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Research Article

Effects of Integrating Assistive Technologies in Learning Mathematics Among the Visually Impaired Learners in Lusaka District, Zambia

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Abstract
Assistive technologies (ATs) refer to equipment, product systems, hardware, software, or services designed to enhance, sustain, or improve the functional abilities of learners with visual impairments. This study examined the impact of integrating ATs in mathematics learning among visually impaired learners in Lusaka district. The research had five key objectives: identifying available ATs supporting mathematics education, assessing how AT integration improves student engagement, motivation, and self-efficacy, determining its impact on learning outcomes, identifying challenges in using ATs, and proposing solutions to these challenges. The study targeted visually impaired learners in selected schools and adopted a descriptive survey design. A stratified random sampling technique was used to categorize learners by class and gender, with a sample size of 13.6 percent, while mathematics teachers were selected using purposive sampling. Data collection tools included questionnaires, interviews, observations, and checklists. The study found that while ATs were sufficient in some schools, others faced shortages. The effectiveness of ATs depended on student induction, integration, and teaching approaches. Addressing these challenges requires teacher training, increased AT access, technical support, curriculum modifications, and collaboration among stakeholders to ensure visually impaired learners receive quality education.
Keywords: Visually Impaired, Assistive Technologies, Disability, Mathematics.

Introduction

Disability is a condition that significantly affects an individual's ability to learn and function to their full potential due to physical, cognitive, psychological, or social challenges. According to the Americans with Disabilities Act, disability is defined as a condition that restricts a major life activity. It can manifest in different forms, including physical, intellectual, psychiatric, visual, hearing, or neurological impairments. Learners with disabilities often face limited educational opportunities, making the use of assistive technologies (ATs) essential in supporting their learning. The World Health Organization (WHO) defines ATs as tools or devices designed to enhance or maintain the functional abilities of individuals with disabilities (WHO, 2007; Hersh and Johnson, 2010).

Scholars have offered various definitions of assistive technology, all emphasizing its role in aiding individuals with disabilities. Soetan *et al.,* (2020) describe AT as technology that enables individuals with visual impairments to carry out functions that would otherwise be challenging. Scherer and Stefano (2017) explain AT as tools used by educators, parents, and schools to assist students with disabilities by providing compensatory solutions, addressing learning difficulties, and fostering independence. Olaosun and Ogundiran (2013) define AT as devices that improve the level of sound available to a listener. Meanwhile, Fernández-Batanero *et al.,* (2022) describe AT as a broad term encompassing all systems and services associated with assistive products and their applications.

The primary objectives of assistive technology are twofold: to augment an individual's capabilities and mitigate the impact of disabilities, and to offer alternative approaches to tasks to compensate for limitations. AT serves as a bridge between students with disabilities and modern digital tools, promoting independent living and enabling individuals with activity limitations to reach their full potential. Even general technologies, when appropriately configured, can provide assistive functions. Emiliani *et al.,* (2011) emphasize that AT aims to support individuals' functional and academic needs, ensuring their social,

physical, and educational well-being. McNicholl *et al.,* (2019) assert that AT products are primarily designed to foster academic success, particularly for VIL in mathematics classes.

Mathematics presents a significant challenge for VIL, as it involves recognizing symbols and performing calculations. Mastery of mathematics is crucial for everyday activities such as financial transactions and measurements (Daroni *et al.,* 2018). Assistive technologies tailored to mathematics learning play a vital role in addressing these challenges. These technologies include Braille textbooks, talking calculators, abacuses, Braille compasses, rulers, protractors, raised line graphs, and tactile geometry kits (Senjam, 2019).

Methodology

The research employed a descriptive survey design to examine how assistive technologies (ATs) are integrated into mathematics instruction for visually impaired learners (VIL) in selected schools. This design combined both qualitative and quantitative data collection methods, providing a comprehensive approach to the study, which was more suited to the teaching and learning of mathematics compared to a case study design. The research instruments used included questionnaires, interview schedules, observation schedules, and an observation checklist, with a 4-point Likert scale to measure variations. After data collection, the data was cleaned to remove any errors and then analyzed using descriptive statistics. Quantitative data was analyzed using SPSS version 21, while qualitative data was first coded numerically before being analyzed quantitatively. The data was recorded, tallied, tabulated, and processed manually, with frequencies, means, and percentages used to interpret and summarize the findings.

Literature Review

Visual impairment (VI) is a significant public health issue around the world because it has a detrimental impact on student's psychosocial and economic well-being, as well as the well-being of their family, community and the country as a whole (Ezinne *et al.,* 2022). Addo *et al.,* (2021), showed that about 36 million individuals are blind, 217 million have a moderate-to-severe visual impairment and 253 million are visually impaired. Visually impaired people make up a larger population in developing nations and are 50 years and above (Thapa *et al.,* 2018).

Assistive technologies in mathematics teaching and preparation is essential in today's education for the VIL as compared to the past (Lucky and Achebe, 2013) hence the need for research in ATs and the need for ever-growing instructional technology in hardware and software applications in mathematics (Osterhaus, 2006). All learners therefore; sighted or not, should have equal access to learning with technology (Sinclair *et al*., 2015).

Majinge and Stilwell's (2014) findings in Zambian universities are consistent with Akakandelwa and Munsanje's (2012) earlier findings in Zambia. In their study, it was noted that most learning institutions in Zambia did not provide adequate and suitable learning and teaching materials to pupils with visual impairment. In addition, many schools did not have resource rooms for storage and use of learning and teaching materials for these pupils. Thus, most children with visual impairment appeared to perform poorly in their studies and were required to drop science and mathematics subjects due to lack of teaching and learning materials (Akakandelwa and Munsanje, 2012).

Students with visual impairment in schools face many challenges which include the lack of skills to use computers to write assignments (Muzata *et al.,* 2019). The dependence on Braille to write assignments and examinations resulted in loss of scripts since course lecturers could not read Braille (Muzata *et al.,* 2019). The lack of assistive devices for learning exacerbates the challenges (Simui *et al.,* 2020). Generally, in Zambia, the utilisation of ICTs in education has been relatively low (Shafika, 2007), although, Daka *et al.,* (2011) reported that ICTs were slowly taking ground and being used by learners and teachers in schools. Studies on the barriers to education for students with visual impairments in higher education in Zambia, show that lack of ICTs is the most restrictive barrier (Simui *et al.,* 2017; Simui *et al.,* 2020). For instance, Simui *et al.,* (2018) recommended the use of modern technology to make access to higher education possible for students with visual impairments.

Another recommendation made by Simui *et al.,* (2017) was the need to empower teaching staff with ICT skills so that they could use such skills to teach students with visual impairment. In another study, Simui *et al.,* (2019) noted from lived experiences of students with visual impairment at a university in Zambia thirteen disablers, which impeded their learning. Key among them were the lack of assistive devices for students with visual impairment, exclusive assessment and pedagogy used by teachers that were seemingly

unprepared in terms of expert knowledge and skills to teach students with. One key recommendation from the study was that the schools should provide access to suitable technology. Muzata (2018) also recommended the introduction of a compulsory ICT course for students with visual impairment.

The success of the teaching and learning process in mathematics depends mainly on the availability and effective use of teaching materials. Babu (2005) recognises the need to use the right equipment and improvise necessary learning aids using locally available materials. If mathematics teachers hope to impart change and improve their performance, there must be adequate and appropriate resources for learners with visual impairments regarding structures and teaching or learning resources. Sahin and Yorek (2009) point out that most African schools did not provide LV with adequate resources that made learning easy. In addition, a study on challenges experienced by LVI in South African township primary schools by Morelle and Tabane (2019) acknowledges that the South African education system still struggles to cater for disabled persons, especially LVI. The slow progress may be attributed to late inclusive education efforts in the South African education system, which relied more on differentiating special and mainstream schools.

Theoretical Framework

This study will be based on two theories: Abraham Maslow's hierarchy of needs (1943) and Linda Harasim's Online Collaborative Learning Theory (2012). ATs are no longer a luxury, but a necessity. Naturally, human beings develop a need where there is value attached. Education has become so competitive that one feels doomed if he/she has failed in the education system. Education has become an essential need in our recent past and present. The VIL also have their needs in education which they regard so dearly-the the need for ATs in learning. This need for ATs will not only increase their independence but also support their aspirations. Therefore, integrating ATs in the teaching of the VIL falls within the confines of Abraham Maslow's hierarchy of needs and is driving VIL towards high consumption of ATs in all spheres of life.

According to this theory, individuals strive to seek a higher need after the lower need has been fulfilled. Once a lower need is satisfied, it no longer serves as a source of motivation because needs are motivators only when they are unsatisfied. In a case of physiological needs, these are needs that are the most basic for human survival, for example air, food and water. Learners and teachers cannot be motivated to use ATs unless these needs are met. For example, a hungry learner cannot be motivated to learn and the attention in class cannot be captured leave alone sustained. Similarly, a teacher cannot teach and deliver effectively using ATs while hungry. The classrooms should be well ventilated to have a good supply of fresh air. The school should ensure that there is an adequate supply of clean water for bathing, drinking, cooking and cleaning, then ATs for the teaching and learning in mathematics would occur.

Data Findings

The primary objective of the study was to explore the different forms of ATs accessible in the school to aid mathematics instruction. Both the VILs and their mathematics teachers were asked to identify and name the ATs currently being utilized during mathematics lessons. In addition to these responses, the researcher also documented the ATs present in the school using an observation schedule and checklist.

The findings showed that 80% of the learners believed there were sufficient ATs to support the teaching and learning of mathematics in their schools. Teachers were also asked about the regularity of AT usage during mathematics lessons. Their responses were as follows: 14.3% stated the ATs were never used, 28.6% said they were used rarely, while 57.1% indicated that they were often used.

Table 1. Shows assistive technologies.

Type of ATs	**Frequency**	**Percentage (%) frequency**
Cubes	15	11%
Abacus	12	9%
Laptops	14	10%
Counters	10	7%
Cuboids	16	12%
Cuberithms	15	11%
Perkins Braillers	15	11%
Talking calculators	20	15%
Braille geometrical instruments	19	14%
Total	136	100%

The breakdown of ATs included 15 cubes (11%), 12 abacuses (9%), 14 laptops (10%), 10 counters (7%), 16 cuboids (12%), 15 cuberithms (11%), 15 Perkins Braillers (11%), 20 talking calculators (15%), and 19 Braille geometrical instruments (14%). These results indicate that the schools generally had an adequate supply of assistive technologies.

Overall, the study concluded that several ATs were actively used in teaching and learning processes in the selected schools. This was supported by 83.7% of the teachers, who affirmed that sufficient ATs were available for the learners, a sentiment echoed by 80% of the VILs who participated in the research.

Extent to Which Assistive Technologies Integration Improves Student Engagement, Motivation, and Self-Efficacy in Learning Mathematics

The second objective focused on determining the level of integration of ATs in the teaching and learning of mathematics. The learners were asked whether they used ATs in every lesson in learning mathematics. The learner responses were interesting as 80 percent agreed and 20 percent disagreed. This implied that some lessons were taught without integrating ATs thus impacting negatively on the learning of mathematics.

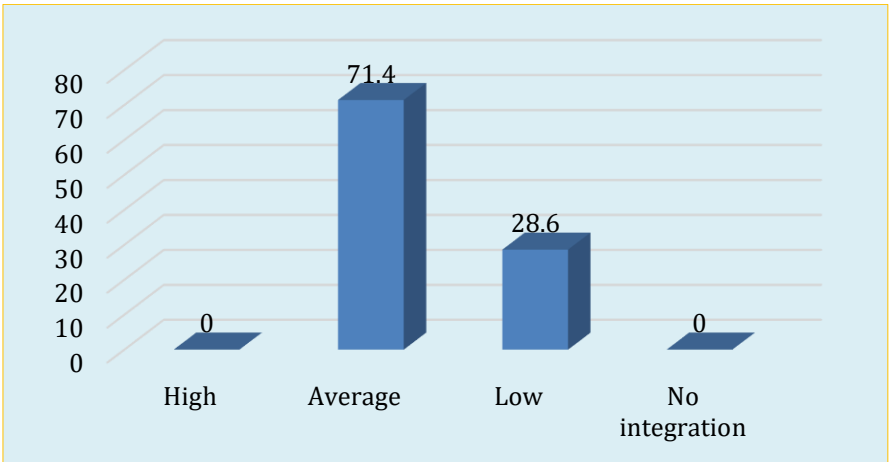

Figure 1. Responses from teachers' extent to which assistive technologies (ATs) were incorporated into mathematics instruction at their schools.

During the interviews with teachers, they were asked to assess the extent to which assistive technologies (ATs) were incorporated into mathematics instruction at their schools. Their responses indicated the following levels of integration: high (0 per cent), moderate (71.4 per cent), low (28.6 per cent), and no integration at all (0 per cent). The research established that the use of ATs had a notable impact on enhancing student involvement in learning mathematics. Visually impaired students reported increased participation in classroom activities when utilizing assistive tools like Braille displays and screen readers. These devices enabled them to access mathematical content instantly, minimizing dependence on teacher support and encouraging greater independence in their learning. Teachers also observed that students using AT were more focused and engaged during lessons.

The use of ATs also appeared to boost learners' motivation to study mathematics. With the ability to independently access content and perform mathematical calculations through specialized software, students developed a stronger interest in the subject. The study highlighted that learners felt a sense of pride and achievement when they were able to solve problems independently, which further inspired them to remain engaged. Moreover, the individualized learning experience offered by ATs allowed students to work at their own pace, promoting sustained motivation. Additionally, the study found that the integration of ATs positively influenced learners' self-efficacy-their belief in their ability to succeed in tasks. Students reported increased confidence in handling mathematical problems after using AT tools. The accessibility features helped eliminate some of the frustrations tied to traditional learning methods, which often made visually impaired learners feel incapable. By facilitating independent access to and interaction with mathematical content, ATs nurtured a sense of empowerment and self-assurance in these students.

Effect of Integrating ATs in Learning Mathematics Among the Visually Impaired Learners

The focus of the study was to establish the effect of integrating ATs in the teaching and learning of mathematics among the VIL in selected schools in Lusaka district. To investigate this impact, the researcher developed a questionnaire designed to determine the impact of assistive technology in the education of the

visually impaired learner. In exploring the impact of assistive technology constructs, items were drawn relating to concepts which were important components of the impacts of assistive technology measurements. They were Likert-scaled item type questions, in which teacher respondents choose from 3-point score; strongly agree (SA), agree (A), and strongly disagree (SD). Their responses were summarized as in Figure 2.

Impact of Assistive Technology in the Education of the Visually Impaired Learner

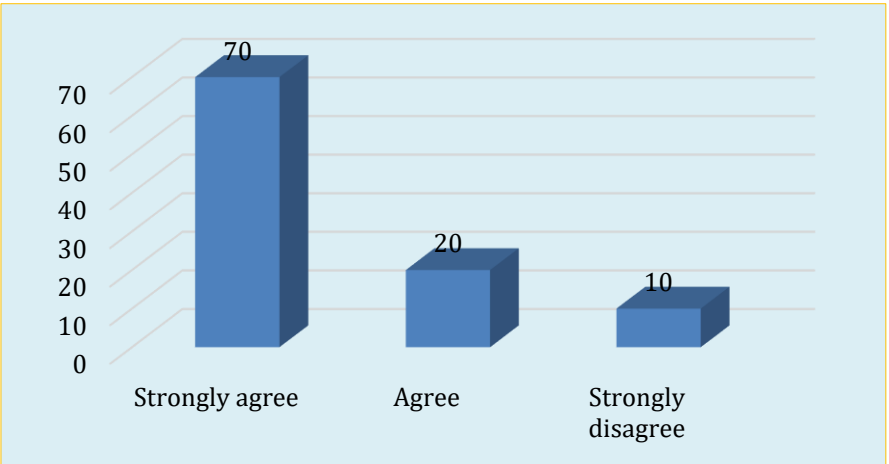

Figure 2. Responses from teachers.

The findings of the study show that a majority (70%) of the teacher respondents strongly held the opinion that use of assistive technology is the way to go, with another 20% of them agreeing that use of assistive technology should be enhanced in special schools such as the selected schools for the visually impaired. It emerged from the finding of the study that the use of assistive technology has great contribution to the curriculum coverage and completion; hence, it positively influences the educational achievement of students with visual impairment. To this end, 40% of the teacher respondents strongly agreed that a lot of work is covered as far as curriculum is concerned when using assistive technology equipped ICT facilities. This was supported by another 20% of the respondents who also agreed that coverage of syllabus content is enhanced when assistive technology is used. The constructivists support practical involvement of students to make learning interesting and worthwhile. Passive students don't gain academically as required compared to active participation. The teachers' questionnaire was used in establishing the effect of the ATs in the learning of mathematics by the VIL. The teachers were asked to state their satisfaction level regarding the effect of ATs on learner performance in mathematics. It was observed that 28.6 percent of the teachers were dissatisfied while 71.4 percent were satisfied.

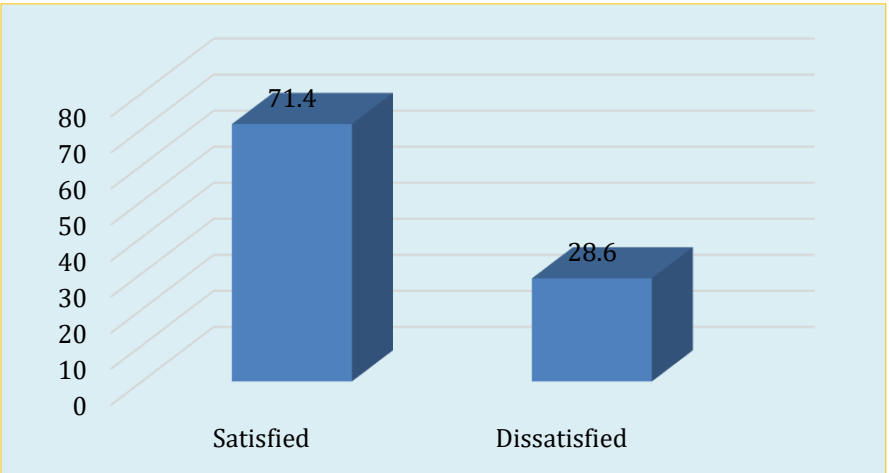

Figure 3. The teachers were asked the rate of the pace of syllabus coverage given ATs.

The Teachers Were Asked If Ats Motivated Learners

Five teachers (71.4 percent) said that 'often' syllabus coverage was faster with ATs while two (28.6 percent) said 'not at all.'

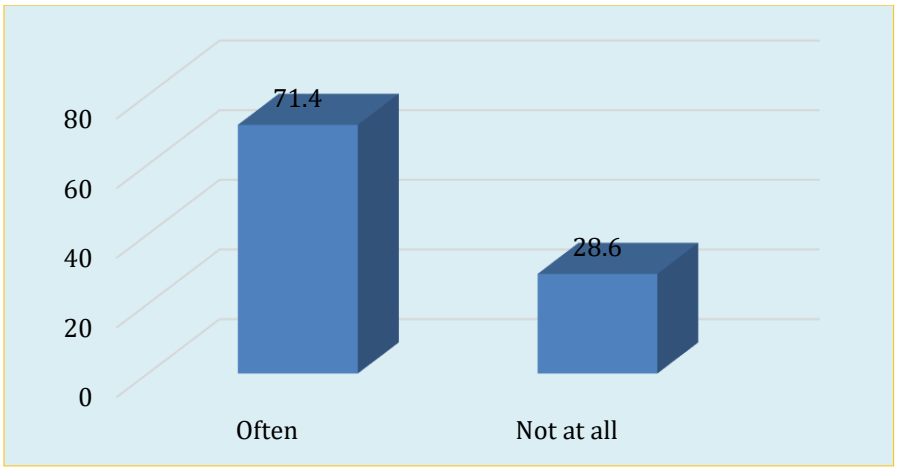

Figure 4. Responses from teachers.

Teachers Were Asked If ATs Improved Pupils' Performance in Mathematics When Used
Three respondents (70 per cent) agreed that 'often' ATs motivated pupils to learn mathematics, while (30 percent) said 'not at all.'

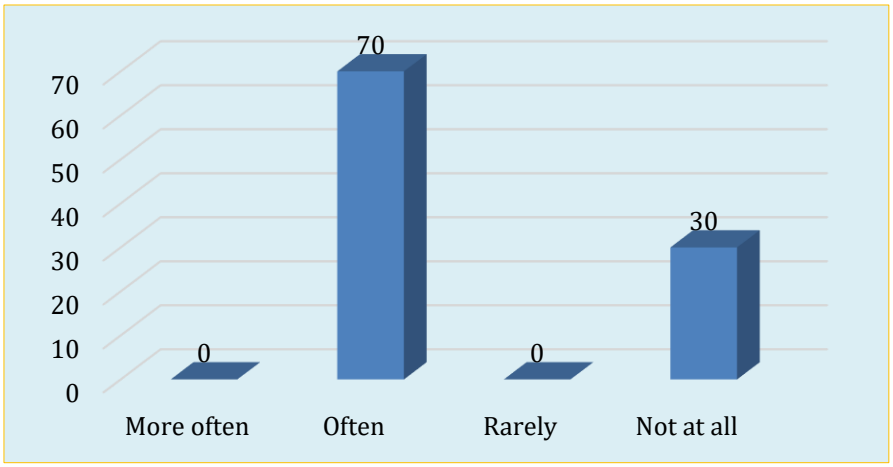

Figure 5. Responses from teachers.

The Teachers Were Also Asked If the ATs Enhanced the Teaching of Mathematics
Further, the teachers were asked if ATs improved pupils' performance in mathematics when used. Two teachers (28.6 percent) said 'often', three (42.9 percent) said 'rarely' while two (28.6 percent) said 'not at all'. Those who said 'not at all' gave inadequacy as the main factor.

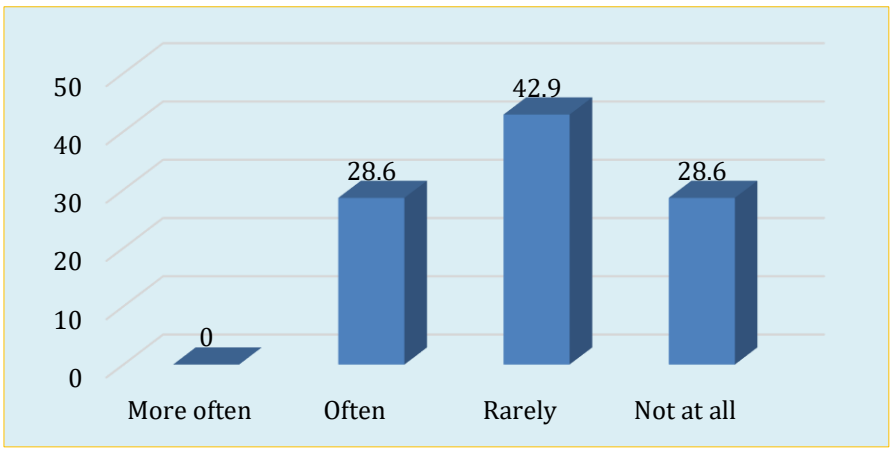

Figure 6. Responses from teachers.

Challenges Faced by the Visually Impaired Learners in Learning Mathematics Using in Assistive Technologies

The findings of the study reveal that lack of adequate resources is a great impediment towards acquisition and provision of assistive technology. Just like in some schools for the visually impaired, have just a few computers in their laboratories for use by the students and teachers. The limited number of computers in the school causes a great challenge to access regular class schedules, thus restricting frequent computer lessons by all students. The learners were asked whether they experienced challenges while learning mathematics using ATs. Apart from one learner (3 percent) who disagreed; 29 learners (47 percent) agreed that they experienced challenges in using ATs while learning mathematics; with 15 out of 30 pupils strongly agreeing. The study revealed that assessment procedures were too demanding and weighed more on visual learning than tactile learning.

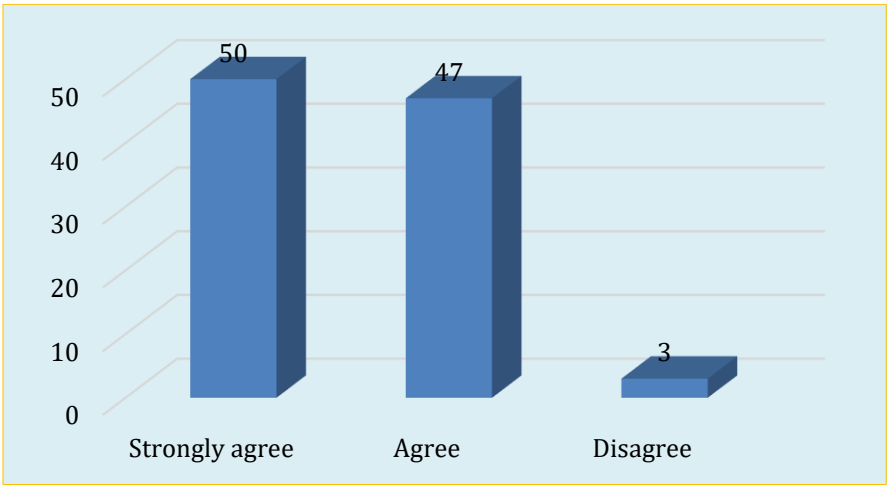

Figure 7. Responses from learners.

This implied that 97 percent of the learners experienced challenges when using ATs while learning mathematics. The learners stated the following as challenges encountered while learning mathematics with ATs:

The study findings show that lack of appropriate and adequate knowledge and skills in computer causes a great challenge to teachers in acquisition and use of computer. Majority of the teacher respondents held the view that most teachers do not have adequate computer knowledge and skills to use the relevant visually impaired programmes or teach the learners on their use. The implication of this is that effective use of computers as tools or equipment of curriculum delivery in terms of teaching and learning is interfered with because computers are located in the computer laboratory not in classrooms. Although the findings of the study show that computers are available in some schools for the visually impaired, they are under-utilized given teachers' lack of the requisite skills and creativity to use them frequently and effectively in their teaching. 85.7 percent reported that 'often' the learners experienced challenges; with 14.3 percent reporting 'rarely'.

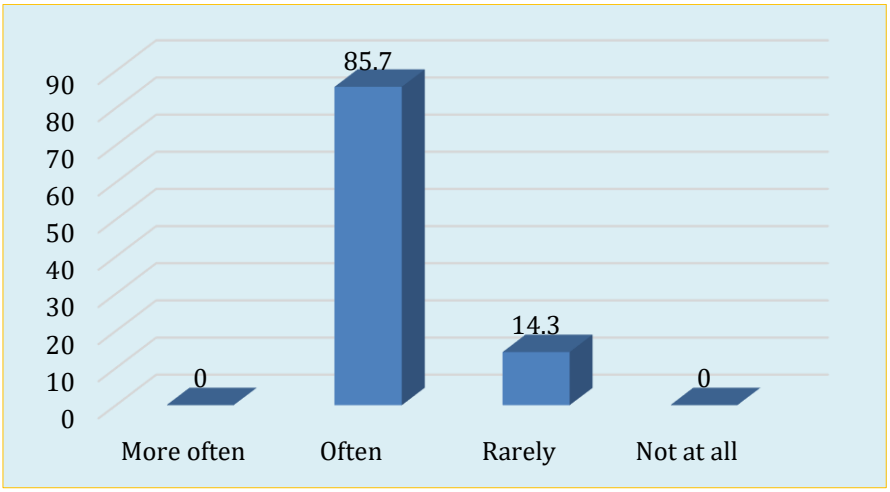

Figure 8. Responses from learners.

The teachers were asked to state the challenges experienced by the VIL when using ATs in learning mathematics. This section was corroborated with section (III) on part C of the teachers' questionnaire which required teachers to state the perceived barriers in the effective teaching and learning in mathematics using ATs. The teachers gave the following as challenges:

Table 2. Challenges experienced by VIL in learning mathematics using ATs.

Challenge	**Frequency**	**Percentage (%) frequency**
Needs a lot of time to integrate	2	7.4%
Negative attitude of the learners towards mathematics	6	22.2%
Inadequacy of the ATs	7	25.9%
Misuse by the learners	1	3.7%
Takes time to train learners	5	18.5%
Inadequate number of trained personnel	6	22.2%
Total	**27**	**100%**

Inadequacy of the ATs was the cited challenge at 25.9 percent. Negative attitude of the learners and an inadequate number of trained and qualified personnel followed at 22.2 percent in each case. The research indicated that the time the teachers took for training the learners on how to use ATs was a challenge on the path of the VIL towards excellence in mathematics and was also confirmed by the respondents at percent. The National Center for Tactile Diagrams-NCTD, 2011; noted that there was need to come up with new ATs to make mathematics more-friendlier and also be more accessible for the VIL to learn with much ease otherwise teachers would always take time in training these learners on how to use ATs.

The observation guide comprised of data that was collected based on utilization of resources and ATs integration in a live classroom situation during a mathematics lesson. The researcher requested and was given an opportunity to get first-hand information in regard to teaching and learning using ATs in a mathematics classroom. The researcher while seated at the back of the class and observing lesson delivery by the teacher, observed the existing resources, the challenges faced by VIL in the course of learning mathematics, the available and accessible ATs for integration, the level of use and the impact created by the utilized ATs through which the research questions were answered. The pupils' as well as the teacher' activities were recorded all through from lesson introduction, development and conclusion level.

From the observation guide the following were observed by the researcher as challenges experienced by the VIL in learning mathematics; in line with the fourth research question, which read 'Which challenges do VIL face in the teaching and learning process?'

As established by this study, is that care and maintenance of the equipment and software which is essential is always inappropriate or insufficient. These equipment are delicate and require good care and regular servicing by trained personnel, which again could not be employed by the school due to insufficient resources. Limited number of computers available was a great challenge to access for schedules hence restricting frequent class computer lessons. The other challenge is that majority of teachers are conversant with analog assistive technology but lack adequate skill to apply while using modern assistive technology. Furthermore, teachers also could not troubleshoot some application malfunctioning and would seek assistance of technician leading to time wastage.

From the observation checklist, the researcher established that the ATs for the teaching and learning of mathematics were inadequate in some school based on availability and accessibility vis-à-vis learner population. Further, modern ATs for the teaching and learning of mathematics like the mathematics daisy were missing in the school some schools under study.

Challenges Faced by the Visually Impaired Learners in Learning Mathematics Using Assistive Technologies

To address the study's fifth objective identifying solutions to challenges visually impaired learners face in learning mathematics using assistive technologies various participants provided key insights.

The head teacher emphasized the need for comprehensive, ongoing training that includes both basic and advanced use of assistive technologies (AT), with practical, hands-on experience and real-world classroom integration. He recommended long-term professional development through workshops, seminars, and

online courses. Another participant highlighted the importance of collaborative learning among teachers through peer support networks. Participants also stressed incorporating ATs into pre-service teacher education to build early familiarity and reduce resistance among future educators.

Additionally, participants noted that effective integration requires access to AT tools, technical support, and instructional materials. Strong institutional and policy backing-including clear guidelines, sufficient funding, and accountability measures was also deemed essential for successful teacher training and AT use in schools. In selected schools in Lusaka district, the availability of assistive technologies (ATs) for visually impaired learners (VILs) varies. While most schools have a range of ATs, some lack essential resources to fully support their students. This variation is influenced by factors like funding, training, and awareness of the importance of ATs in education. According to the learners (96.7%) and teachers (57.1%), the available ATs were generally adequate for the number of students. For instance, the ratio of talking calculators, abacuses, and calculation cubes to learners was 1:1. The most common ATs for learning mathematics included talking calculators (14%), Braille geometric instruments (15%), and cuboids and cubes (12%). However, there is a need to keep up with advancements in mathematical tools for VILs, as much of the language in mathematics depends on visual objects (Osterhaus, 2012).

The study highlights the significant role of integrating ATs into the mathematics curriculum for visually impaired learners. The integration level was considered 'high' by 71.4% of teachers, with 71.4% of learners using ATs in every mathematics lesson. However, in some schools, the lack of ATs negatively impacted the integration process. Teachers reported an 85.7% satisfaction rate with the integration of ATs, indicating that the use of ATs in teaching mathematics was adequate. According to UNESCO (2010), inclusive education should focus on those excluded from education, including those who are not learning with ATs, which can create disconnection for VILs in mathematics.

The impact of ATs on educational achievement was significant, as teachers noted that tools like Jaws, iPads, smart phones, and computers are essential for enabling VILs to perform at the same academic level as their sighted peers. The study suggests that three levels of knowledge construction-idea generation, idea organizing, and intellectual convergence-are critical for VILs and should be supported through ATs (Harasim, 2012). Additionally, VILs benefit from more independent access to information, enhancing their academic performance and engagement (Chikonzo *et al.,* 2021; Svensson *et al.,* 2021).

Despite these benefits, challenges persist, including limited access to computers, insufficient training of teachers on modern ATs, and inadequate maintenance of AT equipment. These barriers, covering 70.3% of the challenges, continue to hinder VILs' learning in mathematics. Research suggests that providing continuous, practical training for teachers and increasing AT availability in schools would significantly improve learning outcomes for VILs (Chukwuemeka and Samaila, 2020; Kirboyun, 2020). To address these challenges, the study calls for increased investment in AT infrastructure, teacher training, and the creation of inclusive learning environments. Collaborative learning, awareness campaigns, and school-wide inclusivity programs are crucial for supporting VILs' educational experiences (Eligi and Mwantimwa, 2017).

The study highlights that the use of assistive technologies (ATs) is essential for reducing obstacles and providing visually impaired learners (VIL) with better access to educational opportunities. The integration of ATs into mathematics instruction has proven transformative for VIL in Lusaka district, significantly improving student engagement, motivation, and self-confidence. AT not only enhances academic performance but also promotes the overall well-being of learners. To fully leverage the benefits, it is crucial for educational stakeholders to invest in the necessary resources and training to ensure effective use of AT in classrooms.

A key challenge identified by visually impaired learners is the limited availability of AT in some schools. Some learners also reported difficulties in using AT devices due to insufficient training in certain schools. Pupils emphasized the need for more tailored learning materials to meet their specific needs. Schools should collaborate with educational content developers to produce Braille mathematics textbooks and tactile learning resources. Furthermore, incorporating audio descriptions into mathematical problems and solutions could help visually impaired learners grasp complex concepts more easily. The success of AT integration in improving learners' mathematics performance is largely dependent on how well VIL are introduced to AT tools, which influences their participation, the integration process, and teaching methods. The study concluded that with appropriate training on ATs, visually impaired learners can overcome their sight loss and effectively learn mathematics. However, these challenges can be addressed with the right

strategies, including comprehensive teacher training, improved access to ATs, technical support, supportive learning environments, and curriculum adjustments. Collaboration between students, teachers, school administrators, and external partners is essential to ensure that visually impaired learners receive the education they deserve.

Based on the discussions above, this paper presents the following recommendations:

- ☞ The ATs Should be Available and Accessible to the Teachers and VIL: This should go a long way in bridging the gap that is created by their loss of sight, and therefore connections in the learning of mathematics will be enhanced. The respondents cited the inadequacy of the ATs as a severe barrier in effective teaching and learning of mathematics by the VIL.
- ☞ Training for Teachers and Learners: Continuous professional development should be provided to teachers on the use of AT in teaching mathematics. Learners should also be given hands-on training to maximize their use of these tools.
- ☞ Resource Allocation: Schools should be equipped with the necessary AT tools to support visually impaired learners. This requires adequate funding and resource allocation from the government and other stakeholders.
- ☞ Policy Development: Educational policies should emphasize the inclusion of AT in the curriculum, particularly for subjects like mathematics where visually impaired learners face significant challenges.
- ☞ The teachers should be encouraged to improvise learning aids by use of locally available materials to mitigate on inadequacy of ATs for learning mathematics.
- ☞ The time allocated for lesson attendance for the VIL should reasonably and adequately be increased. The 35 minutes lesson was not adequate for an effective mathematics lesson delivery compounded by the problem of inadequacy of the ATs and the element of adoption and adaptation of these resources by the VIL.

Declarations

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Conflict of Interest: The author confirms that there are no conflicts of interest related to this paper.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

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References

1. Addo, E.K., Akuffo, K.O., Sewpaul, R., Dukhi, N., Agyei-Manu, E., et al. 2021. Prevalence and associated factors of vision loss in the South African National Health and Nutrition Examination Survey (SANHANES-1). BMC Ophthalmology, 21: 1-15.

2. Akakandelwa, A. and Munsanje, J. 2012. Provision of learning and teaching materials for pupils with visual impairment: Results from a National Survey in Zambia. British Journal of Visual Impairment, 30(1): 42-49.

3. Babu K. 2005. Improvised aids for effective science education in rural schools. Abstract Retrieved August 22, 2007 from www. geocities.com/ednsekara/18th conference –b.htm/

4. Chikonzo, A.C., Muziringa, M. and Munyoro, J. 2021. The role of assistive technology (AT) in enhancing the educational experience of students with special needs in higher education: A case of University of Zimbabwe Library. Library Philosophy and Practice (E-Journal): 6780. https://digitalcommons.unl.edu/libphilprac/6780/

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

6. Daka, K.L., Chisunka-Mwila, C.P., Mulauzi, F. and Njobvu, B. 2011. Integration of ICTs in education: The level at which ICT training should be introduced in Zambian education. Zambia Library Association Journal, 25 (1 & 2): 5-18.
7. Daroni, G.A., Gunarhadi, G. and Legowo, E. 2018. Assistive technology in mathematics learning for visually impaired students. Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah, 3(1): 1-9.
8. Eligi, I. and Mwantimwa, K. 2017. ICT accessibility and usability to support learning of visually-impaired students in Tanzania. International Journal of Education and Development Using Information and Communication Technology, 13(2): 87-102.
9. Emiliani, P.L., Stephanidis, C. and Vanderheiden, G. 2011. Technology and inclusion–past, present and foreseeable future. Technology and Disability, 23(3): 101-114.
10. Ezinne, N.E., Shittu, O., Ekemiri, K.K., Kwarteng, M.A., Tagoh, S., Ogbonna, G. and Mashige, K.P. 2022. Visual impairment and blindness among patients at Nigeria Army Eye Centre, Bonny Cantonment Lagos, Nigeria. Healthcare, 10(11): 2312.
11. Fernández-Batanero, J.M., Montenegro-Rueda, M., Fernández-Cerero, J. and García-Martínez, I. 2022. Assistive technology for the inclusion of students with disabilities: A systematic review. Educational Technology Research and Development, 70(5): 1911-1930.
12. Harasim, L. 2012. Learning theory and online technologies. New York, USA: Routledge Publication.
13. Hersh, M. and Johnson, M.A. (Eds.). 2008. Assistive technology for visually impaired and blind people. Springer, London.
14. Kirboyun, S. 2020. High-tech or low-tech? Impact of assistive technology in school settings for students with visual impairments: Review of research. International Journal for Infonomics, 13(1): 1945-1953.
15. Lucky, A.T. and Achebe, N.E.E. 2013. Information service delivery to the visually impaired: A case study of hope for the blind foundation Wusasa, Zaria (Nigeria). Research Journal of Information Technology, 5(1): 18-23.
16. Majinge, R.M. and Stilwell, C. 2014. ICT use in information delivery to people with visual impairment and on wheelchairs in Tanzanian academic libraries. African Journal of Library, Archives and Information Science, 24(2): 151.
17. Maslow, A.H. 1943. A theory of human motivation. Psychological Review, 50(4): 370-396.
18. McNicholl, A., Casey, H., Desmond, D. and Gallagher, P. 2019. The impact of assistive technology use for students with disabilities in higher education: A systematic review. Disability and Rehabilitation: Assistive Technology, 16(2): 1-14.
19. Morelle, M. and Tabane, R. 2019. Challenges experienced by learners with visual impairments in South African township mainstream primary schools. South African Journal of Education, 39(3): 1-6.
20. Muzata, K.K. 2018. Assessing soft skills among students with disabilities in teacher training institutions in Zambia. Zambia Journal of Education, 5(1): 1-10.
21. Muzata, K.K., Simalalo, M., Kasonde-Ng'andu, S., Mahlo, D., Banja, M.K. and Mtonga, T. 2019. Perceptions of students with visual impairments towards their inclusion in the faculty of education at the university of Zambia: A phenomenological study. Multidisciplinary Journal of Language and Social Sciences, 2(2): 170-210.
22. NCTD. 2011. Making tactile graphics. Available at: http/www.nctd.org.uk/
23. Olaosun, A.O. and Ogundiran, O. 2013. Assistive technology for hearing and speech disorders. Journal of Biology, Agriculture and Healthcare, 3(17): 116-120.
24. Osterhaus, S.A. 2006. Obstacles and the importance of advocacy. Journal of Visual Impairment and Blindness, 4(9): 7.
25. Osterhaus, S.A. 2012. http//susanosterhaus@tsbvi.edu. Retrieved on 06/10/2014.
26. Sahin, M. and Yorek, N. 2009. Teaching science to visually impaired students: A small-scale qualitative study. US-China Education Review, 6(4): 19-26.

27. Scherer, M. and Stefano, F. 2017. Assistive technology assessment handbook. CRC Press, Taylor and Francis Group.

28. Senjam, S.S. 2019. Assistive technology for people with visual loss. Delhi Journal of Ophthalmology, 30(2): 7-12.

29. Shafika, I. 2007. ICT education in Zambia. Lusaka: www.infodev.org.

30. Simui, F., Kasonde-Ngandu, S., Cheyeka, A.M. and Makoe, M. 2019. Lived disablers to academic success of the visually impaired at the university of Zambia, Sub-Saharan Africa. Journal of Student Affairs in Africa, 7(2): 41-56.

31. Simui, F., Kasonde-Ngandu, S., Cheyeka, A.M., Simwinga, J. and Ndhlovu, D. 2018. Enablers and disablers to academic success of students with visual impairment: A 10-year literature disclosure, 2007–2017. British Journal of Visual Impairment, 36(2): 163-174.

32. Simui, F., Muzata, K.K., Sakakombe, L. and Mtonga, T. 2020. Disablers to academic success of learners with special education in selected higher education institutions in Zambia. Zambian Journal of Educational Management, Administration and Leadership, 1(1): 21-38.

33. Simui, F., Ngandu, S.K. and Nyaruwata, L.T. 2017. ICT as an enabler to academic success of students with visually impaired at Sim University: Hermeneutics approach. Zambia ICT Journal, 1(1): 5-9.

34. Sinclair, N., Haspekian, M., Robutti, O. and Clark-Wilson, A. 2023. Revisiting theories that frame research on teaching mathematics with digital technology. In: The mathematics teacher in the digital era: International research on professional learning and practice (pp. 391-418). Cham: Springer International Publishing.

35. Soetan, A.K., Onojah, A.O., Alaka, T.B. and Aderogba, A.J. 2020. Hearing impaired students' self-efficacy on the utilization of assistive technology in federal college of education (special) Oyo. International Journal for Cross-Disciplinary Subjects in Education, 11(1): 4658-4666.

36. Svensson, I., Nordström, T., Lindeblad, E., et al. 2021. Effects of assistive technology for students with reading and writing disabilities. Disability and Rehabilitation: Assistive Technology, 16(2): 196-208.

37. Thapa, R., Bajimaya, S., Paudyal, G., Khanal, S., Tan, S., Thapa, S.S. and Van Rens, G.H.M.B. 2018. Prevalence and causes of low vision and blindness in an elderly population in Nepal: The Bhaktapur retina study. BMC Ophthalmology, 18: 1-10.

38. UNESCO. 2010. UNESCO science report 2010: The current status of science around the world. United Nations Educational, Scientific and Cultural Organization.

39. World Health Organization. 2007. International classification of functioning, disability and health: Children and youth version: ICF-CY. World Health Organization. Retrieved from https://iris.who.int/handle/10665/43737/

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