Vol. 3 (Iss. 3) 2026, pp. 481-493 African Quarterly Social Science Review https://quarterlyreview.net ISSN: 3006-3493

Integration of universal design for learning principles to accommodate students with visual impairments in inclusive public secondary schools of Mwanza City, Tanzania

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Recommended Citation: Manase, J. J., Muzata, K. K., & Simalalo, M. (2026). Integration of universal design for learning principles to accommodate students with visual impairments in inclusive public secondary schools of Mwanza City, Tanzania. African Quarterly Social Science Review, 3(3), 481–493. https://doi.org/10.51867/AQSSR.3.3.41

ABSTRACT

Universal Design for Learning (UDL) is an educational framework for promoting inclusive education through its three core principles: multiple means of representation, engagement, and expression, which emphasize flexible teaching and assessment practices to accommodate students' diverse educational needs. This study explored how teachers integrate UDL principles to support students with visual impairments in the selected inclusive public secondary schools of Mwanza City, Tanzania. Guided by the Social Model of Disability, the study employed a qualitative approach with a case study design involving 20 participants who were purposively selected, including teachers, school administrators, and students with visual impairments. Data were generated through interviews and observations and analysed thematically. The findings revealed that teachers integrated UDL principles through different strategies, including verbal explanations, the use of tactile materials, using Braille resources, audio-recorded lessons, the use of assistive devices such as Orbit Readers, peer support, oral assessments, and Braille -based assessments. It was also revealed that teachers integrated technology through the use of voice recorders, orbit readers and audio books. These approaches enhanced students' access to the curriculum and assessment, fostering their learning independence and participation. However, the integration of UDL principles was partial and informal, challenged by inadequate training, shortage of assistive technology, workload, and time pressure resulting from the low number of trained personnel. The study concluded that this commitment by teachers demonstrates a step toward the practical realization of inclusive education, though more efforts are still required for true and institutionalized inclusive practices. The study recommended that the educational authority should prioritize teacher training and the procurement of assistive technology. In addition, the authority should establish a clear and feasible policy and framework for UDL implementation.

Keywords: Engagement and Action, Inclusive Education, Multiple Means of Representation, Universal Design for Learning, Visual Impairment

I. INTRODUCTION

As a result of advocacy by international policies and frameworks for inclusive education system, the enrolment of learners with special education needs in all educational levels is increasing rapidly. The Salamanca Framework for action in 1994 for example recognizes the inclusion and participation as essential to human dignity and to the enjoyment and exercise of human right. It further put clear that fundamental principal of the inclusive school is that all children should learn together, wherever possible, regardless of any difficulties or differences they may have. This assertation instruct the schools to recognize and respond to the diverse needs of their students accommodating both different styles and rates of learning and ensuring quality education to all through appropriate curricula, organizational arrangements, teaching strategies and resources. In addition, Convention on the Rights of Persons with Disabilities CRPD (2006) require the member countries to recognize the right of persons with disabilities to education. It further mandates that, persons with disabilities should access an inclusive, quality and free primary and secondary education on an equal basis with others in the communities in which they live (Possi & Milinga, 2017).

Similarly, Sustainable Development Goal 4 emphasize on ensuring inclusive and equitable quality education and promotes lifelong learning opportunities for all (United Nations [UN], 2006). This means that guaranteeing access to quality education to all population in the community is one of the practical means and efforts to eliminate poverty in the world by 2030. For learners with special education needs, this can be implemented if reasonable accommodation of the individual's requirements is provided. Schools should ensure that curriculum content for learners who are blind, deaf or deafblind, is delivered in the most appropriate languages and modes in environments which maximize academic and social development (Mambo & Banja, 2021). For practical implementation of this shift, different national, international and non-state actors have joined efforts to ensure access to education by all the people.

To adhere to these international proclamations on inclusive education, Tanzania made efforts in improving access to Basic education by all citizens for the reason of inclusive education. Tanzania has signed and ratified different UN conventions, including child rights, rights for people with disabilities, and Education for All as means to ensure equity in development for all citizens. Regarding Children with Disabilities, the National Policy on Disability was established in 2004 to steer the government in partnership with education stakeholders to deliver a supportive setting for the unique requirements of individuals with disabilities including children with disabilities. Moreover, in 2006, Tanzania ratified the UN Convention on the Rights of Persons with Disabilities (CRPD), which encourages the member states to provide education for children with disabilities without bias based on fairness opportunities (United Nations, 2006). Likewise, the Education and Training Policy established in 2014 supported the entitlement to education for every citizen across all educational tiers from pre-primary through tertiary levels. Additionally, The Persons with Disabilities Act no. 9 of 2010 mandates that every child with disability shall attend an ordinary public or private school except where a need for special communication is required and shall be provided with appropriate disability related support services or other necessary learning service from a qualified teacher or a teacher assigned for that purpose.

As a result of this commitment, the enrolment for learners with disabilities in secondary school raised to 10,749 in 2018/2019, in Tanzania Mainland (United Nations Environmental, Scientific and Cultural Organization [UNESCO], 2020; United Nations, 2006). The current data from the President's Office Reginal Administration and Local Government report (2024) show that in 2023, 386 students with blindness and 6,011 students with low vision enrolled in secondary schools bringing the total number of students with visual impairments in inclusive public secondary schools to 6,397. This enrolment trend has changed the nature of classrooms from regular classes to inclusive classrooms which would now requires flexible pedagogical approaches that benefit all learners regardless of their diversities. For successful learning outcomes for diverse learners, it is necessary to modify pedagogical approaches (Tomlinson, 2017). According to Hall et al. (2015), technology-enhanced learning, differentiated instruction, and universal design for learning (UDL) increase student engagement and performance across a range of needs. This implies that teachers should realize that not everyone learn in the same way.

Students with visual impairments (SwVI) for example, often require explicit verbal instructions, detailed oral descriptions of written content, clear modelling of examples, and the use of accessible learning materials to support effective learning (Dalton, 2017). From an educational perspective, visual impairment is generally categorized into total blindness, functional blindness, and low vision. Student with total blindness may depend more on braille and audio instructions. They can also benefit from oral description of visual resources or audio recorded lessons. Students with functional blindness may combine tactile and auditory learning with limited use of residual vision. According to Muzata (2020) assistive technologies such as screen readers, talking calculators, speech-to-text and text-to-speech software, as well as Braille devices, enable both students with total blindness and functional vision to access instructional content more effectively. SwVI face unique challenges in mainstream classrooms, where teaching materials and assessment approaches are typically designed with visual ability in mind. Rule et al. (2011) recommend the integration of multimedia resources across the curriculum to support learners in interpreting and accessing visual information more effectively. In light of these unique characteristics conventional teaching methods used in traditional classrooms are currently inadequate in addressing the diverse needs present in inclusive classrooms. Teachers are now required to employ flexible instructional strategies that can effectively support all learners. This means that schools are expected to employ flexible and diversified instructional approaches to effectively respond to learner diversity (Aithal & Kumar, 2016).

In response to this shift, there has been efforts to develop frameworks to guide the teaching and learning in inclusive settings. The emerged practices include adaptations, differentiated teaching approaches and universal design for learning (UDL). Contrary to other inclusive frameworks the UDL is proactively focused on addressing learning barriers to learners with diverse learning in inclusive settings. UDL is rooted from the concept of the universal design for products and environments, whereby architects make physical environments accessible to everyone, regardless of potential barriers such as physical, cognitive or developmental barriers (Courey et al., 2013). By witnessing how architects planned physical environments to create accessibility, educators began to apply the principles of Universal Design to education, later forming the basis of the factors of accessibility in education within the UDL framework (Katz, 2013). The three core principles of UDL require teachers and curricula to offer multiple means of representation, expression, and engagement to form the second piece of UDL (Lapinski et al., 2012). By providing multiple means of expression, teachers create multiple opportunities for students to showcase their understanding through the use of various tools, increased access to these tools, and strategies to overcome barriers to learning (Katz, 2013). When teachers integrate multiple means of engagement through flexible options for students' choice, they capitalize on the affective networks of students' brains (Rose & Strangman, 2007). In planning for multiple means of representation, expression and engagement, teachers create various means for students to access and showcase their knowledge of a topic. This flexibility in how knowledge is acquired and represented gives opportunity to create unique learning experiences for a diverse group of learners within one classroom.

In an inclusive setting with SwVI the UDL framework can be used to address the learning barriers of the learners. However, although the UDL framework is recognized and accepted as an educational framework to address learning barriers studies from Tanzania show that SwVI still face challenges related to inflexible pedagogies and inadequate equipment (Seliane & Kgothule, 2022; Larios & Zetlin, 2023; Ajani & Ntombela, 2025). For example, most SwVI reported difficult in Mathematics and Science related subjects such as lack of understanding of the contents, lack of logical and mathematical thinking skills, and lack of understanding of the question requirements. These challenges were among of the factors causing underperformance in Primary School Leaving Examination. This implies that there is a need for teachers to employ accessible teaching approach and assessment style. Studies further report the inadequate provision of accessible learning materials, and limited curriculum adaptations to accommodate diverse learning needs (Kisanga & Richards, 2018; Losioki & Ngowoko, 2024; Karoli & Upadhyaya, 2024). Studies by Samwel et al. (2025) and Mussa (2025) report that teachers who teach in inclusive classrooms lack professional competence in managing inclusive classrooms hance relying on traditional instructional approaches that inadequately address learner variability. As a result, SwVI continue to experience challenges in accessing instructional content, engaging in classroom activities, and demonstrating their learning through appropriate assessment methods. These challenges raise concerns about how inclusive teaching approaches are being implemented into classroom practices to promote equitable learning opportunities for all students including those with VI. Most of the studies from Tanzania focus on challenges facing SwVI and teacher preparedness for inclusive education, leaving a gap on how teachers integrate the UDL principles into their instructional practices in inclusive secondary schools in Tanzania. This study addressed this knowledge gap by exploring the ways in ways in which teachers integrate UDL principles to accommodate SwVI in public inclusive secondary schools in Mwanza City, Tanzania.

1.2 Research Questions

i. What UDL related pedagogical strategies do teachers use to support students with visual impairments in the selected public inclusive secondary schools of Mwanza city Tanzania?
ii. How do teachers integrate technology in teaching and learning of students with visual impairments in the selected public inclusive secondary schools of Mwanza city Tanzania?

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Social Model of Disability

The study was guided by the Social Model of Disability. It argues that disability results from societal barriers rather than individual impairments, emphasizing the need to eliminate physical, attitudinal, and institutional obstacles to achieve a true inclusion. For instance, a student with visual impairment (SwVI) is not disabled by their impairment condition but by the obstacles such as absence of mobility training, braille devices, tactile and audio learning material in a school, which prevents curriculum access and independent mobility (Rule et al., 2011). In Tanzanian inclusive public secondary schools, the Social Model frames challenges faced by SwVI, such as inaccessible pedagogies, inadequate assistive devices and technology, teachers' limited training in special needs education as barriers that hinder effective inclusion (Losioki & Ngowoko, 2024). The Social Model is relevant to this study as it provides a lens for analyzing teachers' integration of UDL principles and the use of technology to accommodate SwVI in inclusive public secondary schools. This model guides the study's exploration of how do teachers apply principles of UDL, such as multiple means of representation multiple means of engagement and multiple means of expression and the way teachers integrate technology to ensure true academic inclusion for SwVI in Tanzanian inclusive primary schools.

2.2 Empirical Review

2.2.1 Integration of UDL Principles and Technology in Pedagogical Strategies to Accommodate SwVI

Video lessons can support UDL implementation by improving accessibility for learners with disabilities. Features such as closed captioning, audio descriptions, and transcripts enable SwVI to access learning content in multiple formats. In the same vein. Dalton et al. (2019) examined teachers' instructional practices in South Africa and found that UDL principles were not systematically applied. Instead, teachers often relied on individualized accommodations for learners with disabilities, particularly SwVI. The study found that teachers viewed UDL approach as an additional assignment placed a heavy workload on them and was not always sustainable in inclusive classroom environments. Similarly, William (2023) investigated pedagogical practices for SwVI in Tanzanian secondary schools and found that although adapted textbooks were available, they lacked sufficient tactile and visual support features. The study further noted that, many teachers lacked knowledge of braille and appropriate instructional strategies for SwVI.

In Tanzania a study by Mgonja and Mwila (2023) revealed that while special needs education teachers attempted to support learners through large-print materials and modified assessments, there still inconsistences in implementation

of inclusive instructional. The study further reported infrastructural barriers such as lack of ramps and accessible school environments, which further hindered effective participation of learners with disabilities. However, the study focused broadly on learners with different disabilities and did not specifically examine how UDL principles guide classroom instruction for SwVI. Kisanga (2019), in an assessment of educational access for SwVI in Tanzania, identified several barriers including inappropriate examination formats, delays in examination administration, lack of feedback, and limited competence among transcribers. The study also noted inadequate access to assistive technologies and skills for using them effectively.

Phelan et al. (2025) conducted a systematic review of UDL implementation in secondary education. The study found that many studies reviewed did not explicitly label their instructional approaches as UDL, suggesting either limited awareness or implicit application of its principles. The study emphasized the need for more context-specific research, particularly in underrepresented regions, to better understand how UDL is operationalized in real classroom settings. Juma (2025), conducted a study in Zanzibar and found that many teachers had limited knowledge of assistive technologies and lacked adequate training to support learners with visual and hearing impairments. The study further reported the challenges such as insufficient professional development, shortage of assistive devices, and lack of continuous support. The study concluded that ongoing training is essential for strengthening teachers' ability to integrate inclusive instructional approaches aligned with UDL principles.

III. METHODOLOGY

3.1 Research Design

A qualitative approach with a case study design was employed to facilitate an in-depth understanding of teachers' perceptions and implementation of UDL practices for SwVI in public secondary schools in Mwanza city. This approach allows for knowledge to be derived from interpreting various events and experiences (Creswell, 2014). Case studies explore the subject matter, covering all aspects of a single unit comprehensively (Creswell, 2014). It facilitated an in-depth exploration of participants' perspectives on UDL within the context of the selected public secondary schools in Mwanza city Tanzania.

3.2 Study Area

The study was conducted in Mwanza City, located in the north-western part of Tanzania along the southern shores of Lake Victoria. Mwanza City is one of the country's major urban centres. According to the Basic Education Statistics (BEST) in 2024, Mwanza City has a total of 1,892 teachers and 52,651 students enrolled in public secondary schools. Of these students, 329 are students with disabilities, with 73 specifically being students with visual impairments. These schools were selected due to their experience in accommodating students with visual impairments, making them ideal for an in-depth exploration of UDL implementation.

3.3 Target Population

The target population for this study included teachers who teach in inclusive classes with visually impaired students, School administrators and Students with visual impairments enrolled in inclusive public secondary schools in Mwanza city Tanzania. The focus of the study was to investigate the application of UDL aimed at accommodating students with visual impairments in inclusive secondary school settings.

3.4 Sampling and Sample Size

A purposive sampling procedure was used to achieve a deep understanding of the study phenomenon rather than seeking to generalize findings (Patton, 2015). Criterion sampling was employed to select 6 SwVI, 10 subject teachers and 4 school administrators totaling 20 participants from two selected inclusive secondary schools. This approach ensures that participants possess specific experiences and perspectives necessary to address the research questions, thereby enhancing the depth and relevance of the findings.

3.5 Data Collection Instruments and Procedures

The study employed semi-structured interviews and observations. An observation guide was developed to assist in systematically observing the implementation of UDL pedagogies by subject teachers in supporting the inclusion of SwVI at the selected inclusive public schools. Additionally, semi-structured interviews were conducted using interview guides that outlined key topics related to the implementation of UDL (Creswell, 2014).

3.6 Data Analysis

The study employed thematic analysis to derive meaningful insights from the participants' responses. The data was analyzed thematically following the six-step process outlined by Braun and Clarke (Braun & Clarke, 2012) which are familiarization, coding, theme development, review, definition and reporting.

3.7 Ethical Consideration

To adhere to research ethics throughout the research process the researchers obtained ethical approval from the University of Zambia Directorate of Research and Graduate Studies prior to commencing the study, along with an introductory letter from the School of Education. The researchers also implemented informed consent, establishing a contract between researchers and participants. Additionally, participant identities were safeguarded through the use of pseudonyms. All research records, including voice recordings, field notes, and interview transcripts were securely stored to maintain confidentiality.

IV. FINDINGS & DISCUSSION

4.1 Integration of UDL Principles for Students with Visual Impairments (SwVI)

4.1.1 Multiple Means of Representation Through Adapted Content Delivery

It was noted that teachers tried to some extent to incorporate the UDL principle of Multiple means of representation to support learning of SwVI. From the interview and observation, it was revealed that teachers modified their instructional approaches by providing detailed verbal explanations, utilizing tactile and concrete learning materials, and the use of Braille materials. The use of detailed verbal explanation to supplement the visual cues: The study revealed that teachers were using verbal explanation to ensure that SwVI benefited from what they were teaching. They were speaking clearly, reading aloud and clearly the written information to help SwVI develop the concept. It was further noted that teachers were trying to describe the visual content such as drawings and diagrams to compensate for SwVI 's lack of access to visual information and incidental learning;

> *When teaching, I normally ensure clear pronunciation and a clear voice because some of the students depend on listening. I also teach at a low pace to ensure that all students can follow what is taught. I also provide oral explanations for diagrams by describing their parts and relationships in words instead of saying 'look at the diagram. I try to ensure that all what are written and drawn on the board are accessible to SwV. This is possible because I read aloud and explain the concept step by steps* (T1MSS; personal communication, 8th April2026)

Another teacher insisted;

> *"In my teaching I try to explain concepts clearly and slowly so that students with visual impairments can follow the lesson. I also encourage them to ask questions whenever they do not understand something*" (T2BSS, personal communication, 8th April 2026)

This indicate that the use verbal descriptions can help SwVI compensate their limited access to visual information. When the written information and the visual resources such as diagram and drawing are well explained and described, SwVI can to some extent befit from the course content. This also underscore that in the selected secondary schools' teachers were to same extent concern to diverse learning needs of SwVI. According to Center for Applied Special Technology [CAST] (2011), offering information through multiple sensory channels such as auditory format especially for learners with limited access to visual information can help to meet their learning needs. This is consistent with Dalton et al. (2019), who found that teachers in African inclusive classrooms frequently rely on verbal mediation due to limited instructional resources and lack of structured UDL training. Although the use of detailed verbal explanation enhance understanding, it may also reflect limitations in instructional materials which would better support the learning of SwVI. Kisanga (2019) noted that in Tanzanian schools, verbal instruction often becomes the primary access route for SwVI due to shortages of Braille and tactile resources. Although verbal explanations improve access, over-reliance on them may restrict the richness of learning experiences, particularly in subjects requiring spatial or visual reasoning such as Science and Geography. Edyburn (2005), emphasize that effective UDL implementation requires combining auditory, tactile, and visual alternatives rather than depending on a single mode of delivery.

Use of Tactile diagrams to represent the visual information: It was further revealed that teachers were using tactile diagrams and drawings to help SwVI develop concept. They used improvised diagrams to simplify the SwVI's understanding of structures such as solar system in Geography subject and other systems in biology. The use of tactile materials helped to make the abstract concepts more meaningful when learners are allowed to touch, manipulate, and explore physical objects;

> *When I draw a diagram on the board, I also use a tactile diagram of the same concept so that students can explore through touch. This helps them understand concepts much better, especially in subjects like Geography and Science where visual information is important. Using models and specimens allows*

> *learners to construct clear mental images of what is being taught*. (T2MSS; Personal communication, 9th April 2026)

Another participant highlighted the role of maps and models in supporting deeper cognitive processing and conceptualization beyond verbal explanations;

> *We use tactile maps and models because some concepts cannot be fully understood through verbal explanation alone. When learners touch and explore the materials, they are able to develop mental pictures and gain a more meaningful understanding of the lesson content*. (T4BSS; personal communication, 9th April 2026)

During one lesson on the solar system, it was observed that SwVI were using Braille textbooks that contained tactile diagrams of planetary structures. SwVI explored the raised illustrations through touch while following the teacher's explanations. Similarly, in a Biology lesson, a teacher was using an improvised tactile diagram of the human heart where SwVI were tracing different parts of the diagram with their fingers enabling them to develop the concept and understanding of the structure of the human heart. However, the findings also revealed that these tactile materials were not effective for all learners.

During student interviews, two SwVI reported experiencing difficulties interpreting some tactile illustrations in textbooks;

> *Sometimes the tactile drawings in the books are difficult to understand because I cannot easily tell what the picture represents. When the teacher explains it verbally, I understand better than when I only use the tactile diagram.*" (SWVI 1; personal communication, 8th April 2026)

Similarly, another learner noted:

> *"Some tactile pictures are confusing, especially when they have many details. I prefer when the teacher describes the image and explains the different parts because it helps me create a clearer understanding."* (SWVI 2; personal communication, 8th April 2026)

Teachers' use of improvised tactile diagram reflect their commitment in traying to fulfill the SwVI's diverse learning needs. This also demonstrate a step towards the realization of inclusive teaching approaches that benefit all learners in an inclusive setting. However, besides these efforts, the revelation that tactile diagrams were not effective to all learners suggests that tactile resources alone are not enough to cover the diverse needs of students in inclusive settings. Teachers who teach in inclusive classrooms with SwVI should think of other instruction channels to supplement the tactile diagram or should ensure that the diagrams are clear, accessible and they simplify learning of intended concept. These findings agree with the findings by Kisanga (2019) who reported that in Tanzanian inclusive classrooms, learning materials for SwVI are often inadequate or difficult to use effectively, making teacher explanation a critical support mechanism. Similarly, William (2023) found that although adapted textbooks were available in Tanzanian secondary schools, they lacked sufficient tactile and visual support features. In the lens of social model of disability, teachers' use of ineffective tactile materials may place SwVI at a disability angle as they may fail to effectively develop the intended concept. This difficulties in learning are the one causing SwVI failing in performance rather than their physical sensory abnormality. Although tactile and concrete materials represent a step toward inclusive pedagogy, their effectiveness depends on thoughtful design, teacher facilitation, and integration with other representational modes.

Use of Braille Learning Materials: Participants further described the use of Braille learning resources as a strategy for enhancing access to curriculum content among SwVI. Teachers emphasized that braille enable students to obtain the same information as their sighted peers while promoting independence in learning and assessment processes;

> *We also have Braille which are provided by the Tanzania Institute of Education. The Braille books help students access the same content that other students use in class. I also use tactile materials and Braille texts so that students with visual impairments can access the same content as other sighted students. These resources help SwVI to engage with a learning content* (T1MSS; personal communication, April 9th 2026)
>
> *Notes are prepared in Braille format for students who cannot read ordinary print. This allows them to study independently both in class and during private study time. Examinations and classroom exercises are also converted into Braille, to enable learners with visual impairment be able to complete the tasks without depending too much on assistance from others.* (T3BSS; personal communication, 9th April 2026)

It was observed that SwVI were using Perkins Braillers to take notes while teachers conducted classroom instruction. SwVI were taking summary using Braille. In addition, the researcher observed a number of Braille textbooks and supplementary reading materials produced by the Tanzania Institute of Education (TIE) available in resource rooms. However, despite the availability of Braille materials, interviews with SwVI revealed mixed perceptions regarding their use. Some students expressed unwillingness to rely on Braille textbooks because of their physical size and portability challenges;

> "*Braille books help us learn, but sometimes they are very bulky. Carrying several Braille books from one class to another is difficult."* (SWVI1; personal communication, 10th April 2026)

Another student shared a similar concern:

> "*We have Braille textbooks, but they take up a lot of space and are heavy compared to the books used by other students. Sometimes I prefer shorter notes because they are easier to manage."* (SWVI2; personal communication, 8th April 2026)

These findings are consistent with Dalton (2017), who argues that the provision of Braille materials, together with clear verbal explanations enables SwVI to access curriculum content that would otherwise be inaccessible through conventional print materials. The findings also support the observations of Muzata (2020), who notes that Braille devices and other assistive technologies are essential tools for enabling SwVI to access instructional content independently. Also, William (2023) found that adapted instructional materials are crucial for supporting SwVI in secondary schools. However, despite the educational value of Braille materials, SwVI expressed concerns regarding the bulkiness and portability of Braille textbooks. Similar challenges were identified by Kisanga (2019), who reported that SwVI often experience difficulties related to inadequate access to appropriate learning resources and assistive technologies. In this context, the students' preference for shorter notes and more manageable resources suggests a need for schools to complement traditional Braille materials with digital and portable assistive technologies such as electronic Braille displays, screen readers, and audio-based resources. This indicate that Braille learning materials continue to play important role in facilitating curriculum access among SwVI in inclusive secondary schools. The over reliance on traditional Braille materials may not adequately address the diverse accessibility needs of all learners, for effective inclusive teaching teachers should invest in multimodal approach that incorporates audio, tactile, and digital learning resources.

4.1.2 Multiple Means of Engagement Through Active Participation

Inclusive Questioning and Group Discussions: The findings indicate that inclusive questioning was used as a pedagogical strategy to promote participation and interaction for SwVI within mainstream classrooms. Teachers emphasized that questioning techniques were structured to ensure that SwVI are not passive recipients of instruction but active contributors to classroom;

> "*I normally give them equal chance to answer questions when I am using question and answer as a teaching strategy so that they are not left behind during the lesson."* (T1MSS, personal communication, 10th April 2026)
>
> *"I involve them during class discussions and I also ask them questions directly so that they can actively participate and follow what is being taught in class."* (T3BSS, personal communication, 10th April 2026)

During a Biology lesson, SwVI were observed participating in oral questioning sessions with their sighted peers. The teacher posed questions to the whole class, and SwVI were given opportunities to respond verbally without exclusion. In several instances, SwVI confidently provided correct answers and engaged in follow-up explanations. In addition, it was also revealed that SwVI value collaborative. They expressed that working in groups with sighted peers enhanced their understanding of content and improves their classroom experience;

> "*I usually enjoy working in groups with my fellow sighted students because they help me when I miss something and we discuss together what the teacher has taught."* (SWVI 1; personal communication, 9th April 2026)

Another SwVI added:

> "*Group work is very helpful for me. I feel included when I work with other students, and I can also answer questions during discussions like everyone else."* (SWVI 2; personal communication, 9th April 2026)

This aligns with Dalton (2017), who emphasizes that SwVI benefit from explicit verbal instruction, clear oral explanations, and detailed descriptions of content that is typically presented visually. The collaborative learning experiences reported by SwVI further reinforce the importance of peer-supported inclusive pedagogy. This finding is consistent with Rule et al. (2011), who argue that integrating collaborative and interactive learning approaches improves access to curriculum content for SwVI by facilitating shared knowledge construction. Zubiri-Esnaola et al. (2020) also stresses that Interactive Groups promoted effective conditions for the inclusive participation of all learners, created a favorable climate for collaborative interactions regarding the target language and raised learning expectations for all students. The findings indicate that inclusive questioning and group discussions are effective pedagogical strategies for promoting participation and engagement of SwVI in inclusive classrooms. These practices enhance peer interaction, and reduce exclusion in classroom. Group Work and Peer-Supported Learning: The findings reveal that teachers organized students into mixed-ability groups, where SwVI were included to facilitate peer interaction and shared learning. Through group work, teachers aim to create an inclusive classroom environment in which SwVI could contribute to discussions and develop communication skills;

> *"I also give them sub topics where they discuss in their groups and present in presentations so that each group member can contribute to the final answer during class sharing*" (T2BSS, personal communication, April 9th 2026).

Similarly, another teacher emphasized inclusion of SwVI within group activities to ensure equal participation and shared understanding;

> "*Learners with visual impairment are included in the groups so that they can participate in discussions and share their understanding of the topic with their peers like other students*" (T4MSS, personal communication, 9th April 2026).

Classroom observations indicated that group work was implemented during lessons, with SwVI engaged in tasks with their sighted peers. SwVIs were assigned specific roles within groups, such as contributing ideas during discussion and responding to questions during group presentations. Sighted peers were also providing verbal descriptions and clarifications to SwVI to facilitate inclusive participation within the classroom. In addition, SwVIs reported that collaborative learning allows them to benefit from peer explanations, clarify difficult concepts, and contribute to classroom tasks without feeling isolated;

> "*I like working in groups because my classmates help me when I do not understand something, and we discuss together so that I can also contribute my ideas during the lesson"* (SWVI 1, personal communication, 9th April 2026).

Another learner added:

> *"Group work makes me feel included. I can participate like other students, and sometimes my friends explain things to me in a way that is easy to understand"* (SWVI 2, personal communication, 8th April 2026).

The findings suggest that groupwork and peer supported learning enhance participation and social integration between SwVI and their sight peers. SwVI enjoy working together with their sighted fellows in groups while benefiting from the oral clarifications of the difficult concepts. Working together in groups also, create a strong bound and cooperation between the sighted peers and SwVI. These findings resonate Han and Lei (2024), who found that learners view inclusive pedagogies such as collaborative learning positively due to their social and academic benefits. Findings by Kisanga (2019) and William (2023), reported barriers in access to appropriate learning resources for SwVI in Tanzanian schools. In such contexts, group work becomes a compensatory strategy rather than a fully planned UDL instructional approach. In the lens of Social Model of Disability, the positive attitudes showed by the sighted students and teachers on peer support and groupworks with both sighted and SwVI, can be seen as a way of reducing the performance barriers which would have resulted from the loss of vision. The revelation that sighted learners where assisting SwVI by clarifying the difficulty visual concepts show how the positive societal attitudes can help to reduce difficulties and barriers which could otherwise cause a restriction to the learners' performance.

4.1.3 Multiple Means of Action and Expression Through Flexible Assessment

4.1.3.1 Oral Responses and Oral Assessment

It was revealed that teachers modify assessment practices by allowing SwVI to demonstrate their understanding through oral presentations, verbal responses, and oral tests. These approaches were used to ensure that SwVI were not disadvantaged by written assessment formats and were given equitable opportunities to express their knowledge. One participant explained:

> *I sometime allow SwVI to present their assignment orally in front of the class so that they can demonstrate what they have learned without relying on written work. They enjoy this opportunity. I just listen careful to their presentation to know where they are strong and where they are weak. During the monthly test and midterm test also Students with visual impairments are allowed to answer questions orally. We do read the prepared questions to them the they respond orally. participation* (T2MSS; T1BSS, personal communication, 9th April 2026).

One SwVI explained that during test and midterm examinations, questions are often read aloud by the teacher or invigilator, enabling them to respond verbally:

> *"For tests and midterm exams, the teacher usually reads the questions to us orally, and we answer them by speaking because sometimes we cannot access the printed paper directly"* (SWVI 1, personal communication, 9th April 2026).

This suggests that Oral responses and assessment can be used as alternative to written assessments. In the context where the braille resources are limited or are not functioning, SwVI can still express their understanding of the curriculum content orally. This assessment style helps may help learners demonstrate their understanding even if they are not braille literacy. The UDL principle of multiple means of expression, advocates for providing learners with diverse ways to demonstrate knowledge more than only traditional written formats (CAST, 2011; Edyburn, 2005). By allowing SwVI to respond orally, teachers are acknowledging learners' variability and attempting to ensure that assessment measures academic competence rather than visual access to print materials. Boothe et al. (2018), emphasize that flexible assessment design is essential for reducing barriers in inclusive classrooms. However, relying too much on oral examinations when Braille transcription is unavailable or when assistive equipment such as embossers is non-functional

reflects systemic challenges within the school environment rather than flexible pedagogical choice. Similar challenges have been reported by Kisanga (2019), who found that inadequate access to assistive technologies and delays in exam preparation often limit equitable assessment practices for SwVI in Tanzania. In this sense, oral assessment functions both as an inclusive strategy and as a compensatory mechanism for infrastructural deficiencies. Braille-Based Assessment: The findings show that where resources were available, schools made efforts to convert standard examination papers into Braille format, thereby maintaining the integrity and inclusiveness of formal assessment processes. One participant explained:

> "*For formal examinations, the exam papers are normally converted into Braille format using an embosser machine so that learners with visual impairments could access the same questions as other students*" (T4MSS, personal communication, 9th April 2026).

While Braille-based assessment remains an important component of inclusive evaluation, its implementation is often dependent on the availability and functionality of assistive technologies, as well as institutional resources. However, the findings revealed that it also introduces workload challenges for teachers. Participants noted that after examinations are administered, Braille scripts must be transcribed into print format to enable subject teachers many of whom are not Braille literate to mark students' work. This additional step was described as time-consuming particularly given the limited number of teachers with Braille proficiency. One participant explained:

> "*Exams and test which are prepared in braille format are very helpful to students with visual impairments because they allow them to work independently, although they create extra workload for us because we must first transcribe all their scripts into print for other subject teachers to be able to mark them"* (T2BSS, personal communication, 10th April 2026)

In the same vein, another teacher highlighted the limited human resource capacity, noting that only a few staff members are trained in Braille, which increases pressure on them;

> *We are only two teachers who can read and write Braille in the school, but we have many classes and other administrative duties. Despite this, we are still expected to transcribe all the exams, which becomes very overwhelming during examination periods"* (T3MSS, personal communication, 10th April 2026).

This show that despite the presences of up to dated technology which is reflected by the use of digital devices, braille-based assessment remains as an important component of inclusive evaluation in an inclusive educational setting with SwVI. The use of braille for assessment and other academic purposes remains a primary option for SwVI especially when the other alternatives are limited. This practice aligns with the UDL principle multiple means of expression, which advocates for offering learners diverse ways to demonstrate their knowledge (CAST, 2011; Edyburn, 2005). This finding supports Boothe et al. (2018), who argue that flexible assessment systems enhance learner achievement by removing barriers inherent in print-based assessment practices. The revelation that Braille-based assessment was constrained by resource-related challenge concur with the findings by Kisanga and Richards (2018), who found that inadequate assistive technologies hinder effective assessment and learning opportunities for SwVI in Tanzania. Furthermore, the workload concerns raised by teachers indicates the gaps in human resource capacity and professional preparedness within inclusive schools. The shortage of teachers who a trained in braille means that a small number of teachers bear the responsibility of transcribing examinations, thereby increasing their workload and affecting the efficiency of inclusive assessment practices. These findings confirm the findings of previous studies by Samwel et al (2025) and Mussa (2025) who found that many teachers had limited knowledge of assistive technologies and lacked adequate training to support SwVI. Their studies further reported challenges such as insufficient professional development, shortage of assistive devices, and lack of continuous support were common. Although Braille-based assessment is a appreciated for promoting equitable participation for SwVI, its effectiveness depends not only on the availability of assistive technologies but also on adequate human resource capacity. Without sufficient numbers of trained Braille specialists and braille infrastructure, the benefits of Braille-based assessment may be undermined.

4.2 Integration of Assistive Technologies and Learning Resources

4.2.1 Use of Audio Recording Devices

The findings indicate that both teachers and students valued audio-based learning tools as effective resources for improving comprehension of lesson content. Audio recording devices, including voice recorders, tape recorders, stereo radios, and SD card were reported to enhance flexible access to instructional content in and outside the classroom environment;

> *I also allow them to record my lecture using their tape recorders so that they will be able to make revisions later when they are studying on their own at home. They record the teacher's explanations so that they can listen again and again when revising the topic, especially when the lesson involves difficult concepts that require repetition* (T2BSS, personal communication, 10th April 2026).

On the other hand, SwVI expressed a preference for audio-based learning compared to Braille textbooks. They reported that listening to recorded lessons helps them understand content more easily and supports more effective

revision. However, they also highlighted a limitation regarding access to these devices, noting that the number of available voice recorders was insufficient relative to student demand, particularly in School A where only four devices were available for a large population of SwVI;

> *I really enjoy using voice recorders because when the teacher is teaching, I record the lesson and later I listen to it again when I am revising. It helps me understand better than reading Braille books because I can hear the teacher's explanation exactly as it was given in class. The problem is that the recorders are very few, only about four in our school, so not everyone gets a chance to use them* (SWVI 1, personal communication, 10th April 2026).

In contrast, insights from School B revealed a more developed integration of audio technologies. An administrator explained that, in addition to voice recorders, the school utilizes stereo radios, tape recorders, and SD cards loaded with audio educational materials, including literature contents such as novels and poetry. These resources were used to enhance accessibility and engagement in learning. The administrator further emphasized that students demonstrate a strong preference for audio learning materials over Braille texts due to their convenience and ease of understanding;

> *We have stereo radios and tape recorders, and we also use SD cards loaded with audio materials. These include literature books like novels and poems in audio form. Students really enjoy listening more than reading Braille books because it is easier and faster for them to understand and follow the content*" (Admin1BISS, personal communication, 9th April 2026).

During observation, SwVI were seen using these devices for revision purposes, indicating that audio-based learning tools were integrated into the teaching and learning process. Both teachers and SwVI reported that voice recorders, tape recorders, stereo radios, and SD card-based audio materials enhanced independent learning for SwVI. Teachers allow learners to record lessons for later revision, a practice that Muzata (2013) found successful promoting students with visual impairment and those without impairments at Mufulira College of Education and Kwame Nkrumah University. The strength of this strategy lies in helping students replaying recordings to reinforce understanding. This further reflects Dalton et al. (2019), who observed that inclusive practices in African classrooms often depend on individualized accommodations rather than structured UDL implementation. In School A, the limited number of voice recorders limited equitable access among SwVI whereas School B demonstrated a more structured integration of audio resources, including stereo radios and SD card-based learning materials. This variation resonates with Mgonja and Mwila (2023), who reported inconsistent implementation of inclusive strategies within Tanzanian secondary schools due to inadequate assistive devices. It also highlights Kisanga's (2019) findings on persistent barriers in access to educational resources for SwVI. Students' preference for audio-based learning over Braille materials suggests that accessibility is not only about availability but also about usability and cognitive ease. This confirm the findings by Phelan et al. (2025), who emphasize that UDL practices are often present in classrooms implicitly, even when not formally identified as such. Audio recording technologies contribute to inclusive learning by enhancing access, supporting repetition, and promoting learner independence. However, their effectiveness may be hindered by inadequate of audio devices.

4.2.2 Use of Orbit Readers and Digital Accessibility Tools

The findings reveal that Orbit Readers were used to facilitate independent access to digital learning materials in Braille format. Teachers and school administrators described these devices as essential tools for expanding access to multiple textbooks, and reducing the physical burden associated with carrying bulky Braille materials. In addition, classroom observations confirmed that students engaged with Orbit Readers during lessons and independent study sessions. One participant explained:

> *…one of them is the Orbit Reader. This device is very helpful because it allows students to access written materials in a form they can use independently. Students use Orbit Readers to access different learning materials stored digitally. Instead of depending only on hard copy Braille books, they can read and revise lessons independently using the device"* (T2BSS, personal communication, 9th April 2026).

From the observation it was observed that SwVI operated Orbit Readers during instructional time, navigating different digital Braille texts stored on SD cards. Learners were seen reading independently, switching between subjects, and using the device without teacher assistance. Students themselves also expressed positive experiences regarding the use of Orbit Readers. One student noted;

> *The Orbit Reader is easy to use because I can read many books in one device. I do not need to carry heavy books, and I can study anywhere at any time. This device helps me a lot because I can access my lessons without waiting for someone to give me books. Everything is already stored in the memory card, so I can revise even when I am alone* (S2MSS, personal communication, 10th April 2026).

Beyond Orbit Readers, both administrators from the two schools showed aspiration to integrate more advanced assistive technologies, particularly talking computers equipped with accessibility software;

"We would really like to have talking computers with assistive software. If we had them, students would be able to type their examinations independently and produce normal printed copies instead of depending on Braille transcription. It would make assessment much easier and fairer." (Admin2BISS, 8th April 2026)

These findings align with the UDL principle of multiple means of representation ensuring that students access information through flexible formats (CAST, 2011; Edyburn, 2005). Orbit Readers extend access to educational content beyond conventional Braille textbooks by enabling students to engage with multiple subjects through a single digital device. This supports Phelan et al. (2025), who argue that effective implementation of UDL requires flexible access to learning materials that enhance students' engagement and participation. The ability of students to independently retrieve and read instructional materials demonstrates how assistive technologies can facilitate self-regulated learning and reduce barriers to participation. This observation is consistent with Muzata (2021), who notes that assistive technologies such as screen readers, talking calculators, speech-to-text and text-to-speech software improve access to instructional content for SwVI. The administrators' desire to acquire talking computers further highlights the potential of technology to transform assessment practices. Such technologies could reduce the burden associated with Braille transcription while simultaneously promoting independence in examination processes. This suggests that although Orbit Readers have already improved access to learning materials, there remains a need for investment in advanced assistive technologies that support both learning and assessment. Therefore, the findings indicate that assistive technologies are essential resources for facilitating inclusive and learner-centred educational environments for SwVI.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The findings show that the UDL principles are integrated into instructional approaches in inclusive secondary schools for SwVI, but they are not integrated in a systematic way. The UDL principles were only partially implemented and in a more differentiated manner rather than as a standardized and institutionalized educational framework. Teachers show their individual commitment to inclusion by using approaches like verbal explanations, tactile materials, and Braille resources to accommodate SwVI in inclusive classrooms. They also used group work, oral assessments, and assistive technologies like audio recorders and Orbit Readers to make learning more engaging and independent. These approaches help SwVI access curriculum and assessment practices. However, the integration of UDL principles is still hindered by challenges such as inadequate resources, professional training related to inclusive teaching approaches, and workload and time pressure resulting from a low number of trained personnel. This commitment by teachers demonstrates a step towards the practical realization of inclusive education, though more efforts are still required for true and institutionalized inclusive practices.

5.2 Recommendations

Based on the findings and conclusions, the study recommends that the schools' management ensure the availability of adequate and sustainable teaching and learning resources, such as Braille devices, Orbit readers, and computers with assistive software, to enable the independent learning of SwVI. The schools and educational management should also develop a clear policy and a well-known framework on the application of UDL. These would help institutionalize the integration of UDL principles and ensure their practical application. Teachers should be trained in inclusive teaching strategies to help those who are not trained in special needs education acquire the skills and knowledge to accommodate students with special needs, particularly SwVI. Training more teachers in inclusive and special needs education and employing them would help alleviate the hurdles resulting from workload and time pressure.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Declaration

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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