

Research Article

Factors Affecting Performance of Learners with Visual Impairment in Mathematics: A Case Study of Magwero School for the Visually Impaired in Chipata Zambia

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Abstract

This study focused on factors affecting the performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired in Chipata District of Eastern province. The research objectives were to establish factors affecting the performance of learners with visual impairment in mathematics, to explore how the factors affect performance of the learners with visual impairment in mathematics, and to establish which strategies can be used to address the factors affecting performance of learners with visual impairment in mathematics. The study used a case study research design and qualitative approach was employed, utilizing observations, focus group discussions, and semi-structured interviews with 10 learners (VIL), 6 teachers (Tr.), and 4 school administrators (SA). The findings revealed a range of contributing factors, including the scarcity of Braille mathematics textbooks, inadequate resources, insufficient assistive technology and negative attitudes towards mathematics. Furthermore, societal stigma, environmental factors, and the absence of continuous professional development for teachers were identified as significant factors. The study highlights the urgent need for targeted interventions, such as enhancing mathematical resource availability, improving teacher training in mathematics with special education, and increasing parental involvement in mathematics learning. Based on the study findings, it was recommended that increasing the availability of Braille mathematics textbooks and enhancing teacher training through continuous professional development were essential strategies to improve the performance of learners with visual impairment in mathematics. A further research on factors affecting performance of visually impaired learners in mathematics can be done to other districts which have such schools.

Keywords

Factors, Learners with Visual Impairment, Performance, Mathematics, Teaching Strategies

1. Introduction

1.1. Background of the Study

Globally, the education of learners with visual impairment

has seen significant advancements, yet challenges remain, particularly in subjects like mathematics. Research by Tshabalala, N. L indicates that learners with visual impairment often face substantial obstacles in accessing quality

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education due to factors such as inadequate teaching materials, lack of trained teachers, and insufficient support systems [10]. According to the World Health Organization, over 285 million people are visually impaired worldwide, with a significant number of these individuals being children of school age. The learners with visual impairment face unique challenges that can hinder their academic performance in mathematics.

Internationally, countries like the United States, the United Kingdom, and Canada have implemented inclusive education policies and specialized resources to support visually impaired learners. Assistive technologies, such as screen readers, Braille displays, and tactile graphics, play a critical role in enhancing the learning experience for these students. However, the effectiveness of these interventions often depends on the availability of resources and the level of teacher preparedness. Studies by Mwanza, P. and Banda M., in Canada have also highlighted that visually impaired students in mathematics face unique challenges [6]. These include difficulties in understanding abstract concepts, visualizing geometric shapes, and interpreting graphs and diagrams. The importance of specialized teaching strategies and the integration of assistive technologies is emphasized in the literature to bridge these gaps. Despite these efforts, disparities in educational outcomes persist, necessitating continuous evaluation and adaptation of educational practices to meet the needs of learners with visual impairment.

David, H. and Robert M. researched on the factors influencing academic performance of learners with visual impairment in America [4]. The research was conducted in various countries across America, including the United States, Canada, Mexico, Brazil, Argentina, Chile and many others. The studies explore a wide range of support on performance of learners with visual impairment such as teaching methods, socio-economic influence, cultural differences and educational policies, providing insights into the diverse challenges and opportunities that impact mathematics performance in different American context. However, the research did not focus attention on factors influencing academic performance of learners with visual impairment in Mathematics.

In Africa, according to African Union, the situation is more challenging due to limited resources, socio-economic barriers, and less developed educational infrastructures [1]. The African Union has acknowledged the importance of inclusive education in its Agenda, emphasizing the need to support vulnerable groups, including learners with visual impairment. However, the implementation of these policies varies significantly across the continent. According to Oluwatosin, A. and Boateng P., research in various African countries highlights several common issues: lack of trained special education teachers, inadequate learning materials in Braille, and limited access to assistive technologies. Cultural attitudes and stigma surrounding disabilities also impact the education of learners with visual impairment, often resulting in their marginalization within the educational system [8]. In countries like Ken-

ya, South Africa, and Nigeria, efforts have been made to improve the education of learners with visual impairment. These include government initiatives, partnerships with non-governmental organizations, and community-based programs aimed at enhancing educational access and quality. Despite these efforts, many learners with visual impairment continue to face significant barriers, particularly in specialized subjects such as mathematics, which require more resources and specialized teaching methods.

According to Patel, R., and Banda. T, the findings from the studies conducted in South Africa have highlighted various factors that influence the academic performance of learners with visual impairment such as specialized learning materials, teacher training, inclusive education policies and the use of assistive technologies [9]. Additionally, Oluwatosin, A. and Boateng P, researched in Kenya were their findings emphasized on the importance of supporting learning environments and the need for tailored teaching methods to address the unique challenges faced by learners with visual impairment in education [8]. Nevertheless, the research by Oluwatosin and Ogunbodede in South Africa did not highlight the issue of factors influencing academic performance in mathematics by learners with visual impairment.

In Zambia, the education of learners with visual impairment is guided by the National Policy on Education, which promotes inclusive education. According to the Mwizenge, C., learners with visual impairment receive various kind of support in Zambia [7]. These include the availability of specialized learning materials such as braille books and tactile aids, the quality of teacher training in inclusive education and specialized teaching methods for mathematics, the extent of inclusion and accessibility in mainstream educational settings, and the role of assistive technologies in supporting learners with visual impairment in their mathematical studies. However, the performance in mathematics has not been good.

The Zambian government has established several schools and resource centers specifically for learners with visual impairment, such as Magwero School for the Visually Impaired. Despite these initiatives, the challenges faced by learners with visual impairment in Zambia are profound. The academic performance of learners with visual impairment learners in mathematics at Magwero School for the Visually Impaired in Zambia has been generally below average. According to the school examination analysis for the years 2019 to 2022, majority of visually impaired learners at Magwero school for the visually impaired fail to achieve passing grades in mathematics at grade 7, 9 and 12. It was also observed that visually impaired learners had higher rate of success in most of other subjects than in mathematics.

There has been various support such as deploying a trained teacher of mathematics with a combination of special education, employing of a braille transcriber and providing of learning materials like braille papers at Magwero School for the visually impaired. Despite the support, the academic performance of the learners with visual impairment in Mathe-

matics at Magwero school for the Visually Impaired has not been pleasing.

It is from this background that this study aimed to investigate factors affecting performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired in Chipata District of Zambia.

1.2. Statement of the Problem

Mwanza, P. and Banda L researched on academic performance among the learners with visual impairment in Zambia [6]. The research revealed that the government has been providing teachers to handle learners with visual impairment, providing teaching and learning materials and providing access to quality education. Despite the Zambian Government's effort of providing equal quality education for all, the performance of the learners with visual impairment in mathematics at Magwero school for the Visually Impaired has significantly been below average. Little research had been done to identify the factors affecting academic performance of learners with visual impairment in Mathematics at Magwero school for the visually impaired.

Therefore, if the academic performance in mathematics at Magwero School for the Visually Impaired was to improve, it was justifiable to undertake a research like this. The findings of the research might help the school, government and other stakeholders to improve performance of visually impaired learners in mathematics at Magwero school for the visually Impaired. This situation prompted the researcher to carry out a research on factors affecting performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired in Chipata District of Zambia.

1.3. Purpose of the Study

The purpose of the study was to establish factors influencing the performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired.

1.4. Research Objectives

To identify the factors affecting performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired.

To establish how the factors, affect the academic performance of learners with visual impairment in mathematics.

To determine strategies that can be used to address the factors affecting performance of learners with visual impairment in mathematics.

2. Findings

The presentation of the research findings was in line with the research objective. The objective was to determine strategies that can be used to address the factors affecting perfor-

mance of learners with visual impairment in mathematics. The presentation was based on the two themes that emerged from the research which were; factors affecting learners with visual impairment when learning mathematics and academic performance of learners with visual impairment in mathematics. The findings were structured around the questions asked in the semi-structured interview guide, focused group discussion guide and observation checklist.

2.1. Factors Affecting Learners with Visual Impairment when Learning Mathematics

Through the analysis of the interviews, several key themes emerged, including: Need for specialized teaching method, provision of adequate learning resources, teacher training and support, learner motivation and confidence, collaboration with parents and the community and use of technology in teaching Mathematics. Each of these themes is discussed below with supporting verbatim excerpts from participants.

One of the recurring themes was the need for teaching methods specifically designed for visually impaired learners. Administrators acknowledged that traditional teaching methods could not be suitable for these learners SA 1 emphasized: *"Teaching mathematics to visually impaired learners is quite challenging with regular methods. We need to be more creative. Tactile materials such as raised diagrams, real-life objects, and more engaging tools could make a difference."* A lack of adequate resources, including Braille textbooks and tactile materials, was frequently highlighted as a major factor to effective mathematics instruction. Many participants suggested that providing specialized learning materials would enhance the performance of learners with visual impairment. SA 2 stated: *"We are working with limited resources. The few Braille materials we have are not enough, and they are outdated. We need updated and relevant materials for our learners in mathematics."*

Participants consistently highlighted the need for more training and professional development opportunities for teachers working with learners with visual impairment. One of the administrators expressed a desire for workshops and specialized training in inclusive teaching methods for mathematics. SA 3 shared: *"Our teachers are dedicated, but they need more support. Providing them with continuous professional development and the right tools to handle learners with visual impairment would go a long way in improving performance in mathematics."* Administrators noted that creating an encouraging and supportive environment could help boost learners' motivation and performance. SA 3 explained: *"Mathematics is already a challenging subject for many learners, but for learners with visual impairment, the challenge is greater. It is important to build their confidence by recognizing small successes and offering praise."* Several administrators emphasized the importance of involving parents and the community in supporting visually impaired learners. They proposed stronger collaboration to ensure that

learning does not stop at school and that parents are equipped to support their children's education at home. SA 4 noted: *"Parents play a vital role in the education of these children. We need to involve them more, provide them with tools and training so they can help their children with homework and practice in mathematics."* The use of assistive technology in teaching mathematics was proposed by several participants as a way to improve learning outcomes. However, administrators noted that there was a lack of access to such technology at the school. SA 4 suggested: *"Technology could play a crucial role in making mathematics more accessible. Screen readers, Braille display devices, and specialized software such as JAWS can help learners engage with complex mathematical concepts."*

Teachers expressed concerns over the lack of adequate learning materials tailored to the needs of visually impaired learners. Tr.1 pointed out, *"increasing access to Braille materials and tactile resources can improve the performance of our learners with visual impairment in mathematics. Our school should invest in updated Braille textbooks and develop tactile diagrams for subjects like geometry and algebra."* Also screen readers, talking calculators, and tactile math software can help bridge the gap in understanding abstract mathematical concepts. Tr. 1 added: *"Braille materials are very scarce, and sometimes, learners have to share. This slows down the learning process, especially in mathematics where each learner needs time to engage with the material."* Teachers also suggested the need to design teaching methods specifically for learners with visual impairment. Tr. 2 noted, *"traditional teaching methods may not be suitable for these learners and that more interactive and tactile approaches should be employed."* Tr. 3 pointed out: *"We have to ensure that concepts are simplified, and learners can feel and touch what they are learning. For example, using materials that can be touched helps the learners to visualize mathematical shapes and graphs."* Teachers also consistently highlighted the need for more training and professional development opportunities for teachers of mathematics working with learners with visual impairment. Tr.3 noted, *"we should be provided with ongoing professional development on how to adapt lessons, use of tactile methods and make mathematics more accessible."* There is also need of working with special education experts and assistive technology specialists so that teachers are provided with additional support and resources. Tr.3 commented: *"I feel that more training is necessary. Teaching learners with visual impairment is not something we are adequately trained for in regular teacher training programs. Specialized workshops on teaching mathematics to these learners would be very helpful."* Providing emotional and psychological support to build learners' self-esteem can help improve their academic performance. Tr.4 noted, *"encouraging collaboration and interaction among learners helps to combat isolation and build a supportive learning environment."* Tr. 4 added: *"We need to encourage them more. Many learners feel like they can't do mathematics, and*

that attitude is a barrier. Instilling a positive mindset is key." Several teachers also emphasized the importance of involving parents and the community in supporting learners with visual impairment. They also proposed stronger collaboration to ensure that learning does not stop at school and that parents are equipped to support their children's education at home. Tr. 4 mentioned: *"We should have more parent-teacher meetings where we discuss strategies to assist learners outside the classroom. Parents are often not aware of how they can contribute to their children's progress in mathematics."*

Ten learners were interviewed on strategies that can be used to address the factors affecting performance of learners with visual impairment in mathematics, and their responses are presented along with direct quotations (verbatim) from each participant. Visually impaired learners at Magwero School highlighted the importance of specialized teaching methods tailored to their unique needs. They expressed that traditional teaching methods were not sufficient for their effective learning in mathematics. A significant portion of the learners emphasized the use of tactile materials and auditory explanations to enhance understanding. VIL 1 remarked, *"I understand better when the teacher gives us time to work with Braille materials, especially for complicated calculations. I wish we could do that more often."*

Another key factor highlighted by the learners was lack of availability of appropriate learning resources. While the school had some resources, they were found to be inadequate or not up to date. VIL 2 explained, *"We don't have enough Braille textbooks, and the ones we have are old. Some pages are worn out, and we miss important topics. If we can have enough textbooks in braille, our performance can improve."* VIL3 similarly stated, *"Sometimes we don't have enough geometry tools that we can use. If we could have rulers and compasses designed for us, it would be easier to follow what the teacher is teaching."* The learners also pointed out that teacher preparedness and continuous support were critical in helping them excel in mathematics. Many learners believed that not all teachers were sufficiently trained in handling the specific educational needs of visually impaired learners, especially in a subject like mathematics. VIL 4 commented, *"Some teachers know how to teach us very well, but others don't seem to understand what we need. I think they need more training on how to teach us mathematics."* VIL 5 stated, *"Teachers should be taught how to use the Braille machines and other tools we use. Sometimes they ask us to explain how to use them, but it would be better if they already knew."* Learners expressed varying levels of motivation and confidence when it comes to learning mathematics. Some indicated that the lack of adequate resources and support negatively affected their confidence, while others shared that positive reinforcement and encouragement from teachers played a vital role in motivating them. VIL 6 explained, *"Sometimes I feel discouraged when I don't understand, especially if I don't get extra help. It makes me feel like I'm not good enough."* VIL 7 shared, *"Mathematics is hard, but*

when the teacher encourages me and praises my small improvements, I feel more confident. I want to try harder." Several participants mentioned the importance of involving parents and the community in their education. Learners noted that support from home and community members could improve their academic performance, particularly in a challenging subject like mathematics. VIL 8 remarked, *"My parents don't know much about mathematics and braille, but when they encourage me to study and ask the teacher about my progress, I feel supported."* VIL 8 added, *"I think if my parents were more involved in my learning, especially helping me with practice at home, it would help me understand better."* The use of technology was highlighted by many learners as a potential strategy to improve their learning experience in mathematics. VIL9 shared, *"current technology available at our school is limited and outdated. We need many modern tools."* VIL 9 suggested, *"If we could have computers with special programs that help us learn mathematics, it would make things easier. Right now, we don't have enough of those."* VIL 10 also mentioned, *"I think using talking calculators or other technology that can explain steps in solving problems would be helpful. Sometimes the teacher's explanation is not enough. We need more talking calculators."*

The study utilized an observation checklist to propose strategies that can be used to address the factors affecting performance of learners with visual impairment in mathematics. The observation involved six teachers and ten learners, focusing on various aspects of teaching and learning processes. Teachers demonstrated a range of instructional techniques, but there was variability in the use of adaptations for learners with visual impairment. Tr.1 did not employ tactile materials and verbal explanations effectively, while Tr. 2 relied heavily on visual aid (chart without being raised) that was not adapted for the needs of learners with visual impairment. Only the sighted benefited from the chart. There was need for consistent use of adapted instructional materials and techniques. Training for teachers on effective methods for learners with visual impairment could address this inconsistency. There is also need for redesigning classroom layouts to ensure accessibility. Tr. 3 did not include features such as braille labels, tactile maps, and organized materials to facilitate navigation and access for visually impaired learners in the classroom. The classroom environment was generally supportive but lacked specific adaptations for visually impaired learners. For example, desks and materials were not always arranged to facilitate easy access and navigation for these learners in the classroom for Tr.4. Improving classroom layout and ensuring materials are accessible can significantly enhance the learning experience. This includes having clear, consistent labeling and spatial organization. There was a noticeable gap in specialized training for teachers in handling the unique needs of learners with visual impairment in mathematics. Tr.5 lacked confidence in using specialized instructional techniques and resources (cub). Therefore, providing professional development and support for teachers in this

area is crucial. Workshops and training sessions focused on specialized instructional strategies could improve teaching effectiveness. Introducing one-on-one support or small group sessions to provide personalized attention and tailor instruction to individual learner needs can also improve the performance of learners with visual impairment in mathematics. Tr. 6 was also observed the lack the knowledge by teacher on braille reading and writing. It was noticed that the teacher relied much on learners to read braille own their own. There was need to capacity build teachers in braille.

Engagement levels varied among learners with visual impairment. VIL1 who had more personalized attention and adapted resources was more engaged and performed better. However, VIL2 who did not receive these accommodations struggled more frequently. Personalized attention and customized resources were essential for maintaining high levels of learner engagement. Strategies such as one-on-one tutoring and adapted materials could help address this issue. Negative attitude towards mathematics was observed in VIL3 who naturally hate mathematics because the learner thought it was just for the sighted peer. It was observed that there was need for providing regular counseling sessions to help learners develop a positive attitude towards mathematics. This was also observed in VIL4. VIL5 was observed to have challenges with the use of talking calculators which affected the learner's performance. There was need to ensure that learners were given more time in learning how to use the assistive technology so that they get familiar with them. The assessment methods used were often not adapted for learners with visual impairment. According to what was observed on VIL6, feedback was frequently not provided in a format that was accessible to the learner, which hindered the ability to understand the progress and areas for improvement. This was also observed in VIL7. Developing and implementing accessible assessment tools and feedback mechanisms was necessary. Ensuring that feedback was provided in a format that learners with visual impairment can access (for example braille, audio) will support their learning and development. Develop and implement assessment methods that accommodate learners with visual impairment was also observed.

One focus group discussion consisting of six teachers and one focus group discussion consisting of 6 learners, were also involved. The focus group discussion with teachers highlighted several key factors affecting learners with visual impairment's performance in mathematics, as well as proposed strategies to address these factors. Teachers emphasized the critical shortage of specialized learning materials such as braille textbooks, tactile diagrams, and mathematical tools adapted for visually impaired learners. They noted that without these materials, learners struggle to engage meaningfully with mathematical concepts. Tr.1 remarked: *"We don't have enough tactile learning aids. It becomes difficult for learners to understand abstract concepts like geometry or algebra without these tools. There is need of increasing investment in specialized teaching resources, including braille textbooks,*

embossed diagrams, and adapted mathematical equipment. There must be collaboration between the Non-Governmental Organizations (NGOs) and government bodies to secure these resources.” The other finding was that many teachers lacked formal training in special needs education, particularly in teaching mathematics to learners with visual impairment. This had led to a reliance on traditional teaching methods that were not effective for learners with visual impairments. Tr.2 stated: *“We were trained to teach regular learners, but teaching mathematics to learners with visual impairment requires a completely different approach, which many of us are not familiar with. We are calling for specialized training in the use of tactile materials and braille, as well as innovative teaching techniques such as hands-on learning, group work, and the use of technology like audio-based learning platforms.”* Teachers acknowledged that the use of assistive technologies, such as screen readers and braille display, could significantly enhanced visually impaired learners' ability to learn mathematics. However, such tools are either scarce or non-existent at the school due to financial constraints. Tr.3 expressed frustration: *“Assistive technology is almost non-existent here. We don't have the funds to buy things like braille displays or talking calculators, which would make a big difference in the way learners experience mathematics. We need to establish partnerships with technology companies or other organizations to provide these technologies.”* Tr.4 suggested, *“The government should subsidize the cost of such tools to make them more accessible.”*

The learners' focus group yielded insights into their own experiences with learning mathematics and highlighted additional factors affecting their performance in mathematics and the strategies to address them. Learners reported that they often struggle with understanding abstract mathematical concepts, particularly without visual aids. VIL1 noted, “certain topics, such as geometry and graphs, are particularly difficult to grasp. There is need of more tactile learning aids” VIL2 added: *“When the teacher talks about shapes and angles, I can't imagine them. I need to feel them to understand. Therefore, there is need of creating more tactile models for topics like geometry, where we can feel the shapes and angles. Teachers should spend more time explaining concepts in a step-by-step manner, using real-life examples to make abstract ideas more tangible.”* Some learners shared that they often felt underestimated by teachers and peers when it came to mathematics, which affected their confidence and performance. VIL3 explained, *“teachers have lower expectations for our success in the subject compared to sighted learners. Teachers should encourage us to learn mathematics.”* VIL 4 added, *“Sometimes it feels like the teachers don't expect us to do well in mathematics, and that makes it harder to try. Therefore, teachers should set high expectations for all learners, regardless of their visual impairment, and create an encouraging learning environment. Regular feedback and positive reinforcement would also help boost our confidence in our mathematical abilities.”* Learners expressed a strong

preference for working in groups, which they found helped them better understand mathematical concepts. Group activities allowed them to share their struggles and work together to find solutions. VIL5 shared: *“When we work together, it helps a lot because we can explain things to each other in a way that we understand. Teachers should integrate more group-based learning activities into mathematics lessons. This collaborative approach could foster peer support, allowing us learners to teach and learn from each other.”*

The findings focused on strategies which can be used to address the performance of learners with visual impairment in mathematics at Magwero School for the Visually Impaired. The investigation focused on various factors affecting these learners, including teaching methods, instructional materials, and classroom environment. The findings highlighted several key strategies which can be used to address the performance of visually impaired learners in mathematics and these were, the need for specialized mathematical instructional materials adapted for visual impairments, the importance of tailored teaching techniques to accommodate different learning styles in mathematics, and the necessity of creating an inclusive and supportive learning environment. Strategies identified to enhance performance in included the use of tactile and auditory resources in mathematics, individualized teaching approaches in mathematics, and ongoing teacher training to better address the unique needs of learners with visual impairment in mathematics.

2.2. Academic Performance of Learners with Visual Impairment in Mathematics

The focus of the interviews was to explore strategies that can be implemented to address the academic performance of learners with visual impairment in mathematics. The results are categorized under the main theme: academic performance of learners with visual impairment in mathematics. Verbatim quotes from the participants were included to give a more in-depth understanding of their views.

The school administrators expressed concern about the learners' difficulties in mathematics, which were linked to various factors including the teaching methods, resources, and learner engagement. However, they also shared a number of strategies that can be implemented to improve performance in Mathematics.

All the administrators highlighted the need for assistive technology to help learners with visual impairment grasp mathematical concepts more effectively. SA1 explained: *“We have tried to use traditional methods to teach mathematics, but the results are not satisfactory. The use of assistive technology, such as braille devices and talking calculators, could make mathematics more accessible. It will help our learners better understand concepts that are otherwise abstract.”* Another strategy proposed was the need for more specialized training for teachers handling learners with visual impairment. The administrators noted that while the teachers at the

school were committed, many lacks the specific skills required to teach mathematics effectively to learners with visual impairments. SA1 stated, "although our teachers are dedicated to teaching mathematics, the academic performance is below average. They need more training in how to teach mathematics to learners with visual impairments. It's not just about knowing mathematics but knowing how to adapt it for our learners." This view was echoed by SA2, who added: "It's crucial that teachers have continuous professional development. We need workshops that are specifically focused on teaching mathematics to learners with visual impairment." The need to adapt the existing curriculum materials was also emphasized. The administrators pointed out that the current curriculum was not fully accommodating the needs of learners with visual impairment, especially in subjects like mathematics that require visual elements like graphs and charts. SA 2 observed, "The curriculum we use does not always align with the needs of our learners. Mathematics, in particular, is very visual. We need materials that can be translated into tactile formats so that our learners can feel and understand concepts." SA 2 added, "The government should invest in developing curriculum materials specifically for learners with visual impairment. We need textbooks in braille and tactile teaching aids." The administrators suggested that individualized learning plans (ILPs) could help address the unique needs of each learner. They emphasized that each learners with visual impairment had different levels of ability and understanding, and a one-size-fits-all approach was not effective in improving mathematics performance. SA3 explained, "Our learners are at different levels in terms of their abilities and needs. We should develop individual learning plans that target each learner's specific challenges in mathematics." SA 3 added: "ILPs will allow us to assess each learner's progress and adjust teaching methods accordingly. This way, we can provide personalized support to those who need it most." Parental involvement was another critical factor identified. The administrators stressed the importance of engaging parents in their children's learning process, especially in subjects like mathematics that require reinforcement at home. SA 4 remarked, "Parents need to be more involved in their children's education. Many of our learners struggle with mathematics because they don't get enough support outside of school. If parents are engaged, they can help reinforce what we teach in class." SA 4 added, "We need to work with parents to ensure they understand the importance of helping their children with mathematics. Workshops and meetings could be organized to educate parents on how they can support their children at home."

The semi-structured interviews were also administered to 4 teachers handling learners with visual impairment in mathematics. One of the key concerns raised by all the four teachers interviewed was the consistently low performance of learners with visual impairment in mathematics. Therefore, teachers were asked to suggest strategies to improve performance of learners with visual impairment in mathematics.

The teachers suggested several strategies that could be implemented to address the low academic performance by learners with visual impairment in mathematics. These strategies focused on enhancing teaching methods, improving access to learning materials, and increasing support for both learners and teachers. The teachers emphasized the importance of tactile materials to enhance understanding. Teachers suggested increasing the availability of embossed graphs, Braille rulers, abacuses, and other tactile resources to help learners better conceptualize mathematical ideas. Tr.1 said, "When learners can touch and feel what they are learning, like using an abacus for basic arithmetic or Braille for reading numbers, they understand better. We need more of these resources to make lessons hands-on, rather than relying too much on verbal explanations." The introduction of technology, such as screen readers, talking calculators, and other assistive devices, was also highlighted as a potential solution for low academic performance in mathematics. Tr. 2 stated, "Technology can be a game-changer for these learners. We've seen how talking calculators, for example, help them with basic operations. But we need more advanced tools to teach higher-level mathematics, like algebra and geometry." The need for curriculum adaptation was another key point raised. Teachers indicated that simplifying certain aspects of the mathematics curriculum to make it more accessible to learners with visual impairment would be beneficial. Tr.3 suggested: "We need to adapt the curriculum so that it is friendly for learners with visual impairment. Some topics need to be simplified or approached differently, and this should be done with input from both teachers and specialists in visual impairment." To ensure that teachers are well-equipped to teach learners with visual impairment, all participants expressed the need for continuous professional development focused on inclusive teaching strategies for mathematics. Tr. 3 expressed: "We need more workshops and training specifically on how to teach mathematics to learners with visual impairment. Without this, we are guessing our way through the subject, and that affects the learners' performance." Some teachers also proposed incorporating peer learning, where learners could learn collaboratively, with sighted peers assisting learners with visual impairment. Tr. 4 commented: "Group work and peer learning are great strategies. Learners who have partial sight or who are more confident in certain topics can help their peers. This also encourages teamwork and a shared responsibility for learning." Lastly, the teachers emphasized the importance of involving parents and the community in supporting the learning for learners with visual impairment. Parental involvement, particularly in practicing mathematics skills at home, was seen as a critical component for sustained improvement. Tr.4 explained, "Parents need to be involved too. They can help reinforce what we teach at school by practicing with their children at home. Sometimes they don't know how to help, so we need to educate them too."

During the interviews, the learners expressed their views

on their experiences with learning mathematics as learners with visual impairment. Several key factors emerged as factors that negatively affected their academic performance. These included lack of accessible learning materials, insufficient teacher support, and limited use of assistive technologies. However, learners also provided insights into strategies that could help improve their performance in mathematics. Learners expressed a strong desire for more mathematics textbooks, worksheets, and practice problems to be provided in Braille. They believed that having tactile access to the same materials used by sighted learners would help bridge the gap in understanding concepts. VIL1 emphasized, *"If we had more Braille textbooks and worksheets, we could do our work independently and practice more at home. This could improve our performance in mathematics."* Several learners suggested that teachers should receive more training on how to effectively teach mathematics to learners with visual impairment. This training could focus on adapting teaching methods to include more verbal descriptions, the use of tactile learning aids, and individualized attention. VIL2 shared, *"It would help if the teachers knew how to teach us better. Sometimes they use methods that are hard for us to understand because they assume we can see like the other learners."* Many learners believed that the introduction of assistive technologies would significantly improve their learning experience. Devices such as talking calculators, specialized educational software, and tactile displays for graphs and geometric shapes were mentioned as tools that could help them grasp complex mathematical concepts. VIL3 suggested: *"If we had more tools like the talking calculator, it would make solving mathematics problems easier for us, especially when we need to do things quickly."* Some learners highlighted the importance of peer support and suggested that group work could be a valuable strategy for improving their mathematics performance. They felt that working with peers, whether visually impaired or sighted, would enable them to learn collaboratively and share knowledge. VIL4 stated, *"It's helpful when we work together as a group. I learn better when my classmates explain things to me, and we solve problems together."*

Four teachers who handle mathematics lessons for visually impaired learners and 10 visually impaired learners were observed. The primary focus was on identifying strategies to address the academic performance of learners with visual impairment in mathematics. The analysis of teaching methodologies revealed a mixture of approaches that both enhanced and hindered the learning experience of learners with visual impairment. Tr.1 who frequently used tactile resources such as embossed diagrams to explain mathematical concepts was more successful in engaging learners. Tr.2 also regularly employed such resources, resulting in more active participation and better comprehension among learners. However, Tr.3 lacked consistency in using tactile tools, which led to disengagement from the learners. Most teachers relied heavily on verbal explanations. Although verbal communication is es-

sential, Tr.4 did not complement it with enough tactile learning strategies, limiting the understanding of abstract mathematical concepts for some learners. More explicit use of mathematical language alongside tactile exploration was found to aid learning. Tr.4 used differentiated instruction, adjusting teaching methods to accommodate different levels of learners' needs. This strategy saw more active engagement from the learners. However, this was not widely implemented, indicating a need for professional development on inclusive teaching strategies.

Assistive technologies play a crucial role in enabling learners with visual impairment to access mathematical content. All 10 learners used Braille textbooks and worksheets to study mathematics. While these materials were available, their use was not fully maximized. VIL1 had difficulty in translating complex mathematical notations into Braille, resulting in inconsistencies and slower comprehension. This suggests a need for specialized training in Braille mathematics for learners. VIL2 and VIL3 were observed using the abacus for solving mathematical problems. This tool proved effective in enhancing mathematical computation and problem-solving skills. However, VIL4 had no access to the abacus for solving mathematical problems, indicating a gap in resource distribution. Only VIL5 used a screen reader for accessing mathematical content, mainly in the form of reading aloud worksheets or instructions. Although helpful, the lack of variety in audio tools limited the learners' experience. Expanding the use of auditory support, such as audio descriptions of diagrams, would likely improve overall performance. The learning environment plays a significant role in the academic performance of visually impaired learners. Although visually impaired learners may not rely on sight, good lighting is still important for those with partial vision. However, two classrooms had poor lighting conditions, which affected VIL6 with low vision who usually helps those who are completely visually impaired. Additionally, inappropriate seating arrangements hindered learners from effectively participating in group discussions or accessing tactile resources. Excessive noise from adjacent classrooms disrupted the learning process in four observed sessions. This distraction reduced the learners' concentration and focus during mathematics lessons. Implementing better classroom insulation or soundproofing could enhance concentration and academic performance. The level of engagement and participation among visually impaired learners varied significantly, depending on the teaching strategy and the classroom setup. Learners who were given the opportunity to manipulate tactile resources and assistive devices during lessons showed higher levels of engagement. VIL7 actively participated in solving mathematical problems. However, in a session where there was limited use of such resources, VIL8 engagement dropped noticeably. Collaborative learning VIL9 and 10 was observed to be an effective strategy. In two sessions where teachers encouraged peer teaching and discussion, learners demonstrated improved comprehension of concepts. Peer support systems

could be a valuable strategy to address performance issues, particularly for complex topics. Some learners exhibited signs of frustration and disengagement when they encountered difficulties with certain concepts or technologies. Four out of the ten learners demonstrated a lack of confidence in solving problems independently, suggesting the need for more encouragement and personalized support from teachers.

The focus group discussion was conducted with six teachers at Magwero School for the Visually Impaired. The discussion focused on exploring strategies to address the academic performance of learners with visual impairment in mathematics. The analysis is organized under the key theme of academic performance, where the responses of teachers were as follows.

The teachers unanimously agreed that the overall performance of learners with visual impairment in mathematics at Magwero School was below expectations. Several factors contributing to this trend were highlighted during the discussion. Among the prominent issues mentioned were: lack of accessibility to learning materials, mathematical concepts and Braille representation, teacher training and support, learner confidence and motivation, inadequate individualized attention and peer support and collaboration.

During the discussion, teachers proposed several strategies to improve the academic performance of visually impaired learners in mathematics. These strategies were aimed at addressing the factors mentioned. Teachers emphasized the need for the provision of more tactile learning aids and technology. These would include Braille materials, raised diagrams, talking calculators, and other assistive devices that can help learners grasp mathematical concepts more effectively. Tr.1 said: "If we had more tactile aids and proper tools, it would make a big difference in how well the learners understand and retain mathematical concepts." Teachers suggested that more specialized training programs should be provided to equip them with the necessary skills to teach mathematics to learners with visual impairment. They highlighted that training on how to use assistive technology and how to adapt the mathematics curriculum to meet the needs of learners with visual impairment would be beneficial. Tr.2 noted: "We need more professional development opportunities that focus specifically on teaching mathematics to the visually impaired." The introduction of structured peer-learning activities was suggested as a way to engage learners and boost their confidence in mathematics. Teachers proposed the idea of pairing learners with visual impairment with sighted learners for collaborative activities. Tr.3 stated, "Collaborative learning can help both sighted and learners with visual impairment. It encourages teamwork, and the learners can support each other in understanding difficult concepts." Teachers mentioned that involving parents in the learning process could enhance the learners' academic performance. They suggested workshops or training sessions for parents to help them better support their children at home, particularly in subjects like mathematics. Tr.4 stated, "Parents

play a critical role in motivating the learners. If they are better equipped to help at home, we believe it could improve their performance in school." Another important strategy proposed by the teachers was the integration of assistive technology in the classroom. Tools such as screen readers, specialized software for mathematics, and other digital aids could be introduced to help learners better understand mathematical concepts. Tr.6 stated, "Technology can bridge the gap for our learners. If we had access to more advanced tools, it would significantly reduce the learning difficulties they face."

The focus group discussion consisted of 6 learners with the discussion centered on understanding the strategies that could address the performance of learners with visual impairment in mathematics. The thematic approach was used to categorize and analyse the responses, with the major theme being the academic performance of learners with visual impairment in mathematics.

When asked about strategies that could help improve their performance in mathematics, the learners provided several suggestions that focused on instructional support, material accessibility, and learning accommodations. Learners expressed the need for more audio-based teaching methods, such as recordings of lessons or the use of talking calculators. They also recommended the incorporation of tactile tools, including Braille rulers, raised graphs, and geometric models that can be felt and manipulated during lessons. VIL 1 explained, "*If we could have recordings of the lessons, we could listen to them again later and understand better.*" VIL1 added, "*We need more tools that we can touch and feel to understand how shapes or graphs work.*" Several participants mentioned the importance of individualized attention from teachers and the opportunity to work in smaller groups or pairs during mathematics lessons. Peer support was also seen as an effective strategy for learning. VIL2 noted, "*Sometimes, when the teacher explains to us one-on-one, it's easier to understand.*" VIL 3 added, "*If we can work in pairs or with a partner, it helps because we can ask each other questions and explain things to each other.*" Learners indicated that they often needed more time to grasp mathematical concepts, suggesting that teachers should adjust the pace of instruction to accommodate their learning speed. Providing extra time for practice and revision was also emphasized as important. VIL4 noted, "*We need more time to practice, especially with difficult topics.*" VIL 5 added, "*The teacher could slow down a little bit, so that we can follow the lessons better.*" The availability of Braille textbooks and tactile materials was a consistent recommendation. Learners stressed the need for more resources, as well as regular access to these materials to reinforce their learning. VIL 6 said, "*If everyone had a Braille book, it would be easier to follow along in class.*" Learners also proposed that more tactile models be made available for topics such as geometry, so that they could have a better sense of the shapes they are learning about.

According to the findings conducted on identifying strate-

gies to improve the mathematical performance of learners with visual impairment, key findings revealed that the overall performance of the learners with visual impairment in mathematics was below average due to factors such as inadequate instructional mathematical materials, limited teacher training in mathematics with a combination of special education, and insufficient individualized support. Strategies suggested to address these factors included the development of tailored mathematical instructional resources to improve the performance of learners, enhanced teacher professional development in mathematics to sharpen their teaching skills which will in turn improve the learners' performance and the implementation of personalized learning plans in mathematics which will also in turn improve the performance in mathematics.

3. Discussion of the Findings

The discussion is based on the on the objective and findings of the study.

3.1. Factors Affecting Learners with Visual Impairment When Learning Mathematics

The findings of the study highlighted several key strategies which can be used to address the performance of learners with the visual impairment in mathematics and these were, the need for specialized mathematical instructional materials adapted for learners with visual impairment, the importance of tailored teaching techniques to accommodate different learning styles in mathematics, and the necessity of creating an inclusive and supportive learning environment. Strategies identified to enhance performance in mathematics included the use of tactile and auditory resources in mathematics, individualized teaching approaches in mathematics, and ongoing teacher training to better address the unique needs of learners with the visual impairment in mathematics.

Mwanza, P. and Banda L conducted a comprehensive study in Manhattan, New York City in the United States of America, focusing on strategies to address the factors affecting the performance of learners with the visual impairment in mathematics [5]. The study found that integrating assistive technology, such as screen readers and tactile diagrams, significantly enhanced the mathematical learning experience for visually impaired students. Additionally, providing individualized instruction tailored to each student's specific needs and learning styles was found to be crucial for improving their mathematical proficiency. Collaborative learning environments, where visually impaired students could work with sighted peers, also proved to be beneficial in promoting peer support and fostering a deeper understanding of mathematical concepts. The findings of the study were similar to the current study because both studies brought to light similar strategies to address the factors affecting the performance of visually impaired learners in mathematics.

The finding of the study were not related to the theoretical framework of Social Cognitive Theory (SCT) by Bandura, A which focused on behaviour as being determined by the interaction between personal factors, environmental factors and behavioural factors while the current study focused on the various strategies which can be used to address the factors affecting the performance of visually impaired learners in mathematics such as the need for specialized mathematical instructional materials adapted for learners with visual impairment [2].

The researcher holds the perspective that strategies to address the factors affecting the performance of visually impaired learners in mathematics might requires a multifaceted approach such as ensuring the availability of Braille mathematics textbooks and other specialized learning materials in mathematics to bridge the resource gap. Finally, increasing parental involvement and raising awareness about the importance of mathematics education for visually impaired learners might contribute to better academic outcomes.

3.2. Academic Performance Learners with Visual Impairment in Mathematics

According to the findings conducted on identifying strategies to improve the mathematical performance of visually impaired learners, key findings revealed that the overall performance of the visually impaired learners in mathematics was below average due to factors such as inadequate instructional mathematical materials, limited teacher training in mathematics with a combination of special education, and insufficient individualized support. Strategies suggested to address these factors included the development of tailored mathematical instructional resources to improve the performance of learners, enhanced teacher professional development in mathematics to sharpen their teaching skills which will in turn improve the learners' performance and the implementation of personalized learning plans in mathematics which will also in turn improve the performance in mathematics.

The findings of the study were similar to the study findings of Chileshe, J. who carried out a study on academic performance by learners with the visual impairment and strategies to enhance performance in mathematics which was conducted in selected schools of Lusaka, Zambia [3]. The study found that the academic performance was below average and suggested that the strategies to improve academic performance of the learners with the visual impairment in mathematics included ensuring that visually impaired learners have access to materials that are accessible to them such as Braille mathematics textbooks, audio recordings, and tactile diagrams in mathematics and utilizing technology such as screen readers, and other assistive technology to help learners with the visual impairment access and understand mathematical concepts. The findings of the study were similar to the current study because both studies found that the overall per-

formance of visually impaired learners in mathematics was below average due to factors such as inadequate instructional mathematical materials, limited teacher training in mathematics with a combination of special education, and insufficient individualized support. Strategies suggested to address these factors included the development of tailored mathematical instructional resources to improve the performance of learners, enhanced teacher professional development in mathematics to sharpen their teaching skills which can in turn improve the learners' performance and the implementation of personalized learning plans in mathematics which can also in turn improve the performance in mathematics.

The revelations of the research are not similar to the Social Cognitive Theory (SCT) of Albert [2]. According to this theory, individuals learn through observing others and their environment while also considering their own thoughts, beliefs, and motivations. This theory emphasizes the reciprocal interaction between personal factors, environmental factors, and behavioral factors while the current study focused on strategies to improve the overall performance of the visually impaired learners in mathematics.

The researcher holds the perspective on academic performance of learners with visual impairment when learning mathematics that the overall academic performance in mathematics was significantly below average. This could be largely due to a combination of inadequate resources in mathematics, insufficient teacher training in mathematics with special education and negative attitudes toward the subject. To address this below-average performance, it could be crucial to implement strategies such as increasing the availability of Braille and digital mathematics textbooks.

4. Conclusion

The ultimate aim of the study was to improve the academic performance of the learners with the visual impairment in mathematics. It was evident from the study that the overall academic performance of the learners with the visual impairment in mathematics was below average.

The study discovered some of the ways of addressing factors affecting the performance of learners with the visual impairment in mathematics and these were increasing the availability of Braille mathematics textbooks and assistive technologies, enhancing teacher training through continuous professional development, and promoting positive attitudes towards mathematics among both learners and teachers. Additionally, fostering greater parental involvement, improving the accessibility of specialized teaching methods, and ensuring a supportive learning environment are essential.

Abbreviations

SA School Administrator

VIL Visually Impaired Learner

Conflicts of Interest

The authors declare no conflicts of interest.

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Research Fields

Gondwe Masauso: Special Education