Effectiveness of Low-Tech Assistive Devices in Facilitating Learning for Visually Impaired Pupils in Inclusive Public Primary Schools in Northern Zone, Tanzania

Kulwa Hamis Mrisho, Kezia Mashingia, Timothy Mandila
Department of Education, Mwenge Catholic University, Tanzania

Abstract
The study investigated the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils in Northern Zone of Tanzania. The study was anchored in the Universal Design for Learning (UDL) Theory. The target population for this study included 7 inclusive public primary schools, 7 head teachers, 142 teachers, 408 visually impaired pupils and 7 District Primary Educational Officers-Special Needs (DPEO-SN). A sample of 6 Inclusive public primary schools, 6 head teachers, 47 teachers, 39 visually impaired pupils, and 4 District Primary Education Officers-Special Needs, making a total of 102 respondents, was included. A census sampling was used to select primary schools, a total population sampling was used to choose head teachers, a Criterion sampling was used to select teachers and a purposive sampling technique was used to select visually impaired pupils and DPEO-SN. Quantitative data were collected through questionnaires and observation schedules from teachers and pupils, while qualitative data were gathered through interviews from Head teachers and District Primary Education Officers-Special Needs (DPEO-SN), and focus group discussions from visually impaired pupils. The validity of the data collection instruments was ensured by MWECAU research experts from the field of curriculum and instruction. A pilot study was conducted in one inclusive public primary school that was not part of the main study. The reliability of the questionnaires was established through Cronbach's Alpha which yielded a coefficient of .761 for Likert-type items, while the trustworthiness of qualitative instruments was ensured through triangulation and peer debriefing. Quantitative data were descriptively analyzed into frequencies, percentages, and mean scores, and presented in tabular form, while qualitative information was thematically summarized and presented in narratives and direct quotations. Ethical considerations were ensured through informed consent, confidentiality, avoidance of plagiarism, anonymity, and adherence to research ethics. The study found that low-tech assistive devices are effectively facilitating learning for visually impaired pupils in Inclusive public primary schools. The study concludes that low-tech assistive devices are not only effective but also sustainable tools for supporting inclusive education hence should be monitored for better educational process of Visually Impaired Pupils. The study recommends that Ministry of Education and stakeholders should expand access to low-tech assistive devices across the region in Inclusive Public Primary Schools.

Keyword: Effectiveness, Low-Tech Assistive Devices, Visually Impaired Pupils, Inclusive Public Primary Schools

1. Introduction

Education for people with special needs has become a global priority, with growing emphasis on Inclusive practices that ensure equitable access to learning for all students (UNESCO, 2020). The United Nations Convention on the Rights for Persons with Disabilities (UN 2006), through Article 24, 2b require state countries to ensure access of Inclusive, quality and free education for persons with special educational needs including visually impaired pupils on an equal basis with others in the community they live (UN 2006). Visually impaired person refer to the one who experience significant loss of vision that cannot be fully corrected by medical treatment, surgery, or ordinary glasses, and whose reduced vision negatively affects the ability to access and process visual information (WHO, 2022). Globally, there are about 43 million people who are totally blind and 295 million who are living with moderate to severe visual impairment (UNICEF, 2022). The educational process for visually impaired pupils is accompanied by several difficulties associated with the fact that they cannot see and one of the ways to effectively solve this problem is the use of Low-tech assistive devices in learning.

Low-tech assistive devices are widely used in learning for visually impaired pupils due to their accessibility, affordability and adaptability across diverse educational and socioeconomic contexts (Kamran and Bano, 2024). Low-tech assistive devices include Braille Slate and Stylus, Braille Books and papers, tactile graphics, Abacus, Small magnifiers, bold line paper, and Reading stand. The Global Report on assistive technolgy devices in 2022 shows important inequities in access of such devices, where only 10% of people have access to the devices they need. In low-income countries, access is as low as 10% where most of devices are Low-tech devices, compared to 90% in high-income countries in which most of devices are more developed (WHO, 2022). Low-tech devices help visually impaired pupils to actively participate in reading, writing, numeracy, and other classroom activities especially for lower classes pupils (Pegon et al., 2023). Despite their recognized potential, still there is a concern regarding the effectiveness to which low-tech assistive devices facilitate learning for visually impaired pupils.

Across countries, the use of Assistive technology devices pray significant role in learning for visually impaired pupils. In United States of America, Assistive technology devices have been widely adopted to enhance the educational experiences of visually impaired pupils (Chen, 2021). The study by Rong and Liu (2023) in United Kingdom reported that tactile

graphics and braille writings enable classroom participation for visually impaired pupils. Similarly, in India, the government and non-governmental organizations ensure proper supply of Assistive technology devices such as magnifiers, braille books, and audio-based learning tools; however, limited availability and insufficient teacher training reduce the effectiveness of these initiatives (Shanker & Kant, 2023). Proper integration of assistive technology devices in teaching practices enhance independent learning promoting social inclusion and confidence among visually impaired pupils (WHO, 2022). Low-tech assistive devices are widely accessible in inclusive environment for visually impaired pupils, this increases the need to examine their effectiveness for better educational outcomes.

In South Africa, the Implementation strategies of inclusive policies such as the Education White Paper 6 and Policy on SIAS (DBE 2014) priorities the use of Assistive technology devices including low tech devices in educational process for visually impaired pupils (Viljoen et al, 2020). In Nigeria, Blind Tech Empowerment Initiative (BTEI), provides assistive technology and digital literacy training; The Keeping It Real (KIR) Foundation, donates devices such as Braille slates, laptops, and tape recorders; and The Federal Nigeria Society for the Blind, offers vocational training and advocacy, helped learners engage in school activities (Okoye, 2024). In East Africa, particularly Kenya, the inABLE organization has established low-tech assistive devices labs providing digital skills training, and the Blind Trust Africa (BTA) supplies digital Braille devices and training to improve literacy and employment skills. Most of the Assistive devices used in African countries especially the least developed countries including Tanzania are low tech-tech devices. This makes the need to examine the effectiveness of Low-tech devices in facilitating learning for Visually impaired Pupils.

Tanzania like other countries shows great effort in providing education for visually impaired Pupils by implementing The United Nations Convention on the Rights of Persons with Disabilities, (UNCRPD) Act of 2006. The government of Tanzania advocates the use of Assistive technology devices including Low-tech devices through a range of frameworks and policies including the National Policy on Disability, 2004, Persons with Disability Act, 2010, Education and Training Policy 2014, 2023 Edition, National Policy on ICT, 2016 and an overall National Strategy for Inclusive Education 2021/2225/2026 which guides and requires the Ministry of Education Science and Technology (MoEST) to ensure provision of equipment and tools for learning of visually impaired pupils, (Losioki & Ngowoko, 2024;

HelpAge, 2024). Despite of the effort made by government, the effective use of assistive technology devices including low-tech devices is not yet full attained. The study by Bahati (2025) indicates that, most of assistive technology devices used in learning for visually impaired pupils are low tech devices. The Northern zone of Tanzania experiences disparities in the use of AT devices there by some schools had limited number devices in which most of them are Low-tech devices due to their accessibility (Morrison, 2020; Mnyanyi, 2021). Most Scholars examined that, low tech devices are more commonly used due to their accessibility and affordability, although the concern remain on the impactful on learning process of Visually impaired pupils. Therefore, to fill the gap the current study examined the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils in Inclusive public primary schools in Northern Zone, Tanzania.

2. Statement of the Problem

The persistence ineffective use of Low-tech assistive devices for visually impaired pupils continues to impede the academic progress of visually impaired pupils. Despite efforts by the Ministry of Education, Science and Technology to provide assistive devices, personal assistants, and policy reforms, challenges persist. Teachers report insufficient training and support in using Low-tech assistive devices effectively, while parent's express dissatisfaction with the limited access their children have to appropriate learning tools and Pupils themselves often struggle with outdated devices, leading to exclusion and reduced learning participation (Zakia et al., 2024).

Although existing studies recognize the potential benefits of Low-tech assistive devices for visually impaired pupils, they have not sufficiently investigated their effectiveness in improving learning outcomes within inclusive school settings (Mwakasaka et al., 2022), despite evidence that visually impaired pupils require a variety of Low-tech assistive tools to address diverse learning needs (Mwantimwa et al., 2025). In response to this the current study examined the effectiveness of low-tech assistive devices in facilitating learning for Visually impaired pupils in Inclusive public primary schools in Northern Zone of Tanzania.

3. Research Questions

The study was guided by one research question;

How effective do low-tech assistive devices facilitate learning for visually impaired pupils in Northern Zone of Tanzania?

4. Significance of the Study

This study is significant as it raises awareness among key education stakeholders; teachers, pupils, and parents about the effectiveness of assistive technology devices in enhancing learning for visually impaired pupils in inclusive public primary schools. It contributes to teachers' professional development by strengthening training in the use and integration of such technologies in inclusive classrooms. The study also holds theoretical significance by enriching existing frameworks in special and inclusive education, particularly by positioning Assistive technology devices as a dynamic element in the learning process of visually impaired pupils. Additionally, it adds to the body of knowledge by providing empirical evidence on the effectiveness of these devices, serving as a foundation for future research and practice. Furthermore, the study informs policymakers on necessary standards, facilities, and regulatory improvements needed to support inclusive education for visually impaired pupils.

5. Theoretical Framework

The Universal Design for Learning (UDL) Theory was developed by Anne Meyer, David H. Rose, and later expanded with contributions from David Gordon at the Center for Applied Special Technology (CAST) during the 1990s, with a comprehensive theoretical articulation published in 2014. The theory is grounded in cognitive neuroscience and inclusive education principles. UDL assumes that learner variability is the norm rather than the exception, and that instructional barriers arise from inflexible curriculum design rather than from learners' disabilities. It emphasizes proactive curriculum planning through three core principles: multiple means of engagement, multiple means of representation, and multiple means of action and expression. These principles aim to create flexible learning environments that accommodate diverse learners from the outset (Meyer, Rose & Gordon, 2014; Rose & Meyer, 2002).

In the context of assistive technology (AT) for visually impaired pupils in inclusive public primary schools, UDL provides a comprehensive conceptual framework for understanding how instructional flexibility enhances learning access and participation. Assistive technologies such as screen readers, braille embossers, audio textbooks, and magnification software operationalize the principle of multiple means of representation by converting visual information into auditory or tactile formats. Similarly, speech-to-text tools and braille writing devices support multiple means of action and expression, enabling pupils to demonstrate understanding in non-visual ways. UDL therefore justifies the integration of assistive

technology not as a remedial accommodation but as an inclusive design strategy that reduces systemic barriers within mainstream classrooms.

Universal Design for Learning Theory (UDL) is its proactive and inclusive orientation. Rather than retrofitting accommodations after learning barriers are identified, it promotes anticipatory design that benefits all learners, including those with visual impairments. The framework aligns strongly with inclusive education policies by emphasizing flexibility in teaching methods, materials, and assessments (Rose & Meyer, 2002). It also supports differentiated instruction and learner autonomy, which enhances engagement and academic participation. Furthermore, UDL integrates neuroscientific insights into instructional planning, strengthening its theoretical and empirical foundation.

Universal Design for Learning Theory has limitations. Its broad and flexible nature can make implementation challenging in resource-constrained contexts, particularly in public primary schools with limited access to assistive technology and teacher training (Edyburn, 2010).The theory may also assume the availability of technological infrastructure that is not uniformly accessible in rural or underfunded educational settings. Additionally, while UDL promotes flexibility, it does not always provide detailed procedural guidance on how to operationalize its principles effectively in low-resource inclusive classrooms.

The theory is relevant to the study as it provides a structured framework for examining how assistive technology devices enhance learning outcomes among visually impaired pupils. By focusing on reducing instructional barriers through flexible representation, engagement, and expression, UDL directly supports the integration of assistive technologies within inclusive public primary schools. It helps explain why devices such as screen readers and braille technologies improve accessibility, participation, and academic performance. Moreover, UDL guides educators and policymakers in designing inclusive interventions that address learner variability, thereby strengthening the effectiveness of assistive technology implementation in the Northern Zone of Tanzania.

6. Review of Empirical Studies

6.1 Effectiveness of Low-tech Assistive devices in facilitating learning for visually impaired pupils.

Under this theme, the study focused on the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils, as the following literature has tried to examine below.

Ajuwon et al. (2024) investigated the use of assistive technology (AT) among teachers of students with visual impairments in Canada and the United States, with the aim of determining how AT is utilized in school settings. Using an online survey, the study gathered responses from 347 Teachers of Students with Visual Impairments (TSVIs). The findings highlighted the use of various technologies, including refreshable Braille devices, Braille embossers, Braille translation software, speech access systems, and tablets. The study concluded that AT has significant potential to support literacy, numeracy, employment, socialization, and community participation among learners with visual impairments. It further emphasized the need for continuous professional development to help teachers keep pace with rapidly evolving technologies. However, despite its contributions, the study presents several limitations when considered in relation to the effectiveness of low-tech assistive devices in enhancing learning outcomes, since the study is largely descriptive and focuses on the availability and usage of devices rather than empirically measuring their effectiveness on pupils' actual learning achievements. Hence, the current addressed these gaps by specifically assessing the effectiveness of low-tech assistive devices in enhancing learning for visually impaired pupils. It goes beyond usage to evaluate actual learning outcomes by providing more relevant and practical insights in learning for pupils with visual impairment.

Muhammad et al., (2024) conducted the study on the Impact of Assistive Technology on Acquiring Learning Competence among Learners with Visual Impairment District Faisalabad, Pakistan. The population of the study consisted of all the teachers of students with visual impairment in government special education schools. The study utilized a sample size of 50 teachers of the government special education schools of the district Faisalabad. The research instrument for data collection was a structured questionnaire. The collected data were tabulated, analyzed, and interpreted in the form of mean and standard deviation. The study revealed that Braille, tactile maps and glasses were the most used as assistive technologies by the students with visual impairment in the classroom. The study relies solely on teachers' perceptions through questionnaires, which limit the depth of understanding regarding actual classroom impact since there is no direct measurement of pupils' learning

progress or performance through the use of AT devices and learning effectiveness. Hence the current study filled the gap, by specifically focusing on how such tools facilitate learning through practical contribution to pupils.

Nankling and Pirman (2025) conducted the study on Evaluation of the use of Abacus on the Academic Performance of Pupils with Visual Impairment, Ganaka International School Jos, in Plateau State, Nigeria. The population for the study comprised 80 pupils with visual impairment. The sample size of this study comprised fifty (50) primary three (3) pupils with visual impairment. One instrument was used for this study, which is a questionnaire on the evaluation of knowledge and usage (EKAU). The findings of the study showed that pupils with visual impairment did not have much knowledge on the use of the tool in mathematics Based on the findings. Although the study contributes to the understanding of AT devices in mathematics learning, the study focused on only one low-tech assistive device (abacus) without comparing it to other low-tech tools such as Braille materials, tactile diagrams, or counting frames. Also, the study relied on a single data collection instrument (questionnaire), which limits the depth and reliability of the findings. Hence the current study filled the gaps by assessing how various low-tech tools contribute to learners' academic progress, engagement, and comprehension. Also, the current study used multiple data collection methods including observation schedule to measure the actual impact of the abacus on pupils' learning.

Mbugua et al. (2021) conducted the study on the awareness of the application of Assistive Technology in educational instruction among learners with visual impairments in learning institutions within Nairobi Metropolitan in Kenya. The study was guided by Bandura's theory of self-efficacy and Michael Diamond's Model. The study employed a mixed-method convergent parallel research design with a target population of 733 visually impaired learners and 70 staff members from 13 Visually Impaired learning institutions in the Nairobi metropolitan. Using a sample size of 320 respondents, stratified random sampling was used to select 5 principals, 23 teachers, and 292 learners. Data collection entailed questionnaires, interviews, and focus group discussions. The data obtained was analyzed quantitatively using descriptive and inferential statistics. Qualitative data were analyzed using thematic content analysis. The findings show that there were disparities in the awareness of the need for AT devices for use in a classroom context, with the majority, 86(34.5%) of the respondents being "not at all aware". Although the study provided valuable insights into awareness levels and institutional readiness for assistive technology integration, it concentrates on awareness rather

than actual classroom practice or learning outcomes. It also focusses on general assistive technology which limits specific insights into low-tech devices, which are often more accessible and practical in resource-constrained environments. Hence to fill the gaps, current study incorporated practical observation of students and focused on low tech assistive devices to measure the effectiveness of Low-tech assistive devices in facilitating learning for visually impaired pupils.

John & Stackus (2025) examined the Accessibility of assistive technologies among primary school learners with visual impairments in Tanzania. The study aims to scrutinize the availability of both high-tech and low-tech ATs, as well as the enabling infrastructure used to enhance the use of ATs in teaching and learning for Learners with visual impairment. The study employed an exploratory case design within a qualitative approach, in which data were collected through observations and semi-structured interviews and analyzed using thematic data analysis procedures. Data was gathered from five teachers, the Deputy Head Teacher, five from one primary school, and the District Special Needs Education Officer in the district where the school is located. The study revealed that despite government efforts to promote equitable quality education within an inclusive framework, Learners with Visual impairment in primary schools remain marginalized due to the inadequacy of both low-tech and high-tech ATs, as well as insufficient enabling infrastructure necessary to support their use. The study provided important insights into the accessibility and availability of assistive technologies in Tanzanian primary schools, rather than the actual effectiveness of assistive devices through evaluating how the available devices contribute to pupils' learning. Hence, to fill this gap the current study assessed how effective do low-tech assistive devices enhance learning for visually impaired pupils.

7. Demonstration of Research Gaps

The reviewed empirical studies on the effectiveness of Low-tech Assistive devices for visually impaired pupils have been conducted globally, including Canada and United States, Pakistan, Nigeria, Kenya, and Tanzania. Despite the contributions of scholars such as Ajuwon et al. (2024), Muhammad et al. (2024), Nankling and Pirman (2025), Mbugua et al. (2021), and John & Stackus (2025) in Low tech assistive devices there are limitations in the body of knowledge that specifically examines the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils. Most of the reviewed studies focused on device usage, awareness, availability, and some relied solely on quantitative instruments, which limit a comprehensive understanding of the outcomes and lived experiences of both

pupils and teachers in inclusive classrooms. Therefore, the current study fills these gaps by examining the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils in inclusive public primary schools in Northern Zone of Tanzania.

8. Methodology

This study used a convergent research design under a mixed research method, collecting both qualitative and quantitative data to comprehensively understand the research problem (Creswell & Creswell, 2023). The target population for this study included 7 inclusive public primary schools, 7 head teachers, 142 teachers, 408 visually impaired pupils and 6 District Primary Educational Officers-Special Needs (DPEO-SN) making a total of 568 respondents. A Census sampling was used to choose 6 inclusive public primary schools, Total population was used to select 6 Head teachers, Criterion sampling was used to select 47 Teachers, and Purposive sampling technique was used to select 39 visually impaired pupils and 4 DPEO-SN making a sample size of 102 participants. Quantitative data were collected through questionnaires and observation schedule from teachers and pupils, while qualitative data were collected through interviews with head teachers and District Primary Education Officer-Special Needs (DPEO-SN) and focus group discussion for visually impaired pupils. Data collection instruments consisted of questionnaires, interview guides and Focus group discussions, which were validated through expert review from the Faculty of Education of Mwenge Catholic University (MWECAU), specifically academic staff specialized in curriculum and instructions, and reliability-tested via a pilot study (Cronbach's alpha = 0.761). The trustworthiness of qualitative data was ensured through triangulation and peer debriefing. Quantitative data were analyzed using descriptive statistics via SPSS version 26, while qualitative data were subjected to thematic analysis. Ethical standards including informed consent, confidentiality, anonymity, and data integrity were strictly observed.

9. Findings and Discussion

The current study sought to investigate the extent to which low-tech assistive devices facilitate learning for visually impaired pupils. The frequency and percentage distribution of responses were categorized as follows: ≤ 20=extremely minority; 21-49=minority; 50-59=moderate; 60-69=majority; 70-89= high majority; 90-99=extremely majority; 100=overwhelming majority Taherdoost, (2019).

Table 1 Teachers Response on effectiveness of Low-tech Assistive devices facilitate learning for visually impaired pupils (n=47)

Statement		VSE		SE		ME		LE		VLE		Mean
		f	%	f	%	f	%	f	%	f	%	
i.	Low-tech assistive devices effectively support the basic learning needs of pupils with visual impairment.	2	4.3	0	0.0	7	14.9	19	40.4	19	40.4	4.13
ii.	Visually impaired pupils demonstrate improved reading and writing skills when using low-tech tools	2	4.3	0	0.0	3	6.4	28	59.6	14	29.8	4.11
iii.	The use of tactile learning materials like maps, textured diagrams enhances pupils' understanding of concepts.	1	2.1	0	0.0	19	40.4	17	36.2	10	21.3	3.74
iv.	Low-technology devices are easily integrated into daily teaching practices for pupils with visual impairment.	2	4.3	0	0.0	3	6.4	17	36.2	25	53.2	4.34
v.	Pupils show greater independence in learning when using low-tech assistive tools.	2	4.3	0	0.0	9	19.1	16	34.0	20	42.6	4.11
vi.	Low-tech assistive devices are more accessible and affordable compared to high-tech assistive devices	3	6.4	1	2.1	4	8.5	28	59.6	11	23.4	3.91
vii.	The use of low-tech assistive technology helps visually impaired pupils complete reading and writing tasks more efficiently.	2	4.3	2	4.3	9	19.1	16	34.0	18	38.3	3.98
viii.	Adequately training for visually impaired pupils help them to use low-technology assistive devices effectively.	1	2.1	3	6.4	11	23.4	16	34.0	16	34.0	3.91
ix.	The simplicity and reliability of low-tech assistive devices make pupils essential for classroom learning activities.	1	2.1	2	4.3	8	17.0	19	40.4	17	36.2	4.
x.	Low-tech assistive devices contribute positively to the learning confidence of pupils with visual impairment.	2	4.3	0	0.0	6	12.8	19	40.4	20	42.6	4.17
	Grand Mean											**4.04**

Source: Field Data, (2025)

Key: Very Small Extent (VSE) = 1, Small Extent (SE). Moderate Extent (ME) = 3. Large Extent (LE) = 4. Very Large Extent (VLE) = 5

To measure the extent, the results were analyzed using the mean score criteria developed by Chyung and Hutchinson (2023), where mean score range: 1.00–1.99 Very Small Extent, 2.00–2.99 Small Extent, 3.00–3.99 Moderate Extent, 4.00–4.49 Large Extent, and 4.50–5.00 Very Large Extent. The responses from teachers are summarized in Table 1.

promoting equitable learning opportunities for visually impaired pupils. The strong agreement captured aligns with inclusive education principles that advocate for the use o

Table 1 Data show that a very high majority of teachers (80.8%) agreed that low-tech assistive devices effectively facilitate the basic learning needs for visually impaired pupils. An extreme minority (4.3%) rated the effectiveness as a very small extent. The mean score was 4.13, reflecting strong agreement on the usefulness of these tools in meeting fundamental learning requirements. This data implies that teachers overwhelmingly recognize the value of low-tech assistive tools such as braille slates, raised line papers and magnifying lenses in promoting equitable learning opportunities for visually impaired pupils. The strong agreement captured aligns with inclusive education principles that advocate for the use of accessible and affordable learning tools to meet diverse learner needs. The data are supported by the argument of the head teacher "HT1" from the school, through a face-to-face interview, who remarked that:

> I have witnessed a real change in how our visually impaired pupils engage with lessons since introducing these tools. They no longer have to rely entirely on others to read or write for them; now they participate with confidence. (HT1 Personal communication, 09th July 2025).

Similarly, the Head Teacher "HT2" noted:

"The use of raised line papers and bold-lined books has allowed some of our pupils to follow instructions more independently, and their performance has improved." ("HT 2" Personal communication, 10th July 2025).

These observations were resonated by the District Primary Educational Officer-Special Needs, who affirmed:

> "The introduction of these low-tech assistive devices has significantly narrowed the learning gap for visually impaired pupils. Even though the tools are simple, their impact on participation and confidence is remarkable, and we

encourage more schools to adopt them." (DPEO Personal communication, 09th July 2025).

During the Focus Group Discussion, visually impaired pupils shared that:

"Magnifiers are very useful for me because I can now read large print books and even see diagrams. Without the magnifier, I used to depend on friends or teachers to read for me, but now I can do it myself" (FGD 1, 09, July 2025).

The information from the head teachers, focus group discussion and District Primary Educational Officer implies that low-tech assistive devices have brought positive and practical changes in the learning for visually impaired pupils. These tools such as raised line papers, bold-lined books, and tactile diagrams, have helped learners participate more actively in class, follow instructions independently, and rely less on others for basic tasks like reading and writing. Magnifiers promote learner independence and reduce overreliance on peers or teachers. Enabling visually impaired pupils to access large print books and diagrams directly, magnifiers foster self-directed learning and enhance participation in classroom activities. As a result, pupils are gaining confidence and showing improved academic performance. This demonstrates that even simple, low-cost tools make a big difference in the learning of pupils. The data aligned by Ajuwon et al. (2024) revealed a strong positive relationship between the use of low-tech assistive devices and improvements in foundational literacy and numeracy skills, highlighting the value of such tools in supporting learner outcomes.

Data in table 1 shows that a very high majority of teachers (89.4%) agreed that visually impaired pupils demonstrate improved reading and writing skills when using low-tech tools. Only an extremely minority (4.3%) selected "very small extent." The mean score of 4.11 confirms that people generally feel strongly positive about the benefits of these tools. This means that low-tech assistive devices are broadly seen as effective in supporting visually impaired pupils to develop important literacy skills, making learning easier and more accessible for them. The data indicate that the value of using simple, practical tools helps to ensure all students have a fair chance to succeed in school. The data are further supported by head teacher HT3, who shared that:

"Since introducing large print books and tactile learning materials, we have seen a clear change in how visually impaired pupils participate in class. They are more confident and

able to follow lessons better, which wasn't the case before" (HT 3 Personal communication, 11th July 2025).

The Head Teacher HT4 added that:

"These tools have made a real difference not just in reading and writing, but also in boosting the students' morale. When they work independently and keep up with their peers, it encourages them to stay motivated and focused" (HT 4 Personal communication, 14th July 2025).

Visually impaired pupil from the focus group discussion, FDG 2, had this to say:

> "Using braille materials has helped me a lot in reading and writing. Before, I used to struggle to follow what the teacher was saying, but now I can take notes and revise on my own. It makes me feel more independent in my studies." (FGD 2, 10th July 2025).

The responses from the head teachers revealed that using low-tech assistive tools does much more than just improve reading and writing skills for visually impaired pupils. These tools help pupils feel more confident and involved in the classroom, which makes a big difference in how they learn. Once pupils work their own and keep up with their classmates, it boosts their motivation and encourages them to stay focused. Braille materials are essential in fostering literacy, academic independence, and self-reliance among visually impaired pupils. Enabling learners to take notes and revise independently, Braille reduces reliance on verbal instruction and external assistance. This enhances equal participation in classroom activities, promotes continuous learning beyond the lesson, and empowers pupils with the confidence to manage their academic progress. This means that providing these simple, accessible materials not only helps students do better academically but also supports their confidence and happiness at school, both of which are important for their long-term success. This supported by Universal Design for Learning (UDL) Theory, these tools support multiple means of representation, action, and engagement, which are core principles of UDL. By enabling pupils to take notes, revise independently, and access content in a tactile format, Braille materials mediate cognitive processing by allowing learners to encode, organize, and retrieve information in ways that suit their individual needs. This reduces reliance on verbal instruction or external support, promotes equal participation in classroom activities, and facilitates self-directed learning beyond the lesson. The increased confidence and classroom

involvement experienced by pupils reflect how UDL-based strategies can scaffold learning, foster motivation, and empower students to manage their academic progress, thereby enhancing both academic outcomes and overall well-being. This is supported by Muhammad et al. (2020) emphasized that inclusive education strategies anchored in the use of affordable assistive technology devices promote active engagement in literacy activities, particularly in under-resourced environments.

Data in table 1 shows that a majority of teachers (57.5%) believed that the use of tactile learning materials like maps and textured diagrams enhances pupils' understanding of concepts. A moderate number of teachers (40.4%) rated the statement at "moderate extent," while only an extreme minority (2.1%) selected "very small extent." The overall mean score of 3.74 indicates a positive perception, though not an overwhelming one. This suggests that most teachers recognize the value of tactile materials, especially for pupils with visual impairments, in making learning more concrete and engaging. However, the strength of this belief seems to vary, which reflects differences in how often these materials are used in actual classroom practice. This viewpoint was echoed in the qualitative responses from Head Teacher HT5, who explained:

"Many of our pupils, especially those with visual impairments, learn better when they can touch and feel what we're teaching. A textured map, for example, helps them understand geography in a way that just talking about it cannot" (HT 5 Personal communication, 14th July 2025).

Similarly, Head Teacher HT6 emphasized the practical benefits of tactile resources by stating that:

"When we use these materials, we see a difference not just in performance, but in how engaged the students are. It builds their confidence because they can finally interact with content more independently" (HT6 Personal communication, 15th July 2025).

Adding a broader perspective, the District Primary Education Officer DPEO shared:

> "Tactile learning materials are essential, but their impact relies heavily on proper teacher training and availability. In schools where teachers are well-supported and materials are regularly available; we observe real improvements in learning outcomes for visually impaired pupils" (DPEO 2 Personal communication, 08th July 2025).

During the Focus Group Discussion, with visually impaired pupil added that:

"Low-tech devices like an abacus and counting frames allow me to keep up with mathematics lessons. Without them, I would always be behind, but now I can solve problems quickly" (FGD 3, 11th July 2025).

The responses from the head teachers and district primary education officer imply that tactile learning materials are not only beneficial for improving academic understanding among visually impaired pupils but also play an important role in boosting their engagement, confidence, and independence in the learning process. Low-tech devices such as an abacus and counting frames play a vital role in improving mathematical competence and inclusivity for visually impaired pupils. These tools enable learners to actively participate in mathematics lessons, practice problem-solving at the same pace as their peers, and build confidence in handling numerical tasks. However, their full potential is realized when these materials are regularly available and when teachers are adequately trained to use them effectively. This indicates the need for policy efforts and school-level strategies to prioritize both the provision of tactile resources and capacity-building for teachers to ensure inclusive and impactful learning experiences for all pupils. This aligns with Nankling and Pirman (2025) highlighted that although many teachers viewed tactile tools as essential for inclusive learning, variations in their implementation were often linked to institutional support and material availability.

Table 1 data shows that an overwhelming majority (89.4%) of teachers agreed that low-technology devices are easily integrated into daily teaching practices, an extreme minority (4.3%) rated it as "very small extent." The mean score of 4.34 reflects a strong level of agreement among teachers, suggesting high confidence in the usefulness and practicality of low-tech tools in the classroom, especially for visually impaired learners. This implies that low-tech devices such as braille textbooks, embossed diagrams, raised maps, audio recorders, and tactile learning aids are not only accessible but also adaptable within the daily teaching routines of most classrooms. Many teachers find these tools simple to use, low-cost, and reliable in environments with limited resources. Unlike high-tech equipment that requires electricity, specialized training and technical support low-tech devices are often teacher-friendly and immediately functional. They allow teachers to engage visually impaired pupils

effectively without disrupting lesson flow or requiring additional infrastructure. This view is supported by the experience of a head teacher who explained that:

> "In our school, low-technology assistive devices have become part of our teaching culture, especially for visually impaired pupils. Teachers use tools like braille slates, tactile diagrams, and audio players almost daily. These devices are easy to maintain and don't rely on electricity, which is a major advantage in our environment. They make lessons more interactive and meaningful for all learners, especially those who would otherwise be left behind" (HT 2 Personal communication, 10th July 2025).

Another head teacher shared that:

> "Low-tech tools are practical and accessible. Most of our teachers are not trained in using advanced technology, but they are very comfortable using simple devices like raised maps, talking calculators, and embossed learning materials. These devices allow them to include every child in the learning process. One of our teachers even developed her own tactile charts using locally available materials, and the students responded very positively" (HT3 Personal communication, 11th July 2025).

District Primary Education Officer added that:

> "We encourage schools to make use of low-tech assistive devices because they are cost-effective and easier to implement. Many schools cannot afford high-tech tools due to the absence of reliable electricity. However, we have seen real improvement in the learning outcomes of pupils with visual impairments where low-tech tools are consistently used. We are working on providing more teacher training to ensure that these devices are used to their full potential." (DPEO 3 Personal communication, 08th July 2025).

The information from the head teachers and the District Primary Education Officer reveals that low-tech assistive devices are not only practical but are becoming integral to inclusive teaching practices for visually impaired pupils in under-resourced schools. These tools, such as braille slates, tactile diagrams, talking calculators, and audio players, are praised for their simplicity, cost-effectiveness, and independence from electricity, making

them highly suitable for rural and semi-urban classrooms. Teachers, even those without advanced training in technology, are using these devices confidently and creatively, with some developing their own materials using locally available resources. This was supported by Mbugua et al. (2021) found that teachers in inclusive schools reported high levels of confidence in using tools such as braille slates, raised line papers, and embossed diagrams, citing their simplicity and compatibility with routine teaching activities.

Data in Table 1 shows that a high majority (76.6%) of teachers reported that pupils show greater independence in learning when using low-tech assistive tools. An extreme minority (4.3%) selected "very small extent." The mean score was 4.11, which reflects a strong belief that these tools empower pupils to manage their own learning processes. This data suggests that low-tech assistive devices are not just helpful tools they are life-changing resources for learners with visual impairments. They allow pupils to engage directly with their learning materials, complete tasks independently, and build confidence in their abilities. When a pupil reads braille text without waiting for someone to read aloud or use a tactile diagram to understand a concept in science, they become less dependent on others. This promotes a sense of ownership over their learning and builds essential life skills like decision-making, responsibility, and problem-solving. Head teacher from school “HT4” expressed this statement during an interview, stating:

“With tools like braille and audio materials, my pupils are now more confident to work alone and even help each other, which was not the case before. They don’t wait for me all the time; they try first, and I guide only when needed” (HT4 Personal communication, 14th July 2025).

Similarly, another head teacher from School “HT5” remarked:

“Before we had these devices, many students needed constant support just to write or read. Now, some even come to class prepared and complete their assignments without needing assistance (HT5 Personal communication, 14th July 2025).

During the Focus Group discussion, with visually impaired pupil had this to say:

“Sometimes teachers prepare tactile maps for geography, and when I feel the rivers and mountains, I remember better than just listening. It helps me to answer questions in exams.” (FGD 4, 14TH July 2025).

The information from the head teachers, pupils and District Primary Education Officer implies that low-tech assistive devices contribute to fostering learner independence and self-initiative among visually impaired pupils. These tools not only reduce the pupils'

reliance on teachers but also promote active participation, confidence, and peer collaboration in the learning process. Tactile maps enhance conceptual understanding and memory retention for visually impaired pupils. Through engaging the sense of touch, pupils are able to form mental images of geographical features, which strengthen comprehension beyond auditory explanations alone. As pupils gain the ability to access, process, and respond to instructional materials on their own, they develop critical academic and life skills such as problem-solving, self-regulation, and responsibility. This shift from dependency to autonomy suggests that equipping classrooms with appropriate low-tech assistive tools can create a more inclusive and empowering learning environment, where visually impaired learners are better positioned to thrive academically and socially. This was aligned by John and Stackus, (2025) who found that students with visual impairments using braille materials and tactile charts performed better in self-directed activities compared to peers with less access to such tools.

Data in Table 1 shows that a high majority (83.0%) of teachers agreed that low-tech assistive devices are more accessible and affordable compared to high-tech ones. A small minority (8.5%) selected "moderate extent," and only an extremely minority (6.4%) selected “very small extent.” The mean score was 3.91, indicating a positive perception of these devices’ accessibility and affordability. This implies that cost-effectiveness and availability make low-tech tools a preferred option for schools and families, especially in resource-constrained settings. The data suggest that the practicality of low-tech assistive devices shows an important role in facilitating learning among pupils with visual impairment by overcoming economic and infrastructural barriers. Such findings align with the views of educational stakeholders who emphasize the importance of affordable, user-friendly tools to support inclusive education. Overall, the evidence strongly supports the integration of low-tech assistive devices as an effective strategy to enhance learning accessibility where resources are limited. During the face-to-face interview with the head teacher from school “HT5” shared that:

> We have found that low-tech assistive devices like big print books, simple magnifiers work really well. They are easy for both teachers and students to use because they don’t need electricity and complicated setups. Many parents like them since they are affordable and easy to replace if they get lost. High-tech devices sound great, but honestly, they are just not practical for our situation. (HT 5 Personal communication, 14th July 2025).

Moreover, the Head Teacher from school "HT6" added that:

> When we try to bring in high-tech devices, we run into a lot of problems, like how to maintain them and the costs involved. Low-tech tools are simple and dependable, so students with visual impairments and other challenges use them all the time without interruptions. Because of this, we have noticed better participation and learning in our classes. (HT6 Personal communication, 15th July 2025).

District Primary Education Officer added that:

> From the district's point of view, we always advise schools to focus on assistive devices that are affordable and easy to manage. While technology keeps advancing, many schools still don't have reliable electricity or internet. That's why low-tech devices are a practical, sustainable way to support inclusive education. We also make sure teachers get the right training so they can use these tools effectively and help the students who need it most. (DPEO, Personal communication, 08th July 2025).

The responses from Head Teachers and District Primary Education Officer (DPEO) imply that low-tech assistive devices play a critical role in promoting inclusive education, especially in resource-limited settings. These tools are not only affordable and easy to use, but they also require minimal infrastructure, making them highly practical for schools that lack electricity or internet connectivity. Their simplicity and reliability ensure that students with visual impairments and other learning challenges participate consistently in classroom activities. This steady access contributes to improved engagement, learning outcomes, and a more inclusive learning environment. This supported John &Stackus (2025) found that in rural schools, low-tech devices promoted consistent participation in learning activities, enabling learners with disabilities to stay engaged and feel included.

Data in Table 1 show that a very high majority (72.3%) agreed that low-tech assistive devices helps visually impaired pupils complete reading and writing tasks more efficiently. Only an extreme minority (4.3%) selected "very small extent." The mean score was 3.98, reflecting strong agreement on the functional benefits of these tools. This data implies that low-tech assistive devices are not simply optional classroom tools, but rather essential learning enablers for pupils with visual impairments. They allow these learners to engage more independently and actively in academic tasks in reading and writing, where vision typically plays a critical role. The positive perceptions revealed that these tools help bridge

the gap between disability and academic achievement, allowing visually impaired learners to participate more equitably in classroom activities. Moreover, the strong agreement aligns with inclusive education goals, which emphasize equal access to quality learning experiences for all students regardless of disability. The data aligned with Universal Design for Learning (UDL) theory developed by David H. Rose and Anne Meyer, which advocates for flexible teaching approaches, multiple means of representation, engagement, and expression to accommodate diverse learners. In the context, low-tech assistive technologies support visually impaired pupils by providing accessible ways of accessing information and demonstrating understanding, thereby enhancing participation, independence, and inclusive learning outcomes. During the face-to-face interview with the Head teacher from "HT1" shared that:

> "I have really seen the difference these low-tech tools make for our visually impaired pupils. Before we had things like braille slates and styluses, some learners were always lagging when it came to writing tasks. They had to rely a lot on others, which affected their confidence. But now, with these simple devices, they're able to write on their own, keep up with classwork, and participate much more actively" (HT1 Personal communication, 09th July 2025).

Moreover, another head teacher from school "HT3" states that:

> "Low-tech assistive devices are not a luxury they are a necessity. Visually impaired learners depend on them daily to complete reading and writing tasks. Without these tools, denying them a fair chance at academic success. Teachers have also noted that learners using these aids show improved confidence and independence in their schoolwork" (HT3 Personal communication, 11th July 2025).

The responses from the head teachers imply that low-tech assistive devices promote educational equity and learner independence among visually impaired pupils. These tools are not supplementary, but essential for enabling learners to actively engage in reading and writing tasks without overreliance on others. Their availability directly influences pupils' academic participation, confidence, and sense of autonomy in the classroom. The shift from

dependence to self-reliance, facilitated by tools such as braille slates and styluses, demonstrates that inclusive education must prioritize the consistent provision of these aids. This aligns with Tibategeza (2022) who found that the consistent provision of such tools significantly enhances classroom participation and reduces overreliance on peers or teachers.

Data in Table 1 shows that a majority (68.0%) of teachers believed that adequate training for visually impaired pupils enables effective use of low-tech assistive devices. A moderate proportion (23.4%) selected "moderate extent," and only a very small minority (6.4%) selected “small extent.” The mean score of 3.91 reflects strong agreement among respondents that training is an important factor in supporting the use of assistive technology devices. This data implies that stakeholders identify the importance of equipping visually impaired pupils with the necessary skills to operate low-tech devices, thereby maximizing their functionality and impact on learning. The data show the need for ongoing instructional support and capacity building for both pupils and educators to ensure optimal utilization of assistive tools in inclusive educational settings. This is supported by Ajuwon et al., (2024) who found that teachers emphasized the necessity of proper training for students to independently and effectively use assistive technologies, particularly low-tech tools such as tactile rulers and Braille slates. The study emphasized training as a significant determinant of successful AT integration in classroom settings. The data supported by interview responses from heads teacher who emphasized the importance of training in ensuring effective use of assistive devices he explained, *“We have been provided with some low-tech tools like braille slates and magnifiers, but unless the pupils and teachers are trained on how to use them, they just sit in storage”* (HT4 Personal communication, 14th July 2025). Another head teacher added that, *“After receiving training from a local NGO, visually impaired students became more independent in using reading stands and tactile rulers. This shows training makes a big difference.”* Similarly, the District Primary Education Officer indicates that, *“Training should not be seen as a one-time activity. Continuous sessions for both students and teachers are essential for the sustainable use of assistive devices in inclusive classrooms”* (HT5 Personal communication, 14th July 2025).

The information from the head teachers and the district primary education officer implies that adequate and continuous training is essential for the effective use of low-tech assistive devices among visually impaired pupils. Without proper training, the presence of assistive tools alone does not guarantee meaningful support for learners, as many of these

devices often remain unused in schools. Their understandings emphasize that both initial orientation and ongoing capacity-building are important in developing the confidence and competence needed by both pupils and teachers to utilize these tools effectively. This aligns with findings by Komba et al. (2025), who emphasized that without proper training, the mere availability of assistive tools does not automatically translate into improved learning outcomes. In many cases, devices remain underutilized due to inadequacy technical knowledge among teachers and pupils.

Generally, data in Table 1 on teachers' responses regarding the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils indicates that these tools are highly effective in learning process of visually impaired pupils. The findings reveal that low-tech devices play a crucial role in supporting the basic learning needs of visually impaired pupils, enhancing their reading and writing skills, fostering independence, and boosting their confidence in classroom learning. With a grand mean of 4.04, the results reflect teachers' strong agreement that low-tech assistive devices are practical, reliable, and essential in facilitating learning for visually impaired pupils in Inclusive settings. Importantly, the responses highlight the need for adequate and continuous training for both pupils and teachers to maximize the utilization of these tools. This underscores a shared commitment between teachers, administrators, and policymakers to ensure that low-tech assistive devices are effectively integrated into teaching and learning processes.

To triangulate data, Pupils' interactions with low-tech assistive devices were observed to assess their effectiveness in facilitating their learning. Pupils' perspectives were also captured, as they are the direct beneficiaries of these devices. The summarized findings are presented in Table 2.

Table 2

Students' Response on Effective Low-Tech Assistive Devices in Facilitating Learning for Visually Impaired Pupils (n=39)

Device	Not effective in learning		Effective in learning	
	f	%	f	%
Braille Slate and Stylus	1	2.6	38	97.4
Braille Books	0	0.0	39	100.0
Tactile graphics	10	25.6	29	74.4
Abacus	6	15.4	33	84.6
Reading stand	28	71.8	11	28.2
Small magnifiers	14	35.9	25	64.1

Bold line paper	30	76.9	9	23.1
Markers	24	61.5	15	38.5
Braille paper	0	0.0	39	100.0
Glasses	5	12.8	34	87.2

Source: Field Data (2025)

Key: F=frequencies, **%**=Percentages

Data in Table 2 shows the data from the pupils' observation on the effectiveness of low-tech assistive devices in facilitating learning for visually impaired pupils. The findings indicate that the Braille Slate and Stylus were reported effective in learning by 97.4% of pupils, while only 2.6% found it not effective. This shows that the device is a highly reliable tool for visually impaired learners in supporting both writing and reading tasks. The dominance of positive responses suggests that pupils value the Braille Slate and Stylus as an essential component of their learning environment. Evidence from the focus group discussion with pupils further reinforces this finding. Pupils expressed that the Braille Slate and Stylus not only enhance their independence in taking notes but also improve their speed and confidence in class participation. Pupil with visual impairment remarked:

"With the slate and stylus, we can write notes during the lesson without waiting for someone to help us. It makes us feel equal to others in class."(FGD 2, 09 July 2025)

Another pupil with visual impairment added:

"The slate and stylus help us practice writing Braille daily. Even if books are not available, we can still write down what the teacher says and read it later." (FGD 2, 08, July 2025).

The responses from pupils with visual impairment suggest that the use of the slate and stylus empowers pupils with visual impairments to actively participate in classroom activities by allowing them to write notes independently. The pupils reported that these low-tech assistive devices enable them to practice Braille daily, record lessons even when textbooks are unavailable, and review the material later. This suggests that the provision of slates and styluses promotes inclusivity, enhances self-reliance, and fosters a sense of equality among learners, ensuring that pupils with visual impairments can engage meaningfully in the learning process alongside their sighted peers. The findings are consistent with a study by Ajuwon et al. (2024) who found that assistive devices enabling independent note-taking significantly increase motivation and academic performance among learners with visual impairment.

Data in Table 2 reveal that Braille Books were rated effective in learning by 100% of the students, with none reporting them as ineffective. This suggests that underscores the fundamental role Braille books play as the most dependable resource for reading and academic engagement among visually impaired pupils. This finding emphasizes the important role Braille books play as the most reliable resource for reading and academic engagement among visually impaired pupils. Braille books are recognized by pupils as a foundation of their academic journey. During the focus group discussion with pupils confirms this significance described Braille books as their primary source of knowledge and emphasized that they enable independent study outside the classroom. Pupil with visual impairment had shared this:

"Braille books are everything for us. Without them, I cannot do homework or revise for exams. They help me learn on my own." (FGD 3, 07, July 2025).

Another pupil with visual impairment highlighted their role in bridging the gap between teacher instruction and self-directed learning:

"When we get Braille books, we can follow what the teacher is teaching and later read again to understand better. It gives us confidence in exams." (FGD 1, 09, July 2025).

The responses suggest that Braille books are a critical resource for pupils with visual impairments, as they enable independent learning and consistent academic engagement. Pupils reported that having access to Braille books allows them to complete homework, revise for exams, and reinforce classroom instruction at their own pace. This implies that the availability of Braille books not only bridges the gap between teacher-led lessons and self-directed learning but also builds learners' confidence, promotes academic autonomy, and enhances their overall ability to participate fully in the educational process. This resonates with findings by Nankling (2023), who observed that access to Braille materials improves literacy and performance for visually impaired learners by supporting continuous and independent learning.

Data in Table 2 indicates that Tactile Graphics were effective according to 74.4% of students, while 25.6% reported them as not effective. This suggests that although tactile graphics aid in illustrating concepts, their effectiveness may vary depending on learners' ability to interpret tactile information. This suggests that tactile graphics are powerful tools for learning; their effectiveness varies depending on the pupils' ability to interpret tactile patterns, the subject being studied, and the quality of the materials provided. From the focus

group discussion with visually impaired pupils, it was clear that many learners' value tactile graphics for bringing abstract ideas to life. Visually impaired pupil explained:

"When I touch a tactile diagram of a map or a plant, I can understand better than just hearing the teacher explain. It helps me connect the theory to something I can feel." (FGD 3, 06, July 2025).

Another learner emphasized how tactile materials increase their engagement in class:

"Tactile graphics make learning interesting. I enjoy lessons more when I can explore diagrams with my hands instead of only listening." (FGD 2, 09, July 2025).

Responses show that tactile materials, such as raised diagrams and graphics, significantly enhance learning for visually impaired pupils by providing a hands-on way to understand concepts. Learners reported that interacting with tactile maps, plant diagrams, and other graphics helps them link theoretical explanations to tangible representations, improving comprehension. This suggests that the use of tactile materials not only strengthens conceptual understanding but also increases engagement, makes lessons more enjoyable, and supports active learning, enabling pupils with visual impairments to participate more fully and meaningfully in classroom activities. This finding echoes Mbugua, et al. (2021) who observed that tactile graphics enhance comprehension when well-prepared and accompanied by adequate teacher explanation, but hinder learning when used without guidance. It also reflects the principle of universal design for learning (UDL), which stresses that teaching aids must be designed to accommodate learners' diverse needs and abilities.

Data in Table 2 shows that Abacus was considered effective by (84.6%) of pupils, whereas 15.4% rated it as not effective. This demonstrates that Abacus is effective in enhancing mathematical learning, though some pupils may face challenges in mastering its use. During the focus group discussion with visually impaired pupils, many pupils spoke positively about how the Abacus supports their mathematical skills. Visually impaired pupils explained:

"The Abacus helps us calculate quickly without waiting for the teacher or using fingers. It makes us feel confident when solving sums." (FGD 3, 06, July 2025).

Another student emphasized the sense of independence it provides in mathematics:

"With the Abacus, we can work on our own during math lessons. I don't have to rely on someone to tell me the answers." (FGD 1, 09, July 2025).

The responses imply that the use of the Abacus significantly enhances the mathematical learning experience for pupils with visual impairments by providing a tactile

and interactive tool for calculations. Learners reported that devices allow them to perform arithmetic operations quickly without needing to wait for guidance from the teacher or assistance from peers, which in turn promotes a sense of autonomy. Pupils show that the Abacus enables independent practice during lessons, eliminating reliance on others to check or provide answers, while another emphasized the boost in confidence it brings when solving sums. This suggests that the Abacus not only supports the development of core mathematical skills but also encourages active engagement, self-directed learning, and a sense of competence. Consequently, integrating the Abacus in mathematics instruction help bridge gaps in accessibility, allowing pupils with visual impairments to participate fully in lessons, reinforce their problem-solving abilities, and foster a positive attitude towards learning mathematics. This was supported by Mokiwa and Phasha (2020) found that the Abacus improves mathematical competence among learners with visual impairment but noted that mastery requires systematic teaching and regular reinforcement.

Table 2 data indicates that Small Magnifiers were reported to be effective by 64.1% of Pupils, while 35.9% found them not effective. This suggests that magnifiers play a helpful role for visually impaired learners, particularly those with partial vision, but their usefulness is not universal. The mixed responses highlight that while some students benefit from magnifiers, others struggle due to limitations in visual acuity or difficulties in using the device effectively. During the focus group discussion, pupils described how magnifiers help in certain learning contexts. Visually impaired pupil shared:

> *"The magnifier makes the text bigger, so I can read notes or exercises without asking for help. It's really helpful when the teacher writes on the board or gives printed materials." (FGD 2, 08, July 2025).*

Another Visually impaired pupil added:

> *"It helps me see small details in diagrams and charts, which I wouldn't otherwise be able to understand. For some subjects, like science, it is very useful." (FGD 3, 06, July 2025).*

The responses suggest that the use of magnifiers improves the learning experience for visually impaired pupils by enhancing their ability to access written and printed materials independently. Learners reported that magnifiers allow them to read notes, exercises, and board work without requiring assistance, thereby fostering autonomy in the classroom. Moreover, pupils highlighted that magnifiers enable them to perceive small details in diagrams, charts, and other visual aids, which is particularly beneficial in subjects such as

science. This implies that magnifiers not only promote independent learning and active participation but also enhance comprehension of complex visual information, ensuring that pupils with visual impairments engage meaningfully with the curriculum and achieve academic success alongside their peers. This is in alignment with John and Stackus (2025) found that the use of handheld magnifiers improved reading speed and comprehension among students with low vision.

Data in the Table 2 shows that Bold Line Paper was rated effective by only 23.1%, whereas 76.9% considered it not effective. This implies that bold line paper is not suitable for the majority of visually impaired learners, as it mainly benefits those with residual vision. This implies that bold line paper is largely unsuitable for most visually impaired learners, as its benefits are limited primarily to those with residual vision who can distinguish thickened lines. The low effectiveness rating suggests that the device does not adequately address the needs for learners with complete or severe visual impairment, limiting their ability to engage with written work independently. Consequently, relying on bold line paper as a primary learning aid hinders academic participation for the majority of visually impaired students, highlighting the need for more inclusive low-tech assistive tools, such as Braille materials or tactile aids, that cater to a wider range of visual impairment and promote equitable access to learning. The data from the visually impaired pupils revealed that the effectiveness of bold line paper in supporting their reading and writing was limited. One pupil explained:

"Bold line paper doesn't help much. I can't see the lines clearly, so I still need help to write or read. Sometimes it is useful if my sight is a little better, but most of the time it doesn't make any difference." (FGD 4, 05, July 2025).

The pupils' response highlights that, while bold line paper provide minimal assistance under certain conditions, it is insufficient for pupils with visual impairment. Similar responses were observed among other participants, indicating a consistent need for additional assistive devices or tailored support to enhance learning outcomes. This suggests that relying solely on bold line paper is not adequate to address the learning needs of visually impaired pupils. More comprehensive assistive devices interventions are necessary to improve accessibility and academic performance in inclusive classrooms.

The information from the pupils with visual impairment suggests that Bold Line Paper poses significant challenges for pupils with visual impairments. Learners reported that they often cannot see the lines clearly, making it difficult to write or read independently. One pupil noted that while the paper may be somewhat useful for those with residual vision, for

most students, it does not significantly improve accessibility or learning outcomes. This implies that Bold Line Paper is largely ineffective as a learning aid for the majority of visually impaired learners, particularly those with severe or total vision loss. This highlights that reliance on such materials continues to require external assistance, limiting learners' independence and engagement. The findings are supported by Universal Design for Learning (UDL) theory which emphasizes the provision of multiple and flexible means of representation and learning support to accommodate diverse learner needs. The ineffectiveness of Bold Line Paper for many visually impaired pupils indicates that educational materials should be designed based on learners' varying visual capabilities rather than relying on a single generalized approach.

Data in the Table 2 indicate that Braille Paper was considered effective by 100% of the students, with none reporting it ineffective. This shows that Braille paper is an essential and indispensable tool for learning, as it enables writing and reading in Braille format. This indicates that Braille paper is an essential and indispensable tool for visually impaired learners, serving as the foundation for writing and reading in Braille. Unlike other aids that may support specific tasks, Braille paper directly enables independent literacy development and academic engagement. Insights from the focus group discussion reinforce this finding. Visually impaired Pupils explained:

> *"With Braille paper, we can write everything we need, practice reading, and complete exercises. We can do schoolwork without waiting for anyone." (FGD 1, 05, July 2025).*

Moreover, Pupils with Visual impairment added:

> *"Even if books are not available, we can still write what the teacher says on Braille paper and read it later. It helps us revise and learn independently." (FGD 2, 07, July 2025).*

The information from the pupils with visual impairment implies that Braille papers are an effective low-tech assistive device for pupils with visual impairments. Learners reported that it allows them to write freely, practice reading, complete exercises, and engage in schoolwork independently without relying on others. Moreover, pupils highlighted that even in the absence of textbooks, they record teacher instructions on Braille paper and revisit the material later, which supports revision and self-directed learning. This implies that Braille

paper not only enhances academic autonomy but also promotes consistent engagement with the curriculum, reinforces learning, and builds confidence among pupils with visual impairments, ensuring they participate meaningfully and equitably in classroom activities.

The findings are consistent with the Universal Design for Learning (UDL) Theory, developed by David H. Rose and Anne Meyer, which advocates for designing learning environments that provide flexible and accessible learning opportunities for all learners, including those with disabilities. UDL emphasizes multiple means of representation, action and expression, and engagement to ensure that every learner can access, participate in, and demonstrate learning according to their abilities. In this context, Braille paper serves as an accessible instructional resource that enables pupils with visual impairments to express their knowledge through writing, access classroom content by recording and reviewing instructional materials, and remain actively engaged in learning despite the limited availability of Braille textbooks. Therefore, the experiences shared by the pupils demonstrate that Braille paper supports the UDL principles by reducing learning barriers, fostering learner autonomy, and promoting equitable participation in the teaching and learning process.

10. Conclusions

The study concluded that low-tech assistive devices are not only effective but also sustainable tools for supporting inclusive education, and their continued use and promotion should be prioritized to improve educational outcomes for visually impaired pupils.

11. Recommendations

Based on the conclusions, the study recommends that schools should strengthen the consistent use of low-tech assistive devices in inclusive classrooms as they facilitate learning for visually impaired pupils.

References

Ajuwon, P. M., Uribe-Zarain, X., Okungu, P., Griffin-Shirley, N., & Nguyen, T. (2024). *Use of assistive technology by teachers of students with visual impairments: A descriptive analysis*. M3 Center Publishing.

Asajenie, G. (2022). Challenges of Using Assistive Technology in Inclusive Education Tanzania: Case of Students with Impairments at Iyunga Secondary. *International Journal of Neonatal Care and Pediatric Nursing.*

Campado, R. J., Toquero, C. M. D., & Ulanday, D. M. (2023). Integration of assistive technology in teaching learners with special educational needs and disabilities in the Philippines. International *Journal of Professional Development, Learners and Learning, 5*(1), ep2308.

Chinwe Okoye, C. (2024). Assistive Technology and Inclusion of Children with Disabilities in Nigeria. *African Journal of Social Sciences and Humanities Research, 7*(3), 218–228. https://doi.org/10.52589/AJSSHR-JPKFGOEW

Cohen, L., Manion, L., & Morrison, K. (2018). Research Methods in Education (8th ed.). Routledge.

Creswell, J. W., & Creswell, J. D. (2023). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (6th ed.). SAGE Publications.

Kachweka, A., & Rupia, C. (2022). Examining Visual Impairment Challenges on Special Needs Pupils' Academic Achievement in Bukoba District, Tanzania. *Journal of Advances in Education and Philosophy, 6*(7), 388–399. https://doi.org/10.36348/jaep.2022.v06i07.006

Kamran, M., & Bano, N. (2024). Employing Assistive Technology (AT) for Children with Special Educational Needs: A Case Study from Pakistan. *The Pakistan Development Review*, 203–220.

Kassah, B. L., & Anthony, J. H. (2021). *Inclusive education and support for learners with visual impairments*. Routledge.

Kisangaa, S. E., & Kisanga, D. H. (2020). The role of assistive technology devices in fostering the participation and learning of students with visual impairment in higher education institutions in Tanzania. Disability and Rehabilitation: Assistive Technology, 15(8), 877-885.

Mbugua, J., Mwangi, P., & Wanjiku, R. (2021). *Use of magnification devices and academic performance among learners with low vision in inclusive schools*. *International Journal of Special Education, 36*(2), 45–58.

Mlolele, R., Chacha, E., & Kimaro, J. (2023). The role of assistive technologies in enhancing literacy for pupils with visual impairments in public inclusive primary schools in Dodoma, Tanzania. *Journal of Inclusive Education and Technology, 9*(1), 45–58.

Muradyan, S. (2023). Assistive technology for students with visual impairments. Armenian Journal of Special Education, 7(1), 77–88. https://doi.org/10.24234/se.v6i1.309

Muradyan, S. (2023). Assistive technology for students with visual impairments. *Armenian Journal of Special Education, 7*(1), 77–88. https://doi.org/10.24234/se.v6i1.309

Murithi, S., Mwirichia, S., & Gichohi, P. M. (2022). Utilization of Listening Assistive Technologies and the Academic Performance in Primary Schools for Learners with Hearing Challenges in Meru and Tharaka Nithi Counties, Kenya. *International Journal of Professional Practice*, *10*(2), 103–114.

Musau, M. K. (2022). The role of low-tech assistive devices in fostering inclusive education in rural Kenyan schools. African Journal of Educational Studies, 10(1), 21–34.

Mwakasaka, T., Mussa, A., & Ndimbo, F. (2021). Teacher perceptions and challenges in using assistive technologies for SEN pupils in rural Tanzania. African Journal of Special Education, 7(3), 121–137.

Nazir, A., Ahmed, S., Khan, M., & Ali, R. (2024). *Access to Braille materials and academic achievement among learners with visual impairments*. *Journal of Visual Impairment & Blindness, 118*(1), 32–45. *(Verify publication details.)*

Ndhlovu, L., & Mukuka, B. (2021). The role of assistive technology in enhancing learning outcomes of students with visual impairments in Zambia. Journal of Inclusive Education in Africa, 6(1), 22–38.

Pegon, P., Sujathamalini, J., & Ravichandran, G. (2023). Assistive and Digital Technology for the Education of Students with Visual Disabilities. International Journal of Research and Review, 10(2), 714–719. https://doi.org/10.52403/ijrr.20230287

Senjam, S. S., Foster, A., & Bascaran, C. (2021). Barriers to using assistive technology among students with visual disability in schools for the blind in Delhi, India. Disability and Rehabilitation: Assistive Technology, 16(7), 802–806.

Shanker, A., & Kant, R. (2023). Assistive Technology in Inclusive and Special Schools of Bihar: A Study of Availability, Readiness of Teachers and Learning Experiences of Students. https://doi.org/10.13140/RG.2.2.13864.03849

Viljoen, H., 2020, 'Instructional leadership for transformational change, learner achievement and care', in M.M. Sefotho & R. Ferreira (eds.), Teaching Learners with Visual Impairment (Opening Eyes Volume 2), pp. 3–32, AOSIS, Cape Town. https://doi.org/10.4102/aosis.2020.BK191.01.

World Health Organization. (2016). Global Cooperation on Assistive Technology (GATE). World Health Organization. (2011). World report on disability. Geneva Switzerland: Who.