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Assistive Technology and Academic Achievement: Learners with Hearing Impairment Perspective in Some Zambian Schools

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Abstract

The integration of assistive technology (AT) in education has become essential in promoting inclusive learning, particularly for learners with disabilities. This study explored the role of AT in supporting learners with hearing impairments (HI) in selected schools in Lusaka and Ndola Districts, Zambia. The study sought (1) to assess the accessibility and availability of assistive technology devices for HI learners, (2) to establish the effect of AT devices on their academic achievement, and (3) to identify the challenges faced in using AT while exploring strategies for improvement. A review of literature from Björk-van Dijk & Bremmer (2020), Chifinda (2017), Kaulu (2019) and other scholars highlighted both the benefits and limitations of AT in facilitating learning for HI students. Guided by Vygotsky's Sociocultural Theory of Cognitive Development (1978), the study adopted an interpretivism paradigm, a qualitative approach and a phenomenological study design to gain insights into learners' experiences with AT. The target population included HI learners, with a sample of 23 participants drawn from five schools. Focus group discussion guides were used as research instruments and data collection was conducted through focus group discussions, with data analyzed thematically and the ethics were upheld. The findings revealed that while AT devices like computers, tablets and projectors were present in most schools, access was inconsistent due to resource constraints, power outages and lack of sign language integration. Additionally, AT positively influenced digital literacy, problem-solving and engagement, yet challenges such as limited availability, inadequate teacher training and exclusion from computer labs hindered its effectiveness. Participants recommended providing more computers, incorporating sign language into digital platforms, training teachers in sign language, and improving infrastructure. The study concludes that AT enhances academic achievement for HI learners but requires institutional and policy improvements to maximize its impact. This research contributes to the body of knowledge by highlighting the need for inclusive digital learning environments and offering practical strategies for enhancing AT integration in Zambian schools.

Key Words: Assistive Technology, Hearing Impairments, Academic Achievement, Inclusive Education, Digital Learning, Special Education, Educational Technology
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1. INTRODUCTION

The assistive technology (AT) has revolutionized the education of learners with disabilities, providing innovative solutions to bridge the gap in academic achievement. Among learners with hearing impairments, the integration of AT has significantly impacted their access to education and ability to perform academically. In Zambia, as in many other parts of the world, the application of AT for learners with hearing impairments is a relatively new but crucial field, with the potential to enhance their educational experiences. This study focuses on the role of assistive technology in the academic achievement of learners with hearing impairments in selected Zambian schools, exploring its benefits, challenges and the overall impact on their academic performance.

Globally, AT has become a key enabler in educational settings for learners with disabilities. In developed regions, such as Europe, a range of assistive technologies are being implemented to support learners with hearing impairments. Björk-van Dijk and Bremmer (2020) says that the European educational systems have integrated various technologies, including hearing aids, captioning software and speech-to-text systems, which have been found to improve the learning experiences of learners with hearing impairments. Similarly, López and Fernández (2021) note that assistive technology is widely used in European classrooms to support learners with hearing loss, providing personalized learning experiences that help bridge communication gaps. These technologies not only enhance accessibility but also foster inclusion, allowing learners with hearing impairments to engage more fully in academic activities.

However, despite the advances in the use of assistive technologies in developed countries, the situation in many parts of the Global South, particularly sub-Saharan Africa, remains less advanced. In Zambia, the integration of assistive technology into the education system for learners with hearing impairments is still in its infancy. Kaindu et al. (2021) observed that schools for learners with hearing impairments in Zambia face significant

challenges in providing adequate learning materials, technology and qualified staff. The absence of proper infrastructure and training has resulted in learners with hearing impairments often being marginalized in traditional educational settings. Additionally, Zulu (2022) identified that factors such as inadequate teacher training and limited access to specialized resources hinder the academic performance of learners with hearing impairments in Zambia.

On a regional level, the use of technology in education for learners with disabilities in Africa is becoming increasingly recognized. Research by Simui et al. (2017) demonstrates that information and communication technology (ICT) has the potential to improve the academic success of learners with disabilities, including those with visual and hearing impairments. The study highlights the growing use of ICT tools in African educational settings to enhance the learning experience and academic outcomes of learners with disabilities (Chanda, et. al., 2025; Mpolomoka, et. al., 2025). Despite these regional strides, Zambia faces a significant gap in the widespread application of these technologies, especially for learners with hearing impairments

In Zambia, the role of assistive technology for learners with hearing impairments is often overshadowed by other educational challenges, such as the lack of qualified teachers and appropriate infrastructure. The research by Kaulu (2019) indicates that while some progress has been made, learners with hearing impairments still face difficulties in accessing educational resources, particularly in remote areas of the country. The study further emphasizes the need for greater investment in the development and integration of assistive technologies to ensure that learners with hearing impairments can thrive academically.

Given the identified challenges and gaps in the use of assistive technology in Zambia, this study is necessary to explore the current state of AT use, identify barriers to its effective implementation, and assess its impact on the academic achievement of learners with hearing impairments in Zambian schools. This research aims to contribute valuable insights to ensure that learners with hearing impairment receive the support they need to achieve their full academic potential.

The academic performance of learners with hearing impairments in Zambia is often hindered by limited access to assistive technology, inadequate resources, and insufficient teacher training. While assistive technologies have shown promising results in enhancing the academic achievement of learners with disabilities in developed regions, their implementation in Zambia remains minimal and largely unsupported by the educational infrastructure (Kaindu et al., 2021; Zulu, 2022). The lack of research and understanding regarding the specific challenges and benefits of assistive technology for learners with hearing impairments in Zambia calls for an investigation into the current state of its use, the barriers to its integration and its impact on learners' academic outcomes. This study bridged this gap by exploring the role of assistive technology in improving the academic performance of learners with hearing impairments in selected Zambian schools.

The following research objectives guided the study:

1. To assess the accessibility and availability of assistive technology devices for learners with hearing impairments in selected Zambian schools.
2. To establish the effect of assistive technology devices on the academic achievement of learners with hearing impairments in Zambian schools.
3. To identify the challenges faced by learners in using assistive technology and explore strategies to mitigate these challenges.

This study is significant as it provides insights into the role of assistive technology in enhancing the academic achievement of learners with hearing impairments in Zambia. The findings will contribute to policy development, helping education stakeholders, including the government and schools, to improve the availability and accessibility of assistive technology. Additionally, the study will benefit educators by highlighting effective teaching strategies that incorporate assistive technology, ultimately fostering a more inclusive learning environment. Furthermore, it will serve as a reference for future research on assistive technology and inclusive education in Zambia.

2. THEORETICAL FRAMEWORK

This study was anchored in Vygotsky's Sociocultural Theory of Cognitive Development (1978), which emphasizes the role of social interaction, cultural tools, and mediated learning in cognitive growth. Vygotsky argued that learning occurs within a Zone of Proximal Development (ZPD), where learners achieve higher understanding with the help of scaffolding and assistive tools. This theory is relevant to the study as it supports the notion that assistive technology serves as a mediating tool that enhances learning for learners with hearing

impairments. For instance, the principles of guided learning and technological mediation align with the study's focus on how assistive technology influences academic achievement. Applying this theory, the study underscores the importance of accessible learning tools in bridging the educational gap for learners with hearing impairments in Zambia.

3. LITERATURE REVIEW

Accessibility and Availability of Assistive Technology Devices for Learners with Hearing Impairments

The availability and accessibility of AT devices are critical in ensuring that learners with hearing impairments receive an equitable education. Studies conducted in Europe have shown that AT devices such as hearing aids, speech-to-text software and FM systems significantly enhance the learning experiences of learners with hearing impairments (Björk-van Dijk and Bremmer, 2020). Similarly, López and Fernández (2021) reviewed various technological solutions designed for deaf and hard-of-hearing learners, emphasizing the importance of ensuring that these tools are widely accessible in educational settings. However, despite these advancements in developed countries, accessibility remains a challenge in many developing nations.

In Zambia, Kaulu (2019) found that access to AT devices for learners with visual impairments was limited due to inadequate infrastructure and funding, suggesting that a similar challenge may exist for learners with hearing impairments. Additionally, Mumba, Kasonde-Ngandu, and Mandyata (2021) observed that teachers and learners in Zambian primary schools cited the unavailability of AT as a major barrier to learning for children with hearing impairments. These studies highlight a gap in research regarding the specific availability of AT for hearing-impaired learners in Zambia, which this study aims to address by examining the current state of AT accessibility in selected schools.

Effect of Assistive Technology Devices on the Academic Achievement of Learners with Hearing Impairments

Assistive technology has been recognized as a significant factor in improving the academic performance of learners with disabilities. De la Cruz and Vega (2022) examined the impact of AT on the academic success of deaf learners in Spain and found that learners who had access to AT performed better academically compared to those who did not. Their study further revealed that the use of captioned media, sign language apps and speech recognition software improved literacy skills and overall engagement in classroom activities. Similarly, Björk-van Dijk and Bremmer (2020) concluded that AT enhances learning by providing real-time communication support for learners with hearing impairments.

In the Zambian context, Chifinda (2017) explored the barriers and facilitators of academic assessment for learners with hearing impairments and found that the lack of AT significantly hindered learners' ability to understand examination questions, affecting their academic performance. Additionally, Simui, Kasonde-Ngandu, and Nyaruwata (2017) demonstrated that ICT plays a crucial role in supporting learners with disabilities, emphasizing that the integration of AT could bridge the learning gap for hearing-impaired learners. However, these studies primarily focus on ICT in general rather than specifically on AT for hearing-impaired learners. Therefore, this study provides empirical evidence on how AT devices influence academic achievement among learners with hearing impairments in Zambian schools.

Challenges Faced by Learners in Using Assistive Technology and Strategies to Mitigate These Challenges

Despite the potential benefits of AT, learners with hearing impairments face numerous challenges in using these devices effectively. A study by López and Fernández (2021) in Europe identified key challenges such as high costs, lack of teacher training and limited awareness of AT tools among educators and learners. Similarly, Mumba et al. (2021) noted that in Zambia, many teachers lack the necessary skills to effectively integrate AT into their teaching, making it difficult for learners with hearing impairments to benefit fully from available technologies. Kaulu (2019) further highlighted that infrastructural limitations and financial constraints significantly impact the sustainability of AT programs in Zambian schools.

Additionally, Adom, Hussein, and Agyem (2018) emphasized the need for strong theoretical and conceptual frameworks to guide the implementation of AT in education. Although these studies shed light on the challenges faced in different contexts, there is limited research on the specific barriers faced by Zambian learners with hearing impairments and how they can be addressed. This study, therefore, aims to explore these challenges in depth and propose practical strategies to improve the use and effectiveness of AT in Zambian schools. Addressing these gaps, this study contributes to existing literature by providing context-specific insights into the accessibility, impact and challenges of assistive technology for learners with hearing impairments in Zambia.

4. METHODOLOGY

This study was guided by the interpretivism paradigm, which focuses on understanding the subjective experiences and meanings individuals attach to their lived realities. The interpretivism approach was appropriate as it enabled the researcher to explore the personal experiences of learners with hearing impairments regarding their use of assistive technology in education (Chikopela, et. al., 2024). By emphasizing participants' perspectives, this paradigm allowed for an in-depth understanding of how learners perceive, interact with and make sense of assistive technology in their academic environments.

A qualitative research approach was adopted to provide an in-depth understanding of the phenomenon under study. The phenomenological design was employed to capture the firsthand experiences of learners with hearing impairments in using assistive technology. This design was appropriate as it enabled the researcher to explore the perspectives, emotions and challenges of learners regarding the role of assistive technology in their academic achievement.

The target population for this study included learners with hearing impairments from five selected schools in Ndola and Lusaka Districts. A total of twenty-three (23) learners with hearing impairments participated in the study. The selection of these learners was based on their experience with assistive technology in academic settings, ensuring that the study captured rich and relevant data.

Snowball sampling was employed to recruit participants for the study. This method was chosen due to the relatively small and specialized population of learners with hearing impairments who use assistive technology. Initial participants identified other potential participants who met the study criteria, allowing for the inclusion of learners who had direct experience with assistive technology in their educational journey.

The study utilized focus group discussion (FGD) guides as the primary research instrument. The guides contained open-ended questions designed to facilitate discussions on the availability, accessibility, effectiveness and challenges of assistive technology in academic performance. Focus group discussions were conducted with the learners with hearing impairments, allowing them to share their views, experiences and concerns in a comfortable and interactive setting. The discussions were moderated using sign language interpreters where necessary to ensure effective communication.

Thematic analysis was used to analyze the data collected from the focus group discussions (Braun and Clarke, 2006). The responses were transcribed and categorized into themes that reflected the key issues raised by the participants and codes were created. This method was effective in identifying patterns and recurring ideas related to the role of assistive technology in enhancing the academic achievement of learners with hearing impairments.

The ethical principles were upheld throughout the study. Confidentiality was ensured by keeping the participants' responses private and using pseudonyms instead of real names. Anonymity was maintained by not disclosing the identities of the participants or their respective schools (Mpolomoka, 2024). Honesty was observed by accurately reporting the findings without any manipulation or bias, ensuring that the voices of the learners with hearing impairments were genuinely represented.

5. RESULTS

This section presents results of the study, segmented into strands that emanate from the research questions that guided the study.

Demographic Characteristics

The twenty-three (23) learner participants from the five (5) schools visited in Lusaka Ndola Districts, were coded as follows: Learner A, Learner B, Learner C, Learner D, Learner E, Learner F, Learner G, Learner H, Learner I, Learner J, Learner K, Learner L, Learner M, Learner N, Learner O, Learner P, Learner Q, Learner R, Learner S, Learner , Learner T, Learner U, Learner V, and Learner W. Total sample size remained twenty-three that was drawn five schools in Ndola and Lusaka Districts, Zambia.

Accessible and Availability of AT Devices for Hearing Impairment Leaners

Learners During the focus group discussions conducted in the four selected schools across Lusaka and Ndola Districts, learners were asked about the availability and accessibility of assistive technology devices in their schools. The first question posed was: "Does your school have a computer laboratory or room? If YES, how can you describe the computer room in relation to learners with hearing impairments?"

The responses from learners revealed varying perspectives on the availability and adequacy of computer rooms in supporting their learning needs. The verbatim responses from participants were as follows:
Learner A from School 1: *"Yes, it helps me disclose more about the topic."* Upon further elaboration, Learner A explained that the presence of a computer lab in the school allows them to explore various academic topics in depth. The learner emphasized that with access to computers, they can independently search for additional information, reinforce classroom lessons and clarify any uncertainties. Additionally, the availability of digital learning resources helps them engage with subject content more effectively, enhancing their understanding.

Learner B from School 1: *"Yes, the office room for the lab is good for learning well."*
Participant, Learner B stated that the school has a designated computer laboratory, which is structured to support the learning of all learners, including those with hearing impairments. The learner highlighted that the room is relatively well-maintained, with adequate space to accommodate a reasonable number of learners at a time. Additionally, the presence of visual instructional materials and digital learning tools enhances the learning experience, making it easier for learners with hearing impairments to follow along with lessons.

Moreover, Learner C from School 1: *"Yes, the situation is very okay; learning is going well, and we have computers."*
Expanding on this response, Learner C noted that the school has made efforts to equip the computer lab with necessary resources, ensuring that learners with hearing impairments have access to computers for educational purposes. The learner pointed out that the computers are functional, and although there may be some limitations, the environment generally supports their academic progress. Having access to digital platforms allows them to engage in interactive learning and benefit from visual aids, which are crucial for their comprehension.

Learner D from School 1: *"Yes, the condition of the computers is good, and they accommodate us."* Learner D elaborated that the school's computer lab is well-maintained and that the available computers are in good working condition. The learner emphasized that the space is inclusive, providing an environment where learners with hearing impairments feel accommodated. Although there may still be room for improvement, the current setup allows them to access educational resources, complete assignments, and develop digital literacy skills that are essential for academic success.

Furthermore, during the focus group discussions, learners from different schools provided insights into the availability and accessibility of assistive technology devices, particularly computer labs, in their respective schools. Their responses varied, highlighting both positive experiences and challenges in utilizing computer facilities.

Responses from School 2; Learner E from School 2: *"Yes, the room is very okay and easy for us to learn."* Learner F from School 2: *"Yes, the room is okay for us; we enter and learn well."* Learner G from School 2: "Yes, but there are very few computers, and this makes us spend more time waiting for our turn." Learner H from School 2: *"No, I do not see any assistive devices in our computer room."*

Responses from School 3; Learner I from School 3: "It is a nice place and well-organized. It has all the devices needed for computer lessons, and there are enough computers for all pupils." Learner J from School 3: *"Yes, but the room is too small to be used as a classroom."*

Learner K from School 3: *"Yes, a computer room is where computer practices happen, and it helps us learn how to communicate. Our computer lab is typically a room with many computers that are networked and can be accessed by many people."* Learner L from School 3: *"Yes, and it is well-improved so that deaf learners can learn without any issues."* Learner M from School 3: *"Yes, we do have a computer lab, but it is not specifically designed for the special unit. I believe it was set up mainly for hearing pupils, but it is still useful for deaf learners."*

Responses from School 4; Learner N from School 4: *"Indeed, our school has a computer lab, but the deaf learners do not have a dedicated one, so we use a shared block. However, the lack of space and seating arrangements do not meet our needs."* Learner O from School 4: *"Yes, it is good. However, there is only one computer laboratory, and the special unit does not have its own. We use the same room, but it does not fully accommodate our needs."* Learner P from School 4: *"Yes, it is good. Our school has only one computer laboratory, and the special unit does not have one, so we share a room that does not fully accommodate inclusivity."* Similar to Learner O's response. Learner Q from School 4: *"Yes, it is helping us very much because we can read and use sign language."* Learner R from School 4: *"Yes, the computer room is good because it has*

the computers we need."

Responses from School 5 were that, participant, Learner S from School 5: *"Yes, we are allowed to enter the computer room and have lessons inside the lab."* Learner T from School 5: *"Yes, but the situation in the lab is difficult for hearing-impaired learners because we do not use it regularly."*

Learner U from School 5: *"Yes, but the room is not friendly for us to learn."* Also, Learner V from School 5: *"Yes, but many hearing pupils use it more often than us."* Learner W from School 5: *"Yes, but even though we are allowed in, we only learn when a class is scheduled, and we do not spend much time there."* Learner W expressed a desire for increased computer lab time, stating that the limited access hinders effective learning. The learner suggested that additional time should be allocated for hearing-impaired learners to benefit fully from digital resources.

Second question was 'from your experience as HI learner, explain different technology devices available in your school that enhance your academic performance as a learner with hearing impairment

During the focus group discussions, learners provided insights into the different technology devices available in their schools that support their academic performance. Their responses varied, with some schools having multiple devices and others had limited resources.

Learner A from School 1: *"We have programmed tablets."* Learner A mentioned that their school provides programmed tablets, which are used for educational purposes. These tablets likely contain pre-installed learning materials, sign language resources, and other assistive applications that help learners with hearing impairments in their academic studies. The learner highlighted that these devices are beneficial in enhancing digital learning and improving comprehension through visual content.

Learner B from School 1 said a router WiFi, monitor and CPU. Learner C from School 1 said computer and mouse. Learner D from School 1 said: computer, router Wifi, and CPU. Learner E and Learner F from School 1 said: Wifi, CPU and Keyboard.

Furthermore, participant, Learner G, Learner H from School 2 mentioned of computers and Wifi. Participant, Learner I from School 2 said: *"There is speakers and monitors even projectors."*

Learners J and K from School 3: *"Computers and keyboards are available."* Both Learners J and K stated that their school provides computers and keyboards, which they use during lessons. These devices play a significant role in improving their academic performance by enabling them to type assignments, access digital learning materials, and communicate through written content. However, they did not specify whether the computers were equipped with assistive technology tailored for deaf learners.

Learner L from School 3: *"None other than a school computer, which we do not even use often."* Learner L expressed concerns about the limited usage of available technology. While the school has computers, the learner mentioned that they are rarely used by hearing-impaired learners, possibly due to a lack of structured access, inadequate training, or absence of assistive tools that cater to their specific needs.

Responses from School 4 were that; Learners M, N, and O from School 4: *"Flash disks, radio, and computers from the school lab are available."* Learners M, N, and O from School 4 mentioned that they have access to flash disks, radios, and computers. Flash disks are likely used for storing academic materials, at the same time radios may be used to transmit educational content, though their effectiveness for deaf learners is uncertain. Computers from the school lab provide digital learning opportunities, but it was not clarified whether they are fully accessible for learners with hearing impairments.

Learner P, Learner Q, Learner R from School 5 said: computers, tablets and a few laptops were available.

Additionally, participants Learners S, T, U, V, and W from School 5: *"Computers, keyboards, mouse, and CPU."* Learners from School 5 highlighted that they have access to essential computer components, including CPUs, keyboards, mice and monitors. These devices allow them to engage in academic activities such as research, document preparation and communication through typing.
However, they did not specify whether the computers are equipped with assistive software such as captioning tools, speech-to-text applications, or sign language resources.

Effect of Technology Devices on Learners with HI's Academic Achievement

The third question was on 'in your opinion, how do these assistive technologies you have mentioned in question 2, impact your academic performance as a learner with hearing impairment?'

Participant, Learner A from School 1 mentioned that: *"Not included sign language hence benefit less because of language barrier."* Learner B from School 1 shared: *"The technology help me to know how to use mouse and easy communication"*

Learner C from School 1 said that: *"Helps us to be at the same time with technology and see well and type."*

Learner D from School 1 mentioned that: "Help me know how to deal with when it when it comes to puzzle games and make them on the computer"

Learner E from School 1 stated as follows: *"The new technology helps me to know how to the sense that I know how to type"* Learner F from School 1 mentioned: "makes me know how to use computers"

Learner G from School 2 said that: *"Somehow help me to know but not much"* Learner H from School 2 *"Me learn writing using computer and able communicate" Learner I from School 2 said: "Monitors help me to use when typing"*

Moreover, participant Learner J from School 2 stated *"Using the class for computer learn to navigate the computer."* Learner K from School 2 *"Me learning in class well." Learner L from School 2 "Computer skills, and knowledge"*

Conversely, Learner M and Learner N from School 3 said that: *"Computer skills, knowledge academically, and boost my English vocabulary*" Learner Q and Learner R from School 3 stated that: *"They help us especially if we learning about computers, to know how it works and its parts."*
Participant, Learner S from School 4 stated that: *"Keyboard help me typing and pressing the computer. Using mouse help me to know how to use the computer"*

Learner T from School 4 said that: *"These thing I have mentioned do not help us because we do not have good time to use the same thing"* Learner U from School 5 mentioned that: *"Understand when using them during time for class"* Learner V from School 5 stated: *"Knowing the technology and how type and work, assessment"* Learner W from school 5 mentioned that: *"Help me watch and play games understand well when solving other problems"*

Challenges in Using Technology

From the theme above, question seven was 'What challenges do you face in using these technology devices to enhance your academic achievement?'

The participants contributed during the focus group discussions that were conducted from the four different schools selected. For example, participant Learner A from school 1 stated that: *"Lack of man power who know to teach sign language. Sign language component lesson not programmed making learning difficult."* Learner B from school 1 mentioned that: *"Computer are few meaning take long to finish."* Learner C from school 1 said: *"When it comes to typing it gives challenges because the keyboards are not friendly to us."*

Learner D from school 1 mentioned that: *"Making the computer friendly when dealing with different pupils and allowing the learner spending more."* Both participants, Learner E and Learner F from school 1 stated that: *"Few computers make us to delay when it comes to using computer. They also added that, it makes us delay the assessment to done."*

Participants, Learner G and Learner H from school 2 said that: *"Few computers and makes us to have challenges in learning"*. Learner I from school 2 said: *"We don't have enough monitors to use when they are interpreting."* Learner J from school 2 stated: *"The computers are few and making the learning take long."* Also, Learner K from school 2 said "Small room to learn." Additionally, Learner L from school 2 mentioned that: *"The language of a computer is hard to understand I can pick only a few."*

Moreover, Learner M from school 3 challenges such as electricity outage, and destitute internet connection. Learner N from school 3 said: *"The language of the computer is rigid. When using the internet sometime*

unwanted contents pop up such as pornographic ads. Interpreting some of the words so that I can understand the whole essence." Learner Q from school 3 said: "If there are no words on the screen it is very difficult forms. If there is no interpreter we get nothing." Participant, Learner R from school 3 stated that: *"We have only one teacher for sign language, so when we is not around on to interpret for us"*

Learner S from school 4 stated that*: "The computer lesson that don't happen regularly and makes us forget."* Learner T from school 4 said: *"The resource to use a few makes one to many, this can be hard to use because are few."* Learner U from school 4 mentioned that: "The lab we use with many be hard us learner and understand because time have is few." The participant, Learner V from School 5 said that: *"Computers are few and many us not have time to spend more time because hearing pupils using.*" Learner W from school 5 mentioned that: *"Challenge is that many pupils using class lab to make it hard not allow learning.*

The findings from the focus group discussions revealed several challenges that hinder learners with hearing impairments from effectively utilizing assistive technology. Key issues included a shortage of trained personnel proficient in sign language, limited access to computers due to resource constraints and inadequate time allocated for computer lessons. Additionally, the lack of sign language-integrated learning programs and unfriendly keyboard designs posed significant barriers to learning. These findings influenced the study by emphasizing the urgent need for teacher training in sign language, increased availability of assistive devices and structured lesson scheduling to ensure that learners with hearing impairments can fully benefit from technological advancements in education.

Strategies in Mitigating Challenges

'Following the response in question 4, what strategies should be put in place to mitigate the challenge you highlighted above?' The participants were able to provide the responses during the focus group discussions that were conducted at the selected schools.

Participant, Learner A from School 1 contributed that: *"Provide lessons in sign language or teachers must use sign language to improve ways of teaching. Sign language component must be included in the devise."* Learner B from School 1 mentioned that: *"Computer are few many take long to finish."* Learner C from School 1 said: *"When it comes to typing it gets gives challenges because the keyboards are not friend to us."*

Also, Learner D from School 1 stated: *"Having many computers will be helpful because we will be able to have skills."* Learner E from School 1 mentioned: *"Having more computers will help each learner including me to know how to use well computers being it will be friendly."* Learner F from School 1 said: *"Few computer makes delay the assessment to done."*

On the other hand, participant, Learner G from School 2 mentioned: *"Building the big lab will make us have well."* Learner H from School 2 stated: *"Need more computers and learning will be easy to make us study."* Meanwhile, Learner I from School 2 mentioned that: *"We are in need of many monitors."*

Both participants, Learner J and Learner K from School 2 contributed during a focus group discussion that: *"The school need to have more class and computers and make learning easy."* Learner L from School 2 said: *"Projecting some context and explained further also to make use of a sign language interpreter."*

Furthermore, Learner M from School 3 stated: "Providing laptops that has a lasting battery capacity, Gensets can work out during PowerPoint." Participants, Learner N and Learner Q from School 3 said that: *"Since we cannot hear, better if the notification is written. I think you can provide more useful ways to let us know if these, devices are in danger, participating with regard to the sounds. Provide sign language interpretation for each lesson with the instructor is not proficient in it to improve comprehension."* Learner R from School 4 stated that: *"We need more teachers for sign language."*

Learner S from School 4 stated: "*Having our own computer lab with many computers will help us having the class regularly and able to learn*." Learner T from School 5 mentioned: *"This will be helpful if we can have our computer lab so that the pupils we can have time to be access and training."* Learner U from School 5 added that: *"Better have many computers and different thing use so that us understand and practice well."* Learner V from School 5 mentioned that: *"Build computer lab for hearing impaired pupils. Helping projector so that that betters us learning."* Learner W from School 5 contributed that: *"Building a good computer lab to make us able to learn and able practice during time learning and making different materials will help us."*

Therefore, the findings from the focus group discussions revealed that learners with hearing impairments face several challenges in accessing and utilizing assistive technology in their schools. A recurring theme among the responses was the need for improved infrastructure, specifically dedicated computer labs equipped with adequate assistive devices. Participants emphasized the importance of expanding existing facilities, increasing the number of computers and incorporating visual learning aids such as projectors to enhance their learning experience. These findings influenced the study by highlighting the critical role of infrastructure development and resource allocation in ensuring inclusive education for learners with hearing impairments. The study underscores the necessity for policymakers and educators to prioritize investments in assistive technology and specialized learning spaces to foster equitable learning opportunities for all learners.

6. DISCUSSION

Availability of Assistive Technology Devices for Hearing Impairment Learners

The findings from the study indicate that while AT devices and computer laboratories are available in most of the sampled schools, their accessibility and suitability for learners with HI vary significantly. These findings align with Björk-van Dijk and Bremmer (2020), who emphasize that the mere presence of AT does not guarantee equitable access unless schools actively adapt learning environments to meet the needs of HI learners. In some schools, learners acknowledged that computer labs were well-equipped and beneficial, while others reported limited access, a lack of assistive devices, or dominance of hearing learners in shared spaces. Therefore, this variation demonstrates how institutional policies, resource allocation, and staff preparedness influence the effectiveness of AT in supporting HI learners.

Similarly, Mpolomoka et al. (2024) highlight the importance of inclusive educational environments, emphasizing that resource availability alone is insufficient unless learning spaces are structured to facilitate meaningful engagement for children with special education needs. Their study underscores the role of socialization and institutional support in ensuring that assistive technologies truly benefit HI learners rather than merely existing as underutilized resources. Vygotsky's Sociocultural Theory of Cognitive Development (1978) suggests that learning occurs through social interaction and cultural tools, meaning that if HI learners are excluded from digital learning environments or lack sufficient exposure to technology, their cognitive development and academic success may be hindered. Schools that do not tailor their technological infrastructure to accommodate HI learners risk marginalizing them, reinforcing educational inequalities rather than addressing them.

Furthermore, the study highlights disparities in the types of assistive technologies available across different schools, with some learners reporting access to programmed tablets, projectors and specialized computers, while others had basic equipment such as flash disks and radios. These discrepancies align with Chifinda (2017), who found that the availability and effectiveness of AT devices for HI learners in Zambia are largely inconsistent, often dependent on funding, school leadership commitment and government policies.

According to Vygotsky's theory, tools such as programmed tablets and projectors serve as mediating instruments that enable HI learners to engage more effectively with educational content. When such tools are available, they act as cognitive scaffolds, enhancing comprehension through visual learning and interactive digital resources. However, schools with limited or outdated technology fail to provide adequate scaffolding, potentially restricting the intellectual and linguistic development of HI learners. This gap suggests the need for policy interventions to standardize AT provisions in schools catering to learners with disabilities. Chirwa, Mpolomoka, Muvombo & Chikopela (2024) further emphasize the importance of structured assessments in understanding the educational needs of learners with disabilities. Their study highlights how systematic evaluation tools, such as the Zambia Neurobehavioural Test Battery, can help identify cognitive and learning barriers, reinforcing the argument that the mere presence of technology is not enough effective implementation and assessment mechanisms are essential to ensuring meaningful educational support for HI learners.

Additionally, the study findings reflect an ongoing challenge of digital inclusion in Zambian schools, particularly for HI learners. Some participants expressed concerns about restricted access to computer labs, indicating that hearing learners had greater privileges in utilizing digital resources. Mumba, Kasonde-Ngandu, and Mandyata (2021) emphasize that HI learners often experience exclusion in mainstream education settings, partly due to a lack of awareness among educators and peers about their specific needs. Vygotsky's sociocultural perspective underscores the importance of social interaction in knowledge acquisition, meaning that when HI learners are marginalized in shared learning spaces, their educational experience is compromised. Digital learning environments should be collaborative and inclusive, allowing HI learners to interact with both peers and teachers in meaningful ways. The study highlights that without structured policies ensuring equal access, HI learners may continue to face systemic barriers in utilizing digital tools for learning.

The findings reinforce the idea that effective AT integration goes beyond device availability it requires pedagogical adaptation, teacher training, and inclusive educational policies. Kaulu (2019) argues that AT devices alone are insufficient if teachers are not trained to incorporate them into lesson delivery effectively. This resonates with Vygotsky's emphasis on the role of the "more knowledgeable other" (MKO) teachers and peers who facilitate learning by guiding HI learners in utilizing AT devices efficiently. Schools that lack trained educators or structured support systems for HI learners may inadvertently limit the effectiveness of AT, reducing its potential as a cognitive developmental tool. The study's findings call for greater investment in teacher capacity building, infrastructure improvements and inclusive learning policies to ensure that HI learners receive equitable opportunities to access and benefit from assistive technologies in their academic journey.

Effect of Technology Devices on Learners with HI's Academic Achievement

The findings indicate that AT devices have a significant impact on the academic performance of learners with HI, though the extent of their effectiveness varies depending on accessibility, usability and integration into learning environments. Some learners reported that AT devices enhanced computer skills, digital literacy and overall academic knowledge, which aligns with De la Cruz and Vega (2022), who found that AT tools improve engagement, comprehension and independent learning among deaf learners. However, other learners highlighted language barriers as a limitation, particularly due to the absence of sign language interpretation in digital learning resources. Kumatongo and Muzata (2021) emphasize that AT in itself is not sufficient; it must be tailored to meet the specific needs of HI learners, including visual learning aids, sign language incorporation, and teacher support. Without these adaptations, the full potential of AT in bridging the communication gap and enhancing academic success remains underutilized.

Ultimately, learners identified specific ways in which AT devices support their academic development, including computer literacy, problem-solving skills and vocabulary enhancement. This aligns with Kaindu, Simuyaba, Muleya and Simui (2021), who argue that AT tools, when effectively utilized, promote cognitive and linguistic development by exposing HI learners to interactive digital resources. The use of keyboards, monitors and computer-based learning applications was particularly beneficial in improving typing proficiency and problem-solving skills, demonstrating the importance of digital competence in modern education. Additionally, some learners noted that AT devices made learning more engaging through visual content and interactive applications, reinforcing Kaulu's (2019) assertion that technology-driven learning provides alternative ways for HI learners to grasp complex concepts. However, the effectiveness of AT depends on proper user training and equitable access, which remains a challenge in some schools, where devices are either limited or not adapted to HI learners' specific needs.

Although many learners reported positive academic outcomes from AT use, others highlighted limitations such as restricted access, lack of adequate support, and digital exclusion. Simui, Kasonde-Ngandu and Nyaruwata (2017) found that the absence of structured ICT training programs for HI learners can hinder their ability to fully utilize AT tools. Some learners mentioned that they could only use computers during scheduled classes or when hearing learners were not occupying the lab, indicating systemic barriers to digital inclusion. This reinforces Vygotsky's Sociocultural Theory of Cognitive Development (1978), which underscores the role of social interaction and guided learning in cognitive development. Without proper teacher facilitation, peer support, and equitable resource distribution, HI learners may struggle to maximize the benefits of AT in their academic journey.

On the other hand, Ngambi, Mpolomoka, and Mushibwe (2023) further highlight the broader implications of inadequate support systems in educational and behavioral contexts, emphasizing that structured interventions are critical in fostering meaningful learning experiences. Their study on counseling practices underscores the importance of tailored support mechanisms in addressing the diverse needs of vulnerable groups, reinforcing the argument that HI learners require not only access to AT but also well-structured guidance to optimize their learning potential. These findings suggest the need for policy improvements, increased investment in adaptive technologies and structured training programs to ensure that AT devices effectively enhance the educational experience of HI learners in Zambia.

Challenges in Using Technology

The study findings reveal several barriers to the effective use of assistive technology (AT) devices for learners with hearing impairments (HI), including limited access to computers, lack of sign language integration, unreliable electricity and language-related difficulties in using digital tools. These challenges align with Kumatongo and Muzata (2021), who argue that technological advancements in education remain underutilized among HI learners due to infrastructural and pedagogical limitations. Many learners reported that computer

shortages lead to delays in learning, reinforcing Chifinda's (2017) findings that resource scarcity in Zambian schools disproportionately affects learners with disabilities. Power outages and weak internet connectivity further disrupt access to AT, which Kaindu, Simuyaba, Muleya and Simui (2021) identified as key obstacles to digital learning for HI learners. Another significant challenge highlighted was the absence of sign language interpretation in digital learning platforms, making it difficult for HI learners to fully comprehend educational content, as emphasized by Sánchez and Martín (2021) in their study on AT barriers in European higher education.

Another recurring challenge was the lack of teacher proficiency in sign language, which negatively impacts how HI learners engage with digital tools. According to López and Fernández (2021), assistive technologies alone are insufficient if educators are not trained to effectively integrate them into teaching practices. Some learners also reported linguistic difficulties when navigating digital interfaces, particularly when encountering unfamiliar terminology or inappropriate online content. This finding supports Björk-van Dijk and Bremmer (2020), who emphasize that without adaptive language settings, HI learners struggle to fully utilize digital learning tools. Moreover, the dominance of hearing learners in computer labs creates further exclusion, reinforcing Zulu's (2022) argument that mainstream educational environments often fail to provide equitable learning spaces for learners with disabilities.

Notwithstanding, Mpolomoka et al. (2019) further highlight the significance of accessible education, noting that inclusive learning environments require deliberate efforts in policy development and teacher training. Their study on adult education in Zambian communities underscores the transformative impact of education when properly structured to meet the needs of diverse learners. In the context of AT for HI learners, this suggests that systemic barriers such as inadequate teacher training and resource allocation must be addressed to ensure equitable access to digital learning tools (Musonda, Sampa and Mpolomoka, 2021). These challenges highlight the need for institutional reforms, policy interventions and greater investment in inclusive learning environments that empower both educators and learners.

Strategies in Mitigating Challenges

To address these challenges, learners proposed several strategies, including the inclusion of sign language lessons, provision of more computers, improved power supply, and better accessibility measures. Many participants emphasized the importance of integrating sign language into digital learning tools, a recommendation supported by Sánchez and Martín (2021), who argue that incorporating sign language into AT interfaces significantly enhances comprehension and engagement for HI learners. Additionally, hiring more teachers trained in sign language was highlighted as a necessary step to bridge the communication gap and improve classroom interaction, aligning with López and Fernández (2021), who emphasize the role of educator preparedness in enhancing AT efficiency. Participants also suggested using projectors and visual aids to make digital learning more interactive and accessible, which resonates with Simui, Kasonde Ngandu, and Nyaruwata (2017), who found that ICT tools, when properly adapted, serve as enablers of academic success for learners with disabilities.

Conversely, learners also recommended increasing the number of computers, improving internet connectivity and investing in alternative power solutions such as generators, reinforcing Björk-van Dijk and Bremmer's (2020) assertion that consistent access to technology is essential for ensuring equity in digital learning. Furthermore, some participants suggested introducing written notifications for sound-based alerts, a strategy that aligns with Zulu (2022), who found that written cues improve accessibility for HI learners in digital environments. The construction of specialized computer labs for HI learners was proposed as a long-term solution to improve accessibility and provide a conducive learning space, echoing Kaindu et al. (2021), who advocate for dedicated learning facilities equipped with customized AT solutions.

In as much as other studies advocated, Mpolomoka (2024) similarly underscores the role of structured investments in education, arguing that resource allocation and institutional policies play a crucial role in shaping equitable access to learning technologies. His analysis of academic capitalism highlights the potential risks of commercialized education models, emphasizing that financial constraints should not hinder the provision of essential learning tools, particularly for marginalized groups such as HI learners. Hence, implementing these strategies would significantly enhance the effectiveness of AT devices in supporting academic achievement among HI learners in Zambia, fostering an inclusive and equitable learning environment.

7. CONCLUSION

This study explored the availability, accessibility, and impact of AT devices on the academic performance of learners with HI in selected schools in Lusaka and Ndola Districts, Zambia. The findings revealed that while AT

devices such as computers, tablets and projectors were available in most schools, their accessibility and effectiveness varied due to resource limitations, lack of sign language integration and inadequate teacher training. Vygotsky's Sociocultural Theory of Cognitive Development (1978) provided a strong foundation for understanding how technology, social interaction and institutional support influence learning outcomes for HI learners (Mpolomoka, Banda and Muyangana, 2018). Despite the benefits of AT in improving digital literacy, problem-solving skills and classroom engagement, challenges such as insufficient computers, power outages, internet connectivity issues and the dominance of hearing learners in shared learning spaces hindered its full effectiveness. Learners proposed several strategies to mitigate these challenges, including incorporating sign language into digital tools, increasing the number of computers, and establishing dedicated computer labs for HI learners.

This study may lead to the generation of new body of knowledge that is so critical in the enhancements of the models of managing special secondary schools for learners with hearing impairment. Overall, the integration of technology into education can significantly enhance the academic performance and education outcomes of learners with hearing impairment by providing them with access to a wider range learning resources, facilitating communication and collaboration, and supporting customized learning experiences tailored to their individual needs. This might enhance the potentials of research and academic collaboration, locally and internationally.

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