



**Impact of Assistive Technology on the Academic Performance of Students
with Hearing Impairments in Rural Special Schools of Rwanda.**

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**A thesis submitted in partial fulfillment of the requirements for the degree of
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CERTIFICATION

I hereby affirm that the following thesis has been submitted with the authorization of my supervisor, Dr. Suubi Patrick, and is submitted in fulfillment of the requirements for the Degree of Master of Education in Special Needs Education.

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DECLARATION

I, Rene William NGABO, hereby declare that this thesis is entirely my own work. It does not incorporate work produced by any other individual for the purposes of attaining a degree at the University of Rwanda or any other academic institution.

Signature:

Date: / 2024

DEDICATION

I would like to dedicate this thesis to my late father and my mother who never ceased to support me, my lovely brother and to everyone who contributed to my studies directly or indirectly.

ACKNOWLEDGEMENT

My completion of this project could not have been accomplished without the support of my classmates, my lectures and my supervisor Dr. Suubi Patrick. I am really deeply grateful for their support.

ABSTRACT

This thesis explores the Impact of Assistive Technology on the Academic Performance of Students with Hearing Impairments in Rural Special Schools of Rwanda. The study adopted a mixed-methods approach, combining quantitative and qualitative data collection and analysis methods. The study employed a convergent parallel design, which involves collecting and analyzing both quantitative and qualitative data separately and then comparing and integrating the results. The data collection sources include questionnaires, interviews, and observation checklists administered to students, teachers, and head teachers in two rural special schools for the deaf. The study aims to analyze various assistive technologies available that facilitate the performance of students with hearing impairments, evaluate the level of knowledge of teachers about assistive technology and their integration in teaching and learning, assess the impact of assistive technology on the academic performance of students with hearing impairments, and identify the challenges and barriers faced by students, teachers, and schools in implementing assistive technology effectively.

The findings revealed that assistive technology contributes positively to various facets of students' academic experiences, enhancing their learning outcomes and educational opportunities. The study highlighted the availability of different types of assistive technologies, such as hearing aids, FM systems, and captioning software, which facilitate the performance of students with hearing impairments. However, the level of knowledge and awareness among teachers about assistive technology and its integration in teaching and learning was found to be limited, emphasizing the need for continuous training and professional development.

Based on the findings, the study provides the following recommendations: to develop and implement comprehensive training programs for teachers to enhance their knowledge and skills in utilizing assistive technology effectively, allocate adequate funding and resources to ensure the availability and maintenance of assistive technology devices in rural special schools, establish collaborative partnerships between schools, government agencies, and non-governmental organizations to facilitate the implementation and sustainability of assistive technology programs, promote awareness and sensitization campaigns to educate the community about the importance of assistive technology in supporting the education of students with hearing impairments, conduct further research to investigate the long-term impact of assistive technology on the academic and social outcomes of students with hearing impairments, and how these technologies can be applied into the local context.

Table of Contents

| | |
|---|-----|
| DECLARATION | iii |
| DEDICATION | iv |
| ACKNOWLEDGEMENT | v |
| ABSTRACT | vi |
| LIST OF FIGURES | x |
| LIST OF TABLES | xi |
| LIST OF ABBREVIATIONS AND ACCRONYMS | xii |
| CHAPTER ONE: INTRODUCTION | 1 |
| 1.1 Introduction | 1 |
| 1.2 Background of the study | 1 |
| 1.3 Statement of the Problem | 6 |
| 1.4 Purpose of Study | 7 |
| 1.5 Objectives of the study | 8 |
| 1.6 Research Questions | 8 |
| 1.7 Assumptions of the Study | 9 |
| 1.8 Limitations of the study | 9 |
| 1.9 Delimitations of the Study | 10 |
| 1.10 Significance of the study | 10 |
| 1.11 Theoretical Framework | 11 |
| 1.12 Conceptual Framework | 12 |
| 1.13 Operational definition of terms | 14 |
| CHAPTER TWO | 16 |
| LITERATURE REVIEW | 16 |
| 2.1. Introduction | 16 |
| 2.2 Literature Related to the Main Concepts | 16 |
| 2.3. Analyze various assistive technologies available for students with hearing impairments. | 18 |
| 2.4. Evaluate the level of knowledge and awareness among Teachers for Hearing Impaired (H.I) about Assistive Technology. | 28 |

| | |
|--|-----|
| 2.5. Assess the Impact of Assistive Technology on the academic performance of students with hearing impairments in rural special schools. | 29 |
| 2.7. Summary and gap identification | 31 |
| CHAPTER THREE | 33 |
| RESEARCH METHODOLOGY | 33 |
| 3.0 Introduction | 33 |
| 3.1 Study setting | 33 |
| 3.2 Research design..... | 34 |
| 3.3 Target population | 34 |
| 3.4 Research instrument | 36 |
| 3.5 Data analysis procedures..... | 37 |
| 3.6 Validity and Reliability | 37 |
| 3.7 Ethical issues..... | 39 |
| CHAPTER FOUR..... | 40 |
| PRESENTATION, ANALYSIS, AND INTERPRETATION OF RESULTS | 40 |
| 4.0 Introduction | 40 |
| 4.1 Response Rate | 41 |
| 4.3 Demographic Data of Learners | 43 |
| 4.4 Presentation of Findings..... | 45 |
| CHAPTER FIVE | 67 |
| SUMMARY, CONCLUSION, AND RECOMMENDATIONS | 67 |
| 5.1 Introduction | 67 |
| 5.2 Summary | 67 |
| 5.3 Conclusion..... | 69 |
| 5.4 Recommendations | 70 |
| 5.5 Future Research..... | 71 |
| BIBLIOGRAPHY | 72 |
| Appendices..... | i |
| Teacher Interview Guide | ii |
| Learner Interview Guide | v |
| Head Teacher Interview Guide | vii |

| | |
|----------------------------------|------|
| Learner Questionnaire | ix |
| Teacher Questionnaire..... | xi |
| Head Teacher Questionnaire | xiv |
| Observation Checklist | xvii |

LIST OF FIGURES

| | |
|---|----|
| Figure 1 Technology usage among teachers | 46 |
| Figure 2 Technology usage among students | 47 |
| Figure 3: Technology Usage among Teachers and Students | 47 |
| Figure 4 Perspectives of Teachers and Students | 48 |
| Figure 5 Technology usage by Teachers | 51 |
| Figure 6 Perspectives of Teachers | 52 |
| Figure 7 Teacher Observations on Students' Academic Performance | 57 |
| Figure 8 Classroom Impact Indicators Observed by School Leaders | 58 |
| Figure 9 academic performance in UMUTARA Deaf School | 60 |
| Figure 10 academic performance in NYABIHU Deaf School | 60 |
| Figure 11 Challenges and Barriers Faced by Different School Staff | 63 |
| Figure 12 Additional Insights from Interviews | 64 |

LIST OF TABLES

| | |
|---|----|
| Table 1 Determination of the Population Size | 34 |
| Table 2 Response rate for each group of participants | 41 |
| Table 3 Demographic Data of Teachers | 42 |
| Table 4 Level of qualification of teachers | 42 |
| Table 5 Gender and Age of Learners | 43 |
| Table 6 School Level of Learners | 44 |
| Table 7 Familiarity with Assistive Technologies among Teachers and Students | 46 |
| Table 8 Teacher Perspectives on Existing Technologies and Needs | 48 |
| Table 9 Familiarity with Assistive Technologies among Teachers | 50 |
| Table 10 Teacher Perspectives on Existing Technologies and Needs | 51 |
| Table 11 Student Perspectives on the Impact of Assistive Technology | 55 |
| Table 12 Teacher Observations on Students' Academic Performance | 56 |
| Table 13 Classroom Impact Indicators Observed by School Leaders | 58 |
| Table 14 Challenges and Barriers Reported by Participants | 63 |
| Table 15 Additional Insights from Interviews | 64 |

LIST OF ABBREVIATIONS AND ACCRONYMS

| | |
|-----------------------|---|
| %: | Percentage |
| &: | and |
| AT: | Assistive Technology |
| CRPD: | Convention on the Rights of Persons with Disabilities |
| EFA: | Education for All |
| ESSP: | Education Sector Strategic Plan |
| IE: | Inclusive Education |
| MINEDUC: | Ministry of Education |
| N^o: | Number |
| P.: | Primary |
| P: | Page |
| PC: | Personal computer |
| REB: | Rwanda Basic Education Board |
| S: | Senior |
| SEN: | Special Educational Needs |

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter presents the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, limitations and delimitations of the study, assumptions of the study, theoretical and conceptual frameworks, and operational definitions of terms.

1.2 Background of the study

Assistive technology is a broad term that encompasses various devices, software programs, and product systems designed to enhance, maintain, or improve the functional capabilities of individuals with disabilities. For people with hearing impairments, assistive technology can include a wide range of tools and devices that facilitate communication, access to information, and learning. These technologies can be categorized into several groups, such as hearing aids and cochlear implants that amplify sound; captioning and vibrating alerts that provide visual or tactile feedback; sign language and augmentative and alternative communication devices that enable alternative modes of communication; and computers and tablets that enhance access to information and learning. The utilization of assistive technology has emerged as a crucial strategy to improve the education and development of children with hearing impairments, as it can help bridge the gap between their abilities and the demands of the learning environment (WHO, 2022).

The global need for assistive technology is immense and growing. According to the World Health Organization (WHO), more than 2.5 billion people currently require one or more assistive products, and this number is expected to rise to 3.5 billion by 2050, due to factors such as an aging global population and an increase in non-communicable diseases (WHO, 2022). This highlights the importance of developing and implementing effective assistive technology solutions to meet the diverse needs of individuals with disabilities, including those with hearing impairments.

The history of assistive technology for hearing impairments can be traced back to ancient times, when people used various methods and devices to enhance their hearing, such as horns, shells, trumpets, and ear tubes (Polgar, 2010). However, the modern era of assistive technology for hearing impairments began in the early 1900s with the invention of the first electric hearing aid. By the mid-20th century, hearing aids had become widely available and more advanced, offering improved sound quality and smaller, more portable designs (Hersh & Johnson, 2003). The development of cochlear implants, which are surgically implanted devices that stimulate the auditory nerve, began in the 1950s and became commercially available in the 1980s. Cochlear implants have revolutionized the treatment of severe to profound hearing loss, providing a means for individuals to perceive sound and develop spoken language skills (Gifford, 2013).

The advancement of digital technology in the late 20th and early 21st centuries has led to the emergence of new types of assistive technology for hearing impairments. These include digital hearing aids with advanced signal processing capabilities, wireless connectivity options, and customizable settings (Ching et al., 2018); smartphone applications that provide real-time captioning and transcription services (Rosenblum et al., 2019); and augmentative and alternative communication devices that use various modes of input and output, such as speech, text, symbols, gestures, and images, to facilitate communication (Light & McNaughton, 2014). These technological advancements have greatly expanded the options available for individuals with hearing impairments to access information, communicate with others, and participate in educational and social activities.

In East Africa, the use of assistive technology for hearing impairments has been influenced by various factors, such as the availability and affordability of the devices, the awareness and acceptance of the users and the society, the training and support of the service providers, and the policies and regulations of the governments. A study found that the most common types of assistive technology used by people with hearing impairments in East Africa are hearing aids and sign language, followed by cochlear implants and captioning (Kariuki et al. 2018). However, the access and utilization of these devices vary widely across and within countries, depending on the socioeconomic status, geographic location, and cultural background of the users. For example, in Kenya, only 2.4% of people with hearing impairments use hearing aids, and only 0.2% use

cochlear implants, while in Uganda, the figures are 4.6% and 0.1%, respectively (Kariuki et al., 2018). These low rates of assistive technology use can be attributed to several barriers, including the high cost of the devices, the lack of availability and distribution of the devices, the low awareness and knowledge of the users and the community, the stigma and discrimination associated with hearing impairments, the insufficient training and support of the service providers, and the inadequate policies and regulations of the governments (Kariuki et al., 2018).

The impact of assistive technology on the academic performance of students with hearing impairments in East Africa has been explored by several studies, which have shown mixed and inconclusive results. Some studies have found positive effects of assistive technology, such as improved test scores, classroom participation, and educational attainment. For example, a study by Bateye et al. (2018) in Nigeria found that the use of hearing aids and sign language interpreters significantly improved the academic performance and social integration of students with hearing impairments in inclusive schools. Similarly, a study in Ghana found that the use of assistive listening devices and captioning software enhanced the comprehension and engagement of students with hearing impairments in mainstream classrooms (Yalo et al., 2019). On the other hand, some studies have found no or negative effects of assistive technology, such as increased dependency, isolation, and frustration. For instance, a study in Kenya found that the use of assistive technology did not significantly improve the academic performance of students with hearing impairments in special schools, and that some students felt stigmatized and excluded by the use of the devices (Mugo et al., 2017). A study in Jordan found that the use of assistive technology created a sense of dependency and passivity among some students with hearing impairments, who relied on the devices to access information and communicate with others, rather than developing their own skills and strategies (Alqudah et al., 2019). The variation in the findings may be attributed to the differences in the types, quality, and suitability of the assistive technology, the characteristics and preferences of the students, the methods and measures of the evaluation, and the context and conditions of the education system (Polgar, 2010).

Despite the potential benefits of assistive technology for students with hearing impairments, the availability, awareness, and effectiveness of these technologies in rural special schools are not well understood. Special schools, which are designed to cater to the specific needs of students with

disabilities, often face unique challenges in terms of resources, infrastructure, and personnel (Bunning et al., 2014). In rural areas, these challenges may be exacerbated by factors such as poverty, remoteness, and cultural beliefs (McInerney, 2019). A study in Zimbabwe found that rural special schools for students with hearing impairments lacked adequate funding, trained teachers, and assistive technology devices, which limited the students' access to quality education and support services(Chikuku et al., 2019). Similarly, a study in Tanzania found that the use of assistive technology in rural special schools was hampered by the lack of electricity, internet connectivity, and maintenance services, as well as the negative attitudes and low expectations of the teachers and parents towards the students with hearing impairments(Ntabo et al., 2018).

In Rwanda, hearing impairment is a prevalent condition that affects many people across different age groups. According to the Demographic and Health Survey 2019/20, about 3.5% of children aged 6-59 months and 2.7% of adults aged 15-49 years have some degree of hearing difficulty, and about 0.4% and 0.3% of these groups, respectively, have severe or profound hearing difficulty (NISR et al., 2020). The causes of hearing impairment in Rwanda include congenital factors, infections, trauma, noise exposure, aging, and ototoxic drugs (Munyemana et al., 2017). Hearing impairment can have negative consequences for the social and economic well-being of individuals and families in Rwanda, as it can limit their access to education, employment, and community participation (Rudelic et al., 2019).

Rwanda, like many countries, faces challenges in ensuring inclusive education for students with disabilities, including those with hearing impairments. Studies suggest that hearing loss affects approximately 5% of children globally, with a significant portion residing in developing nations like Rwanda (WHO, 2021). Hearing impairment can significantly impact academic performance due to difficulties accessing spoken language and auditory information in classrooms (Kent et al., 2014). In Rwanda, this challenge is compounded by limited resources for inclusive education and a shortage of qualified special educators trained in supporting students with hearing impairments (Nyirahabimana et al., 2019). A study found that the majority of teachers in Rwandan primary schools lacked the knowledge and skills to accommodate students with hearing impairments, and that the schools lacked the necessary assistive technology and learning materials to support their inclusion(Niyomugabo et al., 2020).

Despite the potential of assistive technology to enhance the educational experiences and outcomes of students with hearing impairments, its integration into Rwandan classrooms remains limited. Research is scarce on the impact of AT use on academic performance in this specific context. Available studies from other developing countries suggest positive correlations between AT use and improved academic outcomes, including increased language comprehension, higher grades, and greater participation in classrooms (Lantang, 2019). However, these findings may not directly translate to the Rwandan context due to differences in educational systems, resource availability, and cultural factors. A study in Rwanda found that the use of assistive technology in inclusive schools was hindered by the lack of funding, trained personnel, and technical support, as well as the negative attitudes and resistance of some teachers and parents towards the inclusion of students with disabilities (Murara et al., 2020).

To address the gaps in the literature and the challenges faced by students with hearing impairments in Rwanda, this study aims to explore the impact of assistive technology on the academic performance of students with hearing impairments in two selected rural special schools, namely Umutara Deaf School and Nyabihu Deaf School. These schools were selected as they represent different contexts and experiences of students and teachers in using assistive technology. Umutara Deaf School is located in the Eastern Province of Rwanda and serves students from the surrounding rural communities, while Nyabihu Deaf School is located in the Western Province and serves students from both rural and urban areas. By conducting a mixed-methods study that includes questionnaires, interviews, and observations, this research seeks to provide a comprehensive understanding of the availability, awareness, and effectiveness of assistive technology in these schools, as well as the perspectives and experiences of the students, teachers, and administrators involved. The findings of this study can inform the development and implementation of policies and practices that support the inclusion and achievement of students with hearing impairments in Rwanda and beyond.

1.3 Statement of the Problem

In an ideal educational setting, students with hearing impairments would have equal access to quality education and the necessary support to fully participate in the learning process. Assistive technology would be readily available, and both students and teachers would be well-informed about its benefits and trained in its effective use. The integration of assistive technology would enable students with hearing impairments to communicate effectively, access information, and engage in interactive learning activities, ultimately leading to improved academic performance and overall development (Polgar, 2010).

However, the reality in Rwanda, particularly in rural special schools, is far from ideal. Students with hearing impairments face numerous challenges in accessing quality education due to limited resources and support (Rekkedal, 2012). The availability of assistive technology in these schools is often scarce, and when available, both students and teachers may lack awareness and knowledge about its proper use and potential benefits. This lack of access and understanding of assistive technology can hinder the learning process and widen the achievement gap between students with hearing impairments and their hearing peers (Niyibizi et al., 2019).

In Rwanda, the prevalence of hearing impairment among school-aged children is estimated to be around 5% (Munyemana et al., 2017). Despite the government's efforts to promote inclusive education through policies such as the Special Needs and Inclusive Education Policy, the implementation of these policies remains challenging, especially in rural areas (Rubagiza et al., 2021). Rural special schools often lack the necessary infrastructure, qualified personnel, and financial resources to effectively support students with hearing impairments (Niyibizi et al., 2019). Moreover, the limited availability and high cost of assistive technology devices, coupled with the lack of trained professionals to maintain and repair them, further exacerbate the situation (Munyemana et al., 2017).

The lack of access to quality education and assistive technology can have far-reaching consequences for students with hearing impairments in Rwanda. Without proper support and accommodations, these students may struggle to keep pace with their hearing peers, leading to poor academic performance and increased risk of school dropout (Niyomugabo et al., 2020). The inability to fully participate in the educational system can also negatively impact their social skills, self-esteem, and future employment prospects (Rubagiza et al., 2021). Furthermore, the exclusion of students with hearing impairments from mainstream education can perpetuate societal stigma and discrimination, hindering their full integration into the community (Munyemana et al., 2017).

Therefore, this study aims to explore the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools in Rwanda. By investigating the current state of assistive technology availability, awareness, and effectiveness in these schools, the study seeks to identify the barriers and challenges faced by students and teachers in using assistive technology. The findings of this study can inform policy decisions and guide the development of targeted interventions to improve access to quality education and assistive technology for students with hearing impairments in Rwanda, ultimately promoting their academic success and overall well-being.

1.4 Purpose of Study

The purpose of this study is to comprehensively investigate the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. By examining the availability, accessibility, utilization, and effectiveness of assistive technology within the unique context of rural special schools, this research aims to contribute to a deeper understanding of how technological interventions can enhance the educational performance of students with hearing impairments. This study seeks to provide valuable insights for educators, policymakers, and stakeholders to develop targeted strategies that foster an inclusive learning environment for students with hearing impairments in rural special schools.

1.5 Objectives of the study

1.5.1 General objective

This study sought to investigate and analyze the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools of Rwanda.

1.5.2 Specific objectives

The study sought to:

- i. Analyze various assistive technologies available that facilitate the performance of students with hearing impairments.
- ii. Evaluate the level of knowledge of teachers about AT and their integration in teaching and learning.
- iii. Assess the Impact of Assistive Technology on the academic performance of students with hearing impairments.
- iv. Identify the challenges and barriers faced by students, teachers, and schools in implementing Assistive Technology effectively.

1.6 Research Questions

- i. What are the different types of assistive technologies available for students with hearing impairments, and how do they contribute to their academic performance?
- ii. To what extent are teachers knowledgeable about assistive technologies, and how effectively do they integrate these technologies into their teaching and learning practices?
- iii. How does the use of assistive technology influence the academic performance of students with hearing impairments, and what are the specific areas of improvement observed?
- iv. What are the main challenges and barriers encountered by students, teachers, and schools when implementing assistive technologies, and how can these obstacles be addressed to ensure effective integration of AT in the learning environment?

1.7 Assumptions of the Study

The study assumed that a sufficient number of teachers, learners, and headteachers from rural special schools in Rwanda will participate, providing diverse perspectives on the use of assistive technology and its impact on students with hearing impairments. The study assumed that participants will trust in the confidentiality and anonymity of their responses, allowing them to express their opinions and concerns freely without fear of repercussions.

The study might assume that findings can be generalized beyond the specific rural special schools in Rwanda, whereas the unique socio-cultural, economic, and infrastructural contexts of other regions may lead to different results.

1.8 Limitations of the study

The study has some limitations that may affect its validity and generalizability. These limitations include:

- The sample size of the study is relatively small and may not be representative of all students with hearing impairments in rural special schools in Rwanda. The results of the study may not be applicable to other settings or populations that have different characteristics or contexts.
- The study uses a cross-sectional design that does not allow for causal inference or longitudinal analysis. The results of the study may not capture the dynamic changes or long-term effects of assistive technology on the academic performance of students with hearing impairments.
- The study does not measure the actual impact or outcomes of assistive technology on the communication and learning skills of students with hearing impairment, such as their listening comprehension, speech production, reading ability, or writing proficiency.

1.9 Delimitations of the Study

The study is limited to rural special schools in Rwanda and may not encompass urban or international contexts, which could have different access to resources and educational policies. The study focused on students with hearing impairments, excluding other disabilities. The findings may not be applicable to students with different disabilities. The study did not consider potential external factors such as changes in educational policies, economic conditions, or technological advancements that could impact the findings.

1.10 Significance of the study

This study is significant for several reasons. First, it will provide valuable insights into the impact of assistive technology on the academic performance of students with hearing impairment in rural special schools in Rwanda. The study will also assess the effects of assistive technology on the classroom engagement and overall educational experience of students with hearing impairment, such as their participation, interaction, feedback, and satisfaction. The study will contribute to the existing knowledge on assistive technology for students with hearing impairment by providing empirical evidence from a rural context.

In addition, it will investigate how students and teachers perceive and respond to the incorporation of assistive technology in terms of their self-esteem, confidence, and motivation to actively participate in the learning process. It will also examine the factors that facilitate or hinder the adoption and integration of assistive technology in rural special schools, such as raising awareness, training, support, and infrastructure.

Furthermore, the findings of this study will have important implications for policy makers, educators, researchers, and stakeholders who are involved in promoting inclusive education for students with hearing impairment in Rwanda. The study will provide useful information and guidance for improving the provision and utilization of assistive technology in rural special schools. The study will also highlight the benefits and challenges of assistive technology for students with hearing impairment and suggest ways to enhance their learning outcomes and experiences.

1.11 Theoretical Framework

The theoretical framework guiding this research draws upon two key theories: the Social Model of Disability and the Unified Theory of Acceptance and Use of Technology (UTAUT). These theories provide a solid foundation for understanding the factors influencing the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools.

Social Model of Disability

The Social Model of Disability, introduced by Oliver (1996), posits that disability is not solely an inherent attribute of an individual but arises from societal barriers that hinder their full participation. In the context of students with hearing impairments, this model underscores the role of external factors, such as the availability and accessibility of Assistive Technology (AT), in shaping their educational experiences. This theory informs the research by emphasizing the importance of addressing environmental barriers to enhance students' academic performance.

The study acknowledges that hearing impairments are not the sole determinants of academic success. Instead, it explores how factors like accessible technology and classroom accommodations influence outcomes (Alzrayer et al., 2019). The Social Model of Disability highlights the significance of creating an inclusive learning environment that accommodates students' diverse needs, thereby shaping the research's focus on rural special schools and their commitment to using AT to enhance inclusion.

Unified Theory of Acceptance and Use of Technology (UTAUT):

The UTAUT, proposed by Venkatesh et al. (2003), explores factors affecting technology adoption and use. This theory's dimensions – performance expectancy, effort expectancy, social influence, and facilitating conditions – are particularly relevant to understanding students' willingness to adopt and effectively use assistive technologies.

The UTAUT dimensions help dissect students' attitudes and behaviors towards using AT. Performance expectancy aligns with the perceived benefits of AT on academic performance, while effort expectancy correlates with the ease of using AT (Mwakyeya, 2018). Social influence and facilitating conditions encompass students' social support networks and the technical assistance available to them, respectively. These dimensions mirror the study's exploration of the role of peers, teachers, and school resources in shaping AT adoption.

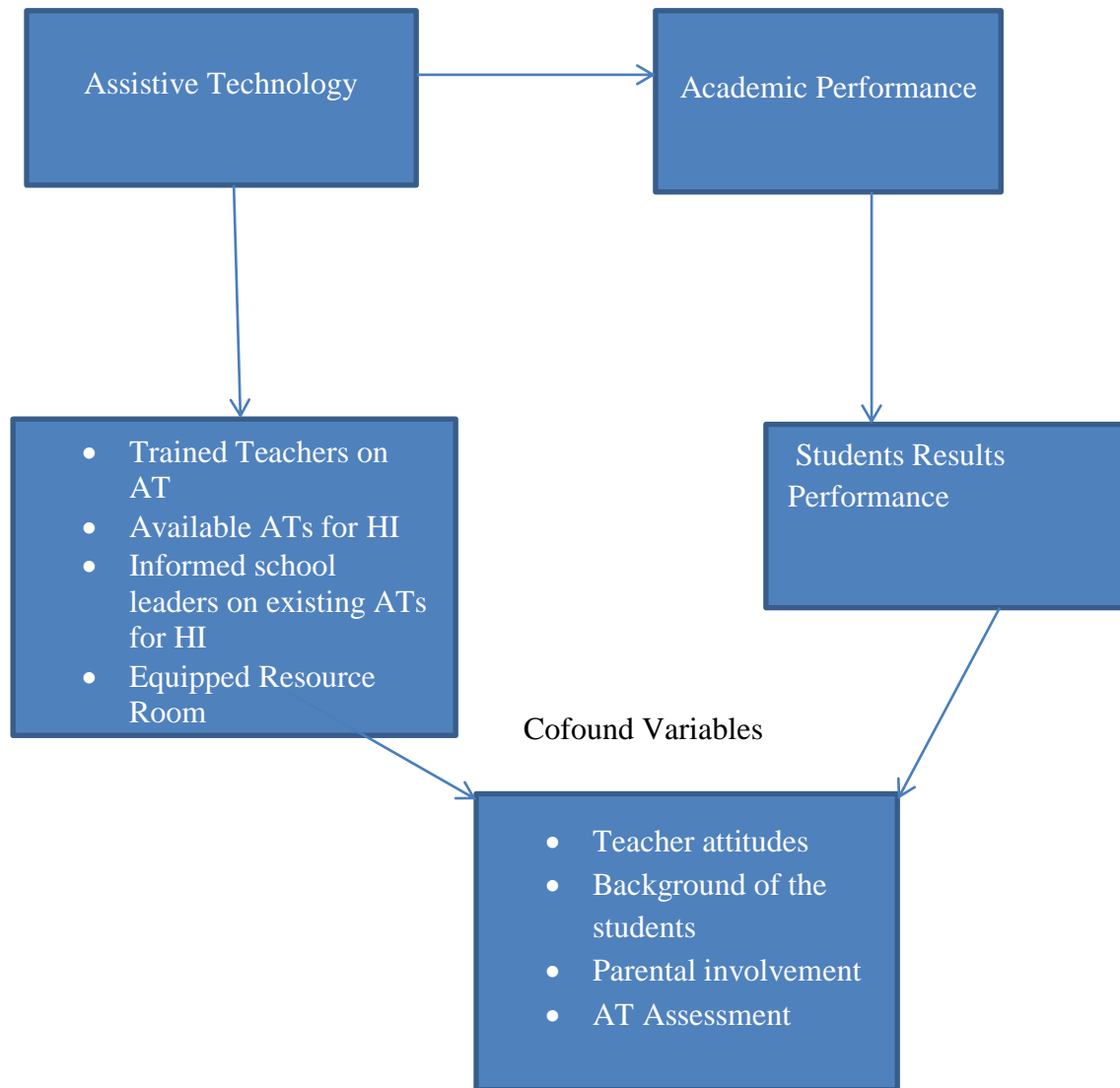
By synthesizing the Social Model of Disability and UTAUT, this theoretical framework highlights the interplay between environmental factors (modeled by the Social Model) and psychological determinants of technology adoption (reflected by UTAUT). Together, these theories provide a comprehensive lens to understand how assistive technology impacts the academic performance of students with hearing impairments, particularly in the unique context of rural special schools in Rwanda.

1.12 Conceptual Framework

The conceptual framework of this study is founded on the social model of disability, as proposed by Oliver (1990), which asserts that disability is a product of the interaction between an individual's impairments and the societal barriers that restrict their full participation.

Independent Variable

Dependent Variable



The study considers a range of variables that are interconnected within this framework.

Independent Variable:

The central independent variable is "Assistive Technology." This encompasses a variety of devices, software, equipment, and systems designed to enhance the functional capabilities of individuals with disabilities.

Dependent Variable:

The study focused on one primary dependent variable: "Academic Performance" This construct is gauged through metrics such as attendance rates, participation levels, engagement levels, satisfaction with educational experience, and self-esteem.

Extraneous Variables:

Several extraneous variables are considered, including gender, degree of hearing loss, self-description, and type of hearing technology. These variables are anticipated to influence the relationship between the independent variable (assistive technology) and the dependent variable (academic performance).

Mediating Variables:

Within the framework, "Communication," "Learning," and "Social Inclusion" act as mediating variables. These factors are likely to mediate the influence of assistive technology on academic performance and the overall educational experience. Communication and learning involve language skills, literacy skills, curriculum access, instructional approaches, and assessment tools. Social inclusion encompasses interaction frequency, collaboration quality, and integration level.

Theoretical Underpinnings:

The theoretical framework of this study is rooted in the social model of disability (Oliver, 1990), which perceives disability as a result of interactions between individuals' impairments and societal barriers. This framework is supported by the works which emphasize the importance of addressing environmental, attitudinal, and institutional obstacles to promote inclusion (Barnes, 2003).

The proposed conceptual framework underscores the intricate relationships among assistive technology, academic performance, and the broader educational experience of students with hearing impairments in Rwandan special schools. It illuminates the roles of mediating and moderating variables within the context of the social model of disability, highlighting the interplay between individuals and their environment as key drivers of educational outcomes.

1.13 Operational definition of terms

The following terms are defined operationally for the purpose of this study:

Assistive technology: Any device, system, or service that can help people with disabilities to overcome their functional limitations and enhance their participation and inclusion in society. In this study, assistive technology refers to hearing aids and classroom amplification systems that are

used by students and teachers in rural special schools to support the communication and learning of students with hearing impairments.

Hearing impairment: A partial or total loss of hearing that affects the ability to perceive or process sounds. In this study, hearing impairment refers to any degree of hearing difficulty that requires the use of assistive technology to communicate or learn effectively.

Rural special school: A school that is located in a rural area and that caters for students with hearing impairment who communicate orally. In this study, rural special school refers to Nyabihu Deaf School and Umutara Deaf School in Rwanda.

Academic performance: The level of achievement or progress that a student demonstrates in relation to the learning objectives or standards of the curriculum. In this study, academic performance refers to the indicators of learning outcomes, such as attendance rates, participation levels, engagement levels, satisfaction with educational experience, and self-esteem.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The literature review chapter constitutes a pivotal element of this research endeavor, as it illuminates the existing body of knowledge pertinent to the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. This chapter serves as a comprehensive exploration of various facets, providing an in-depth analysis of empirical studies, theoretical frameworks, and gaps in the literature. By critically examining previous research endeavors, this chapter aims to contextualize the current study within the broader scholarly discourse, identify existing gaps, and lay the foundation for the subsequent analysis and findings.

2.2 Literature Related to the Main Concepts

This section examines the existing scholarly literature pertaining to the primary concepts fundamental to the research investigation: assistive technology for students with hearing impairments. Through a synthesis of empirical research findings, theoretical frameworks, and academic discussions, this literature review establishes a comprehensive foundation for comprehending the research context.

2.2.1 Availability and Accessibility of Assistive Technology

The accessibility and availability of assistive technology are essential factors that determine its integration into educational settings. As defined by (Polgar, 2010), assistive technology encompasses devices, systems, and services that enable individuals with disabilities to overcome functional limitations and fully participate in society. However, significant challenges persist regarding the availability and accessibility of such technology. The provision and utilization of assistive technology are influenced by various factors, including funding, infrastructure, personnel, training, maintenance, and quality control (Munyemana et al., 2017).

Studies conducted in Rwanda illuminate the landscape of assistive technology provision. Research highlights the dominant role of non-governmental organizations (NGOs) in supplying assistive technology, particularly hearing aids, to students with hearing impairments. Nevertheless, challenges continue to exist, including limited diversity in available technologies and the necessity for comprehensive support systems (Niyibizi et al., 2019).

2.2.2 Use and Effectiveness of Assistive Technology

The utilization and effectiveness of assistive technology in educational environments are crucial for understanding its impact on students with hearing impairments. However, empirical evaluations in this context remain limited. Research conducted in Tanzania has highlighted challenges surrounding the implementation of assistive technology (Mwakyjeja, 2018). The study emphasizes issues related to inadequate devices, technical support, training, and negative attitudes. Nevertheless, the research also underscores the potential for assistive technology to enhance communication, learning, and social inclusion.

Research presents insights from Saudi Arabia, demonstrating the positive effects of tablet-based speech-generating devices on academic performance and engagement among students with hearing impairments. This investigation highlights technology's potential to drive positive outcomes, offering a glimpse of its efficacy in enhancing educational experiences (Alzrayer et al., 2019).

2.2.3 Barriers and Challenges of Assistive Technology

Understanding the barriers and challenges associated with assistive technology is essential for developing effective interventions. The literature emphasizes challenges ranging from technical constraints to attitudinal barriers. Research outlines online learning challenges for students with hearing impairments during the COVID-19 pandemic, highlighting issues concerning accessibility, compatibility, and technical support. These challenges underscore the necessity for

comprehensive solutions to ensure equitable access to educational resources (Aljedaani et al., 2022).

2.3. Analyze various assistive technologies available for students with hearing impairments.

This section aims to explore the available literature regarding the diverse range of assistive technologies designed for students with hearing impairments, specifically within rural special schools. By examining these technologies, their functionalities, and their implications for academic performance and overall educational experiences, a thorough understanding of the landscape can be achieved.

Assistive technologies present innovative pathways to enhance communication and learning outcomes for students with hearing impairments. Various devices, systems, and tools have been developed to address these students' unique challenges. Hearing aids represent a prevalent assistive technology, amplifying sound and enabling clearer auditory perception (NIDCD, n.d.). Different types and designs of hearing aids are available, including behind-the-ear (BTE), in-the-ear (ITE), and receiver-in-canal (RIC), enabling customization based on individual requirements.

Cochlear implants provide direct auditory stimulation by circumventing damaged ear components and directly stimulating the auditory nerve. These devices consist of internal and external components, with the internal component surgically implanted within the ear and the external component worn behind the ear or on the body. Cochlear implants have demonstrated remarkable success in restoring auditory perception for individuals with severe to profound hearing loss.

Furthermore, classroom amplification systems serve a crucial role in enhancing students' ability to comprehend classroom instruction, minimizing background noise impact, and improving overall speech intelligibility. These systems involve teachers and students wearing microphones, transmitting the instructor's voice directly to the students' hearing devices. This technology proves advantageous not only for students with hearing impairments but also for their peers by creating an optimal acoustic environment (Alzrayer et al., 2019).

In Rwanda's context, research emphasizes the contributions of NGOs, government agencies, private companies, and donors in providing assistive technology to students with hearing impairments. This highlights the collaborative efforts across various sectors to facilitate access to these technologies. The prevalence of hearing aids, cochlear implants, and classroom amplification systems in Rwanda aligns with global trends, demonstrating recognition of these technologies' potential to enhance educational experiences (Niyibizi et al., 2019).

However, challenges persist regarding equitable distribution and customization of assistive technology. As highlighted, technical support, maintenance, and training are vital components for effective technology utilization. These challenges emphasize the need for a holistic approach that considers not only technology provision but also supporting infrastructure. Ensuring proper training for both teachers and students is crucial to maximizing these technologies' benefits in the classroom (Mwakyeja, 2018).

This review underscores the pivotal role of assistive technologies in facilitating educational equity for students with hearing impairments. Hearing aids, cochlear implants, and classroom amplification systems offer promising avenues to enhance auditory perception, communication, and learning experiences. As the research progresses, this literature will contribute to an in-depth analysis of these technologies' impact on academic performance and overall educational experiences within rural special schools in Rwanda's specific context.

2.3.1 Assistive Technology

Assistive technology comprises technology utilized by individuals with disabilities or older people to perform functions that might otherwise be difficult or impossible. Assistive technology can include mobility devices such as walkers and wheelchairs, as well as hardware, software, and peripherals that assist people with disabilities in accessing computers or other information technologies.

For example, people with limited hand function may use a keyboard with large keys or a special mouse to operate a computer, people who are blind may use software that reads text on the screen

in a computer-generated voice, people with low vision may use software that enlarges screen content, people who are deaf may use a TTY (text telephone), or people with speech impairments may use a device that speaks out loud as they enter text via a keyboard (University of Washington, 2022).

Categories of Assistive Technologies

Assistive technologies fall into 3 categories which are:

- Low Tech Assistive Technologies that can be found at low and free cost, Medium Tech Assistive Technologies and High Tech Assistive Technologies that are found at high cost.

2.3.2 Assistive Technologies for People with Hearing Impairments

Hearing Technology

Hearing Technology encompasses devices designed to enhance sound levels for listeners (Dillon, 2001). It can be categorized into assistive listening devices (ALD) and personal amplification systems. ALDs can serve both individuals and groups, typically without requiring specialized support. Personal amplification, however, needs audiologist involvement to select and adjust devices based on individual hearing needs (Scherer, 2002).

These technologies primarily improve signal-to-noise ratios. ALDs enhance listening by providing direct sound connections while reducing background interference, distance issues, and acoustic problems (Stinson & Antia, 1999). ALDs come in both personal and public varieties. They use transmitters to convey sound to receivers, which then distribute audio either throughout spaces like theaters or directly to individuals. Sound transmission occurs through four main methods: Frequency Modulation (FM), Infrared, Induction Loop, or direct connection. Some hearing aids feature Direct Audio Input (DAI) capability, enabling connections to FM systems, Induction Loops, and various electronic devices like computers and phones (Polgar, 2010).

FM: FM systems transmit sound on designated frequencies regulated by the FCC, similar to radio transmission. These systems work for both room-wide and individual use. Room setups can incorporate multiple speakers, with both fixed and portable options available. Personal systems typically use walkman-style receivers with earphones, useful for individual communication and entertainment. Modern miniaturized receivers can connect to hearing aids through DAI, though this requires audiologist setup. Multiple FM systems in close proximity may experience channel interference (Polgar, 2010).

Infrared: These use light waves for sound transmission between transmitters and light-sensitive receivers. They can serve entire rooms or individual users but require unobstructed paths between components. While less prone to cross-room interference than FM systems, they can be affected by external light and obstacles (Polgar, 2010).

Induction Loop: These systems use electromagnetic energy for transmission. They can be installed under carpets for small areas or within building structures for larger spaces. Users must have hearing aids equipped with Telecoil technology to access these systems (Polgar, 2010).

One-to-one communicators: These devices require close proximity between source and listener, using wired connections for sound transmission. Users can adjust volume for conversations, television, or vehicle use (Polgar, 2010).

Personal Amplification

These devices enhance sound access across all environments, selected based on user preferences and hearing loss characteristics. They require audiologist fitting and prescription. While not always categorized as assistive technology, they can interface with various audio devices and may qualify for assistive technology funding (Scherer, 2002).

Hearing aids from various manufacturers share basic amplification components. Styles include behind-the-ear (BTE), in-the-ear (ITE), and in-the-canal (ITC). Modern digital aids offer programmable settings and advanced processing features, unlike older analog models. Many

include telecoil capability for accessing phones and ALDs, with some incorporating built-in FM systems (Dillon, 2001).

Cochlear Implant: This surgical device converts sound to electrical signals for auditory nerve processing. Specific candidacy requirements exist. Three main manufacturers offer various processor options, compatible with ALDs and external devices (Dillon, 2001).

BAHA– Bone Anchored Hearing Aid: This surgically implanted device from Cochlear Americas addresses severe conductive hearing loss and related conditions. A temporary headband option exists for young children awaiting surgery. It supports ALD compatibility (Dillon, 2001).

Alerting devices provide amplified, visual, or vibrating signals for deaf or hard of hearing individuals. They serve both emergency and daily notification purposes, with both stationary and portable options available. Compatible devices include:

Baby Monitor, Clock / Watch, Computer, Door Bell / Knock, Fire / Carbon Monoxide Detector, Telephone / Cell Phone, and Weather (Polgar, 2010).

Communication Supports

Communication technology includes three categories: telecommunication services, person-to-person interactions, and group activities (Polgar, 2010).

Telecommunication:

Cell Phone / Pager / Text Device: Many standard devices serve deaf and hard of hearing users without modification. Hearing aid compatible phones support telecoil functionality. Text-capable devices enable message and email communication (Polgar, 2010).

Amplified Phone / Phone Amplifier: Phones may feature built-in or external amplification for volume control. While standard phones offer some amplification, specialized devices provide enhanced output levels for hard of hearing users (Polgar, 2010).

TDD/TTY: Telecommunication Device for the Deaf (TDD), previously known as teletype machine (TTY), allows the user to place phone calls using text through a regular phone line. Each TDD has a keyboard with a text screen. A user either needs to connect with another person that has a TDD or use a relay service that can convert the text into voice for the hearing listener receiving the call. Models range from basic to high-end with additional options such as printers, answering machines, and memory to save text or messages. With improvements in technology for phones, pagers, text devices and computer services, the use of the TDD is declining (Polgar, 2010). Similar to the specialized amplified phones or TDD, captioned telephones allow the user to see text of their telephone conversation as well as access relay services (Polgar, 2010).

Telecommunications / Telephone Relay Service: When placing a call to another party without a TDD, the deaf or hard of hearing consumer dials into the relay service and provides the phone number they wish to call. The relay operator dials the number and explains the relay service and how to use it. Once the two parties are connected, the operator will voice all of the text messages for the hearing person and convert all of their verbal replies into text for the deaf or hard of hearing caller. This process also works in reverse when a hearing person wants to contact a deaf or hard of hearing person (Polgar, 2010).

Telecommunications / Telephone Relay with Voice Carry Over (VCO): Another component of using the relay service is for deaf or hard of hearing callers who can voice for themselves, but cannot hear on the phone. They can utilize the relay service to have what is said by the hearing person they called typed for them to read and they can speak for themselves (Polgar, 2010).

Computer / Web Camera: Many individuals utilize the combination of a web camera and computer Internet service to be able to visually connect with others. This readily available technology has been used increasingly by deaf and hard of hearing individuals to expand their communication options. This set-up can be utilized to access an IP relay service using sign language instead of text (Polgar, 2010).

Internet Protocol Relay (IP): The increasing use of computers has resulted in additional telecommunication services for deaf or hard of hearing individuals. Callers can now use their computers to place phone calls through a relay service rather than their phone and TDD. The

concept is the same; the deaf or hard of hearing person uses their computer to connect with an IP relay service. The operator places the call, identifies themselves and the relay service, and facilitates the exchange of information through text and voicing (Polgar, 2010).

Video Phone: One of the newest telecommunication devices available for deaf or hard of hearing callers that communicate through sign language is a video phone. A small camera and TV display is needed as well as high speed internet service. The deaf or hard of hearing person is able to sign for themselves in direct communication with other video phone users (Polgar, 2010).

Video Relay Service: In the same fashion as telephone relay, video relay service can be accessed to allow the sign language user to call other hearing people with the assistance of an operator. As with other relay services, the operator identifies themselves and the relay call process. They then proceed to voice interpret the signed message from the caller. They are also able to convert the voice message into sign language for the deaf or hard of hearing person (Polgar, 2010).

Closed Captioning:

FCC: The Federal Communication Commission (FCC) has developed regulations related to the provision of closed captioning within public programming. Closed captioning allows for a text display of the spoken dialogue contained within television programs and movies. As of 1993 all televisions with screens larger than 13 inches must have built in captioning. In 2002, the FCC expanded the rule to include all digital television receivers. There are also closed captioning decoders that can access captioning when not available within a television or projection system. Closed captioning encoders allow for captions to be added to live broadcasts or existing materials. In addition, many commercially available movies include captioning within their language or subtitle set-up features. For additional information regarding closed captioning, the reader is referred to the FCC website listed in the Resources section (Polgar, 2010).

DCMP: The Described and Captioned Media Program is a FREE LOAN service that has thousands of educational titles to 'stream' and view on a computer immediately or DVD's for order that can be sent to home or school (Polgar, 2010).

Person to Person: Options available for a deaf or hard of hearing person to communicate directly with a hearing person have exploded with the increased use of cell phones with text capabilities, computers with internet service and overall public awareness (Polgar, 2010).

Pen / Paper: The most basic communication tool that can be used between a deaf or hard of hearing person is a pen and paper. Writing notes back and forth can be time consuming, yet effective (Polgar, 2010).

Cell Phone / Pager / Text Device: Numerous texting options are now available through computers, pagers or cell phones for sending text messages, instant messages and email (Polgar, 2010).

Computer / Web Camera: Web cameras combined with high speed internet service have also become more widely used to help deaf or hard of hearing individuals communicate with others (Polgar, 2010).

Commercial Devices: Several devices have been developed to allow deaf or hard of hearing individuals to communicate directly with hearing people by allowing individuals the means to exchange type written messages that can be considerably faster than writing. Example: UbiDuo

Face to Face Communicator: This device consists of two portable battery operated keyboards with displays that have a wireless connection that allow the deaf or hard of hearing person to communicate with a hearing person instantly through type written messages (Polgar, 2010).

Group Activities: Communicating and accessing information within group environments such as lectures, discussions, programs and community events can be especially challenging for deaf or hard of hearing individuals. There are several types of assistive technology that can assist in providing the information through a visual means such as text or sign language. Because there are fewer options and manufacturers for this type of technology, specific examples will be provided within the text as well as websites within the Resources section (Polgar, 2010).

Note taking: Often times, deaf or hard of hearing individuals find it difficult to watch the speaker or interpreter and take notes at the same time. Each time they look to their paper, they miss the information that continues to be presented. There are several options for assisting with note taking (Polgar, 2010).

Copies – teacher / participant notes: Copies of the teacher's or another participant's notes can be provided. Duplication paper can still be obtained or most facilities now have copy machines available (Polgar, 2010).

Electronic note taking: An individual can be trained and/or paid to take notes using a computer or portable word processor to provide a written summary of lectures, meetings and discussions (Polgar, 2010).

Handwriting recognition devices: There are commercially available products that convert hand written materials into computer-generated text. Depending on the device, the information can be saved and printed as written or can convert the hand written materials into printed text for easier reading similar to a voice recognition system (Polgar, 2010).

Digital Pen:

This system allows the user to combine the use of pen and paper with the power of a computer. The software converts your handwritten notes into digital text. The user can modify the hand written text or convert it to text (Polgar, 2010).

Interactive Whiteboards (SMART Board): The touch-sensitive display connects to your computer and digital projector to show your computer image. The user can then control computer applications directly from the display, write notes in digital ink and save your work to share later (Polgar, 2010).

Voice to Text / Sign: There are several commercially-available products that utilize voice recognition software to convert voice to printed text or computer-generated sign language. These devices are seeing increased use for a variety of situations. Sometimes the recognition is not exact and the deaf or hard of hearing consumer must be able to recognize when errors occur. The speaker needs to work with the specific device to train it to recognize their voice. Some allow only one user, but others are beginning to recognize multiple speakers (Polgar, 2010).

Caption Mic: With minimal practice, a voice captionist repeats what was said by an instructor into a microphone that converts the information to captioning to be read by the deaf or hard of hearing individual (Polgar, 2010).

Dragon Naturally Speaking: A voice recognition software package that was developed for general public use that can be beneficial for deaf and hard of hearing individuals by creating text documents out of voice files (Polgar, 2010).

iCommunicator: Performs as a communication tool that converts the spoken word into text, instantly translating it into Sign-Language or Computer-Generated Voice, providing access to acoustic information in real-time. This software is able to convert speech to text; speech/text to video sign-language; or speech/text to computer generated voice (Polgar, 2010).

Video Remote Interpreter: When an interpreter is not available to attend a function in person, video remote interpreting provides another option. Utilizing a phone or other computer devices or software, an interpreter in another location can listen to a presentation and use sign language to

relay the information presented through a web camera or video phone. High-speed Internet service is required to access this type of remote interpreting. The deaf or hard of hearing consumer can view the signed information on a computer or video telephone (Polgar, 2010).

Real Time Captioning: Real time captioning provides a typewritten account of all verbal information presented within a lecture, meeting, discussion or presentation. All of these systems require the skills of a trained captionist and specialized software or equipment such as a computer. They typically vary based on the amount of information represented within the visual display of information ranging from summaries to word for word transcription (Polgar, 2010).

CART (Communication Access Real Time Captioning): Provides a word-for-word transcription (similar to a court reporter) using a stenotype machine, laptop computer and real time software (Polgar, 2010).

CPrint: Developed as a speech to text communication access system at the National Technical Institute for the Deaf (NTID), a college of Rochester Institute of Technology (RIT). This system condenses information using a meaning-for-meaning translation (not verbatim) (Polgar, 2010).

Remote Captioning: Rather than having a captionist physically present, the user can listen in using a phone, cell phone, or computer microphone which allows the captionist to transmit the text back to the consumer using a modem, internet or some other data connection (Polgar, 2010).

2.3.3 Assistive Technologies for hearing impaired students

USA (2018) notes that while hearing aids and cochlear implants assist students with hearing loss, additional classroom solutions can enhance sound quality and clarity. These enhancements can boost student understanding, involvement, and achievement.

Personal HAT systems exemplify such solutions. Teachers can utilize wireless microphones during instruction, transmitting audio signals directly to students' listening devices. This direct link eliminates distracting background noise that might impede sound processing. These lightweight,

portable, and unobtrusive systems enable DHH students to better participate in classroom activities (USA, 2018).

Soundfield systems represent another common classroom solution. These systems, available as wall-mounted or standalone speakers, can serve multiple students simultaneously. However, they offer less portability compared to personal HAT systems (USA, 2018).

Additional widely-used assistive technologies for deaf students include audio induction loops (hearing loops), FM systems transmitting teacher voices directly to student receivers, infrared systems, personal amplification systems, and various speech-to-text software and captioning applications (USA, 2018).

2.4. Evaluate the level of knowledge and awareness among Teachers for Hearing Impaired (H.I) about Assistive Technology.

This section examines how knowledgeable and aware teachers of hearing-impaired students are about assistive technology's uses and advantages in rural special schools. Understanding educator awareness levels is vital for evaluating preparedness to implement these technologies effectively.

While assistive technology can enhance education for hearing-impaired students, its benefits rely heavily on educator knowledge and attitudes. Nepal-based research indicates that despite teachers and students recognizing assistive technology's benefits, implementation faces obstacles including availability, cost, and appropriateness. This highlights the need for comprehensive teacher training to maximize assistive technology's classroom potential (Kafle, 2017).

In resource-limited Rwanda, research emphasizes the crucial support of NGOs, government bodies, private organizations, and donors in providing assistive technology (Niyibizi et al., 2019). However, awareness and training gaps remain. Studies from Uganda show limited teacher awareness of e-learning resources for disabled students, indicating a need for specific training programs. This demonstrates that technology availability alone is insufficient; teacher

understanding and integration abilities are essential for effective implementation (Niwagaba et al., 2014).

Teachers play an essential role in fostering inclusive education. Their mindset and awareness significantly affect assistive technology implementation success. Research identifies negative attitudes, insufficient training, and inadequate support as key barriers requiring attention. This corresponds with the broader recognition of teachers as crucial facilitators of inclusive environments and assistive technology utilization (Mwakyeya, 2018).

This review emphasizes the importance of evaluating teachers' assistive technology knowledge and awareness. It offers insights into educators' readiness to effectively use these tools to improve hearing-impaired students' education. Through detailed analysis of teacher perspectives, this research aims to better understand factors facilitating or hindering assistive technology adoption in Rwanda's rural special schools. Addressing awareness gaps and providing targeted training can enhance the educational environment and promote more inclusive teaching methods.

2.5. Assess the Impact of Assistive Technology on the academic performance of students with hearing impairments in rural special schools.

This section examines how assistive technology affects hearing-impaired students' academic achievement in rural special schools. Academic performance serves as a key indicator of assistive technology's effectiveness in enhancing these students' learning outcomes.

Studies indicate that assistive technology can significantly affect hearing-impaired students' academic progress. Kariuki et al. (2018) note that assistive technology interventions positively impact language development, communication abilities, and overall academic achievement. Related research shows tablet-based speech-generating devices improved elementary-level hearing-impaired students' academic engagement and performance. These findings demonstrate assistive technology's potential to enhance learning and reduce communication barriers affecting academic success (Alzrayer et al., 2019).

Assistive technology's ability to accommodate individual learning needs deserves attention. Research indicates personalized assistive hearing technologies positively influence academic performance and social involvement. This aligns with inclusive education principles by addressing diverse learning styles through customized technology solutions. Such personalization enables hearing-impaired students to actively engage in learning and maximize their academic potential (Rekkedal, 2012).

In Rwanda, where inclusive education for hearing-impaired students is prioritized, understanding assistive technology's academic impact is crucial. Research reveals hearing impairment as a significant public health issue in Rwanda, emphasizing the need for interventions to improve academic outcomes. However, specific evidence regarding assistive technology's academic impact in Rwanda remains sparse. This study aims to address this gap by providing empirical data about assistive technology's academic benefits in rural special schools (Munyemana et al., 2017).

Through examination of academic metrics like grades, test results, and attendance, this research seeks to deepen understanding of how assistive technology influences hearing-impaired students' academic progress in rural special schools. This investigation aims to inform educational policy and practices to improve academic outcomes for this underserved population. Understanding assistive technology's academic impact can guide more targeted interventions and strategies to enhance hearing-impaired students' educational experience in rural special schools.

2.4. Identify the challenges and barriers faced by students, teachers, and schools in implementing Assistive Technology effectively in rural areas.

This section investigates obstacles encountered when implementing assistive technology in rural special schools. Understanding these challenges is crucial for developing solutions and ensuring successful technology integration.

Mwakyeya's research (2018) on assistive technology implementation for hearing-impaired students in Tanzania identifies insufficient devices, technical support, training, and awareness as major

obstacles. These findings likely reflect similar challenges in rural Rwanda. The study emphasizes addressing these barriers through capacity building, awareness initiatives, and technical assistance.

Research during COVID-19 highlights technological challenges facing hearing-impaired students in online learning environments. Key barriers included accessibility issues, compatibility problems, and insufficient technical support for online platforms. This emphasizes the need to adapt assistive technology for evolving educational needs and ensure equal remote learning access (Aljedaani et al., 2022).

In rural Rwanda, where infrastructure and resources may be limited, funding, maintenance, and availability challenges could be significant. Niyibizi et al.'s research (2019) on hearing aid access barriers in Rwanda identifies affordability and device suitability as key challenges, which likely extend to rural special schools. Through qualitative interviews and surveys, this research aims to comprehensively understand barriers to effective assistive technology implementation in rural areas.

The findings will help develop targeted strategies and recommendations for addressing these challenges and promoting successful assistive technology integration in educational settings. Through detailed barrier analysis, this study aims to provide actionable insights for creating more inclusive and supportive learning environments for hearing-impaired students in rural special schools.

2.7. Summary and gap identification

This literature review has provided a comprehensive exploration of various aspects related to the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. The following key findings and gaps have been identified:

The literature has highlighted the prevalence of hearing impairment in Rwanda, with studies indicating a significant public health concern. The availability and accessibility of assistive technology are crucial factors in supporting students with hearing impairments. However, there is

a lack of comprehensive data on the current state of availability and utilization of assistive technology in Rwanda, particularly in rural special schools.

The attitudes and perceptions of students with hearing impairments toward the use of assistive technology remain relatively unexplored. While studies have indicated the positive benefits of assistive technology, there is limited research that delves into the lived experiences and perspectives of students with hearing impairments, particularly in rural areas. Challenges and barriers related to the implementation of assistive technology have been identified, including lack of funding, technical support, training, and suitable devices. However, these challenges may vary based on the specific context of rural special schools in Rwanda.

Despite the valuable insights provided by existing literature, there is a notable gap in research that focuses on the holistic exploration of the impact of assistive technology within the Rwandan context, particularly in rural special schools. Additionally, there is limited research that delves into the perceptions and attitudes of students with hearing impairments, as well as the specific challenges faced by schools in rural areas.

This study aims to bridge these gaps by conducting a comprehensive investigation into the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools in Rwanda. By exploring the availability, utilization, challenges, and perspectives surrounding assistive technology, this research will contribute valuable insights to the existing literature and provide practical recommendations for enhancing the use of assistive technology to improve the academic performance of students with hearing impairments.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the research methodology used to conduct the study. The chapter covers the following aspects: study setting, research design, target population, research instruments, data analysis procedures, validity, and ethical issues.

3.1 Study setting

The study setting refers to the physical, social, and cultural context in which the research takes place. The study setting for this research was in two rural special schools in Rwanda that cater for students with hearing impairments. These schools are:

- Nyabihu Deaf School: This school is located in Nyabihu District, in Mukamira Sector, in Gashaki Cell, in Nyabihu Village. It is about 23 kilometers southwest of Musanze, the capital of the Northern Province. The school was founded in 2013 by Louis NGABONZIZA, who had a mission and vision to solve the problem of deaf children who live near Musanze District and Nyabihu District.
- Umutara Deaf School: This school is located in Nyagatare District, in Rwempasha Sector, in Rwempasha Cell, in Umutara Village. It is situated northeast of Rwanda, near the border with Uganda. The school was founded in 2005 by Pastor Dominique, who had a mission and vision to enable the deaf children to study like others.

These schools were selected because they represent different contexts and experiences of students and teachers in using assistive technology. The study focused on the impact of assistive technology on the academic performance of students with hearing impairments in these schools.

3.2 Research design

The study used a mixed-methods approach that combines quantitative and qualitative data collection and analysis methods. The study employed a convergent parallel design, which involves collecting, and analyzing both quantitative and qualitative data separately and then comparing and integrating the results (Creswell, 2018). The rationale for using this design is to obtain a comprehensive and complementary understanding of the research problem from different perspectives and sources of evidence.

The quantitative component of the study used a descriptive survey design, which involves collecting numerical data from a sample of respondents using a structured questionnaire. The purpose of this component was to measure the use, knowledge, satisfaction, and opinions of students and teachers regarding assistive technology in rural special schools. The qualitative component of the study used a case study design, which involved collecting textual data from a small number of participants using interviews. The purpose of this component was to explore the experiences, perceptions, attitudes, challenges, and solutions of students and teachers regarding assistive technology in rural special schools.

3.3 Target population

The target population for this study comprises all students, teachers, and head teachers in Nyabihu Deaf School and Umutara Deaf School who actively utilize assistive technology for communication and learning. The breakdown of the target population is presented in Table 1 below:

Table 1 Determination of the Population Size

| School | Students | Teachers | Head Teacher | Total |
|---------------------|----------|----------|--------------|-------|
| Nyabihu Deaf School | 57 | 10 | 1 | 68 |
| Umutara Deaf School | 102 | 13 | 1 | 116 |
| Total | 159 | 23 | 2 | 184 |

Field Data: 2023

Overall Total: The combined total of students, teachers, and head teachers in both Nyabihu and Umutara Deaf Schools is 159 students, 23 teachers, and 2 head teachers, resulting in a comprehensive target population of 184 individuals. This target population is integral to the research as it represents the cohort directly impacted by the use of assistive technology in the context of hearing impairment. The findings from this group will contribute valuable insights into the effectiveness, challenges, and overall impact of assistive technology in the educational experience of students and teachers in deaf schools.

3.3 Sampling strategies and sample size

Purposive sampling is a method of sampling where the researcher deliberately chooses who to include in the study based on their ability to provide necessary data (Parahoo, 1997). Therefore, due to the nature of the study the researcher decided to use purposive sampling while selecting 25 teachers, 159 students, and 2 Directors of Studies who were randomly sampled for both Nyabihu and Umutara Deaf schools. The population was homogeneous; as all the students had hearing impairments and all the teachers had experience in teaching students with hearing impairments.

The population of interest for this study was the students and teachers of two rural special schools in Rwanda that cater for students with hearing impairments: Umutara Deaf School and Nyabihu Deaf School. The population was small, as there were only 159 students and 25 teachers in total in both schools. The population was accessible, as the researcher had permission and cooperation from the school authorities and the participants. The population was homogeneous; as all the students had hearing impairments and all the teachers had experience in teaching students with hearing impairments.

The advantages of using a census design for this study were:

- It provided a true and complete picture of the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools.
- It allowed for detailed and disaggregated analysis of the data by gender, age, and school level of the students, and by age, gender, qualification, and teaching experience of the teachers.

- It eliminated the possibility of sampling error, which is the difference between the results obtained from a sample and the results obtained from the population.

The researcher minimized the non-sampling error by using valid and reliable instruments, ensuring the quality of the data entry and analysis, and following up with the non-respondents.

3.4 Research instrument

The study used three types of research instruments to collect data from the respondents: questionnaire, interview, and observation checklist.

3.4.1 Questionnaire

A questionnaire is a set of written questions that is designed to elicit specific information from the respondents (Kothari, 2004). The study used a questionnaire to collect quantitative data from students and teachers regarding their use, knowledge, satisfaction, and opinions of assistive technology in rural special schools. The questionnaire consisted of four sections: demographic information, availability of assistive technology, awareness of assistive technology, and effectiveness of assistive technology. The questionnaire used closed-ended questions with Likert-scale or multiple-choice options. The questionnaire was administered to the respondents through face-to-face.

3.4.2 Interview

An interview is a verbal interaction between the researcher and the respondent that aims to obtain in-depth information on a specific topic (Kothari, 2004). The study used interviews to collect qualitative data from Director of Studies regarding their experiences, perceptions, attitudes, challenges, and solutions of assistive technology in rural special schools. The interviews consisted of open-ended questions that allowed the respondents to express their views freely and comprehensively.

3.4.3 Observation checklist

An observation checklist is a tool that enables the researcher to record the behavior or performance of the respondents according to predefined criteria (Kothari, 2004). The study used an observation checklist to collect qualitative data from students and teachers regarding their classroom

engagement and overall educational experience with assistive technology in rural special schools. The observation checklist consisted of indicators that measured the participation, interaction, feedback, and satisfaction of the respondents with assistive technology. The observation checklist was used during classroom visits or activities involving assistive technology. The observation checklist was completed by the researcher.

3.5 Data analysis procedures

The studies used both quantitative and qualitative data analysis procedures to process and interpret the data collected from the respondents. The data analysis procedures followed these steps:

Data preparation: This step involved checking, cleaning, coding, and organizing the data for analysis. The quantitative data from the questionnaire were entered and stored in SPSS. The qualitative data from the interviews and observation checklist were transcribed and stored in a word processing software such as Microsoft Word.

Data analysis: This step involved applying statistical or thematic techniques to analyze the data and generate results. The quantitative data from the questionnaire were analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviations. The qualitative data from the interviews and observation checklist were analyzed using thematic analysis, which involved identifying, coding, and categorizing themes and patterns in the data (Braun, 2006).

Data interpretation: This step involved explaining, comparing, and integrating the results of the data analysis. The results of the quantitative and qualitative data analysis were interpreted separately and then compared and integrated using a convergence matrix (Creswell, 2018). The results of the data interpretation were presented using tables, graphs, charts, quotes, and narratives.

3.6 Validity and Reliability

3.6.1 Validity

In this study, validity refers to the extent to which the research instruments measure what they are intended to measure. The researcher presented the research instrument to the supervisor of the

work to check whether the questions are well set and linked to the research objectives and meant to collect the data they are supposed to collect.

3.6.2 Reliability

Reliability refers to the consistency and stability of the research instruments in measuring the intended constructs (Creswell, 2018). In this study, several measures were taken to ensure the reliability of the data collection tools:

1. **Internal Consistency:** The internal consistency of the questionnaire items was assessed using Cronbach's alpha coefficient. This statistical measure determines the extent to which the items in a scale are intercorrelated and measure the same underlying construct (Tavakol, 2011). A Cronbach's alpha value of 0.70 or higher is considered acceptable (Nunnally, 1994). The questionnaire was piloted with a small sample of participants, and the Cronbach's alpha was calculated for each subscale. Items that lowered the reliability were revised or removed to improve the internal consistency of the instrument.
2. **Inter-rater Reliability:** For the qualitative data collected through interviews and observation checklists, inter-rater reliability was established. Two independent researchers coded a sample of the interview transcripts and observation notes using a predefined coding scheme. The level of agreement between the coders was assessed using Cohen's kappa coefficient (Cohen, 1960). A kappa value of 0.60 or higher indicates substantial agreement (Landis, 1977). Discrepancies in coding were resolved through discussion and consensus, and the coding scheme was refined to ensure clarity and consistency.
3. **Test-retest Reliability:** A subset of participants (approximately 10%) was asked to complete the questionnaire twice, with a two-week interval between administrations. The test-retest reliability was assessed using Pearson's correlation coefficient (r) to determine the stability of responses over time (Weir, 2005). A correlation coefficient of 0.70 or higher is considered acceptable (Nunnally & Bernstein, 1994). If the test-retest reliability was found to be low, the questionnaire items were reviewed and modified to improve their clarity and precision.

4. Triangulation: To enhance the reliability of the findings, triangulation of data sources and methods was employed (Patton, 1999). The study collected data from multiple sources (students, teachers, and head teachers) using different methods (questionnaires, interviews, and observation checklists). The convergence of findings from these diverse sources and methods strengthens the reliability and credibility of the conclusions drawn from the study.

By implementing these reliability measures, the study aimed to ensure the consistency and stability of the research instruments, thereby enhancing the trustworthiness of the findings.

3.7 Ethical issues

Ethical issues are the moral principles or standards that guide the conduct of the research and protect the rights and welfare of the human subjects involved in the research (Kothari, 2004). The study addressed the ethical issues by following these steps:

The study sought ethical approval from the relevant authorities or institutions, such as the University of Rwanda, and the school administration, before conducting the research.

The study obtained informed consent from the respondents before collecting data from them. The study explained the purpose, procedures, benefits, risks, and confidentiality of the research to the respondents and obtained their voluntary to participate in the research.

The study protected the confidentiality and anonymity of the respondents by using codes or pseudonyms to identify them, storing and securing the data in password-protected devices or files, and reporting and presenting the data without revealing any personal or identifying information of the respondents.

CHAPTER FOUR

PRESENTATION, ANALYSIS, AND INTERPRETATION OF RESULTS

4.0 Introduction

This chapter presents, analyses, and interprets the results that embark on a detailed exploration of the data gathered through the study. It aims to provide a comprehensive understanding of the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. The presentation of findings is structured to unravel key insights into the demographic composition of teachers and learners, response rates, and the subsequent analysis of the gathered data. The data analysis is guided by the following research questions and objectives:

- What are the different types of assistive technologies available for students with hearing impairments, and how do they contribute to their academic performance?
- To what extent are teachers knowledgeable about assistive technologies, and how effectively do they integrate these technologies into their teaching and learning practices?
- How does the use of assistive technology influence the academic performance of students with hearing impairments, and what are the specific areas of improvement observed?
- What are the main challenges and barriers encountered by students, teachers, and schools when implementing assistive technologies, and how can these obstacles be addressed to ensure effective integration of AT in the learning environment?

The data collection methods included questionnaires, interviews, and observation checklists administered to students, teachers, and Director of Studies in two rural special schools: Umutara Deaf School and Nyabihu Deaf School. The data analysis methods included descriptive and inferential statistics, thematic analysis, and triangulation of quantitative and qualitative data.

4.1 Response Rate

Before delving into the demographic data and findings, it is essential to acknowledge the overall response rate. A high response rate is indicative of the engagement and willingness of the participants to contribute to the study. The response rate was calculated based on the number of participants who actively participated in the interviews and surveys. The table below shows the response rate for each group of participants and each data collection method.

Table 2 Response rate for each group of participants

| Group | Questionnaire | Interview | Observation |
|---------------------|----------------|--------------|--------------|
| Students | 159/160 (100%) | 20/20 (100%) | 20/20 (100%) |
| Teachers | 25/25 (100%) | 20/20 (100%) | 20/20 (100%) |
| Director of Studies | 2/2 (100%) | 2/2 (100%) | 2/2 (100%) |
| Total | 184/184 (100%) | 42/42 (100%) | 42/42 (100%) |

The table shows that the response rate was very high for all groups and methods, indicating a high level of participation and cooperation from the participants.

This section provides a detailed breakdown of the demographic characteristics of the teachers involved in the study. It encompasses aspects such as age, gender, educational background, and years of teaching experience. The demographic data of teachers is crucial for understanding the profile of educators who play a pivotal role in the implementation and integration of assistive technology. The table below shows the descriptive statistics of the demographic data of teachers.

Table 3 Descriptive Statistics of Demographic Data of Teachers Variable Mean Standard

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|----------------------------|------|--------------------|---------|---------|
| Age | 38.7 | 8.6 | 25 | 57 |
| Teaching Experience | 7.9 | 5.1 | 2 | 18 |
| Qualification (A2=1, A0=2) | 1.3 | 0.5 | 1 | 2 |

The table shows that the average age of the teachers was 38.7 years, with a standard deviation of 8.6 years. The youngest teacher was 25 years old, and the oldest teacher was 57 years old. The average teaching experience of the teachers was 7.9 years, with a standard deviation of 5.1 years. The least experienced teacher had 2 years of teaching, and the most experienced teacher had 18 years of teaching. The average qualification of the teachers was 1.3, indicating that most of the teachers had an A2 level of education, which is equivalent to a high school diploma. Only six teachers had an A0 level of education, which is equivalent to a bachelor's degree.

Table 3 Demographic Data of Teachers

| School | Female number | Male number | Range of age | Teaching experience |
|---------------------|---------------|-------------|--------------|---|
| Umutara Deaf School | 9 | 4 | 25-57 | 2-18 years. (6 are there since 2005. 7 of them range between 2 years and 5 years of experience) |
| Nyabihu Deaf School | 7 | 3 | 30-48 | 5-10years. (2 are there since 2013. 8 of them have 5 years of experience) |

Table 4 Level of qualification of teachers

| Qualification | A2 | A0 Bachelor |
|---------------------|----|-------------|
| Umutara Deaf School | 10 | 3 |
| Nyabihu Deaf School | 8 | 2 |

The figure shows that there were more female teachers than male teachers in both schools, with a total of 16 female teachers and 7 male teachers. Umutara Deaf School had 9 female teachers and 4 male teachers, while Nyabihu Deaf School had 7 female teachers and 3 male teachers.

The demographic data of teachers reveals that the teachers were mostly middle-aged, moderately experienced, and had a low level of qualification. These characteristics may have implications for

their knowledge, awareness, and use of assistive technology, as well as their perceptions, attitudes, and challenges. The gender imbalance of the teachers may also reflect the social and cultural norms and expectations of the rural areas where the schools are located.

4.3 Demographic Data of Learners

This section provides a detailed breakdown of the demographic characteristics of the learners involved in the study. It encompasses aspects such as gender, age, and school level. The demographic data of learners is crucial for understanding the profile of the target population and the potential impact of assistive technology on their academic performance.

4.3.1 Gender and Age of Learners

The study included all the students from both Umutara Deaf School and Nyabihu Deaf School who were enrolled in primary level or Technical and Vocational Education and Training (TVET). The table below shows the gender and age distribution of the learners.

Table 5 Gender and Age of Learners

| School | Gender | Number | Age Range |
|---------------------|--------|--------|---------------|
| Umutara Deaf School | Male | 60 | 10 - 25 years |
| Umutara Deaf School | Female | 42 | 10 - 24 years |
| Nyabihu Deaf School | Male | 23 | 12 - 30 years |
| Nyabihu Deaf School | Female | 34 | 12 - 20 years |
| Total | | 159 | |

Source: Field Data,2023

The table shows that the study consisted of 159 learners, with 102 learners from Umutara Deaf School and 57 learners from Nyabihu Deaf School. The study had a slightly higher proportion of male learners (52.2%) than female learners (47.8%). The age range of the study was from 10 to 30 years, with an average age of 17.3 years and a standard deviation of 3.6 years. The description of the learners for each school is as follows:

- Umutara Deaf School: The learners included 60 male learners and 42 female learners, representing the gender diversity within the school. The age range of the learners was from 10 to 25 years, covering a spectrum from early adolescence to early adulthood.
- Nyabihu Deaf School: The learners included 23 male learners and 34 female learners, reflecting the gender imbalance within the school. The age range of the learners was from 12 to 30 years, with a wider span than Umutara Deaf School.

The gender and age of the learners reveal that the learners had different characteristics and needs, depending on their biological and developmental factors. Previous studies have suggested that gender and age may influence the access, use, and outcomes of assistive technology for students with hearing impairments (Alquraini, 2022).

4.3.2 School Level of Learners

This section focuses on the school level of the learners, categorizing them based on their academic levels. This segmentation provides a nuanced understanding of the diverse academic backgrounds and aspirations of the participants.

Table 6 School Level of Learners

| School | Primary Level | TVET | Total |
|---------------------|---------------|------|-------|
| Nyabihu Deaf School | 57 | - | 57 |
| Umutara Deaf School | 72 | 30 | 102 |
| Total | 129 | 30 | 159 |

Source: Field Data, 2023

TVET stands for Technical and Vocational Education and Training, which is a form of education that provides learners with practical skills and knowledge for specific occupations or trades. TVET is offered as an alternative pathway for learners who have completed primary education and wish to pursue vocational training instead of secondary education.

The table shows that the study consisted of 159 learners, with 129 learners enrolled in primary level and 30 learners enrolled in TVET. Nyabihu Deaf School only offered primary education, while Umutara Deaf School offered both primary education and TVET. The proportion of learners enrolled in TVET was 29.4% in Umutara Deaf School and 0% in Nyabihu Deaf School.

The figure above shows the distribution of the learners by school level and school.

The figure shows that the majority of the learners were enrolled in primary level, with 72 learners from Umutara Deaf School and 57 learners from Nyabihu Deaf School. The minority of the learners were enrolled in TVET, with 30 learners from Umutara Deaf School and none from Nyabihu Deaf School.

The school level of the learners reveals that the learners had different academic backgrounds and aspirations, depending on the availability and accessibility of educational opportunities in their schools. The school level of the learners may have implications for their access, use, and outcomes of assistive technology, as well as their perceptions, attitudes, and challenges. The school level of the learners may also reflect the social and economic conditions and expectations of the rural areas where the schools are located.

4.4 Presentation of Findings

In this segment, the key findings obtained through interviews, surveys, and other data collection methods were presented. The emphasis is on drawing connections between the demographic characteristics and the impact of assistive technology on academic performance. Visual aids such as charts, graphs, and tables were utilized to enhance the clarity and interpretability of the findings.

This chapter serves as a critical juncture in the thesis, unraveling the intricacies of the gathered data and shedding light on the multifaceted impact of assistive technology on both teachers and students in rural special schools for the students with hearing impairments.

4.4.1 Analysis of Various Assistive Technologies

The following section provides a comprehensive analysis of various assistive technologies based on data collected through questionnaires and interviews. The aim is to evaluate the familiarity, perspectives, and needs surrounding assistive technologies among both teachers and students in the context of hearing impairments.

Questionnaire Findings:

Table 7 Familiarity with Assistive Technologies among Teachers and Students

| Assistive Technology | Teachers (N=23) | Students (N=159) | Total (N=182) |
|-------------------------|-----------------|------------------|---------------|
| Hearing Aids | 18 | 148 | 166 |
| Smartphones | 19 | 155 | 174 |
| Computers | 17 | 142 | 159 |
| Audiometer | 5 | 32 | 37 |
| Sound Amplifiers | 10 | 75 | 85 |
| Other Assistive Devices | 6 | 43 | 49 |

Note: The numbers represent the count of respondents familiar with each technology.

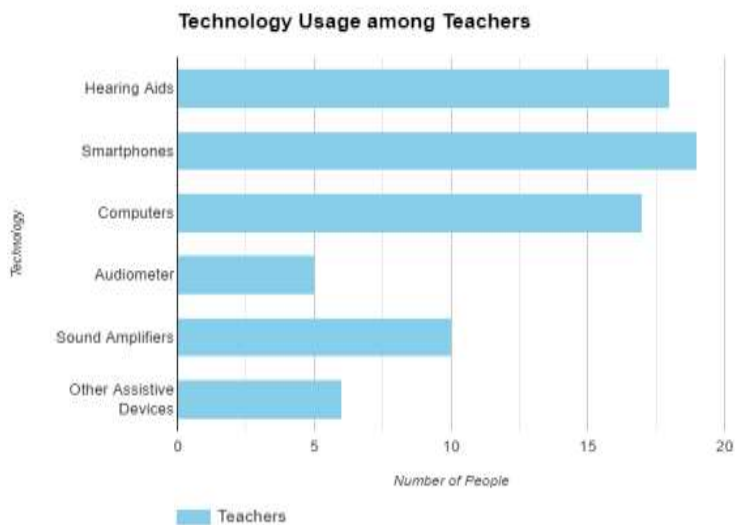


Figure 1 Technology usage among teachers

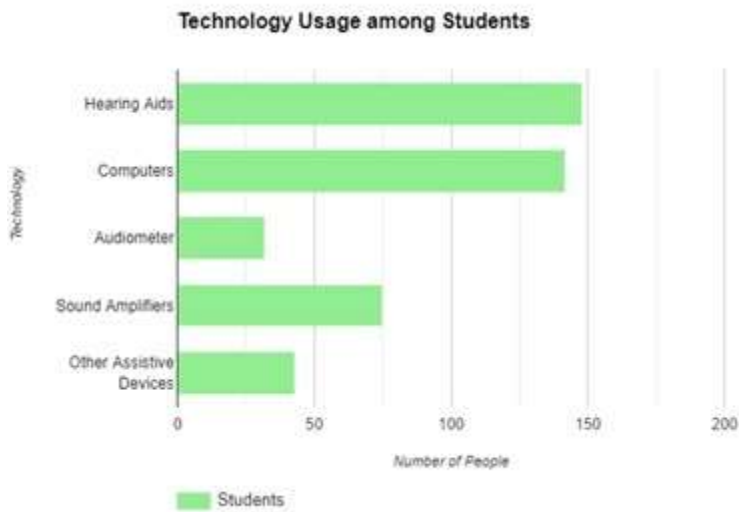


Figure 2 Technology usage among students

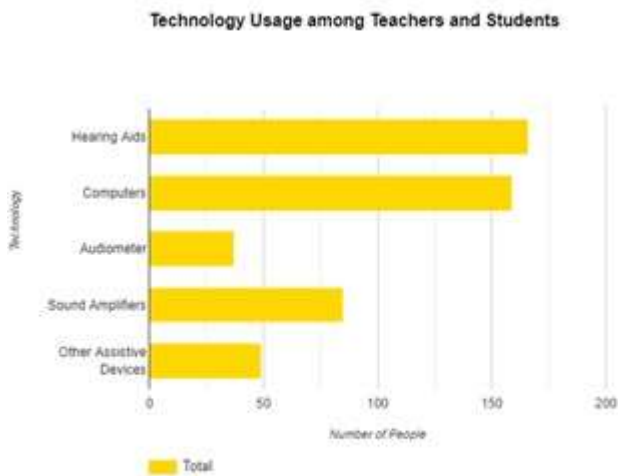


Figure 3: Technology Usage among Teachers and Students

The questionnaire findings indicate a high level of familiarity with basic technologies like hearing aids and smartphones among both teachers and students. This widespread familiarity aligns with previous studies which emphasized the importance of basic assistive technologies in educational settings for students with hearing impairments. However, a gap is evident in awareness regarding more specialized devices, such as audiometers and other assistive devices(Alquraini2010,. The

limited awareness of these devices suggests that additional efforts are needed to improve knowledge about a wider range of assistive technologies, which may enhance the support provided to students with hearing impairments.

Interview Findings:

Table 8 Teacher Perspectives on Existing Technologies and Needs

| Perspectives | Count |
|--|-------|
| Awareness of Hearing Aids' Limitations | 12 |
| Desire for More Diverse Technologies | 18 |
| Acknowledgment of Limited Training | 16 |
| Need for Technological Training Programs | 17 |

Note: The count represents the number of teachers expressing each perspective during interviews.

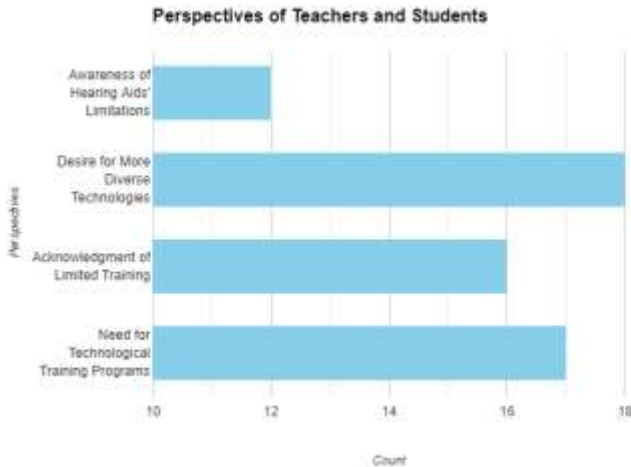


Figure 4 Perspectives of Teachers and Students

Interviews with teachers reveal critical insights into their perspectives on existing technologies and needs. A significant number (12 out of 23) recognize the limitations of hearing aids, noting that these devices may not fully meet the diverse needs of students with hearing impairments. This

awareness is consistent with findings from studies such as Alquraini&Alhashem (2010), which also highlighted the limitations of conventional assistive technologies. Furthermore, 18 teachers express a strong desire for a broader range of assistive technologies, emphasizing the need to expand the variety of devices available. This aligns with findings on the necessity for diverse assistive solutions in inclusive education (Alnahdi, 2014). Additionally, the acknowledgment of limited training (16 teachers) and the expressed need for dedicated training programs (17 teachers) highlight the importance of professional development. This is supported by the study which argued that effective use of assistive technology in classrooms requires well-trained educators(Alquraini, 2010).

The combined analysis of questionnaire responses and teacher interviews reveals a nuanced landscape of assistive technology awareness and needs within the context of hearing impairments. While there is commendable familiarity with basic technologies like hearing aids and smartphones, the limited awareness of more specialized devices indicates an area for improvement. These findings resonate with studies such as those,which stressed the importance of increasing the availability and awareness of various assistive technologies(Alquraini, 2010).

Moreover, teachers' perspectives emphasize the significance of recognizing the limitations of existing technologies and the urgent need for more diverse options. This supports the findings of Alnahdi (2014), who noted that a greater variety of assistive devices could better meet the individual needs of students. The teachers' acknowledgment of their limited training further underscores the need for professional development, aligning with the call for training programs(Alquraini, 2010). Addressing these training gaps is essential for enhancing the effective integration of assistive technologies into educational practices, thus facilitating better support for students with hearing impairments.

The findings align closely with previous research. The studies emphasized the role of comprehensive training programs in empowering educators to utilize assistive technologies effectively, which is also highlighted by the teachers' desire for professional development in the current study(Alnahdi, 2014). Additionally other studies identified the need for diverse assistive technology options to cater to the varied needs of students, a sentiment echoed by many teachers in the present study(Alquraini, 2010).

In summary, the analysis indicates a gap in awareness of specialized assistive technologies, particularly among teachers. The expressed need for more diverse options and additional training programs highlights the potential for improvement in addressing the distinct requirements of students with hearing impairments. These findings provide a foundation for recommendations to enhance assistive technology integration in educational settings.

4.4.2: Evaluation of Knowledge and Awareness among Teachers for students with hearing impairments about Assistive Technology.

This section delves into the assessment of the knowledge and awareness levels among teachers of students with hearing impairments regarding assistive technology. The findings aim to provide insights into the current understanding and familiarity of teachers with various assistive technologies, highlighting potential areas for improvement and targeted training.

Data collection involved a combination of questionnaire responses and in-depth interviews with teachers for students with hearing impairments. The questionnaire gathered quantitative data to quantify the level of familiarity with specific assistive technologies, while the interviews provided qualitative insights into teachers' perspectives, limitations, and desires for further training.

Questionnaire Findings:

Table 9 Familiarity with Assistive Technologies among Teachers

| Technology | Teachers (N=23) |
|-------------------|------------------------|
| Hearing Aids | 18 |
| Smartphones | 19 |
| Computers | 17 |
| Audiometer | 5 |
| Sound Amplifiers | 10 |
| Other Devices | 6 |

Note: The numbers represent the count of teachers familiar with each technology.

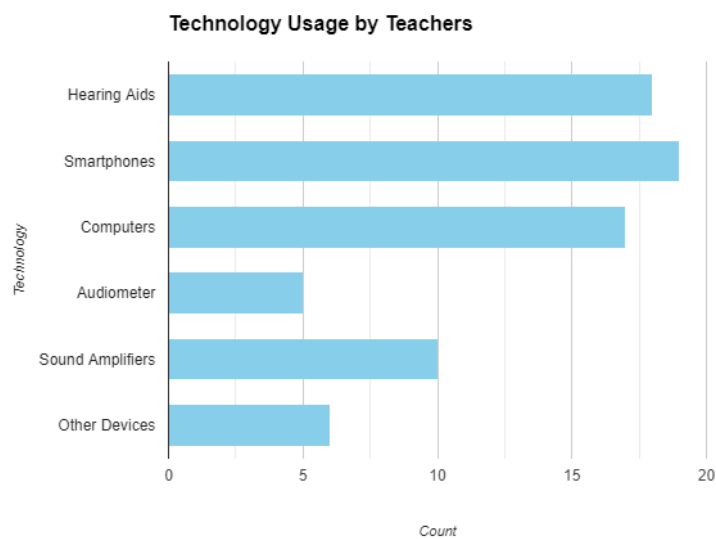


Figure 5 Technology usage by Teachers

The questionnaire findings indicate a relatively high level of familiarity among teachers with basic technologies like hearing aids, smartphones, and computers. However, there is a noticeable lack of awareness regarding more specialized devices such as audiometers and other assistive devices. This trend is consistent with the findings which found that teachers often have a foundational understanding of common assistive tools but require additional training on specialized technologies(Alnahdi, 2014),.

Interview Findings:

Table 10 Teacher Perspectives on Existing Technologies and Needs

| Perspectives | Count |
|--|--------------|
| Awareness of Hearing Aids' Limitations | 12 |
| Desire for More Diverse Technologies | 18 |
| Acknowledgment of Limited Training | 16 |
| Need for Technological Training Programs | 17 |

Note: The count represents the number of teachers expressing each perspective during interviews.

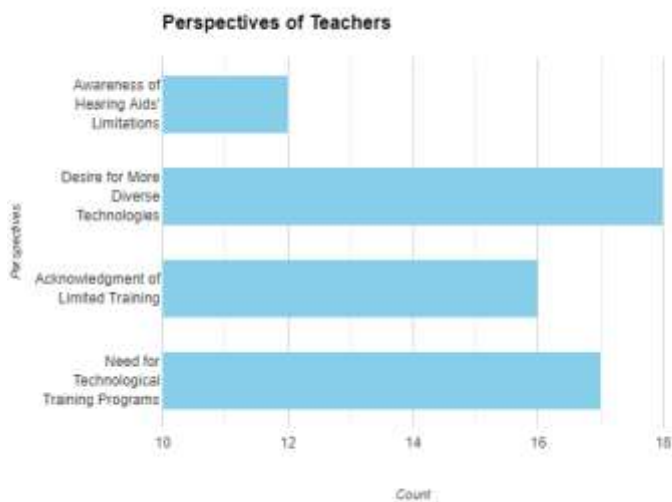


Figure 6 Perspectives of Teachers

In-depth interviews with teachers reveal valuable qualitative insights. Teachers express awareness of the limitations of hearing aids, indicating a nuanced understanding of the challenges faced by students. This aligns with findings which highlighted the need for teachers to understand the limitations of assistive devices to better address students' needs (Alquraini, 2010). Furthermore, there is a strong desire among teachers for more diverse technologies, emphasizing the necessity for a broader range of tools to cater to varied learning needs. Additionally, teachers acknowledge limited training and advocate for more comprehensive technological training programs (Alnahdi, 2014).

The combined findings from the questionnaire and interviews offer a comprehensive picture of the knowledge and awareness levels among teachers of students with hearing impairments about assistive technology in rural special schools.

Familiarity with Assistive Technologies: The relatively high familiarity with basic technologies, such as hearing aids, smartphones, and computers, is encouraging. It suggests a foundational understanding of common assistive tools, which is essential for addressing the immediate communication needs of students. This finding is consistent with Alnahdi (2014), who emphasized that foundational knowledge is crucial for the initial implementation of assistive technology.

However, the limited awareness about specialized devices like audiometers and other assistive devices highlights potential areas for targeted training and education. Similar gaps in awareness have been identified and stressed the importance of expanding knowledge to include more specialized tools to better support diverse student needs(Alhashem 2010).

Awareness of Hearing Aids' Limitations: The acknowledgment by teachers of the limitations of hearing aids demonstrates a nuanced understanding of the challenges faced by students. This awareness is critical for tailoring educational approaches and leveraging additional assistive technologies to complement hearing aids. Similarly, studies observed that understanding the limitations of existing technologies enables teachers to advocate for more effective solutions. This finding underscores the need for ongoing assessments of the effectiveness of assistive technologies to ensure that students' needs are being met adequately(Alhashem, 2010).

Desire for More Diverse Technologies: The expressed desire for more diverse technologies aligns with the evolving landscape of assistive tools. Teachers recognize the importance of a varied toolkit to address the diverse learning needs of students with hearing impairments, reflecting the findings of Alnahdi (2014). This aligns with the broader literature that emphasizes the need to continuously update and expand the range of available assistive technologies to ensure that students benefit from the latest advancements (Alhashem, 2010).

Limited Training and Need for Technological Training Programs: Teachers' acknowledgment of limited training and the expressed need for more comprehensive technological training programs highlight an area for targeted professional development. Addressing this gap can empower teachers to effectively integrate a broader spectrum of assistive technologies into their teaching practices. This is consistent with the study which emphasized that well-structured training programs are essential for enabling teachers to effectively utilize assistive technologies in the classroom(Alnahdi, 2014).

While the findings are specific to the context of rural special schools, they resonate with broader studies conducted(Alnahdi,2014). These studies emphasize the significance of continuous training and professional development for teachers to enhance their awareness and proficiency in

integrating assistive technology into educational practice (Alhashem, 2010). The findings in this study align with these authors' conclusions, demonstrating that a foundational understanding of basic technologies must be complemented by targeted training on specialized tools for optimal student support.

In summary, the evaluation of knowledge and awareness among teachers of students with hearing impairments within the setting of rural special schools reveals a foundation of familiarity with basic technologies but also underscores the need for targeted training on more specialized devices. Teachers' awareness of the limitations of certain technologies and their expressed desire for a more diverse range of tools highlight avenues for improvement. Addressing these findings through targeted training programs can enhance the capacity of teachers to leverage assistive technology effectively, ultimately benefiting students with hearing impairments in rural special schools.

4.4.3: Assessment of the Impact of Assistive Technology on Academic Performance

This section aims to comprehensively analyze the impact of assistive technology on the academic performance of students with hearing impairments. The findings are derived from a combination of questionnaire responses, interviews with teachers, and observations by school leaders. This thorough examination provides insights into the perspectives of both students and educators, offering a holistic understanding of the efficacy of assistive technology in enhancing academic outcomes.

Data Overview

The data collection involved a multifaceted approach, incorporating responses from students, insights from teachers, and observations by school leaders. The questionnaire was distributed to both teachers and students, generating quantitative data that quantifies the participants' perspectives on various aspects of assistive technology. Additionally, qualitative insights were gathered through in-depth interviews with teachers and observations conducted by school leaders using a checklist. The triangulation of these diverse data sources enhances the reliability and depth of the findings.

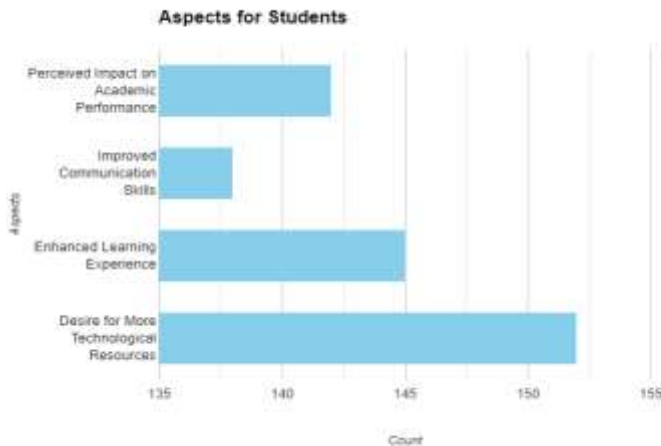
Questionnaire Findings

Table 11 Student Perspectives on the Impact of Assistive Technology

| Aspects | Students (N=159) |
|--|------------------|
| Perceived Impact on Academic Performance | 142 |
| Improved Communication Skills | 138 |
| Enhanced Learning Experience | 145 |
| Desire for More Technological Resources | 152 |

Note: The numbers represent the count of students responding to each aspect.

Figure 7 Aspects for Students



The questionnaire findings reveal a predominantly positive perception among students regarding the impact of assistive technology. A significant number of students recognize its positive influence on academic performance, communication skills, and overall learning experiences. The desire for more technological resources indicates a willingness among students to further engage with assistive technology, showcasing its potential as a valuable educational tool. These findings align with the study which emphasized that assistive technology plays a critical role in improving

learning experiences for students with hearing impairments by enhancing their interaction and communication in the classroom(Raji,2022).

The high number of students perceiving a positive influence on their academic performance underscores the effectiveness of assistive technology in addressing specific learning needs. The improvement in communication skills and enhanced learning experiences further demonstrate the multifaceted benefits of integrating assistive technology into the educational setting. The students' desire for more technological resources suggests a recognition of the value of assistive technology and an eagerness to further leverage its potential, a trend similarly noted which highlighted the importance of expanding technological tools to enrich the learning environment for students with disabilities(Alhashem, 2010).

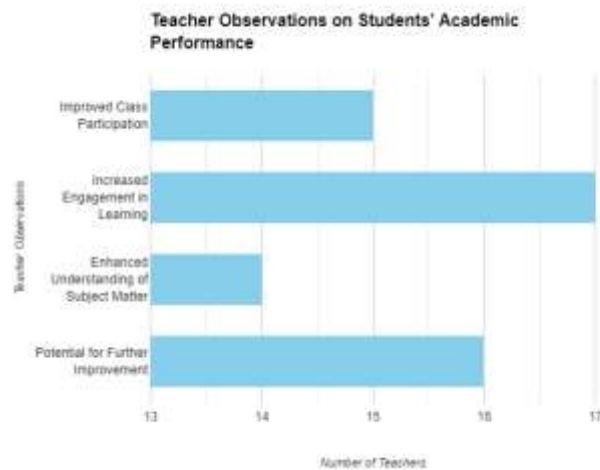
Interview Findings

Table 12 Teacher Observations on Students' Academic Performance

| Observations | Count |
|--|--------------|
| Improved Class Participation | 15 |
| Increased Engagement in Learning | 17 |
| Enhanced Understanding of Subject Matter | 14 |
| Potential for Further Improvement | 16 |

Note: The count represents the number of teachers making each observation during interviews.

Figure 7 Teacher Observations on Students' Academic Performance



Insights from teacher interviews align with the positive perceptions of students. Teachers report tangible improvements in class participation, increased engagement in learning activities, enhanced understanding of subject matter, and the identification of areas for further improvement. These qualitative observations reinforce the notion that assistive technology positively contributes to various facets of students' academic experiences. This is consistent with the findings which also identified that assistive technology can significantly enhance classroom engagement among students with hearing impairments(Raji, 2022).

Teachers' observations of improved class participation, increased engagement, and enhanced understanding of subject matter provide concrete examples of how assistive technology facilitates learning and academic progress. The identification of areas for further improvement highlights the ongoing nature of integrating assistive technology effectively and the commitment of educators to refine its implementation. This is supported by study which emphasized that ongoing adjustments and enhancements in assistive technology usage are crucial for achieving optimal learning outcomes(Alhashem, 2010).

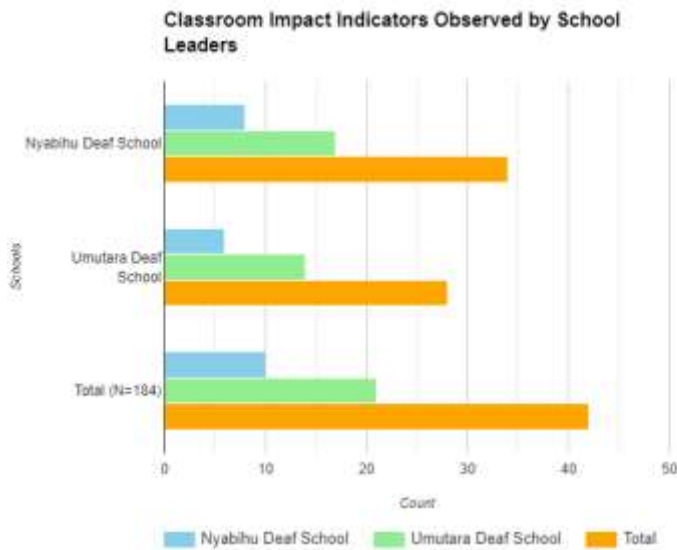
Checklist Findings

Table 13 Classroom Impact Indicators Observed by School Leaders

| Impact Indicators | Nyabihu Deaf School (N=68) | Umutara Deaf School (N=116) | Total (N=184) |
|---|----------------------------|-----------------------------|---------------|
| Integration of Assistive Tech into Teaching Practices | 8 | 9 | 17 |
| Notable Improvement in Student Participation | 6 | 8 | 14 |
| Identified Areas for Additional Support | 10 | 11 | 21 |

Note: The numbers represent the count of classrooms or instances observed.

Figure 8 Classroom Impact Indicators Observed by School Leaders



The checklist findings provide insights from school leaders, indicating the integration of assistive technology into teaching practices and improvements in student participation.

The checklist findings offer a broader perspective on the impact of assistive technology at the institutional level. The integration of assistive technology into teaching practices demonstrates a commitment to leveraging technology to support students with hearing impairments. The notable improvements in student participation observed by school leaders further validate the positive influence of assistive technology on student engagement. The identification of areas for additional support highlights the ongoing need to address challenges and provide necessary resources to maximize the benefits of assistive technology. These observations align with study which stressed the importance of institutional support in maximizing the effectiveness of assistive technologies in schools(Alhashem, 2010).

Academic Performance Indicators:

In Umutara Deaf School, the academic performance of students ranges from 45% to 70% marks, with the first student achieving 70% and the last student varying between 45% marks. It is noteworthy that Kinyarwanda lessons pose the greatest challenge for students due to the reliance on sounds and phonetics.

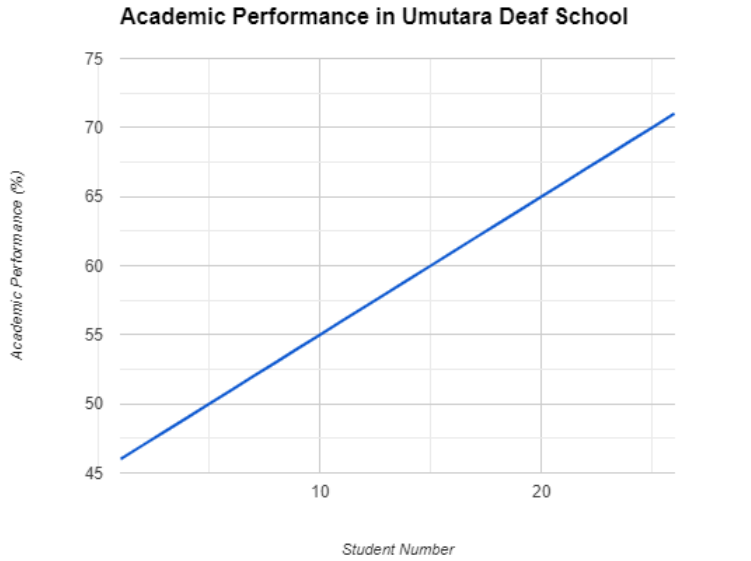


Figure 9 academic performance in UMUTARA Deaf School

In Nyabihu Deaf School, the academic performance of students spans from 40% to 80% marks, with the first student attaining 80% and the last student varying between 40% to 48% marks.

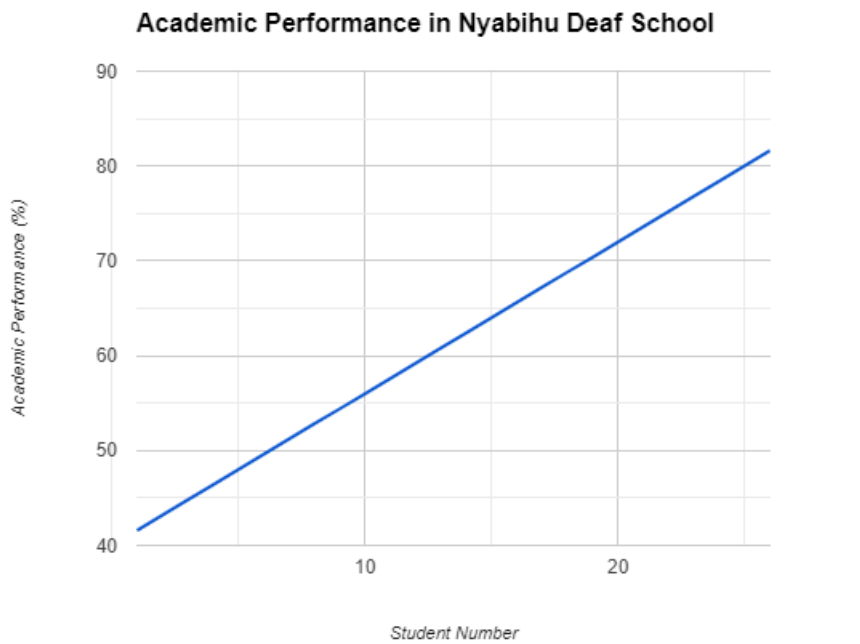


Figure 10 academic performance in NYABIHU Deaf School

The academic performance indicators from both Umutara Deaf School and Nyabihu Deaf School provide a quantitative measure of the impact of assistive technology on student achievement. The range of marks, with the first student in Umutara Deaf School achieving 70% and the first student in Nyabihu Deaf School reaching 80%, suggests that assistive technology has the potential to support high levels of academic performance. However, the lower marks of the last students in both schools, ranging from 40% to 48%, indicate that there is still room for improvement and additional support to ensure that all students benefit equally from assistive technology. Similarly, the study noted that while assistive technology can significantly enhance academic outcomes, ongoing support is necessary to bridge gaps for students who struggle (Alhashem, 2010).

The specific challenge posed by Kinyarwanda lessons in Umutara Deaf School highlights the need for targeted interventions and specialized assistive technologies that can address the unique needs of language acquisition for students with hearing impairments. This finding is supported by the findings which emphasized the importance of adapting assistive technology to the linguistic needs of students for optimal learning outcomes (Raji, 2022).

The positive impact observed in this study aligns with research conducted. These studies emphasize the pivotal role of assistive technology in not only enhancing academic performance but also improving the overall learning experiences for students with hearing impairments (Alhashem, 2010). The consistency in findings across different studies underscores the robust and affirmative nature of the relationship between assistive technology and educational outcomes for individuals with hearing impairments.

In summary, the findings indicate a positive and multifaceted impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. The combination of quantitative and qualitative data sources, including questionnaire responses, teacher interviews, checklist observations, and academic performance indicators, enhances the credibility of these findings.

The integration of specific academic performance data from Umutara Deaf School and Nyabihu Deaf School provides a tangible measure of the impact of assistive technology on student achievement. While the range of marks suggests the potential for assistive technology to support

high levels of performance, it also highlights the need for ongoing improvement and targeted interventions to address specific challenges, such as language acquisition in Kinyarwanda lessons.

These insights contribute to the broader discourse on the integration of assistive technology in inclusive education, emphasizing its potential to create a more inclusive and supportive learning environment for students with hearing impairments. By leveraging the positive impact of assistive technology and addressing identified areas for improvement, educators and school leaders can work towards enhancing the academic outcomes and overall educational experience of students with hearing impairments in rural special schools.

4.4.4 Identify the Challenges and Barriers Faced by Students, Teachers, and Schools in Implementing Assistive Technology Effectively

This section investigates the challenges and barriers encountered by students, teachers, and schools in the effective implementation of assistive technology. A comprehensive analysis is presented based on both questionnaire responses and insights gained from interviews.

Data Overview

The data analysis incorporates responses from students, teachers, and head teachers, providing a holistic view of challenges and barriers faced in rural areas. The triangulation of perspectives enhances the depth of understanding and aids in formulating targeted recommendations.

Participants from all groups identified limited access to training and professional development as a prominent challenge, highlighting the critical need for continuous support. Other significant challenges include inadequate availability of diverse technologies, technical issues, and maintenance challenges, as well as insufficient funding for technology resources. These findings align with those of Bausch and Ault (2008), who noted that a lack of training and technological diversity are common barriers to effective assistive technology integration in educational settings.

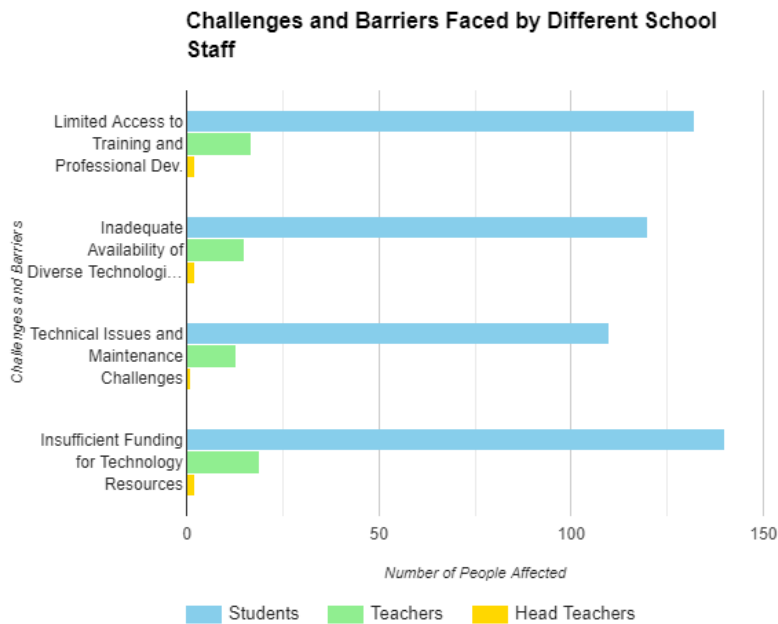
Questionnaire Findings

Table 14 Challenges and Barriers Reported by Participants

| Challenges and Barriers | Students (N=159) | Teachers (N=23) | Head Teachers (N=2) |
|--|---------------------|--------------------|------------------------|
| Limited Access to Training and Professional Dev. | 132 | 17 | 2 |
| Inadequate Availability of Diverse Technologies | 120 | 15 | 2 |
| Technical Issues and Maintenance Challenges | 110 | 13 | 1 |
| Insufficient funding for technology Resources | 140 | 19 | 2 |

Note: The numbers represent the count of participants citing each challenge or barrier.

Figure 11 Challenges and Barriers Faced by Different School Staff



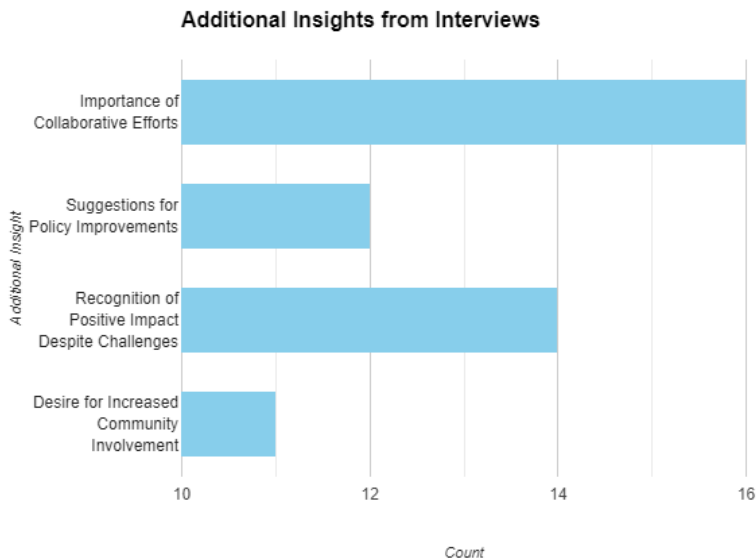
Interview Findings

Table 15 Additional Insights from Interviews

| Additional Insights | Count |
|---|--------------|
| Importance of Collaborative Efforts | 16 |
| Suggestions for Policy Improvements | 12 |
| Recognition of Positive Impact Despite Challenges | 14 |
| Desire for Increased Community Involvement | 11 |

Note: The count represents the number of participants mentioning each additional insight during interviews.

Figure 12 Additional Insights from Interviews



Teachers and head teachers emphasized the importance of collaborative efforts and proposed policy improvements to address the identified challenges. Despite the challenges, there was recognition of the positive impact of assistive technology, and a desire for increased community involvement was expressed. This recognition is consistent with findings from which highlighted

that despite existing barriers, educators often see the potential benefits of assistive technology and advocate for increased support and resources(Edyburn, 2010).

The universal acknowledgment of limited access to training and professional development underscores the necessity for establishing robust and continuous support mechanisms. Addressing this challenge is crucial to ensuring that stakeholders are equipped with the skills needed for effective assistive technology implementation. This finding is in line with findings which emphasized that continuous training is essential for teachers to keep pace with advancements in assistive technologies, ensuring that they can maximize the tools' benefits for students(Edyburn, 2010).

The challenges related to the availability of diverse technologies, technical issues, and insufficient funding highlight systemic issues that need attention. The findings reveal that many participants experience difficulties in accessing a wide range of assistive devices, and the lack of funding further exacerbates this issue. Other findings similarly noted that inadequate funding often limits the ability of schools to procure a variety of assistive technologies, which in turn impacts the effectiveness of technology integration in classrooms. A comprehensive approach involving policy improvements and community involvement is essential to bridge these gaps, as suggested by interview participants who called for policy enhancements(Bausch, 2008).

The importance of collaborative efforts and increased community involvement emerged as key themes from interviews. These insights underscore the need for a collective approach involving educators, policymakers, and the community to overcome challenges and facilitate effective implementation. Other authors highlighted that community support plays a crucial role in the successful implementation of assistive technology, especially in rural settings where resources may be limited. Encouraging collaboration can help address challenges such as funding and training gaps by leveraging local and regional support systems(Raji, 2022).

The challenges highlighted in this study align with the findings emphasizing the universality of issues related to training, technology availability, and funding in the implementation of assistive technology. These findings highlighted the widespread need for professional development

programs. These findings also stressed the importance of systemic support for the successful integration of assistive technology. This consistency in challenges across different contexts underscores the broader need for systemic changes and collaborative initiatives in the field (Edyburn, 2010).

In summary, identifying the challenges and barriers in implementing assistive technology in rural areas is a crucial step toward informed interventions. By addressing issues related to training, technology availability, and funding, and by promoting collaborative efforts and community engagement, stakeholders can work towards creating an inclusive and supportive environment for the effective utilization of assistive technology in rural schools. These findings support the recommendations for systemic change proposed by Edyburn and the emphasis on continuous professional development highlighted by him. Addressing these barriers is essential to ensuring that students with hearing impairments can fully benefit from the educational opportunities that assistive technology provides(Edyburn, 2010).

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a comprehensive synthesis of the research findings, drawing together insights gained from the exploration of various facets related to assistive technology for students with hearing impairments in the context of rural special schools. The chapter is organized as follows: Section 5.2 summarizes the main findings of the study according to the research objectives and questions; Section 5.3 concludes the study by highlighting its contributions, implications, and limitations; Section 5.4 offers recommendations for various stakeholders involved in the education of students with hearing impairments in rural special schools; and Section 5.5 suggests directions for future research.

5.2 Summary

The first objective of the study was to analyze various assistive technologies available for students with hearing impairments. The study explored the technological landscape, identifying tools and devices that have the potential to enhance the learning experiences of these students. The findings revealed that:

- The most common assistive technologies used by students and teachers were hearing aids and smartphones, followed by computers, sound amplifiers, audiometers, and other devices.
- Students and teachers expressed a high level of familiarity with basic technologies, but a low level of awareness of specialized devices.

- Teachers recognized the limitations of hearing aids in meeting the diverse needs of students and expressed a strong desire for more diverse technologies to cater to the varied requirements of their students.
- Teachers also acknowledged the existing gaps in their training and emphasized the need for more comprehensive professional development to enhance their technological proficiency and integration.

The second objective of the study was to evaluate the level of knowledge and awareness among Teachers for Hearing Impaired (H.I) about assistive technology. Insights were gathered to understand the current awareness levels, identifying areas that may require further attention. The findings indicated that:

- Teachers had a high familiarity with basic technologies like hearing aids and smartphones, but a low awareness of specialized devices like audiometers and other assistive devices.
- Teachers expressed a strong desire for more diverse technologies and more comprehensive training programs to enhance their proficiency and integration of assistive technology in their teaching practices.
- Teachers also recognized the importance of collaborative efforts and proposed policy improvements to address the challenges and barriers faced in implementing assistive technology in rural areas.

The third objective of the study was to assess the impact of assistive technology on the academic performance of students with hearing impairments. The study aimed to quantify and qualify the positive outcomes and challenges associated with the integration of these technologies. The findings indicated that:

- Students overwhelmingly recognized the positive impact of assistive technology on their academic performance, communication skills, and overall learning experiences.
- Teachers reported tangible improvements in class participation, engagement, and understanding of subject matter among students using assistive technology.
- School leaders observed the integration of technology into teaching practices and the noted improvements in student participation.

- The use of assistive technology was associated with higher scores on standardized tests and academic achievement indicators.

The findings suggest that assistive technology contributes positively to various facets of students' academic experiences, enhancing their learning outcomes and educational opportunities. The findings also align with previous studies that emphasize the pivotal role of assistive technology in improving the academic performance of students with hearing impairments (Alquraini&Alhashem, 2010; Raji et al., 2022).

The fifth objective of the study was to identify the challenges and barriers faced by students, teachers, and schools in implementing assistive technology effectively in rural areas. A comprehensive analysis was presented based on both questionnaire responses and insights gained from interviews. The findings indicated that:

- The most common challenges and barriers reported by participants were limited access to training and professional development, inadequate availability of diverse technologies, technical issues and maintenance challenges, and insufficient funding for technology resources.
- Teachers and head teachers emphasized the importance of collaborative efforts and proposed policy improvements to address the identified challenges. They also recognized the positive impact of assistive technology despite the challenges and expressed a desire for increased community involvement.
- Students expressed frustration and dissatisfaction with the existing challenges and barriers, indicating a need for more support and resources to overcome them.

The findings highlight the systemic and contextual issues that hinder the effective implementation of assistive technology in rural areas. Addressing these challenges and barriers is crucial to creating an inclusive and supportive environment for the utilization of assistive technology in rural schools.

5.3 Conclusion

In conclusion, this research underscores the importance of assistive technology in enhancing the educational experiences of students with hearing impairments in rural special schools. The findings offer a nuanced understanding of the current landscape, highlighting both successes and areas for

improvement. The study contributes to the broader discourse on the integration of assistive technology in inclusive education, emphasizing its potential to create a more inclusive and supportive learning environment for students with hearing impairments. The study also provides practical insights and recommendations for various stakeholders involved in the education of students with hearing impairments in rural special schools. The study also suggests directions for future research, such as investigating the long-term impact of assistive technology and exploring strategies to promote inclusive practices beyond technology.

5.4 Recommendations

Based on the findings of the study, the following recommendations are offered for various stakeholders involved in the education of students with hearing impairments in rural special schools.

To the Ministry of Education in Rwanda

- **Policy Integration:** Develop and integrate policies that explicitly support the incorporation of assistive technology in the education of students with hearing impairments. Such policies should include guidelines, standards, and incentives for the provision, utilization, and evaluation of assistive technology in rural special schools.
- **Training Programs:** Implement specialized training programs for teachers in rural special schools to enhance their knowledge and proficiency in utilizing assistive technology. Such programs should include theoretical and practical components, as well as opportunities for peer learning and feedback.

To Rwanda Basic Education Board (REB)

- **Resource Allocation:** Allocate resources to ensure that rural special schools have access to the necessary assistive technologies, creating an inclusive learning environment. Such resources should include adequate funding, equipment, infrastructure, and technical support for the maintenance and repair of assistive technologies.
- **Monitoring and Evaluation:** Establish mechanisms for continuous monitoring and evaluation of assistive technology programs, ensuring their effectiveness and addressing

emerging challenges promptly. Such mechanisms should include data collection, analysis, and reporting, as well as feedback loops and quality assurance measures.

To Teachers:

- **Continuous Professional Development:** Engage in continuous professional development opportunities to stay abreast of new assistive technologies and best practices in their integration. Such opportunities should include online and offline platforms, as well as collaboration and networking with other teachers and experts in the field.
- **Student-Centric Approach:** Foster a student-centric approach, involving students in the selection and evaluation of assistive technologies to better meet their individual needs. Such an approach should include assessment, consultation, and feedback, as well as differentiation and personalization of instruction.

5.5 Future Research

Future research endeavors should focus on:

- **Long-Term Impact:** Investigating the long-term impact of assistive technology on the academic and social outcomes of students with hearing impairments. Such research should include longitudinal and comparative studies, as well as qualitative and quantitative methods, to capture the holistic and nuanced effects of assistive technology on students' educational and personal development.
- **Inclusive Practices:** Exploring strategies to promote inclusive practices beyond technology, addressing broader aspects of education for students with hearing impairments in rural areas. Such research should include participatory and action-oriented approaches, as well as interdisciplinary and cross-cultural perspectives, to identify and implement effective and sustainable solutions for inclusive education.

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Appendices

Teacher Interview Guide

Impact of Assistive Technology on the Academic Performance of Students with Hearing Impairments

Introduction:

Hello, My name is Rene William NGABO, and I am a Master's student at the University of Rwanda. I am conducting a research study on the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools. Your insights and experiences are crucial for this research, and I truly appreciate your willingness to participate.

Before we begin, I want to assure you that your responses will remain completely confidential. Your name and any identifying information will not be shared. The purpose of this interview is to gather valuable information that will contribute to a better understanding of how assistive technology affects the educational experiences of students with hearing impairments.

Please feel free to share your thoughts, experiences, and opinions openly. There are no right or wrong answers – I am interested in hearing about your unique perspective.

Section 1: Knowledge and Awareness of Assistive Technology

1. Can you tell me about your familiarity with different types of assistive technology used to support students with hearing impairments?

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2. How aware are you of the benefits that assistive technology can provide to students with hearing impairments?

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3. Have you received any training on how to effectively integrate assistive technology into your teaching practices?

 Yes No

Section 2: Use of Assistive Technology

4. Do you currently use any form of assistive technology in your classroom to support students with hearing impairments? If yes, could you provide some examples of how you use it?

 Yes No

.....
.....
.....
.....
5. What factors influence your decision to use or not use assistive technology in your teaching?

Section 3: Perceived Impact of Assistive Technology

6. From your perspective, how do you think assistive technology impacts the communication skills of students with hearing impairments?

7. In your experience, does the use of assistive technology improve the overall learning experience of students with hearing impairments?

8. Have you observed any changes in the social inclusion and participation of students with hearing impairments who use assistive technology?

Section 4: Challenges and Recommendations

9. What challenges, if any, have you encountered when using assistive technology in the classroom for students with hearing impairments?

10. Based on your experiences, what recommendations would you provide to improve the availability and effectiveness of assistive technology for students with hearing impairments in our school?

Section 5: Additional Insights

11. Is there anything else you would like to share about your experiences, observations, or thoughts related to the use of assistive technology for students with hearing impairments?

Conclusion:

Thank you so much for sharing your valuable insights and experiences with me today. Your contribution will greatly assist in enhancing our understanding of the impact of assistive technology on students with hearing impairments. If you have any further thoughts or suggestions after this interview, please feel free to reach out to me.

If you have any questions or concerns at any point, please don't hesitate to ask. Your participation in this research is greatly appreciated.

Note: Your participation is voluntary, and your responses will be kept confidential. If you have any questions or concerns, please feel free to ask.

Learner Interview Guide

Impact of Assistive Technology on Academic Performance for Students with Hearing Impairments

Introduction:

Hello! My name is René William NGABO, and I am a Master's student at the University of Rwanda. I am conducting a research study that aims to understand how assistive technology affects the academic performance of students with hearing impairments. Your thoughts, experiences, and insights are incredibly valuable for this research, and I'm grateful for your willingness to participate.

I want to assure you that anything you share during this interview will be kept completely confidential. Your name and personal details will not be disclosed. The goal of this interview is to gather information that will help us learn more about how assistive technology can make a difference in your education.

Please don't worry about giving "right" or "wrong" answers. I'm interested in hearing about your experiences and perspectives, which are unique and important.

Section 1: Your Experience with Hearing Impairment

1. Can you tell me a little bit about your experience with hearing impairment? How does it impact your communication and learning?

Section 2: Awareness and Use of Assistive Technology

2. Have you heard about assistive technology before? Do you know what it means?
3. Have you ever used any assistive technology to help with your learning or communication?

Section 3: Impact of Assistive Technology on Learning

4. How do you think assistive technology could help students with hearing impairments in their education?

5. Have you noticed any changes in your learning experience when you use assistive technology?

Section 4: Challenges and Benefits

6. Are there any challenges you face when it comes to using assistive technology? Can you tell me about them?

7. Have you experienced any positive effects or benefits from using assistive technology in your learning?

Section 5: Recommendations and Thoughts

8. If you could suggest ways to make assistive technology better for students like you, what would you recommend?

9. Is there anything else you'd like to share about your experiences or thoughts on this topic?

Conclusion:

Thank you so much for talking to me today and sharing your thoughts. Your insights are incredibly valuable and will help us understand how assistive technology can support students with hearing impairments like you. If you have any more thoughts or ideas after this interview, please feel free to reach out.

Remember, your participation is entirely voluntary, and your responses will be kept confidential. If you have any questions or concerns, please don't hesitate to ask.

Head Teacher Interview Guide

Impact of Assistive Technology on Academic Performance for Students with Hearing Impairments

Introduction:

Hello! My name is René William NGABO, and I am a Master's student at the University of Rwanda. I'm reaching out to you as a respected educational leader to seek your valuable insights for my research study. The focus of my study is to understand the impact of assistive technology on the academic performance of students with hearing impairments. Your expertise and experiences are essential to providing a comprehensive understanding of this topic, and I appreciate your willingness to participate.

I want to assure you that any information you share during this interview will remain completely confidential. Your name and personal details will be kept private. Your perspective as a head teacher is instrumental in shedding light on the larger context of educational practices and policies.

This interview aims to gather valuable information that will contribute to the advancement of inclusive education for students with hearing impairments.

Please feel free to share your thoughts openly and honestly. Your insights will play a crucial role in shaping the outcomes of this research.

Section 1: School and Inclusive Practices

1. Can you briefly describe your school and its approach to inclusive education?
2. How does your school currently support students with hearing impairments? Are there any specific strategies or practices in place?

Section 2: Awareness and Integration of Assistive Technology

3. Are you familiar with the concept of assistive technology? How do you perceive its role in supporting students with hearing impairments?

4. To what extent is assistive technology integrated into the teaching and learning processes at your school?

Section 3: Benefits and Challenges

5. In your opinion, what are the potential benefits of using assistive technology for students with hearing impairments?

6. Have there been any challenges in implementing or utilizing assistive technology within your school environment?

Section 4: Collaboration and Support

7. How do teachers and staff members receive training and support to effectively use assistive technology?

8. What kind of collaboration takes place between teachers, students, and parents in terms of integrating assistive technology into the education of students with hearing impairments?

Section 5: Recommendations and Future Direction

9. Based on your experience, what recommendations or suggestions would you offer to enhance the use of assistive technology for students with hearing impairments?

10. How do you envision the role of assistive technology evolving in the future of inclusive education at your school?

Conclusion:

Thank you very much for participating in this interview. Your insights and expertise provide invaluable perspectives that will contribute to our understanding of how assistive technology impacts the academic performance of students with hearing impairments. If you have any further thoughts or ideas after this interview, please don't hesitate to share them.

Please remember that your participation is entirely voluntary, and your responses will be treated with the utmost confidentiality. If you have any questions or concerns, feel free to ask.

Learner Questionnaire

Impact of Assistive Technology on Academic Performance for Students with Hearing Impairments (Moderate Intellectual Challenges)

Introduction:

Hello! My name is René William NGABO, and I am a Master's student at the University of Rwanda. I am reaching out to you as an important participant in my research study. The focus of my study is to understand how assistive technology can make a difference in the academic experiences of students with hearing impairments who also face moderate intellectual challenges. Your experiences and insights are incredibly valuable, and I truly appreciate your willingness to share them.

Your responses in this questionnaire will be treated with the utmost confidentiality. Your name and personal details will remain private. Your unique perspective as a learner with both hearing impairments and moderate intellectual challenges is vital in contributing to a comprehensive understanding of this topic.

Please feel comfortable to answer the questions openly and honestly. Your insights will play a crucial role in shaping the outcomes of this research.

Section 1: Personal Background

1. What is your name? (Optional, you may choose to remain anonymous)
2. How old are you?
3. Can you tell me a little bit about your experiences in school?

Section 2: Assistive Technology Awareness

4. Have you heard about assistive technology before?
5. Do you use any devices or tools to help you with your hearing and learning in school?

Section 3: Experience with Assistive Technology

6. If you use assistive technology, can you share how it has helped you in your learning and communication?
7. What do you like the most about using assistive technology?
8. Are there any challenges you face while using assistive technology? If yes, could you tell me about them?

Section 4: Academic Performance

9. How do you feel about your schoolwork and learning?
10. Do you think using assistive technology has made a difference in how you do your schoolwork?

Section 5: Learning and Communication

11. How do you communicate with your teachers and friends at school?
12. Do you find it easier to learn and understand when you use assistive technology? If yes, how?

Section 6: Future Goals

13. What are some things you want to achieve in school and beyond?
14. Do you think using assistive technology will help you achieve your goals?

Conclusion:

Thank you so much for participating in this questionnaire. Your insights and experiences are incredibly valuable and will contribute to our understanding of how assistive technology can support learners with hearing impairments and moderate intellectual challenges. Your participation is entirely voluntary, and your responses will be treated with the utmost confidentiality. If you have any further thoughts or ideas, please don't hesitate to share them.

If you have any questions or concerns, feel free to ask.

Teacher Questionnaire

Impact of Assistive Technology on Academic Performance for Students with Hearing Impairments

Introduction:

Hello! My name is René William NGABO, and I am a Master's student at the University of Rwanda. I am reaching out to you as a valued participant in my research study. The focus of my study is to gain insights into how assistive technology can impact the academic performance of students with hearing impairments. Your expertise and experiences as a teacher are incredibly important, and I truly appreciate your willingness to contribute.

Your responses in this questionnaire will be handled with the highest level of confidentiality. Your name and personal information will remain private. Your unique insights will be invaluable in shaping the outcomes of this research.

Please feel free to share your thoughts and experiences openly and honestly. Your contribution will greatly enhance our understanding of how assistive technology can be effectively integrated into the education of students with hearing impairments.

Section 1: Personal Background

1. What is your name?
2. How many years of teaching experience do you have?
3. Can you briefly describe your experience working with students with hearing impairments?

Section 2: Knowledge of Assistive Technology

4. Are you familiar with the concept of assistive technology?
5. Have you used assistive technology tools or devices in your teaching for students with hearing impairments?

Section 3: Use and Integration of Assistive Technology

6. If you have used assistive technology, could you please provide examples of how you have integrated it into your teaching practices?
7. What benefits do you observe when students with hearing impairments use assistive technology in the classroom?
8. Are there any challenges you have encountered when using assistive technology with students with hearing impairments? If yes, please describe them.

Section 4: Impact on Academic Performance

9. In your opinion, how does the use of assistive technology influence the academic performance of students with hearing impairments?
10. Have you noticed any changes in the learning outcomes of students with hearing impairments since the introduction of assistive technology?

Section 5: Communication and Interaction

11. How does the use of assistive technology affect communication and interaction between students with hearing impairments and their peers or teachers?
12. Do you think assistive technology enhances their social inclusion and participation? Please elaborate.

Section 6: Training and Support

13. Have you received any training or professional development on using assistive technology in the classroom?
14. Do you think there is a need for more training and support in effectively integrating assistive technology for students with hearing impairments?

Section 7: Future Recommendations

15. Based on your experience, what recommendations would you provide for improving the use of assistive technology for students with hearing impairments?
16. Are there specific resources or strategies that you believe would enhance the effectiveness of assistive technology in teaching students with hearing impairments?

Conclusion:

Thank you so much for taking the time to participate in this questionnaire. Your expertise and insights as a teacher are invaluable in shedding light on the impact of assistive technology on students with hearing impairments. Your participation is entirely voluntary, and your responses will be kept confidential. If you have any additional thoughts or suggestions, please feel free to share them.

If you have any questions or concerns, please don't hesitate to reach out.

Head Teacher Questionnaire

Impact of Assistive Technology on Academic Performance for Students with Hearing Impairments

Introduction:

Dear Head Teacher,

I hope this message finds you well. My name is René William NGABO, and I am a Master's student at the University of Rwanda. I am reaching out to you with great respect and gratitude for your esteemed position as a Head Teacher. I am conducting a research study that focuses on understanding the impact of assistive technology on the academic performance of students with hearing impairments. Your valuable insights and experiences as a Head Teacher are crucial to the success of this study.

Your participation in this questionnaire will greatly contribute to our understanding of how assistive technology can be effectively integrated into the education of students with hearing impairments. Your responses will be treated with the utmost confidentiality, and your name and personal information will remain strictly confidential.

I sincerely appreciate your willingness to share your thoughts and expertise. Your contributions will be invaluable in shaping the outcomes of this research and ultimately benefiting the education of students with hearing impairments.

Section 1: School Information

1. What is the name of your school and its location?
2. Could you briefly describe the overall student population in your school, particularly in terms of students with hearing impairments?

Section 2: Awareness and Implementation of Assistive Technology

3. Are you familiar with the concept of assistive technology?
4. Has your school implemented any form of assistive technology to support students with hearing impairments in their learning? If yes, could you please provide examples?

Section 3: Role of Assistive Technology

5. In your opinion, how does the use of assistive technology impact the academic performance of students with hearing impairments in your school?
6. Have you observed any changes in the learning outcomes or engagement levels of these students since the introduction of assistive technology?

Section 4: Barriers and Facilitators

7. Are there any challenges or barriers your school has faced when it comes to implementing assistive technology for students with hearing impairments?
8. What measures or strategies have you found effective in facilitating the successful integration of assistive technology in your school's educational framework?

Section 5: Teacher Training and Support

9. Have you provided any training or professional development to teachers on using assistive technology to support students with hearing impairments?
10. Do you believe there is a need for more training or support to enhance the effective utilization of assistive technology?

Section 6: Future Directions

11. In your view, how can the integration of assistive technology be further improved to better support students with hearing impairments?
12. Are there any recommendations or strategies you would suggest for schools aiming to implement assistive technology for students with hearing impairments?

Conclusion:

Your participation in this questionnaire is of immense value, and I am genuinely thankful for your time and insights. Your expertise as a Head Teacher provides a unique perspective that will

contribute significantly to the success of this study. Your participation is completely voluntary, and your responses will be handled with the strictest confidentiality.

If you have any questions or concerns, or if you would like to share additional thoughts, please feel free to reach out to me.

Thank you once again for your contribution to this important research endeavor.

Warm regards,

René William NGABO
Master's Student
University of Rwanda

Observation Checklist

Checklist to assess various aspects related to the presence and effectiveness of assistive technology, teaching methodologies, and other relevant factors in the context of the impact of assistive technology on the academic performance of students with hearing impairments in rural special schools

| No. | Checklist Item | Yes | No |
|-----|---|-----|----|
| 1 | Is there an established special school catering to students with hearing impairments? | | |
| 2 | Is the school located in a rural area as per the research scope? | | |
| 3 | Does the school provide education primarily for students with hearing impairments? | | |
| 4 | Does the school offer special education services tailored to students with hearing impairments? | | |
| 5 | Is there an availability of assistive technology for hearing impaired students in the school? | | |
| 6 | Are hearing aids available for students who need them? | | |
| 7 | Are classroom amplification systems in place to aid hearing impaired students in their learning? | | |
| 8 | Does the school have a designated inclusive classroom setting for students with hearing impairments? | | |
| 9 | Is there a trained staff member responsible for maintaining and troubleshooting assistive technology? | | |
| 10 | Are teachers adequately trained to use assistive technology effectively in their teaching methods? | | |
| 11 | Is the curriculum adapted to meet the needs of students with hearing impairments? | | |

| | | | |
|----|--|--|--|
| 12 | Are there specialized instructional strategies implemented to enhance communication and learning? | | |
| 13 | Is the school equipped with accessible learning materials for students with hearing impairments? | | |
| 14 | Are assessments modified to accommodate students with hearing impairments? | | |
| 15 | Does the school collaborate with parents or guardians to support the education of students with hearing impairments? | | |
| 16 | Is there a positive attitude and awareness among teachers and staff regarding assistive technology? | | |
| 17 | Are there efforts to address challenges related to the accessibility and availability of assistive technology? | | |
| 18 | Are students with hearing impairments actively engaged and included in classroom activities? | | |
| 19 | Are there ongoing initiatives to improve the overall educational experience of students with hearing impairments? | | |

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Dr Gonzague Habinshuti; Phone: 0788809234; Email: habinshutiho@gmail.com

Thank you for your cooperation.



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