening assistive devices was attributed to inadequacy of devices, lack of skills for using them, poor equipment maintenance and lack of sufficient support from schools, government, home and the community.

#### **5.4.2 Conclusion on Augmentative and Alternative Assistive Technologies**

This study noted that the rate of non-utilization of augmentative and alternative assistive technology devices was high across the three primary schools for learners with hearing challenges in Meru and Tharaka Nithi counties. This was affecting the learners' level of participation in class and group work activities, and the rate of understanding of contents taught in class. It was subsequently causing them to have poor academic performance.

#### **5.4.3 Conclusion on Alerting Assistive Technologies**

The three schools did not have adequate alerting assistive devices. The few available ones were poorly maintained, and most learners lacked the skills to utilize them. Most buildings across the three primary schools for learners with hearing challenges had not been fitted with the requisite alerting technology devices. This curtailed the learners as they navigate their movements in the school environment, and complicated their adherence to schedules, hence, difficulties in organizing their time. This was contributing to the low academic accomplishment of pupils with hearing issues from Meru and Tharaka Nithi Counties' three elementary schools.

#### **5.4.4 Conclusion on the Attitudes of the Hearing-Impaired Learners towards Assistive Technologies**

The learners with the hearing challenge had negative attitudes towards the hearing assistive technology devices, and this was affecting how they were utilizing them at school, at home, and in social settings. The same outcome was trickling down to affecting their academic performance across the three primary schools in Meru and Tharaka Nithi Counties. The negative attitudes of learners with hearing challenges towards assistive technology devices were precipitated by stigma, criticisms and mockery from the immediate environment. The other thing noted by this study was that the nature of the hearing assistive technology devices, in terms of their adequacy, functionality and ability to use them, was affecting the motivation of learners to utilize the devices. Measures for addressing this challenge require a conglomerate of support, including home-based, community-based, school-based, and government-based support.

The moderated multiple linear regression model confirmed that the attitudes of learners with hearing impairments towards assistive technology devices play a critical role in moderating the relationship between the hearing assistive technologies and the academic Performance in elementary schools for students with hearing impairments in Meru and Tharaka Nithi counties

#### **5.4.5 Conclusion on Academic performance of primary schools for learners with hearing challenges**

The findings indicate that the academic performance of students with hearing impairments was below expectations, which was a concern. It was clear that the poor academic performance scores in the three primary schools for learners with hearing challenges in Meru and Tharaka Nithi Counties were supposedly due to the non-utilization of assistive devices by learners in class and

during examinations. The problem was also attributed to a lack of skills in using hearing assistive devices, insufficient assistive technology devices in the school, a shortage of teachers with knowledge in utilizing assistive devices, a failure of learners to use assistive devices outside of the classroom and at home, and stigmatization and mockery for using assistive devices.

## **5.5 Recommendations of the Study**

In this study, the recommendations were derived after careful consideration of the findings, observations and conclusions made in the above section. The research made suggestions based on its findings, which were followed by a synthesis of the significance of the findings for theories, practices, and policies.

### **5.5.1 Recommendations Based on the Study Findings**

The following suggestions are based on the study's main variables.

#### **5.5.1.1 Recommendations on the Listening Assistive Technology Devices**

The shortage of listening assistive technology devices indicates a need for more. The Ministry of Education should establish a strategy to acquire all of the necessary listening assistive technology equipment for all primary schools for students with hearing impairments, according to the findings of this study. Equipment upkeep is also essential. Therefore, the Ministry of Education should allocate some funds which schools will utilize to repair a malfunctioning listening assistive device. The complexity of some assistive listening devices indicates a need to train users on appropriate use to minimize the rate of breakages and breakdowns. The head teachers should therefore come up with training schedules for learners and staff regarding the usage and maintenance of the assistive listening devices.



### **5.5.1.2 Recommendations on the augmentative and alternative Assistive Technology Devices**

The augmentative and alternative assistive technology devices usually enhance class facilitation for hearing impaired learners. This points to the need for classes to be customized and fitted with acoustic features. This has cost implications; hence, through the Ministry of Education, the government should facilitate funding of such undertakings. Once the government has purchased the augmentative and alternative assistive technology devices, the head teachers should develop school-based strategies to ensure comprehensive utilization of assistive technologies by learners in and outside the class. This requires creating a culture that encourages learners to always utilize the augmentative and alternative assistive technology devices in the school environment. The frequent use of the augmentative and alternative assistive technology devices by learners will result in a good mastery; hence, they will appreciate the value of the same in realizing improved academic performance.

### **5.5.1.3 Recommendations on the alerting Assistive Technology Devices**

Concerning alerting assistive technology devices, the Ministry of Education should embrace and enforce compliance with the National Institute on Deafness and Other Communication Disorders [NIDCD] safety regulations. As a result, the Ministry of Education should work with principals to ensure that all primary school buildings for students with hearing impairments are equipped with the necessary alerting assistance equipment. The Ministry of Education's quality audit organ should consider these topics in their regular quality audit. This has ramifications for the Ministry of Education's budget and funding distribution, and it also asks for the scope of quality audits to be expanded.

The installation of all needed hearing assistive equipment (listening assistive technology devices, augmentative and alternative assistive technology devices, and alerting assistive technology

devices) necessitates that the teaching staff have certain abilities to assist students. The Ministry of Education and the Instructors Service Commission should take steps to guarantee that all teachers assigned to primary schools for students with hearing impairments have the necessary skills to operate all assistive equipment.. Some of the critical skills noted included; skills to carry out simple repair and maintenance of the assistive technologies, skills to operate and fit the technological devices, for example, audiometer; computer literacy skills, skills to assess the knowledge levels of every child; sign language skill, digital literacy skills, knowledge/skill to measure hearing loss; skills to assess the safety of the devices, and communication skills. Considering the value of the assistive technology devices, the study noted that the primary schools for learners with a hearing impairment which fail to establish and foster the three assistive technologies would have learners underperform academically. Therefore, the study recommends the full adoption of these three hearing assistive technology devices in all primary schools for learners with hearing impairment in Kenya.

#### **5.5.1.4 Recommendations on the Attitudes of the Hearing-Impaired Learners towards Assistive Technologies**

According to the study, learners with hearing impairments' views regarding assistive technology hindered them from using them productively. To mitigate this challenge, the study recommends a concerted effort from all stakeholders (parents, teachers, community and government) to establish measures that would help impart positive attitudes to hearing impaired learners. This points to the need for sensitization and education of all the stakeholders involved.

### **5.5.1.5 Recommendations on Academic Performance of Primary Schools for Learners with Hearing Challenge**

The finding suggest that the government, through the Ministry of Education, should allocate more funding to elementary schools to help hearing-impaired students buy assistive technology equipment and pay non-teaching staff salaries. Furthermore, using assistive technology devices in the classroom and during exams necessitates a modification in the curriculum. As a result, the research advises that the Ministry of Education develop a hearing-impaired curriculum and fully implement the Individualized Education Program (IEP) in primary schools for students with hearing impairments.

The study's findings have indicated a need for adequate teachers who know about hearing assistive devices as an essential step towards improving the academic performance in primary schools of learners with the hearing challenge. This has implications for the number of teaching staff hired and their qualifications. This indicates that action is needed by the Teacher Service Commission (TSC) concerning the employment policy.

Participants in this research with hearing impairments and teachers had concerns about the amount of time allotted to each topic for national tests. As a result, the study suggests that the Ministry of Education adjust/increase the time allotted for examinations for each topic for students with hearing problems. This was to allow time for translation. The Ministry of Education should further put up measures to ensure that the supervisors and invigilators engaged during national examinations are fully conversant with the sign language to provide appropriate assistance to learners. This means that the Ministry of Education should vet the teachers assigned to invigilate examinations in primary schools for learners with hearing challenges.

### **5.5.2 Implications of the Findings on Theories, Practices and Policies**

The philosophical reasons of theories addressed in chapter two are supported by this study. In one study, for example, low use of assistive equipment in three primary schools in Meru and Tharaka Nithi Counties was linked to poor academic performance of learners with hearing impairments. Regarding the cause-and-effect theory developed by Peb Jourdan in 1919, the root causes for poor performance were traced to poor utilization of assistive devices. In this study, a relationship between the independent variables (assistive technology devices) and the dependent variable (poor academic performance) and the moderating variable (attitude of learners with hearing challenges) was ascertained and necessary remedies were identified.

With regards to the capability theory, which Tobobso developed in 2011, the findings of this study have confirmed that the academic performance of learners with hearing impairment can be enhanced by the use of assistive technology devices. The study noted that when learners are supplied with the requisite assistive technology devices and trained on how to utilize them, coupled with strategies to demystify their usage, then it helps improve their academic performance to a great extent.

Among order to elicit motivation and foster a positive attitude in students with hearing impairments, self-efficacy is essential. This notion was supported by the fundamental argument of Albert Bandura's Social Cognitive Theory, which he promoted in 1986, and Miller's Learning Theory, which he proposed in 1957. As a result, when systems support the use of assistive technology devices, the targeted goals, increased academic performance in primary schools for learners with hearing challenges, can be attained.. The Moderated multiple linear regression confirmed that the strength of the impact improves upon addressing the attitude of learners towards the hearing assistive technology devices. The findings have provided empirical evidence that

hearing impaired learners can improve their attitudes towards the utilization of assistive technologies when support systems address the self-efficacy drivers found in the areas of interaction, for example, at school, home and in society.

The findings have implications for the Ministry of Education on budgetary policies and allocation of funds to special needs primary schools to absorb the salary bills for the non-teaching staff, acquire and maintain hearing assistive devices and cater to for professional development of staff. Adopting a hearing-impaired curriculum and fully implementing the Individualized Education Program in primary schools for learners with hearing impairments necessitates a policy shift to ensure that all subjects taught in primary schools for hearing-impaired students are specifically facilitated and examined in sign language.

The proposed changes imply a need to shift from conventional pedagogy and classroom instruction delivery methods. This is because the study recommended that lessons be taught using modes that are friendly to hearing impaired learners. For example, the teachers should be recording all lessons and have them transformed or recorded in a visual format to foster better understanding and utilization by hearing impaired learners. Adopting the proposed change also implies a great need for Teacher Service Commission to hire interpreters during national examinations in all primary schools for learners with hearing challenges. The findings further imply the need for incorporating special needs teachers in the process of setting examinations. This initiative would also require awareness to be created in the community about using assistive technology. In addition, the government should ensure that the education and other programs on TV are deaf-friendly.

## **5.6 Recommendation for Further Studies**

In implementing this study, the researcher noted other areas that can be investigated further, as stipulated below.

- a) The current study focused on the use of hearing assistive technology in the classroom setting. It was noted that parents and the community also play a role in contributing to improved academic performance. The extent of the same was not validated in this study; hence, a further investigation can be carried out to investigate the home-based factors affecting the academic achievement of students with hearing impairments.
- b) The main respondents of this research were learners with hearing challenges, where the main concern was the utilization of assistive technologies and academic performance. The study negated the visually impaired learners. As a result, a comparison research may be conducted to determine whether there is a statistical difference in the performance of hearing and visually impaired students in elementary schools.
- c) This study targeted primary schools for learners with hearing impairment. A similar analysis can be conducted in secondary school to ascertain the status.
- d) A quasi-experimental longitudinal study can be carried out in primary schools that are fully equipped with hearing assistive devices to ascertain academic performance. This will inform on water-tight strategies for addressing the situation in the country and other nations in the region. This study was cross-sectional research.

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## APPENDICES

### **Appendix I: Consent to Participate in the Study**

Sabina Murithi

Kenya Methodist University

P.O. Box 267 – 60200.

Dear respondent,

I am writing to request for consent to participate in my study which will help me to actualize my academic research that investigates on *Utilization of Assistive Technology in Improving Academic Performance of Learners with Hearing Challenges in Specialized Primary Schools in Meru and Tharaka Nithi Counties, Kenya*. This research hope to impact practices in the teaching of the hearing impaired learners and hence improve their academic performance in primary schools in Kenya.

#### **Procedure to be followed**

The specific questions in the questionnaire and interview is organized into sections ranging from section A to I. Section A covers the introduction part constituting the biographical information of the sampled respondents. Sections B, C, D, E, and F, contain questions regarding the independent variables, while section H constitutes questions on the dependent variable. Several questions in the questionnaire are closed-ended, and some open-ended ones for each construct. All sentiments in the questionnaire are in 5 points Likert scale. In total. It takes approximately 10 to 15 minutes to complete the questionnaire and respond to interview session. The respondent is under no obligation to complete the questionnaire or to answer all questions presented or participate in the interview. If one comes across a question which one don't wish to answer, simply skip it.

I hope you will be willing to allow the pupils to participate because their responses are important and valued in this study, and will go a long way to help in designing appropriate framework. I hope you will also be willing to participate in this study in your capacity as the head teacher or as a teacher.

#### **Discomforts and risks**

In this study, there is no risks of participating in the research. The reputation of the participant will also not be injured. The respondent is welcome to discontinue participation in the study at any time, should one wish to do so due to discomfort. You may also stop the interview at any time. The interview may take about 30 minutes to complete.

**Benefits**

If you participate in this study you will help us to strengthen the academic performance of hearing impaired learners in primary schools in Kenya. Your input is therefore critical in generate new knowledge and will go a long way in strengthening assistive technology availed to learners with hearing challenge in primary schools.

**Rewards**

There is no reward for anyone who chooses to participate in the study.

**Confidentiality**

Your participation and those of the pupils will remain strictly confidential. No name will be recorded on the questionnaire or attached to any of the data you provide. The data collection will be kept in a confidential location after collection and in future and, moreover, will not have anything to identify you.

**Contact Information**

Should you have questions regarding your participation, please contact me on [sabinamurithi@gmail.com](mailto:sabinamurithi@gmail.com). You may also contact my research supervisor at [severina.mwirichia@kemu.ac.ke](mailto:severina.mwirichia@kemu.ac.ke)

I am kindly asking you to sign the consent form (below) indicating agreement for you to participate in the study. By head teacher signing this consent form, is also an indicator that one has agreed to make arrangement for pupils from his/her school to participate in the study.

**Participant’s Statement**

The above statement regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will not be victimized at my place of work whether I decide to leave the study or not and my decision will not affect the way I am treated at my work place.

Name of Participant..... Date.....

Signature.....

**Investigator's Statement**

I, the undersigned, have explained to the volunteer in a language s/he understands the procedures to be followed in the study and the risks and the benefits involved.

Name of Interviewer.....Date.....

Interviewer Signature.....

## **Appendix II: Pupils Questionnaire**

### **INSTRUCTIONS**

Please respond by either ticking (✓) or filling the blank spaces provided. Do not indicate your name anywhere in this questionnaire.

#### **Section A: General Information**

1) What is your gender:

Male            [   ]

Female         [   ]

2) What is your level of academics?

Class eight    [   ]

Class seven    [   ]

Class six       [   ]

Class five      [   ]

Class four     [   ]

Class three    [   ]

**Section B: Listening Assistive Technology**

3) The statements below refers to issues on the utilization of listening assistive technologies your school. Please indicate with a tick (√) how these statements apply to your school in relation to the technological devices; SA = Strongly agree (5), A = Agree (4), N = Neutral (3), D = Disagree (2), SD = Strongly disagree (1).

No	Sentiments on listening assistive technologies	SD(1)	D(2)	N(3)	A(4)	SA(5)
1	I have enough skills on how to use listening assistive technologies	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
2	Our school have enough listening assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
3	Our school have variety of listening assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
4	The school has provided the required support to enhance maximum utilization of listening assistive technologies	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
5	Learners utilize listening assistive devices in class	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
6	Our school has clear guidelines regarding using of listening assistive	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
7	Learners utilizing the listening assistive technologies are recognized at our school	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
8	The listening assistive devices are repaired in timely manner	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]



**Section C: Augmentative and Alternative Assistive Technologies**

- 4) Please, indicate by ticking (√) whether, you Strongly Disagree (SD), Disagree (D), No Opinion (NO), Agree (A) or you Strongly Agree (SA), regarding each of the following statements concerning the augmentative strand alternative assistive technology utilization in your school.

No.	Statements on augmentative and alternative assistive technologies	SD(1)	D(2)	N (3)	A(4)	SA(5)
1	We utilize a variety of augmentative and alternative assistive technological devices in our school	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
2	We have adequate number of augmentative and alternative assistive devices in our school	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
3	Our school has clear guidelines on the utilization of augmentative and alternative assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
4	Learners are sensitized to use augmentative and alternative assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
5	Learners utilize augmentative and alternative assistive devices in classroom	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
6	Our school has instituted measures / guidelines to foster the utilization of augmentative and alternative assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
7	The augmentative and alternative assistive technological devices are repaired in timely manner	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
8	I have the skills to use augmentative and alternative assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]

**Section D: Alerting Assistive Technology**

5) The statements below refers to issues on the utilization of alerting assistive technologies in your school. Please indicate with a tick (✓) how these statements apply to your school; SA = Strongly agree (5), A = Agree (4), N = Neutral (3), D = Disagree (2), SD = Strongly disagree (1).

No.	Sentiments on alerting assistive technologies	SD(1)	D(2)	N(3)	A(4)	SA(5)
1	All building in our school are fitted with alerting devices which can notify us in case of an emergency	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
2	I have the skills to use alerting assistive technology devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
3	Our school has clear guidelines on the utilization of alerting assistive technology devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
4	The alerting assistive devices are repaired in timely manner	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
5	Learners are sensitized to use alerting assistive technology devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
6	We have adequate alerting assistive devices in our school	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]

6) What do you think should be done to improve the utilization of assistive (listening, augmentative and alternative and alerting) technologies?

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## Section E: Attitudes of Learners with Hearing Impairment

- 7) In this section, tick, where your best opinion lies ((√) use the scale 1 = Strongly, Disagree (SD) 2 = Disagree (D) 3 = Neutral (N) 4 = Agree (S) 5 = Strongly Agree (SA) to show the extent of agreement or disagreement with the given statement on your attitudes towards using assistive technology.

No.	Sentiments	SD(1)	D(2)	N(3)	A(4)	SA(5)
1)	I like wearing the assistive technological devices on daily basis	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
2)	I enjoy utilizing assistive devices because they help me both in the classroom and outside the school environment.	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
3)	Wearing the hearing assistive devices has made me perform well in examinations	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
4)	Using listening, augmentative and alternative and alerting devices have made me get along well in performing activities I was unable to do before	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
5)	My teachers make me feel encouraged to wear the assistive devices	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
6)	The availability of adequate required devices by the learners boost my morale	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
7)	I don't like wearing the devices because no one helps me fix them when I need for help	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
8)	Learners only ask for the devices when the teacher is in the class	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
9)	There are rare cases reported on learners wearing the devices facing stigma, criticism and mockery from hearing counterparts in our school	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
10)	The hearing assistive devices are user friendly, hence, the pupils with hearing impairment love utilizing them	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]

1) What do you think should be done to improve the attitudes of learners towards using assistive technology?

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**Section F: Academic Performance**

No.	Statements regarding academic performance	SD(1)	D(2)	N(3)	A(4)	SA(5)
1	Utilization of a listening, augmentative and alternative and alerting devices has enabled me to improve my academic performance.	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
2	Using assistive technology has made me perform better in the continuous assessment tests	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
3	Using assistive devices has made me to perform better in end of term examinations	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
4	My attitudes towards the utilization of assistive technologies negatively affect my academic performance	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
5	Using assistive technologies has boosted my communication abilities	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
6	Using assistive technologies have made me respond quickly to questions in class	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
7	The use of hearing assistive devices has enabled me to remain active in class	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]
8	The use of assistive technologies has boosted my ability to participate in group discussions	[ 1 ]	[ 2 ]	[ 3 ]	[ 4 ]	[ 5 ]

2) What do you think should be done to improve your academic performance?

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Thank You

### Appendix III: Interview Schedule for Head teachers

1) What is your highest academic qualification?

KCPE Certificate [ ]

KCSE Certificate [ ]

Diploma [ ]

Degree [ ]

Masters [ ]

PhD [ ]

2) For how long have you been working in this special primary school?

Less than a year [ ]

Between 1- 5 years [ ]

Between 6-10 years [ ]

Between 11-15 years [ ]

Between 16- 20 years [ ]

Over 20 years [ ]

3) What relevant knowledge and skills are both teaching and technical staff expected to have regarding the assistive technologies?

4) Comment on the number of assistive devices required by pupils in your school.

5) Discuss the nature of support that you provide to enhance the utilization of listening assistive technologies at your school

6) Describe the training and development programs that are provided for teachers and technical support staff regarding assistive technologies at your school

- 7) Discuss how you motivate teachers and technical support staff regarding the utilization of the assistive technologies
- 8) Describe the nature of infrastructural resources and facilities that you provide at your school to support the utilization of the assistive technologies. Comment on their maintenances.
- 9) Describe the nature of support that government or the County provide to the school towards supporting the utilization of assistive technologies
- 10) Provide suggestions on what should be done to improve the utilization of assistive (listening, augmentative and alternative and alerting) technologies in learning and during examinations?
- 11) What do you think should be done to improve the attitudes of learners towards using assistive technology?
- 12) What do you think should be done to improve the academic performance of hearing impaired learners at your school?

#### **Appendix IV: Interview Schedule for County Director of Education**

- 1) What relevant knowledge and skills are both teaching and technical staff expected to have regarding the assistive technologies?
- 2) Comment on the nature of assistive devices required by pupils who have hearing impairment in primary school.
- 3) Describe the training and development programs that the government provide to teachers and technical support staff to support use of assistive technologies
- 4) How does government motivate teachers and technical support staff regarding the utilization of the assistive technologies
- 5) Describe the government support the infrastructural resources and facilities in primary schools for hearing impaired with regards to assistive technologies.
- 6) Describe the nature of support the government provide to the primary schools for hearing impaired towards supporting the utilization of assistive technologies
- 7) What are the government's guidelines on the utilization of assistive (listening, augmentative and alternative and alerting) technologies in learning and during examinations?
- 8) What do you think should be done to improve the attitudes of learners towards using assistive technology?
- 9) What do you think should be done to improve the academic performance of hearing impaired learners at your school?

## **Appendix V: Focused group Discussion questions for teachers and support staff**

1) What is your highest academic qualification?

KCPE Certificate [ ]

KCSE Certificate [ ]

Diploma [ ]

Degree [ ]

Masters [ ]

PhD [ ]

2) For how long have you been working in this special primary school?

Less than a year [ ]

Between 1- 5 years [ ]

Between 6-10 years [ ]

Between 11-15 years [ ]

Between 16- 20 years [ ]

Over 20 years [ ]

### **Members will be asked to discuss the following:**

- 3) Discuss the knowledge and skills that both teaching and technical staff are expected to have regarding the assistive technologies.
- 4) Discuss the number of assistive devices required by pupils with hearing impairment at your school.
- 5) Discuss the nature of support that is provided by the school administration to enhance the utilization of listening assistive technologies at your school



- 6) Discuss the nature of training and development programs that are provided for teachers and technical support staff regarding assistive technologies.
- 7) Discuss the schemes that have been put in place for motivating teaching and non-teaching staff regarding the utilization of the assistive technologies at your school.
- 8) Discuss the nature of infrastructural resources and facilities provided at the school to support the utilization of the assistive technologies.
- 1) Discuss the nature of support that government or the County provides to the school towards supporting the utilization of assistive technologies in teaching and supporting learners during examinations.
- 2) What do you think should be done to improve the utilization of assistive (listening, augmentative and alternative and alerting) technologies in learning and during examinations?
- 3) What do you think should be done to improve the attitudes of learners towards using assistive technologies at your school?
- 4) What do you think should be done to improve the academic performance of hearing impaired learners at your school?

## Appendix VI: Form for Collecting Secondary Data

The KCPE Mean Scores, 2015 – 2021 for the three primary schools for learners with hearing impairments in Meru and Tharaka Nithi Counties were noted and compared with the county mean scores for the same period.

<b>Year</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2021</b>
Njia Primary School - KCPE Mean Scores						
Kaaga Primary School - KCPE Mean Scores						
<b>Meru County - KCPE average mean scores</b>						
Kamatungu primary school - KCPE Mean Scores						
<b>Tharaka Nithi County - KCPE average mean scores</b>						



## Appendix VIII: Ethical Clearance Letter from Ethical Committee



### KENYA METHODIST UNIVERSITY

P. O. BOX 267 MERU - 60200, KENYA  
TEL: 254-064-30301/31229/30367/31171

FAX: 254-64-30162  
EMAIL: [INFO@KEMU.AC.KE](mailto:INFO@KEMU.AC.KE)

August 3, 2022

KeMU/SERC/EDU/2/2022

SABINA MURITHI  
EDU-4-1285-2/2019

Dear Sabina,

**SUBJECT: UTILIZATION OF ASSISTIVE TECHNOLOGY IN IMPROVING ACADEMIC PERFORMANCE OF LEARNERS WITH HEARING CHALLENGES IN SPECIALIZED PRIMARY SCHOOLS IN MERU AND THARAKA NITHI COUNTIES, KENYA**

This is to inform you that Kenya Methodist University Scientific Ethics and Review Committee has reviewed and approved your research proposal. Your application approval number is KeMU/SERC/EDU/2/2022. The approval period is 3<sup>rd</sup> August, 2022 – 3<sup>rd</sup> August, 2023.

This approval is subject to compliance with the following requirements:-

- I. Only approved documents including (informed consents, study instruments, MTA) will be used.
- II. All changes including (amendments, deviations, and violations) are submitted for review and approval by Kenya Methodist University Scientific Ethics and Review committee.
- III. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KeMU SERC within 72 hours of notification.
- IV. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KeMU SERC within 72 hours.

- V. Clearance for export of biological specimens must be obtained from relevant institutions.
- VI. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- VII. Submission of an executive summary report within 90 days upon completion of the study to KeMU SERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.

Yours sincerely,





**Appendix IX: Authorization letter from County Commission – Tharaka Nithi County**



**THE PRESIDENCY**

**MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT**

Telegrams: "DISTRICTER", Chuka  
Telephone: Chuka 630005  
Fax No. 630356  
Email: cctharakanithi@gmail.com  
While replying please quote:  
Ref: TNC/ED/VOL.II/226

OFFICE OF THE COUNTY COMMISSIONER  
THARAKA NITHI COUNTY  
P.O BOX 80-60400

**CHUKA**

1<sup>st</sup> August, 2022

Deputy County Commissioner  
THARAKA NORTH SUB COUNTY

**RE: RESEARCH AUTHORIZATION -MS.SABINA MURITHI**

Reference is made to the Research License NACOSTI/P/22/18138 dated 7<sup>th</sup> June 2022 authorizing Ms. Sabina ~~R~~. Rukunga of Kenya Methodist University to research on Utilization of Assistive Technology in improving Academic performance in Primary Schools for learners with Hearing challenges for the period ending 7<sup>th</sup> June 2023.

This is to introduce you to the researcher and inform you that she has been authorized to carry out research in your area of jurisdiction.

You are requested to accord her the necessary support.

COUNTY COMMISSIONER  
THARAKA NITHI COUNTY

WILFRED O. ODHIAMBO  
For: COUNTY COMMISSIONER  
**THARAKA NITHI**

**Copy to:**

National Commission for Science  
Technology & Innovation.

Appendix X: Authorization letter from County Commission – Meru County



**OFFICE OF THE PRESIDENT  
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL  
GOVERNMENT**

Telegrams:  
Telephone:  
Email: [ccmeru@yahoo.com](mailto:ccmeru@yahoo.com)  
Fax:

COUNTY COMMISSIONER  
MERU COUNTY  
P.O. BOX 703-60200  
MERU.

When replying please quote  
Ref:EDU.12/3.VOL 1V (56)

And Date:

2<sup>nd</sup> August, 2022

**TO WHOM IT MAY CONCERN**

**REF: AUTHORITY TO CONDUCT RESEARCH**

This is to inform you that **Sabina B. Rukunga** of Kenya Methodist University in the School of Education and Social Sciences has reported to this office as directed by the National Commission for Science, Technology and Innovation and will be carrying out research on “ **Utilization of Assistive Technology in improving Academic Performance in Primary Schools for Learners with Hearing Challenges** in Meru County.

Since authority has been granted by the said Commission, and the above named person has reported to this office, She can embark on her research project for a period ending on **7<sup>th</sup> June, 2023**.

Kindly accord her the necessary assistance she may require.

**MARTHA K. IMBUSI  
FOR: COUNTY COMMISSIONER  
MERU**

COUNTY COMMISSIONER  
MERU COUNTY  
P. O. Box 703-60200, MERU

**Appendix XI: Authorization letter from County Director of Education – – Tharaka Nithi  
County**



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

**Telegrams:** "Elimu", Chuka  
**Telephone:** Chuka 630353  
**FAX:** 064 630166  
**Email:** tharakanithicountyedu@gmail.com  
*When replying please quote:*

COUNTY DIRECTOR OF EDUCATION  
THARAKA NITHI  
P.O. BOX 113-60400  
**CHUKA.**

**TNC/ED/RA/GEN/129/86**

**2<sup>nd</sup> August ,2022**

Sabina Murithi  
**KENYA METHODIST UNIVERSITY**


**RE: RESEARCH AUTHORIZATION FOR SABINA MURITHI  
REG NO. EDU-4-1285-2/2019**

I am pleased to inform you that you have been authorized to undertake research on  
**"Utilization of assistive technology in improving academic performance in  
primary schools for learners with hearing challenges in Meru and Tharaka Nithi  
Counties, Kenya"** for the period ending 7<sup>th</sup> June 2023.

On completion of the research, you are expected to give a hard copy and soft of the  
research report/thesis to this office.

The research Authorization is granted according to all existing rules and regulations in  
force from time to time and observance of Covid-19 Guidelines and protocols as  
recommended by the relevant government MDAs.

Good luck!

  
County Director of Education  
Tharaka Nithi  
P. O. Box 113 - 60400,  
Chuka  
Bridget Wambua (Mrs.)  
County Director of Education  
**THARAKA NITHI**



**Appendix XII: Authorization letter from County Director of Education – – Tharaka Nithi  
County**



**REPUBLIC OF KENYA  
MINISTRY OF EDUCATION**  
State Department of Early learning and Basic Education

[Email.cdemerucounty@gmail.com](mailto:Email.cdemerucounty@gmail.com)  
Telegrams: "ELIMU" Meru  
When Replying please quote  
MERU

County Director of Education  
Meru County  
P.O. BOX 61

Ref: MRU/C/EDU/11/1/297

2<sup>nd</sup> August, 2022

**TO WHOM IT MAY CONCERN**

**RE: RESEARCH AUTHORIZATION –MS SABINA B. RUKUNGA**

Reference is made to letter Ref.NO.NACOSTI/P/22/18138 dated 7<sup>th</sup> June, 2022.

Authority is hereby granted to **Ms. SABINA B. RUKUNGA** to conduct research on  
**"UTILIZATION OF ASSISTIVE TECHNOLOGY IN IMPROVING ACADEMIC  
PERFORMANCE IN PRIMARY SCHOOLS FOR LEARNERS WITH CHALLENGES  
IN MERU COUNTY"**, for the period ending 7<sup>th</sup> June, 2023.

The person undertaking this study is bound by all the ethical rules and  
regulations governing surveys of this nature.

**P. J. MUINDE**  
**For: County Director of Education**  
**MERU COUNTY**

FOR: COUNTY DIRECTOR OF EDUCATION  
MERU COUNTY  
P. O. BOX 61- 60200  
Tel: 064-32372 MERU