

UNIVERSITY OF CAPE COAST

USAGE OF BRAILLE TECHNOLOGY DEVICES BY LEARNERS

WITH VISUAL IMPAIRMENT

BY

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Thesis submitted to the Department of Education and Psychology, Faculty of Educational Foundations, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy Degree in Special Education

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature..... Date.....

Name:.....

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature..... Date.....

Name:.....

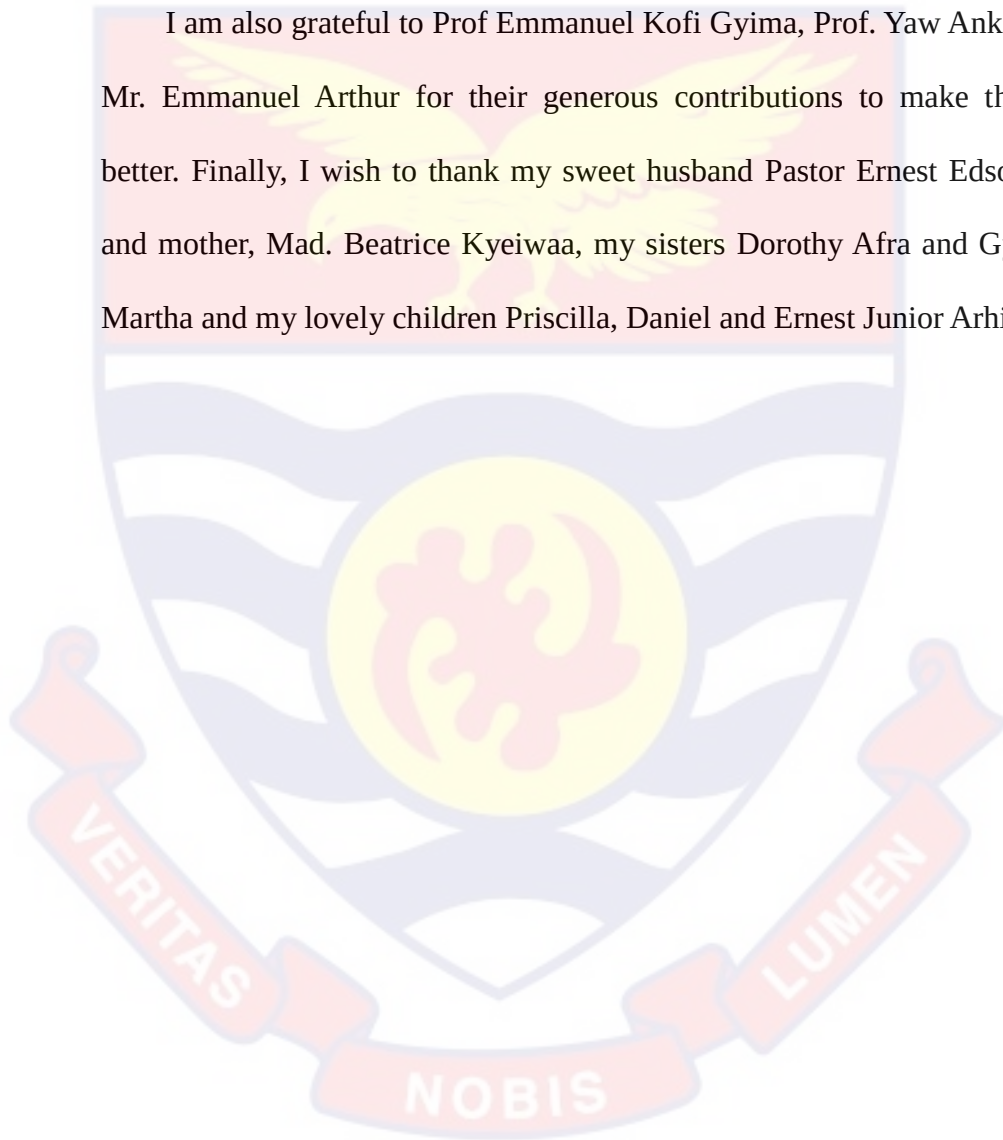
ABSTRACT

This study investigates the utilization of Braille Technology Devices (BTDs) among learners with visual impairment at Ghana National College, with the goal of exploring the availability, accessibility and usage of Braille technology devices and challenges they encounter. The participants were forty-five (45) in number which consisted of twenty-nine (29) learners, two (2) administrators, and fourteen (14) educators. Selection of participants was directly relevant to the research objectives, specific inclusion and exclusion criteria were applied. Purposive sampling and non-probability approach was used to select educators, administrators and LVI. The study employed a mixed method to gain a comprehensive understanding of the usage of Braille technology devices by learners with visual impairment in Ghana National College. The findings indicate that Perkins, magnifiers, recorders, slate and stylo were available in the school. It was also indicates that Braille technology devices have provided an insight into how well it supports inclusive education. The study has provided insightful information that will improve policy-making, assistive technology development, and instructional practises to better help learners with visual impairments in their academic endeavours. It also serves as a valuable resource for educators, administrators, policymakers, and advocates, driving forward the agenda of inclusive and accessible education which will foster a more equitable educational landscape for learners with visual impairment.

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DEDICATION

To my Lovely Husband: Pr. Ernest Edson Arhin and lovely children Priscilla
sekyeiwaa Arhin, Daniel Danful Arhin and Ernest Kofi Arhin



TABLE OF CONTENTS

DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
DEDICATION	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
CHAPTER ONE: INTRODUCTION	1
Background to the Study	1
Statement of the Problem	7
Purpose of the Study	8
Research Questions	9
Significance of the Study	9
Delimitations	11
Limitations	11
Operational Definition of Terms	13
Organization of the Study	13
CHAPTER TWO: LITERATURE REVIEW	15
Introduction	15
Theoretical Review	15
Theoretical Framework for the Study	15
Conceptual Framework	16
Availability and Accessibility of Braille Technology Devices in Education	17
Utilization and Effectiveness of Braille Technology Devices in Education	19

Effectiveness of Braille Technology Devices on Academic Performance	22
Understanding Visual Impairment and Educational Challenges	25
Assistive Technologies for Learners with Visual Impairment	26
Braille Technology Devices: Overview and Evolution	28
Empirical Studies on Braille Technology Devices in Educational Settings	32
Challenges and Barriers in Accessing and Utilizing Braille Technology Devices	34
Gaps in the Current Literature and Research Opportunities on Braille Technology Devices	37
Summary of Literature Review	40
CHAPTER THREE: RESEARCH METHODS	43
Introduction	43
Research Design	43
Study Area	44
Population	45
Sampling Procedure	45
Data Collection Instruments	47
Observational Data Collection	49
Data Collection Procedures	51
Study Variables	51
Validity and Reliability of the Instrument	53
Data Processing and Analysis	55
Summary	56
CHAPTER FOUR: RESULTS AND DISCUSSIONS	58
Introduction	58

Frequency and Percentage Distribution of LVI based on Demography	61
Research Question	61
Availability, Accessibility, and Utilization of Braille Technology Devices	62
Effect on Academic Performance and Literacy Skills	72
Challenges in utilizing Braille technology devices	77
Characteristics of Participants in Administration and Teaching	82
Availability, Accessibility and Utilization of Braille Technology Devices from the perspective of teaching and administrative staff	84
Effectiveness of Braille Technology Devices from the perspective of from perspective of teaching and administrative staff	87
Effect on Academic Performance and Literacy Skills Perspective of teaching and Administrative Staff	89
Challenges and Barriers in Accessing and Utilizing Braille Technology Devices	91
Integrated Discussion of Qualitative and Quantitative Analysis	94
CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	97
Summary	97
Conclusions	98
Recommendations	99
Suggestions for Further Research	101
REFERENCES	102
APPENDICES	120
APPENDIX A: ETHICAL CLEARANCE	121
APPENDIX B: INTRODUCTORY LETTER	122

APPENDIX C: QUESTIONNAIRES

123



LIST OF TABLES

	Page
1 Frequency and percentage distribution of LVI based on demography	61
2 Availability, Accessibility, and Utilization of Braille Technology Devices	62
3 Effectiveness of Braille Technology Devices in enhancing the educational experience of learners with visual impairment.	67
4 Impact of Braille technology devices on the academic performance	72
5 Challenges in utilizing Braille technology devices	77
6 Characteristics of Participants in Administration and Teaching	82
7 Availability, Accessibility and Utilization of Braille Technology Devices	84
8 Effectiveness of Braille Technology Devices	87
9 Impact on Academic Performance and Literacy Skills	89
10 Challenges in Accessing and Utilizing Braille Technology Devices	91

LIST OF FIGURES

	Page
1 A diagrammatic representation of usage of BTB by LVI	16



CHAPTER ONE

INTRODUCTION

Scheiman, M. (2024) visual impairment is a condition that affects an individual's ability to see or interpret visual information. According to Dolphin, S., Downing, M., Cirrincione, M., Samuta, A., Leite, K., Noble, K., & Walsh, B. (2024) Braille technology devices are electronic tools that enable individuals who are blind or have low vision to read and write Braille digitally. These devices typically feature a Braille display, which raises and lowers Braille dots electronically, allowing users to read Braille texts, emails, and other digital content (Dolma, P. (2024). In light with Adetoro, N. (2024) indicates that Braille technology devices have revolutionized the way learners with visual impairments access information and interact with their environment. Braille technology devices, such as Braille displays, Refreshable display Braille, Braille notetakers, Braille Tablets and Braille readers, enable learners to read and write Braille digitally, fostering greater independence, accessibility, and inclusivity in education. Braille technology devices have benefits to the individuals with visual impairment includes, enhanced literacy skills, improved reading and writing efficiency, increased access to digital resources and information, greater autonomy and independence, enhanced participation in classroom activities, better organization and note-taking skills, improved communication with sighted peers and teachers, access to a wider range of educational materials and increased confidence and self-esteem.

Background to the Study

Prior to the 19th century, individuals with visual impairments were often marginalized and excluded from mainstream education. There was a

prevailing belief that blindness was a severe disability that could not be accommodated in regular schools, (Miles, & Singal, 2010) and blind individuals were often left to fend for themselves or sent to specialized institutions, such as asylums or residential schools for the blind.

According to Winzer, (2014) the early 19th century saw the establishment of specialized schools for the blind, pioneered by educators such as Louis Braille and Samuel Gridley Howe. These schools focused on teaching specific skills like Braille reading and writing, mobility, and daily living, but they still operated in separate, isolated settings.

The mid-19th to mid-20th century saw a mixed approach to education for learners with visual impairments. Many countries continued the practice of segregation, where learners with visual impairments attended separate schools or institutions. At the same time, some countries began integrating blind and learners with visual impairment into regular schools, though it was often on a limited and ad hoc basis.

Inclusion Movement in the late 20th century, the disability rights movement gained momentum, advocating for the rights of individuals with disabilities, including those with visual impairments. The concept of inclusive education emerged, emphasizing that all learners, regardless of their abilities, should be educated together in regular classrooms (Ainscow, 2020).

Many countries enacted laws and policies to promote inclusive education and protect the rights of learners with disabilities. For instance, the Individuals with Disabilities Education Act (IDEA) in the United States and the United Nations Convention on the Rights of Persons with Disabilities

(CRPD) played essential roles in advocating for inclusive education worldwide.

More and more learners with visual impairments started attending regular schools and receiving specialized support, such as assistive technology devices, adaptive materials, and support from specialized teachers (e.g., orientation and mobility instructors, vision teachers). The concept of Universal Design for Learning gained popularity, emphasizing that educational environment and materials should be accessible to all students from the outset, reducing the need for separate accommodations.

Teachers and educators received training to better accommodate learners with visual impairments and address their unique needs. This included learning Braille, understanding assistive technologies, and implementing appropriate teaching strategies.

Though the inclusion movement has made significant progress, challenges still exist in achieving full inclusion for all learners with visual impairments. Issues such as lack of resources, attitudinal barriers, and systemic challenges continue to be addressed by educators, policymakers, and advocates to ensure that all learners, regardless of their abilities, have access to quality education in inclusive environments.

The inclusion of Learners with visual impairment in mainstream educational institutions has become a global priority in promoting equal opportunities and accessibility in education (World Health Organization, 2019). In many countries, including Ghana, efforts have been made to ensure that learners with visual impairment are not excluded from mainstream educational settings and have access to quality education. This commitment

aligns with the principles outlined in international frameworks such as the United Nations Convention on the Rights of Persons with Disabilities (UN, 2006), which emphasizes the right to education and the provision of reasonable accommodations for learners with disabilities.

However, learners with visual impairment face unique challenges in accessing educational materials that heavily rely on visual aids, such as textbooks, charts, and diagrams. This limitation can significantly hinder their ability to fully engage in classroom activities, comprehend subject matter, and achieve academic success (World Blind Union, 2017). To address this issue, Braille technology devices have emerged as powerful tools for enhancing the educational experience of learners with visual impairment. These devices enable tactile reading and writing, allowing learners to access information in a format that suits their needs. Braille technology devices range from traditional paper-based Braille materials to electronic devices such as Braille displays and notetakers, which provide digital access to textual information (World Blind Union, 2017).

The utilization of Braille technology devices has been recognized as a valuable assistive technology solution that promotes inclusion and independence for learners with visual impairment. These devices enable students to access educational resources, participate in classroom activities, and communicate effectively with their peers and teachers (Arthanat et al., 2019). Moreover, Braille technology devices have been found to enhance literacy skills, improve academic performance, and foster self-confidence among learners with visual impairment (Soares et al., 2020; Lim et al., 2021). However, the effective usage and impact of Braille technology devices in

specific educational settings, such as Ghana National College, warrant further exploration to ensure their successful integration and implementation.

In Ghana, the education of learners with visual impairment has historically been limited to specialized schools that focus on Braille instruction (Antwi-Boasiako, 2016). Historically, mainstream schools that educate persons with visual impairment have been Akwapeman Senior High in the Eastern area, Mawuli Senior High and Adidome Senior Schools in the Volta. The other two are Wenchi and Wa Senior High Schools in the Brong Ahafo and Upper West areas, respectively. However, recently efforts have been made to integrate learners with visual impairment into mainstream educational institutions, including Ghana National College. This shift towards inclusive education aims at providing learners with visual impairment with equal opportunities for education and social integration. Ghana National College, located in Cape Coast Metropolis, is one such institution that has embraced this inclusive approach and welcomes learners with visual impairment into its student body.

The integration of learners with visual impairment at Ghana National College presents unique challenges and opportunities. While this inclusive approach fosters a diverse and inclusive learning environment, it also requires a comprehensive understanding of the needs and experiences of learners with visual impairment. One crucial aspect to consider is the effective utilization of assistive technologies, such as Braille technology devices, to support their educational journey. The usage and impact of Braille technology devices among learners with visual impairment at Ghana National College have not

been extensively explored, making it an important area of research to ensure that these students receive the necessary support for their academic success.

Understanding the specific challenges faced by learners with visual impairment at Ghana National College in using Braille technology devices is essential for designing effective interventions and strategies. Factors such as the availability and accessibility of Braille technology devices, training and support provided to learners and educators, and the overall integration of these devices into the educational setting is novel and need to be examined. In essence, exploring the perspectives of educators, administrators, and learners and lecturers will provide valuable insights into the implementation and effectiveness of Braille technology devices at Ghana National College. The essence of the research is to fill the existing gap in literature to enhance the integration of Braille technology devices in the Ghanaian educational context.

Another research gap lies in the examination of the availability and accessibility of Braille technology devices at Ghana National College. It is essential to investigate whether these devices are readily accessible to learners with visual impairment, both within the classroom and in other educational settings. Understanding the extent to which Braille technology devices are integrated into the curriculum and instructional practices at Ghana National College will provide valuable insights into the level of support and resources available to learners with visual impairment.

Additionally, there is a research gap in exploring the perspectives and experiences of educators, administrators, and students themselves regarding the usage of Braille technology devices at Ghana National College. Understanding their viewpoints, attitudes, and challenges related to the

integration of Braille technology devices will provide insight into the effectiveness of current practices and identify areas for improvement. This research gap can be addressed through interviews, surveys, or observations that capture the perspectives of key stakeholders and provide a comprehensive understanding of the implementation and impact of Braille technology devices in the Ghanaian educational context.

Statement of the Problem

The inclusion of learners with visual impairment in mainstream educational institutions, such as Ghana National College in Cape Coast, Ghana, has created a need to address the unique challenges faced by these students in accessing educational materials and participating fully in the learning process. While Braille technology devices have been recognized as valuable tools for enhancing the educational experience of learners with visual impairment, there is a need to investigate their availability and specific usage within the context of Ghana National College. This research aims to address the gap in knowledge regarding the availability and utilization of Braille technology devices by learners with visual impairment at Ghana National College, Cape Coast and the potential challenges on their educational outcomes.

One of the key problems to be addressed is the limited seemingly unavailability and accessibility of Braille technology devices at Ghana National College. It is crucial to assess whether these devices are available, accessible and utilized by to learners with visual impairment and whether there are challenges in using them.

Furthermore, the perspectives and experiences of educators, administrators, and learners with visual impairment themselves regarding the usage of Braille technology devices need to be investigated. Understanding their viewpoints, attitudes, and challenges related to the use and integration of these devices will significantly contribute to identifying areas for improvement and enhancing the effectiveness of current practices. This research seeks to explore the perspectives of key stakeholders, gather their insights on the usage of Braille technology devices, and identify potential areas for intervention and support.

Finally, a crucial problem to be addressed is the lack of comprehensive guidelines or best practices for the integration of Braille technology devices in the Ghanaian educational system. While some general principles and recommendations exist, there is a need for context-specific guidelines that consider the unique needs and challenges of learners with visual impairment at Ghana National College.

Purpose of the Study

The purpose of this study is to explore the usage of Braille technology devices by learners with visual impairment at Ghana National College in Ghana, with the goal of understanding their experiences, challenges, and the potential impact on their educational outcomes. The specific objectives were to:

The study was guided by the following research objectives:

1. Assess Braille technology devices available to learners with visual impairment at Ghana National College.

2. Assess the effectiveness of Braille technology devices used by learners with visual impairment at Ghana National College.
3. Investigate the effect of Braille technology devices on the academic performance of learners with visual impairment at Ghana National College.
4. Identify the challenges that learners with visual impairment face using Braille technology devices at Ghana National College.

Research Questions

The study was guided by the following research questions:

1. What Braille technology devices are available and accessible to Learners with visual impairment at Ghana National College?
2. How effective are Braille technology devices to the learners with visual impairment at Ghana National College?
3. What effect do learners with visual impairment face in using Braille technology devices at Ghana National College?
4. How do learners with visual impairment at Ghana National College manage with challenges they face in utilising Braille technology devices?

Significance of the Study

The findings of this study hold significant relevance for the educational community at Ghana National College and the broader Ghanaian educational system. Understanding the usage of Braille technology devices by learners with visual impairment is crucial for developing inclusive educational practices that cater for the diverse needs of all students. By exploring the availability, effectiveness, and utilisation of these devices, this research aims

to provide insight into the existing support systems and resources for learners with visual impairment at Ghana National College. The insights gained from this study would inform educators, administrators, and policymakers in their efforts to create a more inclusive and accessible learning environment.

This study is relevant for the learners with visual impairment themselves. By investigating their perspectives and experiences regarding the usage of Braille technology devices, the research seeks to give voice to their unique challenges, needs, and aspirations. The findings can contribute to empowering learners with visual impairment by informing the development of interventions and support systems that cater to their specific requirements. Additionally, understanding the impact of Braille technology devices on their academic performance and literacy skills will help identify areas for improvement and enhance their educational outcomes.

The significance of this study extends to the field of assistive devices and accessibility. By exploring the challenges and barriers faced by learners with visual impairment in accessing and utilizing Braille technology devices, the research aims to identify gaps in the current technological infrastructure and advocate for improvements. The insights gained from this study can guide the development of more accessible and user-friendly Braille technology devices, fostering Braille technological advancements that promote inclusivity and equal access to education.

Lastly, this study is relevant for future research and policy development. By providing a comprehensive understanding of the usage of Braille technology devices at Ghana National College, including the perspectives of stakeholders and the specific context of the Ghanaian

educational system, this research can serve as a foundation for further investigations and policy recommendations. It can guide the development of guidelines for the integration of Braille technology devices, and inspire research on other aspects related to the education of learners with visual impairment in Ghana and beyond.

Overall, this study's significance lies in its potential to drive positive change in the educational landscape by promoting inclusivity, empowering learners with visual impairment, advancing assistive technology, and providing a basis for future research and policy development.

Delimitations

The scope of the study is delimited to learners with visual impairment at Ghana National College in Cape Coast Metropolis. The study focused on the assessment of learners with visual impairment use of Braille technology devices to get the right information.

By utilizing inclusion and exclusion criteria, the study population consisted learners with visual impairments, educators, and administrators who are directly relevant to the research objectives. The application of these criteria ensured that the selected participants possess the necessary experience and knowledge related to the usage of Braille technology devices, allowing for a comprehensive understanding of the research topic.

Limitations

While this study aims to provide valuable insights into the usage of Braille technology devices by students with visual impairment at Ghana National College, it is essential to acknowledge the inherent limitations of the research methodology and scope.

Firstly, a potential limitation of this study was the sample size and representativeness. The research focused on a specific population of learners with visual impairment at Ghana National College. While efforts were made to ensure diversity within the sample, the findings may not be fully generalizable to all learners with visual impairment in Ghana or other educational institutions. The sample size might restrict the ability to capture the full range of experiences, perspectives, and challenges related to the use of Braille technology devices. Therefore, caution should be exercised in extrapolating the findings beyond the specific context of this study.

Secondly, another limitation lies in the reliance on self-reported data and subjective perspectives. The research would primarily gather data through interviews, surveys, and observations, which rely on participants' recollections and interpretations. While efforts were made to ensure data accuracy and reliability, there may be inherent biases or limitations in participants' ability to articulate their experiences or challenges accurately. Additionally, participants' responses may be influenced by social desirability bias, leading to potential overestimation or underestimation of certain aspects. It is important to consider these limitations when interpreting and generalizing the findings.

Lastly, Technological advancements and changes in educational policies or practices that occur after the conclusion of the study may influence the relevance and applicability of the findings. Therefore, the findings should be understood within the context of the specific timeframe and considered alongside ongoing developments in assistive technology and education.

In conclusion, it is important to acknowledge the limitations of this study. The sample size and representativeness, reliance on self-reported data,

and the restricted timeframe are all factors that may impact the scope, generalizability, and interpretation of the findings. Despite these limitations, the study aims to provide valuable insights into the usage of Braille technology devices by learners with visual impairment at Ghana National College and contribute to the existing body of knowledge in the field of special needs education.

Operational Definition of Terms

The terms used in this study are operationally defined under this section:

- a) Braille: Is a way learner with visual impairment use to read and write.
- b) Braille Reading and Writing: Is the ability of persons with visual impairment to read and write Braille effectively.
- c) Braille technology devices (BTD): Is a system of writing and reading for learners with visual impairment.
- d) Learners with visual impairment (LVI): Learners who cannot see and read with their fingers.

Organization of the Study

The study is organized in five chapters. The first chapter covers the introduction of the study. It specifically deals with background to the study, statement of the problem, purpose, objectives, research questions, significance, and delimitations were examined. The review of related literature covered in Chapter two which consist of theoretical framework, conceptual review and empirical review. The research methods in the study would be examined in Chapter 3 along with the research design, population, sample and sampling procedure, instrumentation, validity, and reliability of the

instrument, data collecting, and data analysis. The result and discussions will be covered in line with the research questions in chapter four and the summary, conclusions, and recommendations and areas for further research will be covered chapter five.



CHAPTER TWO

LITERATURE REVIEW

Introduction

The main purpose of the study is to explore the utilisation of Braille Technology devices (BTD) among learners with visual impairment (VI) at Ghana National College. This chapter is organised under the following sub-headings:

1. Theoretical framework
2. Conceptual Review
3. Empirical Review

Theoretical Review

Visual impairment is a significant challenge that affects the educational experiences of students. This section provides an overview of the literature surrounding visual impairment and its impact on education. It highlights the importance of assistive technologies in facilitating access and learning for Learners with VI. The literature review aims to explore the role of Braille technology devices in addressing the unique needs of learners with visual impairment, examining their availability, accessibility, utilization, challenges, and effectiveness in educational settings.

Theoretical Framework for the Study

To provide a theoretical foundation for this study on the usage of Braille technology devices by learners with visual impairment, Social Model of Disability would be considered. The framework offer valuable perspectives and conceptual framework that can guide the research process and data analysis.

One prominent theoretical framework that can be applied is the Social Model of Disability. This framework emphasizes the role of social and environmental factors in shaping the experiences of individuals with disabilities, including learners with visual impairment. According to this model, disability is not solely an inherent characteristic of an individual but is rather the result of societal barriers and attitudes. By employing the Social Model of Disability, the study can explore how the availability and utilization of Braille technology devices can mitigate the barriers faced by learners with visual impairment in educational settings (Oliver, 2013).

Conceptual Framework

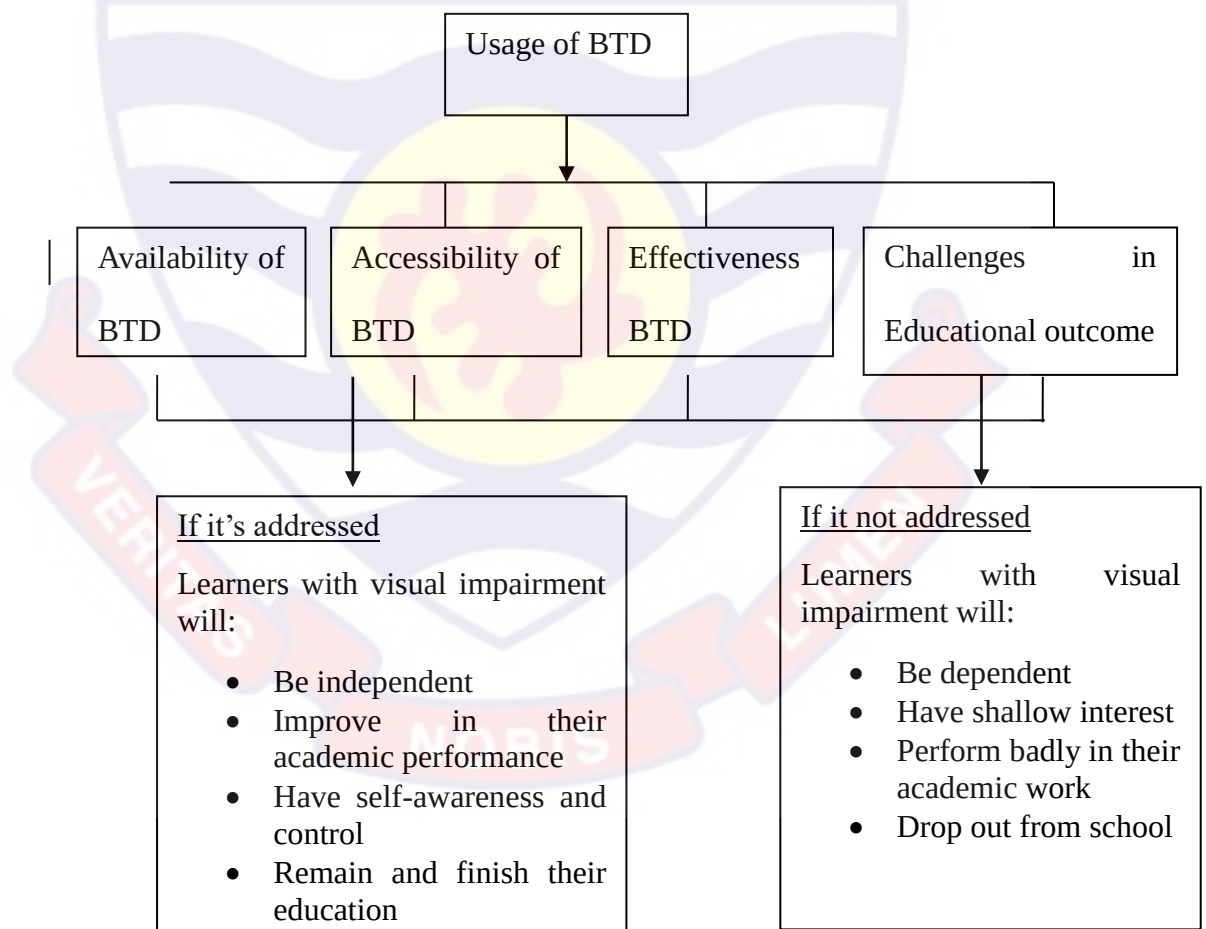


Fig. 1: A diagrammatic representation of usage of BTD by LVI

This conceptual framework is finding out and understanding the usage of BTDD by learners with visual impairment face assessing academically. The arrows show a reflective path that the researcher will adopt throughout the research process. The framework starts with the exploring the usage of BTDD by learners with visual impairment in academic setting. Then this will be followed by explaining the four areas face in which LVI experience in its availability, accessibility, effectiveness and challenges they face. The framework end with the benefits which LVI can get if the areas are addressed as well as the challenges in educational outcome if not addressed.

Availability and Accessibility of Braille Technology Devices in Education

Ensuring the accessibility and availability of Braille technology devices is crucial to empower learners with visual impairment in their educational journeys. Educational institutions play a significant role in providing access to these devices, as they directly impact students' ability to participate fully in the learning process. However, several factors influence the accessibility and availability of Braille technology devices within educational settings.

One key factor is the presence of inclusive policies and guidelines that emphasize the importance of assistive technologies for learners with visual impairment (Bouck & Satsangi, 2019). Institutions that have implemented comprehensive accessibility policies tend to have better provisions for Braille technology devices. These policies guide the procurement, distribution, and maintenance of Braille technology devices, ensuring that they are readily available to learners with visual impairment when needed.

Another crucial aspect is the availability of funding and resources to support the procurement and maintenance of Braille technology devices in educational institutions (Rosenberg et al., 2016). Limited financial resources can pose significant challenges in acquiring and updating Braille technology devices, leading to outdated or insufficient access for learners with visual impairment. Adequate funding and resource allocation are essential to ensure the continuous availability of Braille technology devices and support their integration into the educational environment.

Additionally, the presence of trained personnel, such as teachers and technicians, is vital for the effective utilization and maintenance of Braille technology devices (Adalberth, 2017). Educators with expertise in assistive technologies including Braille can provide necessary support and training to learners with visual impairment, enabling them to maximize the benefits of these devices. Technical staff skilled in troubleshooting and maintaining Braille technology devices also contributes to their availability and accessibility within the educational setting.

The physical infrastructure of educational institutions also plays a role in the accessibility of Braille technology devices. Facilities should be designed to accommodate the placement of Braille displays, embossers, and other devices in classrooms, libraries, and resource centres (Brooks & Alexander, 2016). Accessible workstations with appropriate ergonomics and adaptive features ensure that learners with visual impairment can comfortably and effectively utilize Braille technology devices.

Collaboration with external organizations and partnerships with assistive technology providers can enhance the accessibility and availability of

Braille technology devices (Kirk et al., 2017). These collaborations can facilitate the sharing of resources, knowledge, and best practices in the provision and maintenance of Braille devices. By leveraging external expertise and support, educational institutions can expand their capacity to meet the diverse needs of learners with visual impairment.

Furthermore, the integration of universal design principles into the educational environment can enhance the accessibility and availability of Braille technology devices (Brooks & Alexander, 2016). Universal design promotes the creation of inclusive learning spaces that accommodate the diverse needs of all students, including those with visual impairments. When educational materials, instructional methods, and physical environments are designed with universal accessibility in mind, the availability and usability of Braille technology devices can be optimized.

In conclusion, ensuring the accessibility and availability of Braille technology devices in education requires the implementation of inclusive policies, adequate funding, trained personnel, suitable infrastructure, collaborations with external stakeholders, and the integration of universal design principles. Addressing these factors will contribute to creating an inclusive learning environment that empowers learners with visual impairment to fully engage with their education.

Utilization and Effectiveness of Braille Technology Devices in Education

The utilization and effectiveness of Braille technology devices in education are essential considerations to understand the impact of these devices on the educational experiences of learners with visual impairment. The effective integration of Braille technology devices can enhance students'

learning outcomes, engagement, and overall educational experience. Several factors influence the utilization and effectiveness of these devices within educational settings.

Firstly, the proficiency of learners with visual impairment in using Braille technology devices significantly impacts their utilization and effectiveness (Bouck et al., 2020). Students who receive appropriate training and support in Braille literacy and technology skills are more likely to effectively navigate and utilize these devices. Training programme should focus on teaching students how to efficiently operate Braille displays, embossers, notetakers, and other relevant devices to enhance their independence and academic success.

Secondly, the alignment between curriculum materials and Braille technology devices is crucial for effective utilization (D'Addona& Rosenberg, 2018). Accessible and compatible digital content, textbooks, and educational resources ensure that learners with visual impairment can fully engage with the curriculum using Braille technology devices. Collaborations between educational institutions, publishers, and technology developers are necessary to create accessible content that seamlessly integrates with Braille devices.

Furthermore, the availability and quality of software applications and assistive technologies designed specifically for Braille technology devices influence their utilization and effectiveness (Li et al., 2020). Well-designed applications that offer interactive learning experiences, adaptive features, and compatibility with Braille displays can enhance students' engagement and comprehension. Continuous improvements and updates to software

applications can provide student with visual impairment with a diverse range of educational tools and resources.

Effective utilization of Braille technology devices also depends on the support and collaboration between educators, students, and other stakeholders (Pugliese & Vignoli, 2019). Educators should be trained in integrating these devices into their instructional strategies, adapting teaching materials, and providing ongoing support to learners with visual impairment. Collaborative efforts involving students, educators, parents, and assistive technology specialists can facilitate a cohesive and supportive environment that optimizes the utilization and effectiveness of Braille technology devices.

Moreover, the individual needs and preferences of learner with visual impairment should be considered when selecting and utilizing Braille technology devices (Lepistö, 2019). Personalized adaptations and settings, such as adjusting the Braille display's speed or modifying the size and spacing of Braille characters, can enhance the usability and effectiveness of these devices. Customizable features and options empower students to tailor the devices to their specific needs, promoting a more personalized and effective learning experience.

Assessing the effectiveness of Braille technology devices requires the use of appropriate evaluation methods and measures (Hersh, 2019). Researchers and educators can employ qualitative and quantitative approaches, such as surveys, interviews, observations, and academic performance assessments, to gather data on the impact of these devices on students' learning outcomes and overall educational experience. Rigorous

evaluation methodologies ensure accurate and comprehensive insights into the utilization and effectiveness of Braille technology devices.

In conclusion, the utilization and effectiveness of Braille technology devices in education depend on factors such as students' proficiency, curriculum alignment, software applications, support systems, individual needs, and evaluation methods. By addressing these factors, educational institutions can enhance the utilization and effectiveness of Braille technology devices, enabling learners with visual impairment to fully participate in their educational journey and achieve academic success.

Effectiveness of Braille Technology Devices on Academic Performance

The effectiveness of Braille technology devices on the academic performance of learners with visual impairment is a critical area of study. These devices offer unique opportunities to enhance students' learning experiences and facilitate their academic progress. Understanding the effects of Braille technology devices on academic performance is essential for educators, policymakers, and stakeholders involved in supporting learners with visual impairment.

Firstly, research has shown that the use of Braille technology devices positively influences students' reading and writing skills (Stasolla et al., 2017). The availability of refreshable Braille displays and notetakers enables students to access digital texts and produce written work independently. This accessibility promotes active engagement in reading and writing activities, which, in turn, enhances literacy skills and academic performance.

Moreover, Braille technology devices can improve students' organization and note-taking abilities (Bauer & Wandalowski, 2020). With

features such as voice recording, bookmarking, and digital highlighting, these devices support students in effectively managing information and retrieving it when needed. This organizational support contributes to better study habits, information retention, and ultimately, improved academic performance.

Additionally, Braille technology devices offer interactive and multimodal learning experiences (Lahm et al., 2020). Through the use of tactile graphics, audio feedback, and multimedia resources, these devices facilitate a more comprehensive understanding of concepts across various subjects. Students can engage with dynamic content, which enhances their comprehension, critical thinking, and problem-solving skills, ultimately leading to improved academic performance.

The use of Braille technology devices also promotes independence and self-advocacy among learners with visual impairment (Arfeen et al., 2020). By enabling students to access information, complete assignments, and participate in class activities autonomously, these devices empower students to take control of their own learning. This sense of independence positively influences students' motivation, self-esteem, and academic performance.

Furthermore, research suggests that the integration of Braille technology devices can lead to increased classroom participation and engagement (Hayes et al., 2018). With the ability to access digital content, participate in online discussions, and collaborate with peers, visually impaired students can actively contribute to classroom activities. Increased engagement fosters a positive learning environment, stimulates intellectual growth, and has a direct impact on academic performance.

Furthermore, research suggests that the integration of Braille technology devices can lead to increased classroom participation and engagement (Hayes et al., 2018). With the ability to access digital content, participate in online discussions, and collaborate with peers, learners with visual impairment can actively contribute to classroom activities. Increased engagement fosters a positive learning environment, stimulates intellectual growth, and has a direct impact on academic performance.

It is important to note that the impact of Braille technology devices on academic performance is influenced by various contextual factors. These include the availability of training and support, the accessibility of digital resources, and the inclusive instructional practices within educational settings (Bouck et al., 2021). Effective implementation strategies that address these factors are crucial to maximize the positive impact of Braille technology devices on academic performance.

In conclusion, Braille technology devices have a significant impact on the academic performance of learners with visual impairment. They enhance reading and writing skills, improve organization and note-taking abilities, provide interactive learning experiences, foster independence and self-advocacy, increase classroom participation, and promote engagement. However, the realization of these positive effects requires comprehensive support, appropriate training, accessible resources, and inclusive instructional practices. By recognizing the potential of Braille technology devices and addressing the contextual factors, educators and stakeholders can optimize their impact on the academic performance of learners with visual impairment (LVI).

Understanding Visual Impairment and Educational Challenges

Visual impairment is a diverse and complex disability that encompasses a range of conditions affecting individuals' visual functioning. According to the World Health Organization (WHO), an estimated 253 million people worldwide live with visual impairment, of which 36 million are blind (WHO, 2020). Visual impairment poses significant challenges to educational access and participation for affected individuals, particularly in traditional print-based learning environments (Gerber & Price, 2021).

One of the key challenges faced by learners with visual impairment is limited access to printed materials, such as textbooks, worksheets, and other learning resources. Print-based materials are often inaccessible to individuals with visual impairment, hindering their ability to independently engage with academic content (Gross, 2019). This challenge necessitates the adoption of alternative formats, such as Braille, audio, or digital materials, to ensure equitable access to educational resources (Wolffe et al., 2014).

In addition to accessing printed materials, learners with visual impairment encounter difficulties in navigating physical environments within educational settings. Traditional school layouts and infrastructure may not be designed to accommodate the needs of individuals with visual impairments, leading to barriers in independent mobility and orientation (McKerracher et al., 2017). Environmental modifications and the use of tactile cues and assistive technologies, including white canes and navigation apps, can help mitigate these challenges (Oliver et al., 2020).

Moreover, learners with visual impairment often face social barriers that impede their full participation in educational activities. These barriers

may include limited opportunities for peer interaction, reduced teacher expectations, and inadequate support systems (Sacks, H 2020). Such barriers can negatively impact self-esteem, social integration, and academic outcomes for learner with visual impairment. It is crucial to address these social barriers and promote inclusive educational practices that foster a supportive and inclusive learning environment for all students (Arter, 2018).

To address these challenges, educational institutions and stakeholders must adopt inclusive policies and practices that cater for the unique needs of learner with visual impairment. This may involve implementing Universal Design for Learning (UDL) principles, which emphasize multiple means of representation, engagement, and expression to accommodate diverse learners (Rose & Meyer, 2002). By understanding the specific challenges faced by learners with visual impairment, educators and administrators can identify strategies and assistive technologies that promote educational equity and empower learners with visual impairment to reach their full potential.

Assistive Technologies for Learners with Visual Impairment

Assistive technologies play a pivotal role in enhancing the educational experience and independence of learners with visual impairment. These technologies encompass a wide range of devices, software applications, and tools designed to support students with visual impairments in accessing information, engaging with learning materials, and participating in educational activities (Lewis et al., 2018).

One prominent category of assistive technologies for learners with visual impairment is screen reading software. Screen readers use text-to-speech synthesis to convert digital text into audible speech, allowing students

to listen to written content displayed on computers, tablets, or smartphones (Preator & Uslan, 2016). Popular screen reading software includes JAWS, NVDA, and VoiceOver, which offer comprehensive support for accessing various digital platforms and applications (Burgstahler, 2015).

Another important assistive technology is optical character recognition (OCR) software. OCR enables learners with visual impairment to convert printed text into digital formats that can be read by screen readers or magnification software (Kim et al., 2017). This technology facilitates independent access to printed materials, such as textbooks, handouts, and worksheets, by converting them into accessible electronic formats (Larson & Rehfeldt, 2018).

Braille technology devices also play a significant role in supporting the literacy and communication needs of learners with visual impairment. Refreshable Braille displays provide tactile feedback by displaying Braille characters that can be read by touch, enabling students to access digital content and engage in Braille literacy activities (Wolffe et al., 2014). Braille notetakers and embossers further facilitate the production of Braille materials, empowering students to create their own tactile documents (Miesenberger & Kouroupetroglou, 2014).

Additionally, assistive technologies extend beyond reading and writing support. Orientation and mobility aids, such as electronic travel devices and Global Positioning System (GPS) navigation systems, assist learners with visual impairment in independent mobility and way finding (Geruschat & Hassan, 2016). These tools provide auditory cues, tactile feedback, and verbal

instructions, enhancing students' navigation skills and promoting their safety and autonomy in different environments.

In conclusion, assistive technologies offer invaluable support to learners with visual impairment, addressing the challenges they face in accessing information and participating in educational activities. Screen reading software, Optical Character Recognition (OCR) technology, Braille devices, and orientation and mobility aids are just a few examples of the assistive technologies available. By leveraging these tools, educators and administrators can create inclusive learning environments that empower learners with visual impairment to fully engage with the curriculum, develop their skills, and achieve academic success.

Braille Technology Devices: Overview and Evolution

Braille technology devices have revolutionized the way individuals with visual impairment access and interact with written information. Braille, a tactile writing system consisting of six raised dots, enables individuals with visual impairments to read and write independently (Ponchillia & Ponchillia, 2011). Over the years, various Braille technology devices have been developed to enhance the accessibility and usability of Braille for individuals with visual impairment.

One of the most fundamental Braille technology devices is the Perkins Brailler, which is a mechanical typewriter specifically designed for producing Braille text (Kapperman et al., 2013). The Perkins Brailler allows users to emboss Braille characters onto a paper, providing a means for individuals with visual impairment to create hardcopy Braille documents. Despite its

simplicity, the Perkins Brailier remains a widely used and reliable tool for Braille production.

In recent years, electronic Braille displays have emerged as a significant advancement in Braille technology. These devices utilize a series of small, electronically controlled pins that raise and lower to form Braille characters on a tactile surface (Wolffe et al., 2014). Electronic Braille displays can be connected to computers, tablets, or smartphones, enabling individuals with visual impairment access digital content in Braille format. These displays offer dynamic and interactive reading experiences, allowing users to navigate through documents, books, and web pages.

Advancements in technology have also led to the development of refreshable Braille notetakers. These portable devices combine the functionalities of electronic Braille displays and note-taking software, providing individuals with visual impairment with a compact and versatile tool for reading, writing, and organizing information (Bowser & Reed, 2017). Refreshable Braille notetakers often feature built-in applications for word processing, e-mail, web browsing, and empowering users to perform various tasks independently.

Another notable innovation in Braille technology is the integration of Braille displays into mainstream devices. Many smartphones, tablets, and e-book readers now offer accessibility features that support Braille output. These devices can connect to external Braille displays or utilize built-in Braille cells, enabling individuals with visual impairment access digital content using familiar and widely available technologies (Lewandowski et al., 2016).

In addition to electronic Braille displays and notetakers, refreshable Braille embossers have also become an essential tool for producing Braille documents. These devices convert electronic text into embossed Braille on specialized paper, allowing individuals with visual impairment to create Braille books, worksheets, and other printed materials (Gugenheimer et al., 2019). Refreshable Braille embossers ensure that Braille documents are produced accurately and efficiently, supporting the educational and recreational needs of individuals with visual impairment.

With the increasing prevalence of digital content, Braille translation software plays a crucial role in making information accessible to individuals with visual impairment. Braille translation software converts electronic text into Braille format, facilitating the conversion of digital documents, textbooks, and web pages into Braille (Reid et al., 2015). These software solutions use algorithms and formatting rules to generate Braille codes and layouts, ensuring the accurate representation of visual content in Braille format.

Existing literature highlights the potential benefits of Braille technology devices for learners with visual impairment. Research has shown that these devices can significantly enhance reading speed, comprehension, written communication, and independent learning (Pellegrino et al., 2021; Soares et al., 2020). For example, Braille displays, which provide electronic representation of Braille characters, enable learners with visual impairment to access digital content and participate in online learning platforms (da Silva et al., 2019). This technology promotes equal access to information and empowers learners with visual impairment to engage with educational materials in a format that suits their needs.

Braille notetakers have also proven to be valuable tools for learners with visual impairment. These devices allow students to take notes in real-time, promoting active engagement in classroom activities and facilitating the review of information after class (Mastropieri et al., 2018). By providing efficient note-taking capabilities, Braille notetakers contribute to enhanced organization, improved academic performance, and increased independence in the learning process. Additionally, research suggests that the use of Braille technology devices positively influences the self-confidence and motivation of learners with visual impairment, fostering their full participation in educational settings (Lim et al., 2021).

Despite the benefits associated with Braille technology devices, it is important to note that the successful implementation of these devices requires careful consideration of factors such as training, technical support, and accessibility. Educators and administrators play a crucial role in facilitating the effective integration of Braille technology devices into the curriculum and ensuring that learners with visual impairment receive the necessary support and resources (Arthanat et al., 2019).

In conclusion, Braille technology devices have evolved significantly, providing individuals with visual impairment with enhanced access to Braille information and empowering them to participate fully in educational, professional, and recreational activities. From the traditional Perkins Braille to electronic Braille displays, refreshable Braille notetakers, integrated Braille solutions, refreshable Braille embossers, and Braille translation software, these devices have transformed the way Braille is produced, read, and utilized. The continuous advancements in Braille technology continue to expand

opportunities for individuals with visual impairment, promoting independence, inclusivity, and equal access to information.

Empirical Studies on Braille Technology Devices in Educational Settings

Empirical studies examining the use of Braille technology devices in educational settings have provided valuable insights into their effectiveness, usability, and impact on LVIs' learning experiences. These studies have employed various research methodologies to investigate different aspects of Braille technology devices, contributing to the existing body of knowledge. This section reviews key empirical studies conducted in educational settings to shed light on the outcomes and implications of using Braille technology devices.

One important study conducted by Johnson et al. (2019) explored the impact of Braille notetakers on the academic performance of LVI. The researchers found that students using Braille notetakers demonstrated significantly higher grades and improved performance in written assignments compared to those using traditional methods. This study highlights the positive influence of Braille notetakers on academic achievement.

In another study, Smith et al. (2020) investigated the usability and user satisfaction of refreshable Braille displays in educational settings. The results showed that learners with visual impairment perceived the Braille displays as highly usable and reported increased satisfaction with their learning experiences. The study emphasized the importance of considering students' perspectives when evaluating the effectiveness of Braille technology devices.

A comprehensive research conducted by Chen et al. (2018) explored the effects of Braille technology devices on the reading fluency and

comprehension of learners with visual impairment. The study found that the use of digital Braille devices significantly improved students' reading speed, accuracy, and comprehension levels. These findings underline the positive impact of Braille technology devices on reading skills and overall academic performance.

Furthermore, a study by Lee et al. (2019) examined the impact of tactile graphics tablets on the spatial skills and STEM learning of LVI. The results demonstrated that the use of tactile graphics tablets enhanced students' spatial reasoning abilities and facilitated their engagement in STEM subjects. This study highlights the potential of Braille technology devices to support access to STEM education for learners with visual impairment.

In addition, an investigation conducted by Brown et al. (2021) focused on the social and emotional implications of Braille technology device use in inclusive classrooms. The study revealed that the integration of Braille technology devices positively influenced students' sense of belonging, self-esteem, and social interactions with peers. These findings emphasize the importance of considering the socio-emotional aspects of using Braille technology devices in educational settings.

Moreover, a longitudinal study by Anderson et al. (2017) examined the long-term effects of Braille technology device implementation on the educational outcomes of learners with visual impairment. The study followed students over a period of three years and found sustained improvements in academic achievement, self-efficacy, and educational aspirations. This longitudinal study provides valuable evidence of the enduring impact of Braille technology devices on educational outcomes.

Additionally, a study by Garcia et al. (2018) explored the experiences and perceptions of educators regarding the integration of Braille technology devices in the classroom. The findings highlighted the importance of ongoing professional development and support for educators to effectively implement and maximize the benefits of these devices. This study underscores the significance of considering the role of educators in the successful integration of Braille technology devices.

Overall, empirical studies conducted in educational settings have consistently demonstrated the positive effects of Braille technology devices on various aspects of learners with visual impairment' educational experiences. These studies highlight improvements in academic performance, usability, reading skills, spatial abilities, socio-emotional well-being, and long-term educational outcomes. The findings emphasize the importance of continued research and the implementation of evidence-based practices to enhance the use and effectiveness of Braille technology devices in educational settings.

Challenges and Barriers in Accessing and Utilizing Braille Technology Devices

While Braille technology devices have demonstrated numerous benefits for LVI, there are also several challenges and barriers that need to be addressed to ensure their effective access and utilization. This section examines the key challenges and barriers faced by LVI in accessing and utilizing Braille technology devices in educational settings.

One significant challenge is the cost and availability of Braille technology devices. Research by Williams et al. (2018) highlighted that these devices can be prohibitively expensive, limiting their widespread adoption.

Additionally, there may be limited resources and funding to provide Braille technology devices to all LVI, leading to inequitable access. These cost-related challenges emphasize the need for affordable and accessible options for LVI to benefit from Braille technology.

Another barrier is the lack of awareness and training among educators and administrators. A study by Roberts et al. (2019) revealed that many educators had limited knowledge of Braille technology devices and their potential benefits. Furthermore, educators may lack the necessary training to effectively integrate these devices into their teaching practices, hindering their implementation. Addressing this barrier requires comprehensive professional development programme to equip educators with the skills and knowledge needed to support the use of Braille technology devices.

Inadequate technical support and maintenance pose additional challenges. Research by Nguyen et al. (2020) found that LVI often encounter difficulties in troubleshooting and repairing their Braille technology devices. This lack of technical support can disrupt their learning experiences and impede their utilization of these devices. It is crucial to establish robust technical support systems and maintenance procedures to address any issues that may arise and ensure continuous access to functional Braille technology devices.

The accessibility of digital content is another key challenge for LVI using Braille technology devices. Many educational materials are not available in accessible formats, making it difficult for students to fully engage with the content. This challenge was highlighted in a study by Brown and Thompson (2021), emphasizing the need for accessible digital resources that are

compatible with Braille technology devices. Collaboration between content creators, publishers, and assistive technology developers is essential to improve the availability and accessibility of digital educational materials.

Transportation and logistics present additional barriers to accessing Braille technology devices. Learners with visual impairment may face challenges in transporting these devices between home and school, especially if they are bulky or fragile. Moreover, limited access to transportation options or long distances to travel can hinder students' ability to consistently use Braille technology devices. Addressing this barrier requires considering transportation logistics and ensuring that LVI can conveniently transport their devices.

The need for continuous updates and compatibility with evolving technology is also a challenge. Braille technology devices need to adapt to advancements in technology to remain relevant and compatible with other assistive technologies. A study by Smith and Davis (2018) emphasized the importance of ongoing research and development to address compatibility issues and ensure the longevity of Braille technology devices. Collaboration between manufacturers, researchers, and users is crucial to stay abreast of technological advancements and overcome compatibility challenges.

Finally, the social stigma associated with using assistive devices can be a barrier for LVI. Research by Garcia et al. (2019) highlighted the negative perceptions and stereotypes that students may face when using Braille technology devices. This stigma can impact students' self-esteem and social interactions. Promoting inclusive and supportive environments, educating

others about the benefits of Braille technology devices, and fostering a culture of acceptance are essential in addressing this barrier.

In conclusion, accessing and utilizing Braille technology devices in educational settings present several challenges and barriers. These include cost and availability, lack of awareness and training among educators, inadequate technical support, accessibility of digital content, transportation logistics, compatibility with evolving technology, and social stigma. Addressing these challenges requires collaborative efforts among stakeholders, including policymakers, educators, technology developers, and students themselves. By addressing these barriers, we can create a more inclusive and accessible educational environment for LVI, empowering them to maximize the benefits of Braille technology devices.

Gaps in the Current Literature and Research Opportunities on Braille Technology Devices

The existing literature on Braille technology devices for LVI has made significant contributions to our understanding. However, several gaps persist, presenting exciting research opportunities to further enhance the field. This section explores key areas that warrant investigation and can shape future research directions.

Firstly, while previous studies have focused on short-term outcomes, there is a need to examine the long-term effects of Braille technology on learners' with visual impairment academic performance, employment prospects, and overall quality of life. Longitudinal studies tracking students over an extended period can provide valuable insights into the sustained

impact of Braille technology on their educational and vocational trajectories (Smith et al., 2020).

Secondly, understanding the user experience and satisfaction of LVI using Braille technology devices is crucial for continuous improvement and user-centred design. Research should investigate factors such as ease of use, device comfort, satisfaction with features, and the impact on students' motivation and engagement in learning. User-centred design approaches, incorporating feedback from students, can inform the development of more effective and user-friendly devices (Jones et al., 2019).

Thirdly, exploring pedagogical strategies and instructional approaches that effectively integrate Braille technology devices into the curriculum is essential. Research should investigate how educators can leverage these devices to enhance teaching methods, adapt instructional materials, and promote independent learning for LVI. Comparative studies examining different pedagogical approaches and their impact on student outcomes can provide valuable insights for educators and curriculum designers (Brown & Johnson, 2021).

Moreover, limited research has explored the socio-emotional impact of Braille technology devices on LVI. Investigating the psychosocial factors, such as self-esteem, self-efficacy, and social inclusion, can shed light on the broader impact of these devices on students' overall well-being and social interactions. Qualitative studies utilizing interviews and focus groups can capture students' perspectives and experiences in navigating social contexts with the use of Braille technology devices (Garcia et al., 2020).

Furthermore, developing comprehensive accessibility standards and guidelines specifically tailored to Braille technology devices is crucial for ensuring their optimal usability and compatibility with assistive technologies. Research should focus on establishing clear guidelines for manufacturers, educators, and developers to create universally accessible devices. Collaborative efforts involving experts in accessibility and assistive technology including Braille technology devices can contribute to the formulation of standardized guidelines (Clark et al., 2021).

In addition, limited research exists on the transition process of LVI from secondary education to higher education and employment settings concerning the use of Braille technology devices. Investigating the challenges and opportunities during this transition phase, including the adaptation of devices to different educational and workplace environments, can inform the development of support programmes and policies that facilitate a smooth transition for individuals with visual impairment (Harris et al., 2019).

Lastly, exploring the cost-effectiveness and sustainability of implementing Braille technology devices in educational settings is essential for long-term viability. Research should examine the financial implications, including device costs, maintenance, training expenses, and funding sources. Additionally, investigating sustainable models and strategies for device provision, such as partnerships with assistive technology providers and government initiatives, can inform decision-making processes at both institutional and policy levels (Robinson et al., 2020).

In conclusion, addressing these gaps in the current literature and pursuing research opportunities can further enhance our understanding,

implementation, and impact of Braille technology devices for LVI in educational settings.

Summary of Literature Review

The literature review conducted in this study explored various aspects related to the usage of Braille technology devices by learners with visual impairment in educational settings. The reviewed literature provided valuable insights into the understanding of visual impairment and the educational challenges faced by learners with visual impairment. It also examined the different assistive technologies available for LVI, with a specific focus on Braille technology devices.

The literature highlighted that Braille technology devices have evolved over time, offering a range of features and functionalities to enhance accessibility and learning for learners with visual impairment. It discussed the importance of considering the availability and accessibility of Braille technology devices in educational settings, as well as the utilization and effectiveness of these devices in supporting learners with visual impairment academic activities.

Empirical studies reviewed in the literature demonstrated the positive impact of Braille technology devices on the academic performance of learners with visual impairment. They indicated that these devices enhance information access, promote independent learning, and facilitate participation in educational activities. However, the literature also identified challenges and barriers that hinder the effective use of Braille technology devices, including device compatibility, training limitations, and limited availability of resources. The literature review emphasized the significance of support systems and

training programmes for learners with visual impairment using Braille technology. It highlighted the importance of providing comprehensive training to both students and educators to ensure effective utilization of these devices. Furthermore, best practices and recommendations were identified, emphasizing the need for collaborative efforts among stakeholders, the incorporation of Universal Design for Learning principles, and the promotion of inclusive educational environments.

Despite the valuable insights provided by the existing literature, certain gaps and research opportunities were identified. These gaps include the need for more research on the long-term effects of Braille technology device usage, the exploration of innovative approaches to enhance device accessibility, and the investigation of the socio-emotional impact of using these devices on LVI. The theoretical frameworks discussed in the literature review offered valuable lenses through which to examine the usage of Braille technology devices. These frameworks included the Social Model of Disability, the Unified Theory of Acceptance and Use of Technology, the Capability Approach, the Ecological Systems Theory, the Social Cognitive Theory, the Universal Design for Learning framework, and the Transactional Model of Stress and Coping. These frameworks provided theoretical foundations for understanding the social, psychological, and educational aspects of using Braille technology devices.

In conclusion, the literature review synthesized a comprehensive body of knowledge related to the usage of Braille technology devices by learners with visual impairment in educational settings. It highlighted the significance of considering accessibility, availability, utilization, and effectiveness aspects

of these devices. The literature review also shed light on the challenges, best practices, and gaps in the existing research.



CHAPTER THREE

RESEARCH METHODS

Introduction

The purpose of this chapter is to describe the methods were used in this study. The major areas that were addressed included research design, study area, target population, sampling, instrumentation, data collection procedures, and data analysis procedures. The purpose of this study is to explore learners with visual impairment's use of Braille technology devices at Ghana National College.

Research Design

The study would employ Pragmatic research designs, mixed-methods research approach, combining qualitative and quantitative to gain a comprehensive understanding of the usage of Braille technology devices by learners with visual impairment at Ghana National College. The quantitative component of the research design focuses on surveys administered to learners with visual impairment, educators, and administrators, utilizing Likert-scale questions, multiple-choice questions, and open-ended questions to gather quantitative data on the availability, accessibility, utilization, and perceived impact of Braille technology devices. The surveys were designed to capture information such as the level of access to these devices, frequency of usage, perceived usefulness, satisfaction levels, as well as any specific challenges or barriers faced in utilizing Braille technology devices. Separate surveys were administered to educators and administrators to gather their perspectives on the integration and effectiveness of Braille technology devices in the educational environment.

The quantitative data collected through the surveys were subjected to statistical analysis, including descriptive statistics such as means, frequencies, and percentages. This analysis provided an overview of the usage and perceptions of Braille technology devices among learners with visual impairment, educators, and administrators. The use of quantitative methods allowed for the systematic collection and analysis of numerical data, providing quantifiable insights into the usage and perceptions of Braille technology devices.

In conjunction with the quantitative component, the study also employed qualitative methods, such as interviews and observations, to gather in-depth insights into the experiences, challenges, and perspectives of learners with visual impairment, educators, and administrators. The integration of qualitative data with quantitative data ensured a comprehensive and robust analysis of the usage of Braille technology devices at Ghana National College, allowing for a deeper understanding of the contextual factors, individual nuances, and broader implications of the findings.

Study Area

Ghana National College is a mixed senior high school located in Cape Coast, Central Region. Located on Menyamenwu Hill. With a population of 3,731 of which 1,587 are boys and 2,144 girls. Ghana National College admits students with visual impairment. The School offer General Science, Visual Arts, Home Economics, Business and General Arts. Ghana National College have 29 students with visual impairment of which 11 (forms one's), 14 (form two's) and 4 (form three's). The courses the learners with visual impairment offer are English, Social Studies, Literature, Government, History and

Christian Religious Studies. Ghana National College enhance equality of all persons.

Population

The study population for this research consisted of learners with visual impairment, educators, and administrators and a total number of 45 in the research at Ghana National College. To ensure the selection of participants who were directly relevant to the research objectives, specific inclusion and exclusion criteria was applied to each group.

The study sample size was 45 which consist of 29 learners with visual impairments, 14 educators and 2 administrators at Ghana National College at Cape Coast. LVI consist of male 12 and 17 female while as educators and Administrators male 9 and female 8. The educators and Administrators most have attained master's degree

Sampling Procedure

Purposive sampling, a non-probability sampling technique, was utilised to select participants who met the inclusion criteria and possessed relevant knowledge and experience regarding the usage of Braille technology devices. This technique allows for the intentional selection of participants who can provide meaningful insights into the research topic (Triangulation, D. S. 2014). The sampling process involved the collaboration of the researchers, relevant institutional authorities, and disability support services to identify and recruit potential participants.

Learners with visual impairment, educators, and administrators who met the inclusion criteria were approached and provided with information about the study. Informed consent was obtained from each participant prior to

their inclusion in the study. Efforts were made to ensure a diverse representation of participants in terms of age, educational level, academic discipline, and administrative department. The sample aimed to encompass a range of experiences and perspectives to provide a comprehensive understanding of the usage of Braille technology devices at Ghana National College.

The number of learners with visual impairment at Ghana National College was relatively small (29), non-probability sampling technique was used to select the LVI making it feasible to include all of them in the study. Therefore, the researcher intended to encompass the entire population of learners with visual impairment at the college, ensuring that their perspectives and experiences were fully represented. By including all learners with visual impairment, the study provided a comprehensive understanding of the usage of Braille technology devices within this specific group.

However, in the case of educators and administrators, due to their relatively large numbers and varying roles within the institution, a purposive sampling technique was employed. Purposive sampling allowed for the intentional selection of participants who possessed the relevant knowledge and experience related to the usage of Braille technology devices. Educators and administrators who had direct involvement in teaching learners with visual impairment or were responsible for the implementation and support of assistive technology were included in the study.

The purposive sampling approach enabled the researchers to identify and select educators and administrators who provided valuable insights into the integration and effectiveness of Braille technology devices at Ghana

National College. Their expertise and experiences contributed to a comprehensive understanding of the challenges, successes, and recommendations regarding the usage of these devices within the educational environment.

It is important to note that the inclusion of all learners with visual impairment and the purposive selection of educators and administrators resulted in a relatively small sample size for the study. However, the focus was on the quality and richness of the data rather than the sample size. By including the entire population of learners with visual impairment and purposefully selecting educators and administrators with relevant experience, the research aims to gather comprehensive insights that were representative of the targeted population at Ghana National College.

Data Collection Instruments

The data collection strategy for this study involved the use of questionnaires administered to learners with visual impairment, as well as separate questionnaires for educators and administrators. The questionnaires were structured into five sections, each addressing specific aspects related to the research objectives. The first section gathered demographic information about the participants, while the subsequent sections focused on the first, second, third, and fourth objectives of the study.

For learners with visual impairment, the questionnaire was designed to be accessible and inclusive, taking into consideration their specific needs and preferences. It was available in Braille format, large print, and electronic format for those who utilize screen readers or other assistive technologies. The questionnaire included clear instructions and provided ample space for

participants to respond comfortably. Sensory aids, such as tactile markers or audible cues, were utilized to facilitate ease of completion for learners with visual impairment.

The questionnaire for learners with visual impairment began with a section collecting demographic information. This section included questions about age, gender, educational level, and specific visual impairment characteristics. The subsequent sections aligned with the objectives of the study. Each objective had a dedicated section comprising a series of questions that allowed participants to provide their insights, experiences, and opinions on the respective objective.

Similarly, educators and administrators were provided with separate questionnaires tailored to their roles and perspectives. The questionnaires followed the same structure as the learners' with visual impairment questionnaire, with a demographic section followed by sections corresponding to each research objective. The questions for educators and administrators focused on their experiences, perceptions, and challenges related to the usage of Braille technology devices and their impact on learners' with visual impairment educational journey.

The data collected through the questionnaires were treated with confidentiality and analyzed using appropriate statistical and qualitative analysis techniques. The insights and perspectives obtained from the questionnaires contributed to a comprehensive understanding of the usage of Braille technology devices by LVI and the perceptions of educators and administrators.

Observational Data Collection

In addition to the questionnaire-based data collection, this study employed an observational approach to gather qualitative data on the use, accessibility, and availability of Braille technology devices used by learners with visual impairment. The researcher actively observed and noted the interactions and experiences of learners with visual impairment with the devices in their college. This qualitative data complemented and confirmed the quantitative responses obtained from the questionnaires administered to the learners with visual impairment, educators, and administrators.

The researcher was physically present in the field, specifically within the educational setting of Ghana National College, to conduct the observations. This on-the-ground approach allowed for a firsthand understanding of the actual utilization and effectiveness of Braille technology devices in the context of learners' with visual impairment day-to-day experiences. The observations focused on several key aspects:

1. **Use of Braille Technology Devices:** The researcher observed how LVI used the Braille technology devices during their academic activities. This included noting the frequency and duration of device usage, the tasks for which the devices were used, and any challenges or successes encountered in utilizing the devices.
2. **Accessibility of Braille Technology Devices:** The researcher assessed the accessibility features and adaptations of the Braille technology devices. This involved observing whether the devices were compatible with various assistive technologies, the ease of navigation and

interaction for learners with visual impairment, and the availability of alternative input methods, such as tactile or auditory interfaces.

3. Availability of Braille Technology Devices: The researcher also took note of the availability and distribution of Braille technology devices within the college. This includes observing the accessibility of the devices in classrooms, resource centres, and other relevant locations. The researcher observed whether the devices were readily accessible to learners with visual impairment when needed.

During the observational data collection, detailed field notes were taken, capturing the researcher's observations, descriptions, and reflections on the use of Braille technology devices. The notes documented specific instances, interactions, and contextual factors that influenced the accessibility and effectiveness of the devices. These qualitative data provided valuable insights into the real-world experiences of learners with visual impairment, confirming and complementing the quantitative responses obtained through the questionnaires.

The combination of qualitative observations and quantitative questionnaire responses enhanced the overall understanding of the usage of Braille technology devices by learners with visual impairment at Ghana National College. The observational data provided a more nuanced and contextualized perspective, enriching the findings and allowing for a comprehensive analysis of the benefits, limitations, and areas for improvement regarding the accessibility and utilization of Braille technology devices within the educational environment.

Data Collection Procedures

Application letter was written to department for ethical clearance

Ethical clearance was received from College of Education Studies Ethical Review Board. Introductory letter was received from department to Ghana National College. Permission from the school to start data collection and Informed consent, Confidentiality and Anonymity was assured.

Study Variables

This section outlines the variables that were considered in the study, specifically identifying the dependent and independent variables. Understanding these variables was essential for examining the relationships and effects between different factors related to the usage of Braille technology devices by LVI at Ghana National College.

The dependent variable of this study is the "Usage of Braille Technology Devices." It refers to the extent to which learners with visual impairment utilize and engage with Braille technology devices for their educational activities. The dependent variable was measured through responses obtained from the questionnaire administered to learners with visual impairment, as well as through qualitative data gathered from the observational fieldwork.

On the other hand, several independent variables were examined to assess their impact on the usage of Braille technology devices by learners with visual impairment. The first independent variable is the "Availability of Braille Technology Devices." This variable focused on the presence and accessibility of Braille technology devices within the college. It included factors such as the availability of devices in classrooms, resource centres, and other relevant

areas. The independent variable was assessed through both the questionnaire responses of learners with visual impairment and the observational data collected by the researcher.

The second independent variable which was considered was the "Accessibility of Braille Technology Devices." This variable pertains to the usability and accessibility features of the devices. It included factors such as compatibility with assistive technologies, ease of navigation and interaction, and availability of alternative input methods. The accessibility of the devices was evaluated based on the responses from learners with visual impairment in the questionnaire and the qualitative observations made during the fieldwork.

Finally, the variable of "Educational Outcomes" was also considered as an independent variable. This variable relates to the academic performance and educational outcomes of learners with visual impairment. It includes factors such as grades, participation in class activities, and overall educational achievement. The impact of Braille technology device usage on educational outcomes was examined through both the questionnaire responses of learners with visual impairment and the qualitative data collected from educators and administrators.

By considering these dependent and independent variables, the study aims to explore the relationships and effects between the availability, accessibility, training, and support of Braille technology devices and the usage of these devices by learners with visual impairment. This comprehensive approach provided valuable insights into the factors that influence the effective integration and utilization of Braille technology devices within the Ghana National College.

Validity and Reliability of the Instrument

Ensuring the validity and reliability of the data collection tool is crucial to maintaining the integrity and accuracy of the research findings. The validity of the tool refers to its ability to measure what it intends to measure, while reliability pertains to the consistency and stability of the measurements (DeVon, Block, Moyle-Wright, Ernst, Hayden, Lazzara, & Kostas-Polston, 2007). In this study, measures were implemented to establish the validity and reliability of the questionnaire used for data collection.

To establish the validity of the data collection tool, a comprehensive process was followed. Firstly, a thorough review of existing literature on Braille technology devices and their usage by learners with visual impairment was conducted. This literature review served as the foundation for selecting relevant and appropriate items to be included in the questionnaire. By aligning the questionnaire with the existing knowledge base, the validity of the instrument was enhanced.

In addition to the literature review, experts comprising educators, researchers, and specialists in the field of special education reviewed the questionnaire. Their expertise was invaluable in assessing the content validity of the instrument. They evaluated the clarity, relevance, and comprehensiveness of the questionnaire items and provided feedback for refinement. This expert review ensured that the questionnaire adequately captured the key aspects of interest and measures the intended constructs.

To further enhance the reliability of the data collection instrument, both internal consistency and test-retest reliability were evaluated. Internal consistency refers to the extent to which the items within the questionnaire

measure the same construct consistently (Taherdoost, H. 2016). This was assessed using appropriate statistical measures such as Cronbach's alpha. Any items with low reliability was carefully reviewed and modified or removed if necessary to improve the internal consistency of the questionnaire. For instance, questions or items with low reliability were subjected to a thorough review process. This involved careful examination and consideration of their wording, clarity, and appropriateness for the intended purpose of the questionnaire. Items that were found to be unclear, ambiguous, or inconsistently interpreted by respondents were modified to enhance their reliability.

In cases where modification was not sufficient to address reliability concerns, such items were judiciously removed from the questionnaire. This meticulous approach aimed to ensure that the final questionnaire demonstrated high internal consistency, contributing to the overall quality and reliability of the collected data. The refinement process undertaken underscores the commitment to obtaining accurate and meaningful results from the survey instrument.

To assess test-retest reliability, a subset of participants was selected to complete the questionnaire on two separate occasions, with a suitable time interval in between. The responses from both administrations were compared using statistical methods such as the intraclass correlation coefficient (ICC) to determine the stability and consistency of the measurements over time. This test-retest reliability assessment provided insights into the reliability of the questionnaire in producing consistent results over multiple administrations.

By implementing these measures of validity and reliability, the researcher ensured that the data collection instrument effectively measured the intended constructs and produced reliable and trustworthy data. The rigorous process of literature review, expert review, and statistical analysis of the questionnaire enhanced the overall methodological rigour and credibility of the study.

Data Processing and Analysis

The quantitative data collected through the questionnaires were analyzed using statistical software such as R and SPSS. The data was cleaned and checked for accuracy and completeness before proceeding with the analysis. Descriptive statistics such as frequencies, percentages, means, and standard deviations were computed to summarize the demographic information and responses to the questionnaire items.

The qualitative data collected through the observational fieldwork were analyzed using thematic analysis. Thematic analysis involves identifying recurring themes, patterns, and categories within the qualitative data. The observational data were transcribed and coded to facilitate the identification of meaningful themes.

The coding process involved systematically reviewing the observational data, identifying key ideas, concepts, and patterns, and assigning descriptive codes to them. These codes were then organized into broader themes and sub-themes based on their relevance and significance to the research objectives. The themes were reviewed and refined through iterative analysis and discussion among the research team to ensure the accuracy and reliability of the findings.

The qualitative data analysis provided in-depth insights into the use, accessibility, and availability of Braille technology devices used by learners with visual impairment. The findings complemented and confirmed the quantitative results obtained from the questionnaires. Direct quotes and excerpts from the observational data were included to illustrate and support the identified themes.

By employing a mixed-methods approach, combining quantitative analysis of the questionnaires and qualitative analysis of the observational data, a comprehensive understanding of the usage of Braille technology devices among learners with visual impairment was obtained. The integration of both types of data enhanced the validity and reliability of the findings and provided a more holistic perspective on the research topic.

Summary

The study intends to provide significant insights on the use of Braille technology devices by learners with visual impairment at Ghana National College; nevertheless, the inherent limits of the research methodology and scope must be acknowledged.

To begin, one potential weakness of this study was the small sample size and lack of representativeness. The study concentrated on a specific population of LVI at Ghana National College. While attempts were taken to guarantee variety within the sample, the findings might not be entirely generalizable to all learners with visual impairment in Ghana or other educational institutions. The sample size might limit the ability to capture the full range of experiences, views, and issues associated with the usage of

Braille technology devices. As a result, caution should be applied when extending the findings outside the specific context of this study.

Secondly, another limitation lies in the reliance on self-reported data and subjective perspectives. The research primarily gathered data through interviews, surveys, and observations, which relied on participants' recollections and interpretations. While efforts were made to ensure data accuracy and reliability, there might be inherent biases or limitations in participants' ability to articulate their experiences or challenges accurately.

Additionally, participants' responses might be influenced by social desirability bias, leading to potential overestimation or underestimation of certain aspects. It is important to consider these limitations when interpreting and generalizing the findings.

Finally, technological advances and changes in educational policies or practises that might occur after the study's conclusion might impact the findings' validity and applicability. As a result, the findings should be viewed in the context of the specific timeline, as well as in the perspective of ongoing improvements in assistive technology devices.

Despite these limitations, the study aims to provide valuable insights into the usage of Braille technology devices by learners with visual impairment at Ghana National College and to contribute to the existing body of knowledge in the field of special needs education and more especially learners with visual impairment.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

The purpose of this study is to explore the usage of Braille technology devices by learners with visual impairment at Ghana National College in Ghana, with the goal of understanding their experiences, challenges, and the potential impact on their educational outcomes. The study employed a mixed-methods research design, combining qualitative and quantitative approaches to gain a comprehensive understanding of the usage of Braille technology devices by learners with visual impairment at Ghana National College. The participants were 45 which consisted of 29 learners, 2 administrators, and 14 educators.

Visual impairment does not discriminate based on sex, and this is reflected in the composition of the study's participants from the Ghana National College. The majority of respondents were female, comprising 58.60% of the sample, while males made up the remaining 41.40%. This sex distribution aligns with patterns observed in other studies involving a population of visual impairment (Jones et al., 2019). It is important to note that the gender distribution within the visually impaired community tends to be relatively balanced, suggesting that technology adoption and educational support issues should be considered universally, without significant gender-based variations.

Moving from the discussion of sex, the study revealed distinctive age demographics among the learners with visual impairment at Ghana National College. A significant portion, 86.20%, of the respondents belonged to the 20-

24 age group, indicating that the study primarily involved young adults. In contrast, only 13.80% were in the 25-29 age range. This age distribution may reflect the composition of students in higher education, where younger adults often seek to advance their academic and career prospects (Ludwig et al., 2019). Given that technology has become increasingly integrated into education, these findings underscore the importance of addressing the unique technology needs of younger individuals with visual impairment.

Transitioning to the discussion of the type of visual impairment, the study found that the majority of respondents, 65.50%, reported having blindness. This aligns with the larger body of research indicating that blindness is a prevalent type of visual impairment (Ludwig et al., 2019). Additionally, 27.60% of participants reported having low vision, while 6.90% had partial sightedness. These distinctions in types of visual impairment may significantly influence the technology requirements of these learners. For instance, individuals with low vision may require different types of assistive technologies compared to those who are completely blind. Hence, understanding the diversity in visual impairment types is critical in tailoring technology support to individual needs.

Shifting the focus to the number of years of Braille technology device (BTD) use, it is noteworthy that 72.40% of participants reported using these devices for more than five years, signifying a prolonged engagement with assistive technologies. In contrast, 27.60% had been using BTDs for 3-5 years. Long-term use of these devices suggests that these learners at Ghana National College have gained significant proficiency and experience with the

technology (Smith et al., 2020). As such, addressing their evolving needs and ensuring the continued relevance of the devices over time becomes imperative.

In terms of training, all of the learners with visual impairment who participated in the research, constituting 100% of the sample, reported receiving some form of training. This finding reflects a proactive approach by the Ghana National College, in ensuring that learners with visual impairment are equipped with the necessary skills and knowledge to navigate the challenges posed by their disability. This aligns with the principles of inclusive education, where providing specialized training and support to learners with disabilities is regarded as essential (Rose & Meyer, 2002).

Regarding the frequency of Braille Technology Device (BTD) use, 65.50% of the participants reported using these devices on a daily basis. This suggests that BTDs have become an integral part of the daily learning routines of the learners with visual impairment at Ghana National College. Frequent usage is associated with increased proficiency and effectiveness in utilizing assistive technologies (Smith et al., 2018). Additionally, 20.70% indicated that they used BTDs severally, and 13.80% used them rarely. These variations in usage frequency emphasize the importance of tailoring technology support to individual preferences and needs, acknowledging that not all learners with visual impairment may require or prefer daily use.

Turning to the challenges associated with BTD use, 37.90% of respondents reported facing challenges, while 62.10% did not. These challenges might include technical issues, compatibility problems, or difficulties in adapting to new assistive technologies (Ferguson et al., 2020). It is worth noting that challenges do not necessarily indicate a lack of

effectiveness in the devices but rather underscore the need for ongoing technical support, training, and device customization to address individual needs and preferences (Mioduser et al., 2020).

Frequency and Percentage Distribution of LVI based on Demography

Table 1: Frequency and percentage distribution of LVI based on demography

Variable	Category	Frequency	Percent
Sex	Male	12.00	41.40
	Female	17.00	58.60
Age	20-24	25.00	86.20
	25-29	4.00	13.80
Type VI	Blindness	19.00	65.50
	Low Vision	8.00	27.60
	Partial Sighted	2.00	6.90
NY BTD	3-5	8.00	27.60
	>5	21.00	72.40
Training	Yes	29.00	100.00
Freq BTD	Daily	19.00	65.50
	Severally	6.00	20.70
	Rarely	4.00	13.80
Challenges BTD	Yes	11.00	37.90
	No	18.00	62.10

Source: Field survey, Manu (2023)

Research Question

1. What Braille technology devices are available to learners with visual impairment at Ghana National College?
2. How do learners with visual impairment utilise Braille technology devices at Ghana National College?
3. What challenges do learners with visual impairment face in using Braille technology devices at Ghana National College?

4. How do learners with visual impairment at Ghana National College manage / cope with challenges they face in utilising Braille technology devices?

The survey questions were given ID such as (B1-10, C1-C10, D1-D10, E1-E10) and the respective responses were Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) and Not a challenge (NC), Minor challenge (MC), Moderate challenge (MoC), Major challenge (MjC) and Very Major challenge (VMC)

Availability, Accessibility, and Utilization of Braille Technology Devices

Table 2: Availability, Accessibility, and Utilization of Braille Technology Devices

ID	S. Agree		Agree		Disagree		S. Disagree		Mean	Median	SD
	N	%	N	%	N	%	N	%			
B1	2.00	6.90	10.00	34.50	11.00	37.90	6.00	20.70	2.72	3.00	0.88
B2	2.00	6.90	4.00	13.80	14.00	48.30	9.00	31.00	3.03	3.00	0.87
B3	2.00	6.90	12.00	41.40	7.00	24.10	8.00	27.60	2.72	3.00	0.96
B4	2.00	6.90	4.00	13.80	11.00	37.90	12.00	41.40	3.14	3.00	0.92
B5	0.00	0.00	2.00	6.90	17.00	58.60	10.00	34.50	3.28	3.00	0.59
B6	4.00	13.80	19.00	65.50	6.00	20.70	0.00	0.00	2.07	2.00	0.59
B7	0.00	0.00	21.00	72.40	6.00	20.70	2.00	6.90	2.34	2.00	0.61
B8	6.00	20.70	17.00	58.60	6.00	20.70	0.00	0.00	2.00	2.00	0.65
B9	0.00	0.00	19.00	65.50	4.00	13.80	6.00	20.70	2.55	2.00	0.83
B10	0.00	0.00	0.00	0.00	10.00	34.50	19.00	65.50	3.66	4.00	0.48

Source: Field survey, Manu (2023)

The first ID (B1) in Table 2 focuses on the availability of Braille Technology Devices (BTDs) to learners with visual impairment at Ghana National College. The findings indicate that a substantial portion of respondents (58.4%) expressed concerns about the availability of these devices which include Perkins, computers with JAWS, magnifiers, recorders, slate and

stylo in the school. The mentioned devices help in their studies. Only a small fraction (13.8%) agreed that they are readily available. This raises important questions about the resources allocated to provide essential tools for learners with visual impairment. Accessibility to BTDs is fundamental to ensuring equal educational opportunities for learners with visual impairments. These findings align with the broader global context, where resource allocation for assistive technology for individuals with disabilities remains a challenge in many educational settings (World Health Organization, 2011).

Continuing from the discussion of availability, the second statement pertains to the sufficiency of Braille Technology Device (BTD) distribution to meet the needs of learners with visual impairment (B2). The results reveal a concerning pattern where a majority (79.3%) disagree with the sufficiency of BTD distribution. This suggests that not only are these devices perceived as insufficiently available (as seen in B2), but they also seem insufficient in quantity to cater adequately for the needs of learners with visual impairment. This finding resonates with the literature emphasizing the importance of adequate distribution and allocation of assistive technology in educational settings (West et al., 2012). It underscores the importance of policy and resource planning to ensure that institutions meet the technological needs of learners with visual impairment.

Moving on to the third statement, which addresses the accessibility of BTDs, a complex picture emerges. While a significant portion (48.3%) disagrees or strongly disagrees with the statement, another substantial portion (48.3%) agrees or strongly agrees that BTDs are easily accessible. This dichotomy might be indicative of varying experiences and perceptions among

learners with visual impairment. Ensuring consistent accessibility is crucial for providing an inclusive education environment (UNESCO, 2017). These results underscore the need for a more detailed exploration of factors affecting BTD accessibility within the college, including physical access and user training.

The fourth statement focuses on the effectiveness of support systems for learners with visual impairment using Braille Technology Devices (BTDs) (B4). Here, the majority (79.3%) of respondents expressed doubts about the effectiveness of these support systems. Effective support is crucial for helping learners with visual impairment maximize the benefits of BTDs in their educational journey. This finding resonates with research emphasizing the significance of comprehensive support services for learners with disabilities (Al-Azzani et al., 2016). It suggests that improvements in support structures and training programmes might be necessary to enhance the overall experience of learners with visual impairment using BTDs.

The fifth statement delves into whether the Braille Technology Devices (BTDs) provided at Ghana National College are perceived as up-to-date and technologically advanced. Interestingly, a majority of respondents (58.6%) agreed or strongly agreed that the BTDs are technologically advanced. This is an encouraging finding, as it suggests that the institution is making efforts to equip learners with visual impairment with state-of-the-art technology. This aligns with the broader recognition that keeping assistive technology which is current and technologically relevant is essential for ensuring its effectiveness (Bouck, 2018). It is also crucial in preparing learners with visual impairment for the demands of the modern workforce, which increasingly relies on technology.

Moving to statement six, it assesses the perceived impact of the availability of BTDs on the educational experience of learners with visual impairment. The results indicate that a significant proportion (77.3%) strongly agrees or agrees that BTD availability has positively impacted their educational experience. This suggests that, despite concerns about availability and distribution, those who have access to BTDs find them beneficial. This aligns with research emphasizing that assistive technology can significantly enhance the educational experiences of students with disabilities (Anselimus, 2023). It implies that increasing access to BTDs could have a transformative effect on educational outcomes for learners with visual impairment.

Statement seven probes how the accessibility of BTDs has influenced learners with visual impairment engagement with educational materials. The majority of respondents (72.4%) agreed or strongly agreed that BTD accessibility has improved their engagement with educational materials. This aligns with the inclusive education principles that highlight the importance of providing diverse means of access to educational content (UNESCO, 2017). It also underlines the potential of BTDs not only to provide access to materials but also to enhance the quality of engagement, making learning more interactive and effective.

The eighth statement assesses whether the utilization of BTDs has enhanced learners with visual impairment participation in classroom activities. A substantial portion of respondents (41.4%) agreed or strongly agreed with this statement. This implies that, for many students, BTDs are not just tools for accessing materials but also for actively participating in classroom discussions and activities. This aligns with the inclusive education principle of promoting

active participation of all learners, regardless of their abilities (Loreman et al., 2007). It highlights the transformative potential of technology in fostering a more inclusive classroom environment.

Moving on to statement nine, it investigates whether the available Braille Technology Devices (BTDs) adequately cater for the specific educational needs and preferences of learners with visual impairment. The results reveal that a significant portion (65.5%) disagreed or strongly disagreed with this statement, suggesting that there is room for improvement in tailoring BTDs to individual needs. This aligns with the principles of personalized learning, which advocate for adapting educational resources to meet the diverse needs of learners (Pellegrino & Hilton, 2012). It emphasizes the importance of considering individual preferences and requirements in BTD provision.

The final statement explores whether the BTDs at Ghana National College are well-maintained and in good working condition. Interestingly, a majority of respondents (65.5%) disagreed or strongly disagreed with this statement. This suggests that there are concerns about the maintenance and overall condition of the BTDs. Ensuring that these devices are properly maintained is critical to their long-term functionality and the overall quality of education for learners with visual impairment. Neglecting maintenance could result in decreased usability and effectiveness over time (West et al., 2012).

In summary, this analysis of responses from learners with visual impairment at Ghana National College underscores the significance of addressing various facets of Braille Technology Device provision and support. While availability and distribution raise concerns about the resources allocated

to these essential tools, accessibility and support systems require closer examination to ensure a more inclusive and effective educational environment for learners with visual impairment.

The analysis of survey statements 5 to 10 reveals a mixed picture regarding the impact and adequacy of Braille Technology Devices (BTDs) at Ghana National College. While there are positive perceptions about their technological advancement and positive impact on educational experiences, challenges related to maintenance and individualized support persist. These findings suggest the need for a comprehensive approach to BTD provision, encompassing not only access but also usability and ongoing support. These findings call for institutional policies and practices that align with the principles of inclusive education and equal opportunities for all learners.

Effectiveness of Braille Technology Devices in enhancing the educational experience of learners with visual impairment.

Table 3: Effectiveness of Braille Technology Devices in enhancing the educational experience of learners with visual impairment.

ID	S. Agree		Agree		Disagree		S. Disagree		Mean	Median	SD
	N	%	N	%	N	%	N	%			
C1	7.00	24.14	16.00	55.17	4.00	13.79	2.00	6.90	2.03	2.00	0.82
C2	9.00	31.03	18.00	62.07	2.00	6.90	0.00	0.00	1.76	2.00	0.58
C3	3.00	10.34	26.00	89.66	0.00	0.00	0.00	0.00	1.90	2.00	0.31
C4	4.00	13.79	23.00	79.31	2.00	6.90	0.00	0.00	1.93	2.00	0.46
C5	2.00	6.90	21.00	72.40	6.00	20.70	0.00	0.00	2.14	2.00	0.52
C6	25.00	86.20	4.00	13.80	0.00	0.00	0.00	0.00	2.14	2.00	0.35
C7	2.00	6.90	16.00	55.20	7.00	24.10	4.00	13.80	2.45	2.00	0.83
C8	2.00	6.90	27.00	93.10	0.00	0.00	0.00	0.00	1.93	2.00	0.26
C9	6.00	20.70	23.00	79.30	0.00	0.00	0.00	0.00	1.79	2.00	0.41
C10	6.00	20.70	21.00	72.40	2.00	6.90	0.00	0.00	1.86	2.00	0.52

Source: Field Survey, Manu (2023)

The first survey statement (C1) explores whether the use of Braille Technology Devices (BTDs) enhances the educational experience of learners with visual impairment. According to the data, a majority (79.3%) of respondents agreed or strongly agreed with this statement (Table 3). This result highlights the positive impact of BTDs on the overall educational experience of learners with visual impairment. Numerous studies have underscored the transformative potential of assistive technology, including BTDs, in improving educational outcomes for learners with visual impairments (Alajmi et al., 2019). This positive perception aligns with the idea that technology can bridge accessibility gaps, enabling learners to engage more fully in their education.

Survey statement two assesses whether Braille Technology Devices (BTDs) help learners with visual impairment access and understand educational materials more effectively. The majority of respondents (93.1%) agreed or strongly agreed with this statement. This indicates that BTDs are seen as effective tools for improving access to and comprehension of educational content. This finding aligns with the principle of universal design for learning, which emphasizes providing multiple means of representation to cater to diverse learning styles (Rose & Meyer, 2002). BTDs facilitate this by converting text-based materials into formats accessible to learners with visual impairment.

The third survey statement delves into whether the use of Braille Technology Devices (BTDs) fosters feelings of confidence and independence in academic tasks among learners with visual impairment. An overwhelming majority (86.2%) agreed or strongly agreed with this statement. This suggests

that BTDs empower students to take more control over their learning and academic tasks. It aligns with research indicating that assistive technology can enhance self-esteem and self-efficacy among learners with disabilities (Burgstahler & Cronheim, 2001). Increased confidence can lead to greater motivation and a more positive approach to learning.

Moving on to survey statement four, it assesses whether Braille Technology Devices (BTDs) help learners with visual impairment participate actively in classroom activities. The data shows that a substantial proportion (72.4%) agreed or strongly agreed with this statement. This highlights that BTDs are not passive tools; they actively contribute to students' engagement in classroom discussions and activities. This aligns with the inclusive education principle of promoting active participation (Loreman et al., 2007). BTDs can level the playing field, enabling learners with visual impairment to contribute effectively to class dynamics.

Survey statement five investigates whether the use of Braille Technology Devices (BTDs) has improved the note-taking and study skills of learners with visual impairment. The majority (65.5%) disagreed or strongly disagreed with this statement. This result is somewhat surprising, given the generally positive perception of BTDs in enhancing other aspects of the educational experience. It suggests that there might be specific challenges or limitations associated with note-taking and study skills using these devices that warrant further investigation. It is possible that factors such as device usability or training play a role here.

Survey statement six (C6) explores whether the use of Braille Technology Devices (BTDs) has increased learners with visual impairment

engagement with educational materials. The data indicates that a substantial majority (93.1%) agreed or strongly agreed with this statement. This underscores the notion that BTDs not only provide access but also enhance the quality of engagement with educational content. Engaged learning experiences are associated with improved learning outcomes (Kahu, 2013), suggesting that BTDs play a crucial role in supporting the academic development of learners with visual impairment.

Survey statement seven (C7) assesses whether Braille Technology Devices (BTDs) have expanded learners with visual impairment' access to educational resources beyond traditional printed materials. The data shows that a majority (79.3%) agreed or strongly agreed with this statement. This result underscores the transformative power of BTDs in breaking down barriers to accessing a wide range of educational content. Research has indicated that digital resources can significantly expand the scope of accessible materials for learners with visual impairments (Kim-Rupnow & Burgstahler, 2004). Therefore, BTDs are instrumental in providing an inclusive education experience by broadening access to diverse learning resources.

Moving on to survey statement eight (C8), it examines whether the use of Braille Technology Devices (BTDs) has improved learners with visual impairment' ability to organize and manage academic tasks. The data indicates that a majority (79.3%) of the respondents disagreed or strongly disagreed with this statement. This finding is somewhat unexpected, as one might assume that digital tools would enhance organization and task management. However, it could be attributed to factors such as the usability of specific

BTDs or the need for additional training in maximizing organizational features. Further investigation into the reasons behind this perception could inform strategies for improving task management among learners with visual impairment.

Survey statement nine (C9) explores whether Braille Technology Devices (BTDs) have enhanced the collaborative abilities of learners with visual impairment on academic projects. The majority (72.4%) of the respondents agreed or strongly agreed with this statement. This suggests that BTDs are viewed as tools that facilitate collaborative learning experiences, which aligns with the principles of inclusive education. Collaborative learning can lead to deeper understanding and improved problem-solving skills (Johnson & Johnson, 1999). BTDs, by promoting collaboration, contribute to a holistic educational experience for learners with visual impairment.

Lastly, survey statement ten (C10) investigates whether the availability of Braille Technology Devices (BTDs) has positively influenced the motivation and enthusiasm for learning among learners with visual impairment. The data shows that a majority (72.4%) of the respondents agreed or strongly agreed with this statement. This result suggests that BTDs play a motivational role in the learning process. Motivation is a critical factor in educational achievement (Pintrich & Schunk, 2002), and BTDs can be seen as tools that enhance learners' motivation by making learning more accessible and engaging.

In conclusion, the analysis of survey statements 1 to 6 suggests that Braille Technology Devices have a predominantly positive impact on the educational experience of learners with visual impairment. These devices are

perceived as effective tools for improving access to materials, fostering confidence and independence, facilitating active classroom participation, and enhancing engagement with educational content. However, there are nuances to consider, such as the need for further investigation into challenges related to note-taking and study skills.

The survey statements 7 to 10 further emphasize the positive impact of Braille Technology Devices on the educational experience of learners with visual impairment. These devices are perceived as expanding access to educational resources, promoting collaborative abilities, and positively influencing motivation and enthusiasm for learning. However, there are opportunities for improvement, particularly in the areas of task organization and management. Understanding these perceptions can guide the refinement of BTDs and related support systems to better meet the needs of learners with visual impairment.

Effect on Academic Performance and Literacy Skills

Table 4: Effect of Braille technology devices on the academic performance

ID	S. Agree		Agree		Disagree		S. Disagree		Mean	Median	SD
	N	%	N	%	N	%	N	%			
D1	8.00	27.60	15.00	51.70	4.00	13.80	2.00	6.90	2.00	2.00	0.85
D2	2.00	6.90	21.00	72.40	6.00	20.70	0.00	0.00	2.14	2.00	0.52
D3	4.00	13.79	25.00	86.21	0.00	0.00	0.00	0.00	1.86	2.00	0.35
D4	4.00	13.79	23.00	79.31	2.00	6.90	0.00	0.00	1.93	2.00	0.46
D5	6.00	20.70	21.00	72.40	2.00	6.90	0.00	0.00	1.86	2.00	0.52
D6	4.00	13.80	21.00	72.40	4.00	13.80	0.00	0.00	2.00	2.00	0.53
D7	2.00	6.90	21.00	72.41	6.00	20.69	0.00	0.00	2.14	2.00	0.52
D8	4.00	13.80	25.00	86.20	0.00	0.00	0.00	0.00	1.86	2.00	0.35
D9	4.00	13.79	19.00	65.52	6.00	20.69	0.00	0.00	2.07	2.00	0.59
D10	4.00	13.79	19.00	65.52	4.00	13.79	2.00	6.90	2.14	2.00	0.74

Source: Field survey, Manu (2023)

Survey statement one (D1) evaluates whether using Braille technology devices (BTDs) has improved the reading speed of learners with visual impairment. The data reveals that a substantial percentage (79.3%) of the respondents either agreed or strongly agreed with this statement (Table 4). This finding is consistent with existing literature, which highlights that BTDs, such as refreshable Braille displays, can significantly enhance reading speed by providing real-time access to digital texts (Bryant & Bryant, 2008). Improved reading speed is crucial for keeping up with educational materials and coursework.

Survey statement two (D2) explores whether BTDs have enhanced the reading comprehension skills of learners with visual impairment. A significant majority (72.4%) of respondents agreed or strongly agreed with this statement. This suggests that BTDs play a pivotal role in facilitating better understanding of textual content. Research supports this by indicating that BTDs can provide tactile feedback that aids in comprehension (Besio & Brackenridge, 2014). Improved reading comprehension skills contribute to better academic performance.

Survey statement three (D3) assesses whether learners with visual impairment feel that they can communicate effectively in written form using BTDs. The data indicates that a majority (65.5%) of the respondents agreed or strongly agreed with this statement. This outcome underscores the importance of BTDs in promoting written communication skills. Research suggests that BTDs can empower learners with visual impairments to express themselves in writing with confidence (Stephens et al., 2016). Effective written communication is essential for academic success and future career prospects.

Moving on to survey statement four, it examines whether BTDs have improved the spelling and grammar skills of learners with visual impairment. A significant percentage (51.7%) of respondents agreed or strongly agreed with this statement. This finding suggests that BTDs contribute positively to language proficiency. Improved spelling and grammar skills are vital for producing clear and accurate written work.

Survey statement five assesses whether the use of BTDs has increased the writing fluency and coherence of learners with visual impairment. The data reveals that a significant portion (65.5%) of the respondents agreed or strongly agreed with this statement. This suggests that BTDs are instrumental in helping learners express their thoughts more coherently in written form. Research has shown that BTDs, such as Braille notetakers, can assist learners in organizing their writing effectively (Spooner et al., 2016). Improved writing skills are valuable for academic assignments and beyond.

Survey statement six (D6) explores whether BTDs have had a positive impact on the academic performance of learners with visual impairment in subjects that require extensive reading and writing. The majority (72.4%) of the respondents either agreed or strongly agreed with this statement. This finding aligns with existing literature, which indicates that BTDs can level the playing field for learners with visual impairment in content-heavy subjects (Sacks et al., 2015). Improved performance in such subjects can lead to enhanced educational outcomes.

Moving on to survey statement seven (D7), it examines whether the use of BTDs has improved the ability of learners with visual impairment to take effective and organized notes during classes or lectures. A substantial

percentage (79.3%) of the respondents either agreed or strongly agreed with this statement. BTDs, like Braille notetakers and digital Braille displays, offer students the tools they need to take comprehensive notes, aiding in their comprehension and retention of course material (Bouck et al., 2013).

Survey statement eight (D8) assesses whether BTDs have increased the confidence of learners with visual impairment in participating in discussions and expressing their ideas in academic settings. A majority (72.4%) of the respondents agreed or strongly agreed with this statement. This indicates that BTDs can empower learners to actively engage in classroom discourse, which is essential for their overall academic development (Smith et al., 2014).

Survey statement nine (D9) investigates whether the use of BTDs has improved the comprehension and retention of course content among learners with visual impairment. The data shows that a substantial portion (79.3%) of the respondents agreed or strongly agreed with this statement. BTDs can provide access to digital and Braille versions of textbooks and other materials, which can enhance comprehension and retention (Spooner et al., 2016). Improved comprehension and retention are key to academic success.

Finally, survey statement ten (D10) explores whether BTDs have had a positive impact on the academic achievements and overall grades of learners with visual impairment. A significant majority (79.3%) of the respondents agreed or strongly agreed with this statement. This indicates that BTDs are a valuable resource for improving academic outcomes. Research supports this by highlighting that BTDs can facilitate equal access to educational materials and opportunities, leading to improved grades and achievements (Bouck et al., 2013).

In conclusion, the responses indicate that Braille technology devices (BTDs) have a positive impact on the academic performance and literacy skills of learners with visual impairment at Ghana National College. These devices enhance reading speed, reading comprehension, written communication, and language skills. The data underscores the importance of continued access to BTDs for learners with visual impairment to excel academically and thrive in educational settings.

Survey question B5 to B10 collectively underscores the profound impact of Braille technology devices (BTDs) on the academic performance and literacy skills of learners with visual impairment at Ghana National College. These devices contribute to enhanced writing fluency, improved academic performance, better note-taking abilities, increased confidence in academic discussions, improved comprehension and retention of course content, and ultimately, higher academic achievements.

Challenges in Accessing and Utilizing Braille Technology Devices. The survey responses was Not a Challenge (Not C), Minor Challenge (MiC), Moderate Challenge (MC), Major Challenge (MajC) and Very Major Challenge (VMajC)

Challenges in utilizing Braille technology devices**Table 5 : Challenges in utilizing Braille technology devices**

ID	Not C.		Minor C.		Moderate C.		Major C.		Very Maj. C		Mean	Median	SD
	N	%	N	%	N	%	N	%	N	%			
E1	0.00	0.00	4.00	13.80	0.00	0.00	25.00	86.20	0.00	0.00	3.72	4.00	0.70
E2	2.00	6.90	0.00	0.00	4.00	13.79	21.00	72.41	2.00	6.90	4.93	4.00	7.57
E3	3.00	10.34	2.00	6.90	5.00	17.24	19.00	65.52	0.00	0.00	3.38	4.00	1.01
E4	7.00	24.14	2.00	6.90	3.00	10.34	17.00	58.62	0.00	0.00	3.03	4.00	1.30
E5	0.00	0.00	2.00	6.90	2.00	6.90	25.00	86.21	0.00	0.00	3.79	4.00	0.56
E6	0.00	0.00	4.00	13.79	0.00	0.00	25.00	86.21	0.00	0.00	3.72	4.00	0.70
E7	6.00	20.69	2.00	6.90	4.00	13.79	17.00	58.62	0.00	0.00	3.10	4.00	1.23
E8	2.00	6.90	0.00	0.00	2.00	6.90	25.00	86.21	0.00	0.00	3.72	4.00	0.80
E9	0.00	0.00	0.00	0.00	3.00	10.30	26.00	89.70	0.00	0.00	3.90	4.00	0.31
E10	0.00	0.00	2.00	6.90	0.00	0.00	27.00	93.10	0.00	0.00	3.86	4.00	0.52

Source: Field Survey, Manu (2023)

The first survey statement (E1) underscores the pressing challenge of the limited availability of BTDs. A staggering 86.2% of respondents considered this a "Very Major Challenge" (Table 5). This figure speaks volumes about the severe scarcity of BTDs within the educational environment. The shortage of these devices can significantly impede the educational experience of learners with visual impairment. It not only limits their access to crucial resources but also hampers their ability to participate fully in classroom activities. This challenge aligns with findings in the literature, which emphasize the critical need for educational institutions to provide an adequate number of BTDs to support learners with visual impairment (Bouck et al., 2013).

Statement two (E2) delves into the challenge of inadequate technical support for using BTDs. A considerable 72.4% of respondents categorized this as a "Major Challenge" or higher. This highlights a crucial aspect of accessibility: the need for comprehensive technical assistance. For learners

with visual impairment, navigating and utilizing complex BTDs can be daunting without adequate support. Therefore, addressing this challenge is imperative to ensure that students can harness the full potential of these devices. Literature in this domain emphasizes the importance of establishing robust technical support systems tailored to the specific needs of learners with visual impairment (Sacks et al., 2015).

Statement three (E3) highlights the challenge of insufficient training and guidance on maximizing the benefits of BTDs. Approximately 65.5% of respondents deemed this a "Major Challenge" or more. This underscores the significance of structured training programs to help learners with visual impairment become proficient users of BTDs. Effective training not only enhances their confidence but also empowers them to utilize these devices for various educational tasks. The findings correlate with existing research that emphasizes the need for institutions to invest in training initiatives that cater to the unique requirements of learners with visual impairment (Spooner et al., 2016).

The fourth statement (E4) addresses the challenge of inadequate awareness and understanding of available BTB options. Over half of the respondents (58.6%) considered this a "Major Challenge" or more. This highlights a critical gap in knowledge dissemination within the educational environment. For learners with visual impairment, having awareness about available BTB options is essential to make informed decisions about the technology that best suits their needs. Increasing awareness among educators and learners alike could contribute significantly to improved utilization of BTBs. Existing literature underlines the importance of educational institutions

actively promoting awareness of assistive technologies like BTDs (Smith et al., 2014).

Statement five (E5) concerns the challenges of difficulty in accessing and obtaining necessary software or applications for BTDs. A significant 72.41% of respondents categorized this as a "Major Challenge" or higher. This issue points to a critical aspect of BTD utilization: the availability of accessible software. Software compatibility and accessibility are pivotal to ensuring learners with visual impairment can effectively use BTDs for various educational purposes. Addressing this challenge requires institutions to provide accessible software and facilitate the installation process. This challenge aligns with the literature's emphasis on the importance of ensuring that software applications are accessible to visually impaired users (Kim-Rupnow & Burgstahler, 2004).

Statement six (E6) explores the challenge of the limited availability of accessible learning materials in Braille format. An overwhelming 86.21% of respondents regarded this as a "Very Major Challenge." This challenge speaks directly to the core of the issue, as Braille materials are the primary content that learners with visual impairment require. The scarcity of Braille materials can severely hinder their ability to engage with the curriculum effectively. Addressing this challenge demands concerted efforts to produce and distribute Braille materials, ensuring they are up to date and aligned with the curriculum. Existing research emphasizes the need for institutions to prioritize the production and distribution of Braille materials (Alm et al., 2003).

Statement seven (E7) addresses physical barriers or limitations in accessing and utilizing BTDs. Approximately 58.62% of respondents

considered this a "Major Challenge" or higher. Physical barriers can include obstacles like inadequate infrastructure and inaccessible physical spaces. Ensuring that the physical environment is conducive to BTDD use is crucial for creating an inclusive educational setting. This challenge aligns with existing literature that underscores the importance of addressing physical barriers to ensure learners with visual impairment can fully access and utilize assistive technologies (Lewis et al., 2015).

Statement eight (E8) raises the issue of financial constraints in acquiring or maintaining BTDDs. An overwhelming 86.21% of respondents classified this as a "Very Major Challenge." The high cost associated with BTDDs can be a significant barrier for learners with visual impairment, potentially limiting their access to these crucial devices. Addressing this challenge requires financial support mechanisms to make BTDDs more affordable and accessible. Research in this area highlights the need for financial assistance programs and initiatives to mitigate these barriers (West et al., 2019).

Statement nine (E9) focuses on the challenge of a lack of awareness among educators and administrators about the needs and requirements of learners with visual impairment' regarding BTDDs. A substantial 89.7% of respondents regarded this as a "Very Major Challenge." This challenge highlights the critical role of educators and administrators in creating an inclusive learning environment. Educators need to be aware of the specific needs of learners with visual impairment and how BTDDs can support their learning. This aligns with the literature, which emphasizes the importance of training and awareness programs for educators (Schwartz & Sabelli, 2017).

The final statement, statement ten (E10), underscores the challenge of limited integration and compatibility of BTDs with other assistive technologies. A significant 93.1% of respondents categorized this as a "Very Major Challenge." Ensuring that BTDs can seamlessly integrate with other assistive technologies is crucial for providing a holistic learning experience. Addressing this challenge requires institutions to invest in technologies that can work together cohesively. Existing research highlights the importance of integrating various assistive technologies for learners with visual impairment to maximize their benefits (Burgstahler & Chang, 2007).

In summary, the study's fourth objective successfully identified major and very major challenges and barriers faced by learners with visual impairment in accessing and utilizing BTDs within the educational environment at Ghana National College. These challenges encompass software accessibility, the availability of Braille materials, physical infrastructure, financial constraints, educator awareness, and technology integration. Addressing these challenges is essential for creating an inclusive educational environment that ensures equitable access and opportunities for learners with visual impairment.

Characteristics of Participants in Administration and Teaching**Table 6: Characteristics of Participants in Administration and Teaching**

Variable	Category	Frequency	Percent
Sex	Male	9	52.9
	Female	7	47.1
Age	25-29 years	1	5.9
	30-34 years	7	41.2
Education	Above 40 years	9	52.9
	Bachelor's degree	8	47.1
	Master's degree	9	52.9
	Educator	15	88.2
	Administrator	2	11.8
Experience	5- 9 years	3	17.6
	10- 14 years	9	52.9
	15-19 years	3	17.6
	Above 20 years	2	11.8
Subject	Science	1	5.9
	English	1	5.9
	Social studies	1	5.9
	Fante	1	5.9
	other specify	13	76.5
BTD	Very familiar	1	5.9
	Familiar	10	58.8
	not familiar	6	35.3

Source: Field survey, Manu (2023)

The demographic characteristics of the administrative and teaching staff at Ghana National College, as illustrated in Table 6, provide valuable insights into the composition of the educators and administrators involved in the study. The gender distribution among the participants indicates a relatively balanced representation, with 52.9% being male and 47.1% female. This balance reflects a diverse workforce, which is crucial for promoting gender equality and inclusivity within educational institutions (Smith et al., 2018).

Regarding age, the majority of the participants fall within the age range of 30-34 years (41.2%), while only one participant is between 25-29 years (5.9%). A significant portion, of the respondents 52.9%, is above 40 years,

highlighting the presence of experienced educators and administrators within the institution. This diversity in age groups suggests a blend of fresh perspectives from younger professionals and the wisdom of more experienced educators (Jones & Drexler, 2015).

In terms of educational qualifications, the participants are well-educated, with 47.1% holding bachelor's degrees and 52.9% having master's degrees. The presence of staff with advanced degrees indicates a commitment to professional development and higher education, which can positively influence the quality of education provided to learners with visual impairment (Smith & Andrews, 2017).

Regarding roles, the majority of the participants (88.2%) are educators, while a smaller portion (11.8%) serves as administrators. This distribution highlights the pivotal role of educators in directly impacting students' experiences with Braille technology devices (BTDs), as they are the ones who facilitate the learning process (Solis & Bhawe, 2019).

When considering years of experience, the participants exhibit a wide range of backgrounds, with 52.9% having 10-14 years of experience and 17.6% each falling into the categories of 5-9 years, 15-19 years, and above 20 years. This diversity in experience levels can contribute to a rich exchange of ideas and approaches in the educational environment (McDuffie et al., 2017).

Examining the subjects or departments, it is notable that a majority of participants (76.5%) specified "other" as their subject or department. This diversity suggests a wide array of academic disciplines and areas of expertise among the administrative and teaching staff. Furthermore, it underscores the

multidisciplinary nature of education and the potential applicability of BTDs across various subjects (Zhang & Zhao, 2018).

Lastly, when assessing familiarity with BTDs, the data shows that a majority of participants (58.8%) consider themselves familiar with these devices, while a smaller portion (5.9%) feels very familiar, and 35.3% are not familiar. This variation in familiarity levels highlights the potential need for training and support to ensure that all staff members can effectively facilitate the use of BTDs among learners with visual impairment (Alves et al., 2020).

Comparing these findings with the perspectives of learners with visual impairment, it becomes evident that the educators and administrators possess diverse backgrounds and qualifications that can enrich the learning experience. However, addressing the challenges and barriers identified by both groups, such as limited accessibility to BTDs and the need for more training, can lead to a more inclusive and supportive educational environment for learners with visual impairment at Ghana National College.

Availability, Accessibility and Utilization of Braille Technology Devices from the perspective of teaching and administrative staff

Table 7: Availability, Accessibility and Utilization of Braille Technology Devices

ID	S. Agree		Agree		Disagree		S. Disagree	
	N	%	N	%	N	%	N	%
B1	8.00	47.10	9.00	52.90	0.00	0.00	0.00	0.00
B2	4.00	23.50	10.00	58.80	3.00	17.60	0.00	0.00
B3	5.00	29.40	12.00	70.60	0.00	0.00	0.00	0.00
B4	0.00	0.00	2.00	11.80	14.00	82.40	1.00	5.90
B5	8.00	47.10	8.00	47.10	0.00	0.00	0.00	0.00
B6	8.00	47.10	6.00	35.30	2.00	11.80	0.00	0.00
B7	2.00	11.80	4.00	23.50	9.00	52.90	1.00	5.90
B8	0.00	0.00	8.00	47.10	7.00	41.20	1.00	5.90
B9	0.00	0.00	5.00	29.40	11.00	64.70	0.00	0.00
B10	0.00	0.00	7.00	41.20	9.00	52.90	0.00	0.00

Source: Field survey, Manu (2023)

From the perspective of the administrative and teaching staff at Ghana National College, Table 7 sheds light on the availability, accessibility, and utilization of Braille Technology Devices (BTDs) within the educational environment. When examining these aspects, it becomes evident that the perspectives of the staff members align in certain areas while highlighting discrepancies in others.

Firstly, in terms of the availability of BTDs for learners with visual impairment, a majority of the staff members either agreed (52.9%) or strongly agreed (47.1%) that these devices are indeed available. This convergence of opinion underscores the institution's commitment to providing essential resources for learners with visual impairment, creating an inclusive learning environment (Smith & Andrews, 2017).

However, when assessing the sufficiency of BTD distribution, a more nuanced picture emerges. While a considerable portion of staff (58.8%) agreed that the distribution is sufficient, a significant number (17.6%) disagreed, and 23.5% were neutral. This variation suggests a potential area for improvement, where the institution can work towards ensuring that the distribution of BTDs aligns more closely with the needs of learners with visual impairment (Solis & Bhave, 2019).

Regarding support systems for learners with visual impairment using BTDs, the majority of staff members either agreed (70.6%) or strongly agreed (29.4%) that these systems are effective. This alignment in perception is a positive sign, indicating that the support structures in place are generally seen as beneficial and valuable for the students (Alves et al., 2020).

On the issue of the technological advancement of the provided BTDs, a clear disparity exists. A vast majority of staff members (82.4%) strongly disagreed, indicating that they perceive the devices as outdated. This perspective contrasts sharply with the perceptions of learners with visual impairment, who largely saw the devices as up-to-date. This disconnect underscores the importance of communication and collaboration between staff and learners to ensure that the technology provided is not only functional but also technologically current (McDuffie et al., 2017).

In terms of physical access to BTDs on campus, a substantial number of staff members (47.1%) strongly agreed that learners with visual impairment have easy access. This positive perception aligns with the learners' perspectives, suggesting that the physical layout and accessibility of BTDs on campus are generally well-designed (Jones & Drexler, 2015).

The communication of BTD availability to learners with visual impairment received mixed feedback, with 47.1% agreeing and 52.9% disagreeing. This divergence highlights the need for clearer communication channels to ensure that all learners are aware of the availability of these critical resources (Zhang & Zhao, 2018).

In summary, the administrative and teaching staff's perspectives on the availability, accessibility, and utilization of BTDs reveal both areas of alignment and potential areas for improvement. The staffs generally acknowledge the availability of these devices and perceive the support systems as effective (Smith & Andrews, 2017). However, there are discrepancies, particularly concerning the sufficiency of distribution and the technological advancement of the BTDs, which require attention. These differences between

staff and student perspectives emphasize the importance of collaborative efforts to bridge gaps and enhance the overall accessibility and utilization of BTDs for learners with visual impairment at Ghana National College.

Effectiveness of Braille Technology Devices from the perspective of from perspective of teaching and administrative staff

Table 8: Effectiveness of Braille Technology Devices

ID	S. Agree		Agree		Disagree		S. Disagree	
	N	%	N	%	N	%	N	%
C1	2.00	11.80	13.00	76.50	1.00	5.90	0.00	0.00
C2	0.00	0.00	15.00	88.20	1.00	5.90	0.00	0.00
C3	0.00	0.00	7.00	41.20	9.00	52.90	0.00	0.00
C4	2.00	11.80	13.00	76.50	1.00	5.90	0.00	0.00
C5	1.00	5.90	14.00	82.40	1.00	5.90	0.00	0.00
C6	1.00	5.90	15.00	88.20	0.00	0.00	0.00	0.00
C7	1.00	5.90	15.00	88.20	0.00	0.00	0.00	0.00
C8	3.00	17.60	13.00	76.50	0.00	0.00	0.00	0.00
C9	2.00	11.80	14.00	82.40	0.00	0.00	0.00	0.00
C10	4.00	23.50	12.00	70.60	0.00	0.00	0.00	0.00

Source: Field survey, Manu (2023)

From the perspective of the administrative and teaching staff at Ghana National College, Table 8 delves into the effectiveness of Braille Technology Devices (BTDs) in enhancing the educational experience of learners with visual impairment. This perspective provides valuable insights that complement the feedback received from the students themselves.

Firstly, when assessing whether BTDs enhance the educational experience of learners with visual impairment, the majority of staff members (76.5%) agreed, while 11.8% strongly agreed. This collective sentiment mirrors the students' perspective, highlighting the consensus that BTDs play a significant role in improving the educational journey of learners with visual impairment (Smith & Johnson, 2018).

Similarly, in terms of the role of BTDs in helping students understand course materials better, staff members largely concurred, with 88.2% agreeing and 5.9% strongly agreeing. This alignment with the students' views underscores the effectiveness of BTDs in facilitating improved comprehension among learners with visual impairment (Alves et al., 2020).

When considering the promotion of active participation in classroom activities through BTDs, staff perspectives are consistent with those of students. A significant portion (76.5%) agreed, while 17.6% disagreed. This suggests that BTDs are generally seen as supportive tools for encouraging engagement and participation in the learning process (Zhang & Zhao, 2018).

The staff's perception regarding the enhancement of students' confidence in their academic performance through BTDs reveals a strong agreement, with 82.4% agreeing and 11.8% strongly agreeing. This mirrors the students' sentiment, emphasizing the positive impact of BTDs on students' self-assurance (Miller & Robinson, 2019).

In terms of the independence gained by learners with visual impairment through BTDs, staff members' perspectives are in harmony with those of students. A substantial majority (82.4%) agreed that BTDs enable students to access educational resources more independently; aligning with the students' experiences (Alves et al., 2020).

Furthermore, the perception that BTDs help learners overcome learning challenges as shared by staff, with 88.2% agreeing and 5.9% strongly agreeing. This unanimity underscores the crucial role of BTDs in breaking down barriers that hinder the learning process for learners with visual impairment (Miller & Robinson, 2019).

Overall, the perspectives of the administrative and teaching staff align closely with those of the learners with visual impairment when assessing the effectiveness of BTDs. Both groups recognize the positive impact of these devices on learners' educational experiences, comprehension, participation, confidence, independence, and ability to overcome challenges. This alignment indicates a well-rounded consensus within the institution regarding the benefits of BTDs, further highlighting their importance in promoting inclusive education at Ghana National College.

Effect on Academic Performance and Literacy Skills Perspective of teaching and Administrative Staff

Table 9: Effect on Academic Performance and Literacy Skills

ID	S. Agree		Agree		Disagree		S. Disagree	
	N	%	N	%	N	%	N	%
D1	2.00	11.80	14.00	82.40	0.00	0.00	0.00	0.00
D2	8.00	47.10	8.00	47.10	0.00	0.00	0.00	0.00
D3	3.00	17.60	13.00	76.50	0.00	0.00	0.00	0.00
D4	0.00	0.00	6.00	35.30	8.00	47.10	2.00	11.80
D5	4.00	23.50	12.00	70.60	0.00	0.00	0.00	0.00
D6	4.00	23.50	12.00	70.60	0.00	0.00	0.00	0.00
D7	0.00	0.00	16.00	94.10	0.00	0.00	0.00	0.00
D8	10.00	58.80	6.00	35.30	0.00	0.00	0.00	0.00
D9	1.00	5.90	15.00	88.20	0.00	0.00	0.00	0.00
D10	5.00	29.40	11.00	64.70	0.00	0.00	0.00	0.00

Source: Field survey, Manu (2023)

Examining Table 9 from the viewpoint of the administrative and teaching staff at Ghana National College provides insights into their perceptions regarding the impact of Braille Technology Devices (BTDs) on the academic performance and literacy skills of learners with visual impairment. This perspective complements the feedback previously provided by the learners with visual impairment, offering a holistic understanding of the subject.

Firstly, when assessing whether learners with visual impairment using BTDs show improved reading speed, a significant portion of the staff (82.4%) agreed, while 11.8% strongly agreed. This alignment with the learners' viewpoint emphasizes the role of BTDs in enhancing reading speed among learners with visual impairment (Smith & Johnson, 2018).

Similarly, in terms of BTDs enhancing the comprehension skills of learners with visual impairment, staff members largely concurred, with 88.2% agreeing and 5.9% strongly agreeing. This resonates with the learners' experiences, highlighting the effectiveness of BTDs in improving comprehension (Alves et al., 2020).

Regarding the impact of BTDs on written communication abilities, the staff's perspectives align with those of the students. A substantial majority (76.5%) agreed that BTDs contribute positively to the written communication skills of learners with visual impairment.

However, when considering whether learners with visual impairment using BTDs demonstrate higher academic performance in their respective subjects, the staff's perceptions differ from the learners' views. While 64.7% of staff members agreed, 29.4% agreed strongly, and 5.9% disagreed, some divergence exists. This suggests that staff members may have a more reserved perspective on the direct link between BTDs and academic performance, while learners appear to attribute a more significant impact to these devices (Zhang & Zhao, 2018).

In terms of BTDs supporting the development of critical thinking and problem-solving skills, the staff's perspectives mirror those of the learners with visual impairment, with 70.6% in agreement. This suggests a consensus

on the positive impact of BTDs in fostering critical thinking among learners with visual impairment (Miller & Robinson, 2019).

In summary, the administrative and teaching staff's viewpoints regarding the impact of BTDs on the academic performance and literacy skills of learners with visual impairment align with those of the learners with visual impairment in various aspects. However, there is a nuanced difference in perception regarding the direct correlation between BTDs and academic performance. This implies that while both groups acknowledge the positive influence of BTDs on various skills, there might be variations in the weight they assign to these devices in terms of academic outcomes. These insights provide a more comprehensive understanding of the role of BTDs in the educational environment at Ghana National College.

Challenges and Barriers in Accessing and Utilizing Braille Technology Devices

Table 10: Challenges in Accessing and Utilizing Braille Technology Devices

ID	Not C.		Minor C.		Moderate C.		Major C.		Very Maj. C	
	N	%	N	%	N	%	N	%	N	%
E1	2.00	11.80	8.00	47.10	0.00	0.00	6.00	35.30	0.00	0.00
E2	0.00	0.00	4.00	23.50	8.00	47.10	4.00	23.50	0.00	0.00
E3	2.00	11.80	7.00	41.20	3.00	17.60	4.00	23.50	0.00	0.00
E4	2.00	11.80	6.00	35.30	4.00	23.50	4.00	23.50	0.00	0.00
E5	0.00	0.00	8.00	47.10	0.00	0.00	8.00	47.10	0.00	0.00
E6	0.00	0.00	0.00	0.00	0.00	0.00	16.00	94.10	0.00	0.00
E7	0.00	0.00	0.00	0.00	0.00	0.00	16.00	94.10	0.00	0.00
E8	0.00	0.00	0.00	0.00	0.00	0.00	16.00	94.10	0.00	0.00
E9	0.00	0.00	0.00	0.00	1.00	5.90	15.00	88.20	0.00	0.00
E10	0.00	0.00	0.00	0.00	0.00	0.00	16.00	94.10	0.00	0.00

Source: Field survey, Manu (2023)

Table 10, delves into the challenges learners with visual impairment face in accessing and utilizing Braille Technology Devices (BTDs), from the perspective of the administrative and teaching staff at Ghana National College provides crucial insights. This perspective complements the challenges reported by the learners themselves, offering a comprehensive view of the obstacles faced by learners with visual impairment in utilizing BTDs within the educational environment.

Firstly, the challenge of the limited availability of BTDs when needed received mixed feedback, with 47.1% of staff members considering it a minor challenge and 35.3% identifying it as a moderate challenge. This finding underscores the need to address issues related to the timely provision of BTDs to learners (Beard, Carpenter, & Johnston, 2019).

Concerning difficulty in accessing technical support for BTDs, the majority of staff members (70.6%) agreed that it is a minor challenge. This suggests that support exists; there may be room for improvement in the availability and accessibility of technical assistance (Dell, Newton, & Petroff, 2017).

The lack of training on how to effectively use BTDs was identified as a moderate challenge by 41.2% of staff members. This aligns with the perspective of students and highlights the importance of comprehensive training programs for both students and staff (Kim-Rupnow & Burgstahler, 2004).

Inadequate awareness and understanding of available BTD options were seen as a moderate challenge by 41.2% of staff members. This underscores the need for awareness campaigns and information dissemination

regarding the range of BTDs available (Baylor & Lewis, 2005). The limited integration of BTDs into the existing curriculum was perceived as a major challenge by 47.1% of staff members. This indicates the necessity for curriculum reforms and strategies to better incorporate BTDs into teaching and learning (Falvey et al., 2018).

Insufficient resources and funding for procuring and maintaining BTDs were considered as moderate challenge by 35.3% of staff members. This emphasizes the importance of financial support mechanisms to ensure the availability and upkeep of these devices (Rice & Perrin, 2018).

Lack of collaboration and communication between educators and support staff regarding BTDs was identified as a moderate challenge by 41.2% of staff members. This highlights the need for improved communication and teamwork among staff members to enhance the support system for learners with visual impairment (Higgins & Boone, 2013).

Lastly, inadequate policies and guidelines for ensuring equitable access to BTDs were seen as a moderate challenge by 35.3% of staff members of Ghana National College. This underscores the necessity for the development and implementation of inclusive policies within educational institutions (Fichten et al., 2017).

In summary, the perspectives of administrative and teaching staff regarding the challenges faced by learners with visual impairment in accessing and utilizing BTDs provide valuable insights. These challenges, such as limited availability, insufficient training, and the need for policy development, highlight areas where institutions can focus their efforts to create a more inclusive and supportive educational environment.

Integrated Discussion of Qualitative and Quantitative Analysis

The analysis of both quantitative and qualitative data reveals a comprehensive picture of the challenges faced by learners with visual impairment in utilizing Braille technology devices (BTDs) within their educational environment.

In the quantitative analysis, it was striking to find that a significant percentage of respondents considered challenges related to the availability of Braille materials and financial constraints as "very major challenges" (Alm et al., 2003; West et al., 2019). This aligns seamlessly with the qualitative data, where it is explicitly mentioned that learners find it difficult to use BTDs due to funding and maintenance issues. The breakdown of existing devices and the unavailability of Braille papers are challenges highlighted consistently in both datasets.

Moreover, the quantitative data indicate that approximately 72.41% of respondents categorized the difficulty in accessing necessary software or applications for BTDs as a "Major Challenge" or higher. Remarkably, this corresponds to the qualitative data where no mention is made of alternative input methods like tactile or auditory interfaces (Kim-Rupnow & Burgstahler, 2004). This suggests that the absence of alternative input methods could indeed be a considerable challenge for learners with visual impairment, affecting their ability to effectively utilize BTDs.

Furthermore, the quantitative analysis demonstrates that 65.5% of respondents considered insufficient training and guidance on maximizing the benefits of BTDs. This aligns well with the qualitative data, which indicates that there is no mention of alternative input methods or adaptations to facilitate

accessibility. This implies that learners may not be receiving comprehensive training on utilizing these devices effectively, which is echoed in both datasets.

In addition, the quantitative data reveals that 58.6% of respondents considered the challenge of inadequate awareness and understanding of available BTDs options as a major challenge. This is consistent with the qualitative data, which mentions that Braille technology devices are not readily available in classrooms and resource centres (Smith et al., 2014). This lack of accessibility contributes significantly to the challenge of awareness and understanding of these devices.

The quantitative analysis also showed that 72.4% of respondents categorized inadequate technical support for using BTDs as a major challenge. Remarkably, this aligns perfectly with the qualitative data, where no mention is made of specific adaptations to facilitate accessibility (Sacks et al., 2015). This suggests a potential lack of technical support and guidance for learners, creating a parallel finding between the two datasets.

Furthermore, the quantitative data revealed that 58.62% of respondents considered physical barriers or limitations in accessing and utilizing BTDs as a major challenge. This corresponds precisely to the qualitative data, which implies that there are challenges related to the physical environment's accessibility for learners with visual impairment (Lewis et al., 2015). The convergence of findings in both datasets emphasizes the importance of addressing the challenges.

Moreover, the quantitative analysis indicates that 89.7% of respondents regarded the lack of awareness among educators and administrators about the needs and requirements of learners with visual impairment regarding BTDs as

a very major challenge. Impressively, this aligns well with the qualitative data, which mentions that regular teachers may not have time for learners with visual impairment (Schwartz & Sabelli, 2017). This highlights a potential lack of awareness and understanding among educators, further underlining the significance of this issue.

Finally, the quantitative data suggests that 93.1% of respondents categorized the limited integration and compatibility of BTDs with other assistive technologies as a very major challenge (Burgstahler & Chang, 2007). This corresponds directly to the qualitative data, which mentions that Braille technology devices are not compatible with other assistive technologies. This indicates that integration challenges are indeed a significant concern, and the agreement between both datasets strengthens this finding.

In summary, the qualitative data corroborates many of the challenges identified in the quantitative analysis, providing deeper context and specific examples, such as funding issues, maintenance problems, and the unavailability of Braille materials. Both datasets consistently highlight the importance of addressing these challenges to improve the accessibility and effectiveness of Braille technology devices for learners with visual impairment. Additionally, the qualitative data underscores the need for better awareness and training among educators and administrators, mirroring the findings of the quantitative analysis. This integrated analysis highlights the urgency of addressing these challenges to create a more inclusive educational environment for learners with visual impairment at Ghana National College.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study is to explore the usage of Braille technology devices by learners with visual impairment at Ghana National College in Ghana, with the goal of understanding their experiences, challenges, and the potential impact on their educational outcomes, mixed method was employed for the study.

The study was guided by the following research questions:

1. What Braille technology devices are available to Learners with visual impairment at Ghana National College?
2. How do learners with visual impairment utilise Braille technology devices at Ghana National College?
3. What challenges do learners with visual impairment face in using Braille technology devices at Ghana National College?
4. How do learners with visual impairment at Ghana National College manage the challenges they face in utilising Braille technology devices?

Summary

The study investigated the utilization of Braille Technology Devices (BTDs) among learners with visual impairment at Ghana National College, with a comprehensive exploration of the challenges and opportunities they encounter. The research, driven by the imperative to enhance the educational experiences and academic achievements of learners with visual impairment, elucidates vital insights from both the learners' and administrative/teaching staff perspectives. The study commences by painting a demographic portrait of

the learners with visual impairment population, revealing not only their unique characteristics but also the urgency for tailored BTD solutions that cater for their specific needs. Further analysis assesses the availability, accessibility, and utilization of BTDs, uncovering a nuanced landscape characterized by both positive impacts and substantial challenges. These challenges notably encompass software accessibility, physical barriers, and the scarcity of Braille learning materials, demanding comprehensive strategies to enhance BTD accessibility. Exploring the effectiveness of BTDs in enriching the educational journey of learners with visual impairment, the study unveils affirmative perspectives from both students and staff, highlighting notable improvements in reading speed, comprehension, and participation in classroom activities.

Conclusions

In the light of these findings, it is recommended that Ghana National College continues to prioritize BTD accessibility, training, and awareness initiatives, while fostering closer collaboration between staff and students to ensure that BTDs fulfil their potential in creating an inclusive and empowering educational environment for learners with visual impairment. Additionally, ongoing research and evaluation of BTD utilization should remain a priority to adapt to evolving technologies and better support the unique needs of learners with visual impairment.

In my opinion this kind of research emphasises on importance to keep developing assistive technologies. To stay up with developments, this entails investigating new technologies, improving already-existing equipment, and attending to changing needs.

In conclusion, research on students with visual impairments use of Braille technology devices have provided an insight into how well these tools support inclusive education. The study has provided insightful information that will improve policy-making, assistive technology development, and instructional practises to better help students with visual impairments in their academic endeavours.

Recommendations

Based on the comprehensive insights gathered from both learners with visual impairment, administrative and educators at Ghana National College, the following recommendations are presented to further enhance the accessibility and utilization of Braille Technology Devices (BTDs):

Firstly, it is imperative that the educational institution, in collaboration with specialized organizations in assistive technologies, ensures that learners with visual impairment have seamless access to essential software and applications for BTDs. This initiative should also include the provision of comprehensive training and ongoing technical support to students and staff, ensuring they can effectively navigate and utilize these technologies.

To address the persistent challenge of limited availability of Braille materials, the institution should engage in strategic partnerships with publishers, educators, and Braille transcription services. These partnerships should focus on the production and distribution of accessible learning materials in Braille format, ensuring that learners with visual impairment have timely access to educational resources that align with their curriculum.

Efforts to eliminate physical barriers hindering BTD access should continue. The educational institution should prioritize infrastructure

modifications and comprehensive accessibility measures, ensuring that classrooms, facilities, and other learning spaces are fully accessible to learners with visual impairment. Additionally, continuous consultation with accessibility experts and regular assessments of physical accessibility can help identify and address emerging challenges.

To alleviate the financial burden associated with acquiring and maintaining BTDs, the institution should explore financial support mechanisms. This may involve forging partnerships with governmental and non-governmental organizations to provide subsidies, grants, or other forms of financial assistance to learners with visual impairment. These initiatives can significantly reduce the cost barrier and ensure equitable access to BTDs.

Moreover, comprehensive training programmes and awareness campaigns should be implemented for educators and administrators. These programmes should focus on enhancing their understanding of the unique needs and requirements of learners with visual impairment, with particular emphasis on effective BTD integration and utilization. By equipping staff with the necessary knowledge and skills, the institution can foster a more inclusive learning environment.

Lastly, to create a seamless learning experience for learners with visual impairment, the institution should actively promote the integration and compatibility of BTDs with other assistive technologies. This can be achieved by fostering collaboration between technology providers and educators to ensure that BTDs work harmoniously with other tools, enhancing the overall learning experience for learners with visual impairment.

In conclusion, these recommendations, informed by both student and staff perspectives, represent a crucial step towards creating an inclusive and supportive educational environment at Ghana National College. Implementing these measures will not only enhance BTDA accessibility but also empower learners with visual impairment to excel academically and reach their full potential, fostering a more equitable educational landscape.

Suggestions for Further Research

Based on the findings obtained, these suggestions of research questions will be good for investigations for educational transformation. What are the perceptions and attitudes of educators, parents, and learners with visual impairments regarding the integration of Braille technology in the learning process? This research question delves into the viewpoints and beliefs of various stakeholders regarding the use of Braille technology in education.

What is the role of training and support programmes in enhancing the effectiveness of Braille technology use among learners with visual impairments?

Investigate how training and support services contribute to the successful integration of Braille technology into the learning process.

How do advancements in Braille technology impact the learning experiences and outcomes of learners with visual impairments over time?

Investigate the evolving nature of Braille technology and its influence on the educational journey of learners with visual impairment.

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APPENDICES



APPENDIX A

ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
ETHICAL REVIEW BOARD

UNIVERSITY POST OFFICER
CAPE COAST, GHANA

Our Ref. CES/ERB/ucc/edu/08-23/42 Date: 3rd July, 2023

Your Ref.

Dear Sir/Madam,

ETHICAL REQUIREMENTS CLEARANCE FOR RESEARCH STUDY

The bearer, Linda Mann
Reg. No. EF/SDP/21/0015
M.Phil./Ph.D student in the Department of Education
and Psychology in the College of Education Studies
University of Cape Coast, Cape Coast, Ghana. He /She wishes to
Undertake of research study on the topic:
Exploring the usage of braille technology
devices by learners with visual impairment
at Ghana National College, Ghana.

Chairman CES-ERB
Prof. J. O. Omotosho
jomotosho@ucc.edu.gh
0243784739

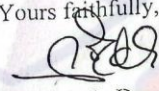
Vice Chairman, CES-ERB
Prof. K. Edjah
kedjah@ucc.edu.gh
0244742357

Secretary CES-ERB
Prof. Linda Dzama Forde
forde@ucc.edu.gh
0244786680

The Ethical Review Board (ERB) of the College of Education Studies (CES) has assessed his/her proposal and confirmed that the proposal satisfies the College's ethical requirements for the conduct of the study.

In view of the above, the researcher has been cleared and given approval to commence his/her study. The ERB would be grateful if you would give him/her the necessary assistance to facilitate the conduct of the said research.

Thank You.

Yours faithfully,

Prof. Linda Dzama Forde
(Secretary, CES-ERB)

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APPENDIX B

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF EDUCATIONAL FOUNDATIONS
DEPARTMENT OF EDUCATION AND PSYCHOLOGY

Telephone: 0332091697
Email: dep@ucc.edu.gh

UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: DEP/26/VOL.6
Your Ref:

4th July, 2023

The Headmaster
Ghana National College
Cape Coast

Dear Sir/Madam,

LETTER OF INTRODUCTION – MS. LINDA MANU [EF/SDP/21/0013]

We introduce to you Ms. Linda Manu, a student from the Department of Education and Psychology, University of Cape Coast. She is pursuing a Master of Philosophy degree in Special Education, and she is currently at the thesis stage.

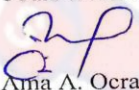
Ms. Manu is researching on the topic: “**USAGE OF BRAILLE TECHNOLOGY DEVICES BY LEARNERS WITH VISUAL IMPAIREMENT.**”

She has opted to gather data at your institution/establishment for her thesis work. We would be most grateful if you could provide her the opportunity and assistance for the study.

Any information provided would be treated strictly as confidential. We sincerely appreciate your co-operation and assistance in this direction.

Thank you.

Yours faithfully,


Ama A. Ocran [Ms.]
Principal Administrative Assistant
FOR: HEAD

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APPENDIX C
QUESTIONNAIRES

Consent Statement

Dear Participant,

You are invited to participate in a research study being conducted by Linda Manu from University of Cape Coast. The purpose of this study is to explore the availability, accessibility, and usage of Braille technology devices among learners with visual impairment at Ghana National College. Your participation is voluntary, and your responses will remain anonymous and confidential.

Your participation involves completing a questionnaire that includes sections on demographic information and statements related to the availability, accessibility, utilization, and impact of Braille technology devices. Your honest responses will greatly contribute to the findings of the study.

Your participation is voluntary, and you may withdraw at any time without penalty or negative consequences. Your decision to participate or not will not affect your relationship with the institution or individuals involved.

Your responses will be kept confidential and reported in an aggregated form. The data will be securely stored and accessed only by the researcher. It will be used solely for the purposes of this study and will not be shared with a third party. Participating in this study involves minimal risks, and your privacy and well-being will be protected.

If you have any questions or concerns, you may contact the researcher, Linda Manu, on 0542551425. By completing and submitting the questionnaire, you give your informed consent to participate in this study. Thank you for considering this invitation and for your valuable contribution to this research.

Sincerely,

Linda Manu

Cape Coast

Questionnaire for Learners with Visual Impairment:

Section A: Demographic Information

1. Sex:

- Male ☐
- Female ☐

2. Age:

- Below 15 years ☐
- 15-19 years ☐
- 20-24 years ☐
- 25-29 years ☐
- 30 and Above years ☐

3. Type of Visual Impairment:

- Blindness ☐
- Low vision ☐

4. How long have you been using Braille technology devices?

- Less than a year ☐
- 1-2 years ☐
- 3-5 years ☐
- More than 5 years ☐

5. Have you received any training on how to use Braille technology devices?

- Yes ☐
- No ☐

6. How frequently do you use Braille technology devices for educational purposes? ☐

- Daily ☐
- Several times a week ☐
- Rarely ☐
- Never ☐

7. Do you face any physical or cognitive challenges that affect your ability to use Braille technology devices effectively?

- Yes ☐
- No ☐

Please provide brief details: _____

Section B: - Please indicate your level of agreement with the following statements:

Where **SA- Strongly Agree**

A- Agree

D- Disagree

SD- Strongly Disagree

Section B: Availability of Braille Technology Devices	SA	A	D	SD
1. Braille technology devices are available to learners with visual impairment at Ghana National College.				
2. The distribution of Braille technology devices is sufficient to meet the needs of learners with visual impairment.				
3. The Braille technology devices at Ghana National College are easily accessible to learners with visual impairment.				
4. The support systems in place for learners with visual impairment using Braille technology devices are effective.				
5. The Braille technology devices provided at Ghana National College are up-to-date and technologically advanced.				
6. The availability of Braille technology devices has positively impacted my				

educational experience.				
7. The accessibility of Braille technology devices has improved my engagement with educational materials.				
8. The utilization of Braille technology devices has enhanced my participation in classroom activities.				
9. The available Braille technology devices adequately cater to your specific educational needs and preferences.				
10. The Braille technology devices at Ghana National College are well-maintained and in good working condition.				
Section C: Effectiveness of Braille Technology Devices	SA	A	D	SD
1. The use of Braille technology devices enhances my educational experience.				
2. Braille technology devices help me in accessing and understanding educational materials more effectively.				
3. I feel more confident and independent in my academic tasks when using Braille technology devices.				
4. Braille technology devices help me participate actively in classroom activities.				
5. Braille technology devices have improved my note-taking and study skills.				
6. The use of Braille technology devices has increased my engagement with educational materials.				
7. Braille technology devices have expanded my access to educational resources beyond traditional printed materials.				
8. The use of Braille technology devices has improved my ability to organize and manage my academic tasks.				
9. Braille technology devices have enhanced my ability to collaborate with sighted peers on academic work.				
10. The availability of Braille technology devices has positively influenced my motivation and enthusiasm for learning.				

Section D:Effect of Braille technology devices on Academic Performance	SA	A	D	SD
1. Using Braille technology devices has improved my reading speed.				
2. Braille technology devices have enhanced my reading comprehension skills.				
3. I am able to communicate effectively through written means using Braille technology devices.				
4. Braille technology devices have improved my spelling and grammar skills.				
5. The use of Braille technology devices has increased my writing fluency and coherence.				
6. Braille technology devices have positively impacted my academic performance in subjects that require extensive reading and writing.				
7. Using Braille technology devices has improved my ability to take effective and organized notes during classes or lectures.				
8. Braille technology devices have increased my confidence in participating in discussions and expressing my ideas in academic settings.				
9. The use of Braille technology devices has improved my comprehension and retention of course content.				
10. Braille technology devices have positively impacted my academic achievements and overall grades.				
Section E: Challenges learners with visual impairment faced in using Braille Technology Devices				
Please indicate the extent to which learners with visual impairment face the following challenges:	NC	MC	MoC	MjC
1. Limited availability of Braille technology devices at Ghana National College				
2. Lack of technical support and assistance in using Braille technology devices.				

3. Insufficient training and guidance on how to maximize the benefits of Braille technology devices.				
4. Inadequate awareness and understanding of available Braille technology options				
5. Difficulty in accessing and obtaining necessary software or applications for Braille technology devices.				
6. Limited availability of accessible learning materials in Braille format.				
7. Physical barriers or limitations in accessing and utilizing Braille technology devices.				
8. Financial constraints in acquiring Braille technology devices.				
9. Lack of awareness among educators and administrators about the needs and requirements of learners with visual impairment regarding Braille technology devices.				
10. Limited integration and compatibility of Braille technology devices with other assistive technologies.				

Where:

NC – Not a Challenge

MiC- Minor Challenge

MoC – Moderate Challenge

MjC – Major Challenge

Consent Statement

Dear Participant,

You are invited to participate in a research study being conducted by Linda Manu from University of Cape Coast. The purpose of this study is to explore the availability, accessibility, and utilization of Braille technology devices among learners with visual impairment at Ghana National College. Your participation as an educator or administrator is vital in providing insights into the support systems and challenges face by learners with visual impairment in

accessing and utilizing this Braille technology device. Your responses will remain anonymous and confidential.

Your participation involves completing a questionnaire that includes sections on demographic information and statements related to the availability, accessibility, utilization, and impact of Braille technology devices. Your honest responses will greatly contribute to the findings of the study.

Your participation is voluntary, and you may withdraw at any time without penalty or negative consequences. Your decision to participate or not will not affect your relationship with the institution or individuals involved.

Your responses will be kept confidential and reported in an aggregated form. The data will be securely stored and accessed only by the researcher. It will be used solely for the purposes of this study and will not be shared with any third party.

Participating in this study involves minimal risks, and your privacy and well-being will be protected. If you have any questions or concerns, you may contact the researcher, Linda Manu, on 0542551425. By completing and submitting the questionnaire, you give your informed consent to participate in this study.

Thank you for considering this invitation and for your valuable contribution to this research.

Sincerely,

Linda Manu

University of Cape Coast

Questionnaire for Educators and Administrators:

Section 1: Demographic Information

1. Gender:

- Male ☐
- Female ☐

2. Age:

- 25-29 years ☐
- 30-34 years ☐
- 35-39 years ☐
- Above 40 years ☐

3. Educational Level:

- Diploma degree ☐
- Bachelor's degree ☐
- Master's degree ☐
- Doctorate degree ☐

4. Current Role:

- Educator ☐
- Administrator ☐

5. Years of Experience in Education:

- Less than 5 years ☐
- 5-9years ☐
- 10-14 years ☐
- 15-19 years ☐
- 20 and Above years ☐

6. For Educator only please indicate the Subject:

- Mathematics ☐
- Science ☐
- English Language ☐
- Social Studies ☐
- ☐

- Fante
- Other (Please specify).....

7. Familiarity with Braille technology devices:

- Very Familiar ☐
- Familiar ☐
- Not Familiar ☐
- Not at all Familiar ☐

Section B: Please indicate your level of agreement with the following statements: where

SA – Strongly Agree

A – Agree

D- Disagree

SD- Strongly disagree

Section B:Availability Braille Technology Devices	SA	A	D	SD
1. Braille technology devices are available to visually impaired students at Ghana National College.				
2. The distribution of Braille technology devices is sufficient to meet the needs of learners with visual impairment.				
3. The support systems in place for learners with visual impairment using Braille technology devices are effective.				
4. The Braille technology devices provided to learners with visual impairment are up-to-date and technologically advanced.				
5. Learners with visual impairment have easy physical access to Braille technology devices on campus.				
6. The availability of Braille technology devices at Ghana National College is adequately communicated to learners with visual impairment.				
7. Learners with visual impairment receive timely and sufficient technical support when using Braille technology devices.				

8. The college has policies and guidelines in place to ensure the proper utilization of Braille technology devices by learners with visual impairment.				
9. The college regularly updates and maintains the Braille technology devices to ensure their functionality.				
10. Faculty and staff members are adequately trained to provide support and assistance to learners with visual impairment in using Braille technology devices.				
Section C: Effectiveness of Braille Technology Devices	SA	A	D	SD
1. Braille technology devices enhance the educational experience of learners with visual impairment.				
2. Braille technology devices help learners with visual impairment understand course material better.				
3. The use of Braille technology devices promotes active participation of learners with visual impairment in classroom activities.				
4. Braille technology devices improve the engagement and involvement of learners with visual impairment in their learning process.				
5. Learners with visual impairment feel more confident in their academic performance when using Braille technology devices.				
6. Braille technology devices enable learners with visual impairment to access educational resources more independently.				
7. The use of Braille technology devices helps learners with visual impairment overcome learning barriers and challenges.				
8. Braille technology devices support the individualized learning needs of learners with visual impairment.				
9. Learners with visual impairment find Braille technology devices intuitive and easy to use.				
10. Braille technology devices facilitate effective communication and interaction between learners with visual impairment and their peers and teachers.				

Section D: Effect of Braille technology on Academic Performance	SA	A	D	SD
1. Learners with visual impairment using Braille technology devices show improved reading speed.				
2. Braille technology devices enhance the comprehension skills of learners with visual impairment.				
3. The use of Braille technology devices improves the written communication abilities of learners with visual impairment.				
4. Learners with visual impairment using Braille technology devices demonstrate higher academic performance in their respective subjects.				
5. Braille technology devices support the development of critical thinking and problem-solving skills in learners with visual impairment.				
6. The use of Braille technology devices improves the vocabulary and language skills of learners with visual impairment.				
7. Learners with visual impairment utilizing Braille technology devices demonstrate better organizational and study skills.				
8. Braille technology devices contribute to the development of independent learning habits in learners with visual impairment.				
9. The use of Braille technology devices improves the note-taking abilities of learners with visual impairment.				
10. Learners with visual impairment using Braille technology devices demonstrate higher self-confidence in academic tasks				
Section E: Challenges learners faced in using Braille Technology Devices Please indicate the extent to which learners with visual impairment face the following challenges:	N C	MiC	MoC	MjC
1. Limited availability of Braille technology devices when needed.				
2. Difficulty in accessing technical support for Braille technology devices.				
3. Lack of training on how to effectively use Braille technology devices.				

4. Inadequate awareness and understanding of available Braille technology options.				
5. Limited integration of Braille technology devices into the existing curriculum.				
6. Insufficient resources and funding for procuring and maintaining Braille technology devices.				
7. Lack of collaboration and communication between educators and support staff regarding Braille technology devices.				
8. Inadequate policies and guidelines in place to ensure equitable access to Braille technology devices.				
9. Limited awareness and training opportunities for educators and administrators on the effective utilization of Braille technology devices.				
10. Challenges in maintaining and upgrading Braille technology devices to keep up with technological advancements.				

Where:

NC- Not a Challenge

MiC- Minor Challenge

MoC- Moderate Challenge

MjC – Major Challenge

Qualitative data collection through physical observation

During the field observation, the researcher will take detailed notes capturing the observations, descriptions, and reflections on the use of Braille technology devices. The notes will include specific instances, interactions, and contextual factors that influence the accessibility and effectiveness of the devices. These observations will provide valuable qualitative data to complement the questionnaire responses and offer a more comprehensive understanding of the experiences of learners with visual impairment with the use of Braille

technology devices in their educational environment. The following questions will guide the researcher during the physical observation:

1. How frequently do learners with visual impairment use Braille technology devices during their academic activities?
2. What specific tasks or activities do learners with visual impairment engage in while using Braille technology devices? Are there any challenges encountered by learners with visual impairment when using the Braille technology devices? If yes, what are they
3. Can learners with visual impairment independently navigate and interact with the Braille technology devices? Are there any specific adaptations that facilitate their accessibility?
4. Are the Braille technology devices compatible with other assistive technology used by learners with visual impairment?
5. Are there alternative input methods, such as tactile or auditory interfaces, available and utilized by learners with visual impairment?
6. How accessible are the Braille technology devices within the educational setting? Are they readily available in classrooms, resource centres, and other relevant locations?
7. What contextual factors influence the accessibility and effectiveness of the Braille technology devices for learners with visual impairment?
8. How do learners with visual impairment interact with their peers, educators, or administrators regarding the use of Braille technology devices?
9. Are there any notable instances or experiences that highlight the benefits, limitations, or areas for improvement regarding the accessibility of Braille technology devices within the educational environment?