Intergenerational Sign Language Learning: Digital Platforms in 3 Zimbabwe Primary Special Schools Assessment

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Abstract : This case study explored the role of digital platforms in promoting intergenerational Sign Language learning at three special primary schools in Zimbabwe. As digital technologies increasingly transform educational practices, it is crucial to assess their potential for enhancing communication and learning among learners of varying ages who have hearing impairment. Despite the growing availability of online resources for Sign Language education, significant research gaps persist regarding their effectiveness in fostering inter-generational learning and cultural continuity within these educational contexts. Guided by a constructivist framework rooted in social learning theory, the study demonstrates that learning occurs through observation, dialogue, and shared practice within social contexts. The study sample consisted of learners with hearing impairment aged 10–15, their family members, and teachers engaged in Sign Language instruction, purposively selected from three special schools. Key actions of this research included assessing the current utilisation of digital platforms for Sign Language learning, identifying challenges and successes experienced by participants, and developing best practices tailored to the unique needs of each school community. This study aimed to provide valuable insights into the intersection of technology, education, and cultural preservation, contributing to the fields of linguistics and special education. Through a thorough investigation of how digital tools can enhance inter-generational learning, the research sought to support the effective transmission of Sign Language skills and foster a sense of cultural continuity within communities of learners with hearing impairment across Zimbabwe. Ultimately, this research aimed to empower these individuals by enhancing their communication skills and preserving their cultural heritage through innovative digital strategies.
Key Terms: Intergenerational Learning, Sign Language, Digital Platforms, Community Cultural Continuity, Hearing impairment.

Résumé : Cette étude de cas a examiné le rôle des plateformes numériques dans la promotion de l'apprentissage intergénérationnel de la langue des signes au sein de trois écoles primaires spécialisées au Zimbabwe. Alors que les technologies numériques transforment de plus en plus les pratiques éducatives, il est crucial d'évaluer leur potentiel pour améliorer la communication et l'apprentissage chez les élèves malentendants d'âges variés. Malgré la disponibilité croissante de ressources en ligne pour l'enseignement de la langue des signes, d'importantes lacunes subsistent dans la recherche concernant leur efficacité à favoriser l'apprentissage intergénérationnel et la continuité culturelle dans ces contextes éducatifs. S'appuyant sur un cadre constructiviste ancré dans la théorie de l'apprentissage social, l'étude démontre que l'apprentissage s'opère par l'observation, le dialogue et la pratique partagée au sein de contextes sociaux. L'échantillon de l'étude était composé d'élèves malentendants âgés de 10 à 15 ans, de membres de leur famille et d'enseignants dispensant des cours de langue des signes, sélectionnés de manière raisonnée dans trois écoles spécialisées. Les principales étapes de cette recherche ont consisté à évaluer l'utilisation actuelle des plateformes numériques pour l'apprentissage de la langue des signes, à identifier les défis rencontrés et les

réussites des participants, et à élaborer des bonnes pratiques adaptées aux besoins spécifiques de chaque communauté scolaire. Cette étude visait à apporter un éclairage précieux sur l'articulation entre technologie, éducation et préservation culturelle, contribuant ainsi aux domaines de la linguistique et de l'éducation spécialisée. En examinant en profondeur comment les outils numériques peuvent enrichir l'apprentissage intergénérationnel, la recherche visait à soutenir la transmission efficace des compétences en langue des signes et à favoriser un sentiment de continuité culturelle au sein des communautés d'élèves malentendants à travers le Zimbabwe. En définitive, cette recherche visait à autonomiser ces personnes en renforçant leurs compétences en communication et en préservant leur patrimoine culturel grâce à des stratégies numériques innovantes.
Mots-clés : Apprentissage intergénérationnel, Langue des signes, Plateformes numériques, Continuité culturelle communautaire, Déficience auditive.

Introduction

The advent of digital platforms has revolutionised educational practices, offering novel opportunities to support diverse learning needs. The Zimbabwean context is shaped by a growing awareness of the need for inclusive education, particularly in the provision of Sign Language instruction. Yet, there remains a significant gap in research and practice concerning the integration of digital technologies into educational frameworks for learners with hearing impairments. While some special schools have begun experimenting with digital tools, little is known about their impact on promoting intergenerational learning or addressing cultural preservation within these communities. Likewise, online resources for Sign Language instruction are increasingly available, yet their effectiveness in promoting intergenerational learning and sustaining cultural practices has not been comprehensively studied. Where it is scantily available, research on Sign Language learning in Zimbabwe reveals significant challenges. Teachers of the deaf in primary schools lack proficiency in Sign Language, compromising effective learning and inclusion for deaf students.[1] This study, therefore, sought to address these gaps by investigating the use of digital platforms in intergenerational Sign Language learning at three special primary schools in Zimbabwe. Focusing on this specific educational context, the research aimed to provide insights into the challenges and opportunities associated with leveraging technology for inclusive education and cultural continuity, further exploring the ways in which digital platforms can enhance Sign Language learning across age groups to create a robust foundation for cultural continuity and improved communication within these communities.

This case study explored the role of digital platforms in promoting intergenerational Sign Language learning at three primary special schools in Masvingo, Harare and Midlands, provinces in Zimbabwe. Key questions for the study were: To what extent do digital platforms facilitate effective inter-generational learning? What are the barriers and enablers experienced by learners, educators, and families? How can digital tools be integrated without eroding traditional cultural practices? Addressing these questions is critical for advancing inclusive education while continuing the tradition of preserving Sign Language as a vital aspect of cultural identity.

Guided by the overarching concern with how digitalisation reshapes the teaching and learning of Sign Language in special schools, this study is structured around three interrelated research questions. First, it asks: In what ways are digital platforms currently being deployed to support Sign Language education, and how do these practices reflect or depart from traditional

[1] P. Sibanda, "Analysis of Sign Language Proficiency among Teachers of the Deaf in Primary Schools in Bulawayo (Zimbabwe): Implications for Learning and Inclusion," Scientific Journal of Pure and Applied Sciences 4 (2015): 157-165, https://doi.org/10.14196/SJPAS.V4I9.1904.

pedagogical approaches? Second, it interrogates: What digital barriers and enablers — including infrastructural capacity, accessibility features, and user readiness — influence the effectiveness of these platforms in diverse school contexts? Third, it explores: Which digitalisation strategies and context-specific innovations can be developed to strengthen Sign Language instruction and ensure inclusivity across school communities? Pursuant to these objectives, the research aimed to provide actionable insights into the intersection of technology, education, and cultural preservation. These insights are expected to contribute to the fields of linguistics and special education by offering strategies for empowering individuals with hearing impairments to enhance their communication skills and sustain their cultural identities. Furthermore, this study aspired to support inclusive educational practices and the effective transmission of Sign Language skills across generations. It sought to demonstrate how innovative digital strategies can play a transformative role in bridging generational divides, preserving linguistic heritage, and fostering a sense of belonging within Zimbabwe's hearing-impaired communities.

Ultimately, the study explored how these technologies support cultural preservation and effective communication among learners with hearing impairments, aged 9-14. The research focused mostly on the intersection of technology, education, and cultural continuity, with the aim of empowering individuals with hearing impairments. Insights generated from the findings will support inclusive education, foster communication skills, and preserve Sign Language as a vital vehicle of cultural heritage preservation, contributing significantly to linguistics and special education.

1. Background

Intergenerational learning refers to the process of knowledge transmission and exchange that occurs between individuals of different ages, generations, and life experiences.[2] This type of learning involves the sharing of skills, values, and cultural practices between older and younger generations, promoting mutual understanding, respect, and empowerment.[3] In the context of Sign Language learning, intergenerational learning involves the transmission of language skills and cultural knowledge from experienced Sign Language users, such as parents, grandparents, or community elders, to younger learners, including children and adolescents.[4] This approach recognizes the importance of cultural continuity and community involvement in language learning, and seeks to promote the development of linguistic and cultural competence among learners of all ages.

Intergenerational learning is pivotal in fostering cultural preservation and community cohesion. For individuals with hearing impairments, this process plays a crucial role in transmitting Sign

[2] G. Mannion, "Intergenerational Education and Learning: We Are in a New Place," in Families, Intergenerationality, and Peer Group Relations, ed. S. Punch, R. Vanderbeck, and T. Skelton, Geographies of Children and Young People 5 (Springer, Singapore, 2016), https://doi.org/10.1007/978-981-4585-92-7_5-1

[3] G. Mannion, "Intergenerational Education and Learning: We Are in a New Place," in Families, Intergenerationality, and Peer Group Relations, ed. S. Punch, R. Vanderbeck, and T. Skelton, Geographies of Children and Young People 5 (Springer, Singapore, 2016), https://doi.org/10.1007/978-981-4585-92-7_5-1

[4] D. Lillo-Martin and J. Henner, "Acquisition of Sign Languages," Annual Review of Linguistics 7 (2021): 395-419, doi: 10.1146/annurev-linguistics-043020-092357.

Language skills and maintaining cultural identity.[5] Despite its importance, challenges such as limited access to resources, a lack of trained educators, and socio-economic barriers hinder the effective implementation of intergenerational learning initiatives, particularly in low-resource settings.

In African societies, intergenerational knowledge transfer is a vital component of cultural continuity. The preservation of cultural continuity through generations can, in our view, become a pressing concern in Africa, particularly in the face of rapid technological advancements. Traditionally, African cultures have relied on oral traditions and folklore to transmit knowledge and values from one generation to the next, ensuring cultural continuity. However, the advent of technology has introduced both opportunities and challenges for inter-generational learning, especially for learners with disabilities. Sign Language plays a significant role in this context, serving as both a language and a skill that bridges the communication gap between the deaf and hearing communities. However, the elders who possess this knowledge often struggle to utilize modern technologies to connect with learners with disabilities. This disparity raises important questions about how technologies can be leveraged to facilitate continuous intergenerational learning for learners with disabilities, while also preserving cultural continuity. It is therefore essential to explore innovative strategies for harnessing technologies to support inter-generational learning, such as adapting digital platforms to accommodate the needs of learners with disabilities, and providing training and support for elders and young learners to effectively utilize these technologies. Fostering this practice can help ensure that the cultural knowledge and values embodied in Sign Language are transmitted to future generations, while also promoting inclusive and accessible learning opportunities for learners with disabilities.

The concept of special schools and special education has its roots in the 19th century, when specialized schools for deaf and blind students began to emerge.[6] These institutions, although groundbreaking for their time, often operated on the fringes of the mainstream education system, yet still representing the first acknowledgment that students with disabilities could benefit from tailored educational approaches.[7]

The early 20th century saw a darker chapter in the history of special education, marked by widespread segregation and institutionalization of children with disabilities.[8] Many were deemed "uneducable" and were either kept at home or placed in institutions that provided little in the way of meaningful education or life skills training. It wasn't until the 1930s-1950s, with the rise of parent advocacy groups, that the tide began to shift towards more inclusive and supportive educational environments.[9] The landmark court cases of the 1970s, such as PARC

[5] S. La Grutta et al., "The Relationship between Knowing Sign Language and Quality of Life among Italian People Who Are Deaf: A Cross-Sectional Study," Healthcare (Basel) 11, no. 7 (2023): 1021, doi: 10.3390/healthcare11071021

[6] M. A. Winzer, From Integration to Inclusion: A History of Special Education in the 20th Century (Washington, D.C.: Gallaudet University Press, 2009).

[7] M. A. Winzer, From Integration to Inclusion: A History of Special Education in the 20th Century (Washington, D.C.: Gallaudet University Press, 2009).

[8] A. Sarman and S. Tuncay, "Problems Experienced by Families of Children with Disabilities and Nursing Approaches," in The Palgrave Encyclopedia of Disability, ed. G. Bennett and E. Goodall (Palgrave Macmillan, Cham, 2024), https://doi.org/10.1007/978-3-031-40858-8_69-1.

[9] A. Sarman and S. Tuncay, "Problems Experienced by Families of Children with Disabilities and Nursing Approaches," in The Palgrave Encyclopedia of Disability, ed. G. Bennett and E. Goodall (Palgrave Macmillan, Cham, 2024), https://doi.org/10.1007/978-3-031-40858-8_69-1

v. Pennsylvania and Mills v. Board of Education, further solidified the right of children with disabilities to a free, appropriate public education.[10]

Currently, the emphasis has shifted from segregation to inclusion, with a focus on providing high-quality, individualized education to students with disabilities within general education classrooms.[11];[12] This shift towards inclusive education recognizes that all students, regardless of ability, have the right to learn together and benefit from diverse perspectives and experiences.

Recent research has focused on developing digital platforms to enhance sign language learning and communication across generations. Studies have explored technology solutions for inter-generational Sign Language into e-learning platforms, addressing challenges in recognition, translation, and presentation.[13] Interactive platforms using machine learning and real-time gesture recognition have been developed to improve accessibility and foster sign language literacy.[14] Mobile applications like Master-ASL have been created to support American Sign Language education through multimedia presentations and game-oriented assessments.[15] Additionally, the EnSenias platform has been designed to address the communicative gap between deaf and hearing individuals, offering adaptable interactive objects and validated through user focus groups.[16] These digital tools aim to bridge communication gaps, strengthen relationships, and promote inclusivity by leveraging technology for effective sign language learning and assessment.

2. Theoretical Framework

This study is grounded in constructivist and social learning theories, which together provide valuable lenses for analyzing the role of digital platforms in intergenerational Sign Language learning. Constructivism emphasizes that knowledge is actively co-constructed through experience, while social learning theory highlights observation, dialogue, and collective practice as central to the learning process. These frameworks thus offer a robust foundation for examining how interactive, community-based, and experiential engagements - facilitated

[10] Ada Avila, "Psychology and Special Education Reform" (Trinity Student Scholarship, Trinity College Digital Repository, 2011), https://jstor.org/stable/community.34030581.

[11] M. Ainscow, "Promoting Inclusion and Equality in Education: Lessons from International Experiences," Nordic Journal of Studies in Educational Policy 6, no. 1 (2020): 7-16, https://doi.org/10/1080/20020317.2020.1729587

[12] A. M. Hayes and J. Bulat, "Disabilities Inclusive Education Systems and Policies Guide for Low- and Middle-Income Countries" (Research Triangle Park, NC: RTI Press, 2017), doi: 10.3768/rtipress.2017.op.0043.1707.

[13] P. Martins et al., "Accessible Options for Deaf People in e-Learning Platforms: Technology Solutions for Sign Language Translation," International Conference on Software Development for Enhancing Accessibility and Fighting Info-exclusion, 2015, https://doi.org/10.1016/j.procs.2015.09.270

[14] R. Deoghare et al., "Interactive Sign Language Learning Platform Fostering Sign Language Literacy," 2024 8th International Conference on Computing, Communication, Control and Automation (ICCUBEA), 2024, 1-5, https://doi.org/10.1109/ICCUBEA61740.2024.10774988.

[15] S. Cheemakurthi and M. Chen, "Master-ASL: Sign Language Learning and Assessment System," 2023 IEEE International Conference on Big Data (BigData), 2023, 6116-6118, https://doi.org/10.1109/BigData59044.2023.10386294.

[16] A. Rodríguez-Fuentes et al., "Presentation and Evaluation of a Digital Tool for Sign Language," Culture and Education 34 (2022): 658-688, https://doi.org/10.1080/11356405.2022.2058793

by digital tools - shape the acquisition and transmission of Sign Language among learners with hearing impairments.

Constructivism emphasizes that knowledge is actively constructed through engagement, interaction, and reflection, rather than passively received. This perspective is especially relevant to Sign Language learning, which requires active participation, contextual understanding, and continuous practice. Constructivism aligns with the study's focus on intergenerational learning, where shared experiences and mutual involvement in learning activities enable both older and younger participants to build and co-construct linguistic and cultural knowledge The theory highlights the importance of learners actively engaging with digital tools to construct meaning and supports the idea that digital platforms can serve as interactive spaces for collaborative learning, encouraging cross-generational communication and skill-sharing.

Proposed by Albert Bandura 1977, social learning theory emphasizes learning through observation, imitation, and modelling within social contexts. It underscores the role of social interactions and relationships in shaping knowledge and behaviour. In the context of intergenerational Sign Language learning, social learning theory is vital for understanding how younger learners acquire skills by observing and interacting with older family members and educators. The theory demonstrates the critical role of role models and interaction in digital learning environments and justifies the study's focus on family and educators as key contributors to the learning process, particularly when mediated by digital platforms.

These theories are well-suited to this study because they emphasize the relational and interactive nature of learning, which aligns with the goals of intergenerational Sign Language education. Employing these frameworks enables the research to analyse how digital tools facilitate meaningful social interactions that are essential for cultural and linguistic continuity, address real-world dynamics of learning in special schools, considering the social and collaborative processes at play and identify strategies for integrating technology in a way that enhances, rather than replaces, traditional community-based practices.

In sum, constructivist and social learning theories provide a comprehensive framework for understanding how learners, families, and educators interact with digital platforms to achieve educational and cultural objectives. These perspectives ensure that the study remains grounded in both the realities of the learners' lived experiences and the broader sociocultural context.

3. Literature Review

This literature review examined key concepts underlying inter-generational Sign Language learning, digital platforms, and their role in cultural preservation, framed by constructivist and social learning theories. The review adopted a stratified approach, linking the social learning theory to the role of technology and learning, and further discussing the study themes globally, regionally, and locally. Finally, the literature review synthesized existing scholarship, identifying gaps and contextualizing the study's significance.

Bandura's social learning theory has been widely applied to understand the role of technology in learning environments.[17] Global studies suggest that digital platforms can replicate social interactions by enabling learners to observe and model behaviour virtually.[18] Yet, the extent to which such platforms can foster the deep interpersonal connections necessary for intergenerational learning is not well-documented, pointing to a critical research area this study addresses.

Globally, digital technologies are increasingly integrated into educational systems to address diverse learning needs. Proliferation of digital technologies has impacted on educational practices, offering innovative tools to enhance learning experiences across diverse contexts. In the field of special education, these technologies are increasingly recognized for their potential to address the unique needs of learners with disabilities, including hearing impairments. Digital platforms, specifically those designed for Sign Language instruction, provide opportunities for interactive and flexible learning, bridging gaps in accessibility and resource availability.[19] UNESCO[20] emphasized the role of technology in promoting inclusive education, enabling learners with disabilities to access customized resources. Research indicates that platforms like YouTube, mobile apps, and virtual classrooms facilitate interactive Sign Language learning.[21] However, much of this literature focuses on individual learning rather than inter-generational dynamics, leaving a critical gap in understanding collaborative applications across age groups. Moreover, when the benefits of digital technologies in transforming education are overstated, while overlooking the importance of equitable access, a biased narrative emerges. To ensure a more comprehensive understanding, it is essential to examine the disparities in digital technology access across gender, socio-economic, and generational lines, with particular attention to the rights and needs of learners with disabilities.

Intergenerational learning has been extensively studied in contexts emphasizing cultural preservation and knowledge transfer. Studies by Muth[22] highlight its effectiveness in fostering mutual respect, shared understanding, and community cohesion. In Sign Language education, intergenerational learning is particularly significant as it ensures the continuity of linguistic heritage. Nonetheless, global literature often overlooks how digital tools mediate this process, focusing instead on face-to-face interactions.[23]

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[17] A. Bandura, Social Foundations of Thought and Action: A Social Cognitive Theory (Prentice Hall, 1986).

[18] K. Subrahmanyam and P. Greenfield, "Online Communication and Adolescent Relationships," Future Child 18, no. 1 (2008): 119-146, doi: 10.1353/foc.0.0006

[19] A. AlShawabkeh et al., "Technology-Based Learning and the Digital Divide for Deaf/Hearing Students During Covid-19: Academic Justice Lens in Higher Education," Educational Technology & Society 26, no. 4 (2023): 136-149, https://www.jstor.org/stable/48747526.

[20] UNESCO, "Technology in Disability-Inclusive Education," 2023, https://unesdoc.unesco.org/ark:/48223/pf0000387737.

[21] Chandra Mani Sharma et al., "Indian Sign Language Recognition Using Fine-Tuned Deep Transfer Learning Model," Procc. of INTERNATIONAL CONFERENCE ON INNOVATIONS IN COMPUTER AND INFORMATION SCIENCE (ICICIS), 2021, pp. 62-67, Available at SSRN: https://ssrn.com/abstract=3932929 or http://dx.doi.org/10.2139/ssrn.3932929

[22] Muth, R. (2026). The occurrence and influence of multi-intergenerational learning among teachers: A qualitative study of two mentor-mentee pairs. Teaching and Teacher Education, 176, 105534. Elsevier. https://doi.org/10.1016/j.tate.2026.105534

[23] Charles I. Jones and Peter J. Klenow, "Beyond GDP? Welfare across Countries and Time," American Economic Review 106, no. 9 (September 2016): 2426-2457.

In Sub-Saharan Africa, the potential of digital platforms for inclusive education is tempered by infrastructural challenges, such as limited internet access and digital illiteracy.[24] For learners with hearing impairments, these challenges are compounded by the scarcity of localized Sign Language resources, which often fail to reflect regional linguistic and cultural diversity.

Research on use of Sign Languages and digital technology in Africa reveals efforts to document and support these endangered languages. The AfricaSign platform enables crowd-sourced documentation of STEM vocabulary in African sign languages, potentially uncovering typological features and improving educational access for the Deaf community.[25] However, challenges persist in sustaining indigenous sign languages due to linguistic colonialism and the dominance of national or Western sign languages.[26] To address digital divide issues, researchers have developed tools to support Deaf adult learners in computer literacy classes using sign language videos.[27] Additionally, technologies for presenting web information in sign language, such as human signer videos and avatars, have been explored, though debates continue regarding the effectiveness of bilingual versus sign language-only websites for comprehension.[28] These efforts aim to improve digital accessibility and preserve linguistic diversity for African Deaf communities.

Digital platforms play a crucial role in promoting sign language learning, offering innovative solutions to address educational challenges faced by deaf and hard-of-hearing individuals. Interactive web applications and mobile platforms provide accessible learning materials, including videos and practice sessions, enhancing the efficiency of the learning process.[29];[30] These platforms incorporate advanced technologies such as real-time gesture recognition using media pipe models, enabling immediate feedback for users (Deoghare et al., 2024).[31] Additionally, 3D simulations and gamification elements, like adventure games and memory exercises, are employed to engage learners and improve their mental capabilities.[32] The integration of Information and Communication Technologies (ICT) with modern pedagogical practices has the potential to create a global learning environment for sign languages.[33]

[24] T. G. Reagan, "Language-in-education policy in South Africa: The challenge of sign language," Africa Education Review 4, no. 2 (2007): 26–41, https://doi.org/10.1080/18146620701652663.
[25] A. Soudi, K. Van Laerhoven, and E. Bou-Souf, "AfricaSign -- A Crowd-sourcing Platform for the Documentation of STEM Vocabulary in African Sign Languages," Proceedings of the 21st International ACM SIGACCESS Conference on Computers and Accessibility, 2019, https://doi.org/10.1145/3308561.3354592.
[26] S. Lutalo-Kiingi and G. A. De Clerck, "Perspectives on the Sign Language Factor in Sub-Saharan Africa: Challenges of Sustainability," American Annals of the Deaf 162, no. 1 (2017): 47-56, doi: 10.1353/aad.2017.0015.
[27] G. G. Ng'ethe, E. H. Blake, and M. Glaser, "Supporting Deaf Adult Learners Training in Computer Literacy Classes," International Conference on Computer Supported Education, 2015, https://doi.org/10.1007/978-3-319-29585-5_34
[28] I. Fajardo, M. Vigo, and L. Salmerón, "Technology for supporting web information search and learning in Sign Language," Interact. Comput. 21 (2009): 243-256, https://doi.org/10.1016/j.intcom.2009.05.005.
[29] Lester Wong Sze Ee et al., "Real-time sign language learning system," J. Phys.: Conf. Ser. 1712 (2020): 012011, https://iopscience.iop.org/article/10.1088/1742-6596/1712/1/012011/pdf
[30] R. Deoghare et al., "Interactive Sign Language Learning Platform Fostering Sign Language Literacy," 2024 8th International Conference on Computing, Communication, Control and Automation (ICCUBEA), 2024, 1-5, https://doi.org/10.1109/ICCUBEA61740.2024.10774988.
[31] R. Deoghare et al., "Interactive Sign Language Learning Platform Fostering Sign Language Literacy," 2024 8th International Conference on Computing, Communication, Control and Automation (ICCUBEA), 2024, 1-5, https://doi.org/10.1109/ICCUBEA61740.2024.10774988.
[32] N. Ackovska, M. Kostoska, and M. Gjurovski, "Sign Language Tutor--Digital improvement for people who are deaf and hard of hearing," 2012.
[33] V. Falvo, L. P. Scatalon, and E. F. Barbosa, "The Role of Technology to Teaching and Learning Sign Languages: A Systematic Mapping," 2020 IEEE Frontiers in Education Conference (FIE), 2020, 1-9, https://doi.org/10.1109/FIE44824.2020.9274169.

However, there is still a need for solutions that enable communication between different sign languages, presenting opportunities for further research and development.[34]

Regional studies emphasize the role of Sign Language in promoting social inclusion and empowerment. Research in South Africa by Ladd and Lane[35] underscores the need for context-specific instructional resources. While digital platforms are emerging as viable tools, their adoption remains limited to urban centres, creating disparities in educational access. Additionally, there is minimal focus on using these tools for intergenerational learning, suggesting a gap this study seeks to fill.

In African societies, intergenerational knowledge transfer is a cornerstone of cultural continuity. Studies by Chabata[36] explore how African communities use storytelling and traditional practices to sustain linguistic and cultural heritage. However, integrating technology into this framework raises concerns about losing the authenticity of these practices. Research must therefore address how digital tools can complement rather than replace traditional methods.

In Zimbabwe, the education system for learners with disabilities faces significant challenges, including inadequate resources, under-trained teachers, and societal stigma.[37] For learners with hearing impairments, the lack of standardized Sign Language instruction across schools exacerbates these issues. The Zimbabwean government's efforts to promote inclusive education, such as the 2013 Constitution mandating Sign Language as an official language, are commendable but have yet to achieve widespread implementation.[38] Local studies suggest that digital platforms are increasingly recognized for their potential to enhance Sign Language education. Chitiyo et al.[39] Pilot projects in urban areas have mobile apps and video tutorials which are used to teach basic Sign Language. However, these initiatives are often isolated and lack scalability. Moreover, there is minimal focus on how digital tools can facilitate inter-generational learning, a gap this study aims to address.

In Zimbabwean culture, intergenerational learning is deeply rooted in family and community traditions. Elders are often custodians of cultural and linguistic knowledge, passing it down to younger generations. However, for families with hearing-impaired members, this process is

[34] R. Kwashira, "Teachers implementing Zimbabwean sign language regulatory frameworks for deaf learners in special schools," International Journal of Studies in Inclusive Education 1, no. 1 (2024): 58-68, https://doi.org/10.38140/ijsie.v1i1.1289.
[35] Ladd, P., & Lane, H. (2022). The Unrecognized Curriculum: Seeing Through New Eyes — Deaf Cultures and Deaf Pedagogies. DawnSignPress. ISBN 9781581211399
[36] Chabata, F. M. (2016). Exploring Zimbabwe's liberation heritage: An assessment of the potential of "protected villages" as a significant heritage typology. In M. Mawere (Ed.), Colonial heritage, memory and sustainability in Africa: Challenges, opportunities and prospects (pp. 259–280). Langaa Research & Publishing CIG..
[37] T. Dube et al., "Interventions to reduce the exclusion of children with disabilities from education: A Zimbabwean perspective from the field," Cogent Social Sciences 7, no. 1 (2021), https://doi.org/10.1080/23311886.2021.1913848.
[38] R. Kwashira, "Teachers implementing Zimbabwean sign language regulatory frameworks for deaf learners in special schools," International Journal of Studies in Inclusive Education 1, no. 1 (2024): 58-68, https://doi.org/10.38140/ijsie.v1i1.1289.
[39] I. M. Dabengwa et al., "Exploring digital competences in Zimbabwean secondary schools using a multimodal view: a hermeneutical phenomenography study," Cogent Education 11, no. 1 (2024), https://doi.org/10.1080/2331186X.2024.2387911.

disrupted by a lack of shared Sign Language proficiency.[40] Research indicates that digital platforms could bridge this gap by providing accessible learning tools for all family members, but empirical evidence remains scarce.

This literature review revealed a global recognition of the potential of digital platforms to enhance education for learners with disabilities. However, the specific application of these tools to inter-generational Sign Language learning remains underexplored. Regional studies in Sub-Saharan Africa highlight the challenges of accessibility and contextualization but rarely address inter-generational dynamics. Locally, Zimbabwean research underscores the importance of cultural preservation but lacks a robust framework for integrating digital tools into traditional learning practices.

This study addressed these gaps by exploring the unique role of digital platforms in facilitating inter-generational Sign Language learning in Zimbabwe ,investigating how these tools can complement traditional methods of cultural preservation, and providing actionable insights into the intersection of technology, education, and cultural continuity. Building on constructivist and social learning theories, this research sought to contribute to a deeper understanding of how technology can support inclusive education and cultural preservation across generational lines, both locally and beyond.

Inter-generational Sign Language learning involves complex dynamics within deaf-parented families and communities, particularly in African contexts where cultural and linguistic traditions are deeply intertwined, and where use of technology is not equal. In many African societies, Sign Language is not only a means of communication but also a vital vehicle for preserving cultural heritage, with the need for the storytelling traditions passed down through generations to also reach deaf children. Deaf parents in African communities play a significant role in transmitting their language and cultural knowledge to their children, who may be deaf or hearing, often through informal learning processes and community-based socialization. However, this process can be influenced by a range of factors, including the family's socioeconomic status, level of access to sign language resources, and experiences of marginalization or empowerment within the broader societal context. As a result, inter-generational Sign Language learning within deaf-parented families and communities in Africa is a rich and multifaceted phenomenon that warrants close examination and understanding.

Despite the growing adoption of digital platforms in education globally, it remains unclear how effectively these tools can support inter-generational Sign Language learning in contexts like Zimbabwe’s special primary schools. While digital technologies are recognized for enhancing accessibility and flexibility in learning, their role in fostering communication and cultural preservation across generations among learners with hearing impairments is not well understood. This raises questions about their effectiveness in addressing unique challenges in these communities.

Existing studies often highlight the potential of digital tools in education, but tend to focus on younger learners or formal classroom settings, leaving the niche of intergenerational learning

[40] T. G. Reagan, "Language-in-education policy in South Africa: The challenge of sign language," Africa Education Review 4, no. 2 (2007): 26–41, https://doi.org/10.1080/18146620701652663.

underexplored.[41];[42] Critics argue that the emphasis on technological solutions risks overshadowing traditional, community-based methods of transmitting Sign Language knowledge.[43];[44] These counterclaims suggest a tension between adopting innovative approaches and maintaining cultural traditions, highlighting a gap in the evidence needed to balance these perspectives.

4. Methodology

This study employed a mixed-methods research paradigm, combining both quantitative and qualitative data collection and analysis methods to explore the role of digital platforms in promoting intergenerational Sign Language learning. Grounded in the constructivist theoretical framework, and informed by social learning theory, this study highlighted the importance of social interactions and shared experiences in the learning process. The mixed-methods approach employed in the research combined structured and semi structured interviews to capture the perspectives of learners with hearing impairments who are aged 9-14, their family members, as well as their educators in the area of Sign Language education. The study was conducted in three primary schools for the deaf in three regions, Masvingo, Harare and Midlands, which cater to the educational needs of deaf and hard-of-hearing students. Due to ethical considerations and the need to maintain confidentiality, the names of the participating schools were not disclosed. The schools were selected based on their reputation for providing quality education to deaf students, and their willingness to participate in the study. The research was carried out with the permission of the school administrators. The study began with a comprehensive literature review, examining existing research on the use of digital platforms in Sign Language education. The literature review explored the current state of knowledge on the effectiveness of digital tools in promoting Sign Language learning, as well as the challenges and opportunities associated with their use. This review also examined the theoretical frameworks that underpin research in this area, including social learning theory and constructivist perspectives on language acquisition.

Quantitative data was gathered through surveys administered to learners, teachers, and parents at the selected special schools. The surveys were designed to assess the current utilization of digital platforms for Sign Language learning, as well as the challenges and successes experienced by participants. In addition to surveys, the study also gathered qualitative insights through interviews with students, teachers, and parents. The interviews were conducted in a semi-structured format, allowing participants to share their experiences and perceptions of using digital platforms for Sign Language learning. The interviews provided

[41] A. Haleem et al., "Understanding the role of digital technologies in education: A review," Sustainable Operations and Computers 3 (2022): 275-285, https://doi.org/10.1016/j.susoc.2022.05.004.
[42] S. Timotheou et al., "Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review," Educ Inf Technol 28 (2023): 6695–6726, https://doi.org/10.1007/s10639-022-11431-8.
[43] M. Zamiri and A. Esmaeili, "Methods and Technologies for Supporting Knowledge Sharing within Learning Communities: A Systematic Literature Review," Administrative Sciences 14, no. 1 (2024): 17, https://doi.org/10.3390/admsci14010017.
[44] S. Hansson et al., "Communication-related vulnerability to disasters: A heuristic framework," International Journal of Disaster Risk Reduction 51 (2020): 101931, DOI: 10.1016/j.ijdrr.2020.101931

rich, contextualized data on the ways in which digital platforms can facilitate or hinder inter-generational Sign Language learning.

Structured and semi-structured questionnaires were used to gather data on usage of digital platforms for learning, frequency and types of inter-generational learning interactions perceived effectiveness of digital tools in learning. The questionnaires were administered digitally and through face-to-face interviews, ensuring accessibility to various participants in both physically accessible and physically inaccessible settings. Semi-structured interviews explored challenges and successes in using digital platforms, experiences with intergenerational learning, and the cultural and linguistic impacts of digital Sign Language learning. Interviews were audio-recorded and transcribed for analysis. School records, digital platform usage logs, and curriculum materials were reviewed to provide contextual information.

The data collected through structured and semi-structured interviews were analyzed using a combination of descriptive statistics and thematic analysis. The quantitative data were analyzed using statistical software, providing an overview of the current state of digital platform utilization and the challenges and successes experienced by participants.

The findings of this study provided valuable insights into the role of digital platforms in promoting intergenerational Sign Language learning, contributing to the fields of linguistics and special education. The study also provided recommendations for the development of best practices tailored to the unique needs of each school community, supporting the effective transmission of Sign Language skills and fostering a sense of cultural continuity within communities of learners with hearing impairment across Zimbabwe.

4.1. Target population and sampling frame

The target population for this study comprised three distinct groups, including first, learners with hearing impairments aged 9–14 years who are enrolled in the selected primary special schools. Additionally, family members of these learners, including parents, siblings, and extended family members of varying ages, who are involved in the learning process and can provide insights into inter-generational dynamics will be interviewed. Finally, teachers responsible for Sign Language instruction at the selected schools, encompassing both experienced and newly trained instructors are also part of the key informants. The selection of schools was based on two key criteria: their utilization of digital platforms for Sign Language learning and their engagement with inter-generational teaching methods. Participants, including learners, family members, and educators, are chosen to ensure a diverse range of experiences and insights related to the research objectives. Structured interviews with open ended questions were conducted with 11 teachers, 9 students and 10 families with 7, 3, 6, 5, 8, 5, 2, 7, 3 and 4 members each, selected through purposeful sampling. For clarity, the study interviewed 33 distinct participants (11 teachers, 11 students, and 11 parents), while the extended family members present during interviews brought the total number of individuals engaged to 70. The analysis is therefore based on 33 core participants, with supplementary insights from additional family members. The sample size was determined by saturation, where data collection continued until no new themes or insights emerged from the interviews, indicating that a comprehensive understanding of the research phenomenon had been achieved. The richness and depth of the data collected from these 70 participants provide

valuable insights into the research questions, allowing for a nuanced understanding of the role of digital tools in sign language learning.

4.2 Data Analysis

The data collected from the interviews were analyzed using descriptive statistics to summarize quantitative responses and thematic analysis to interpret qualitative narratives. Coding was conducted to identify recurring patterns, while cross-tabulation was employed to compare responses across groups of learners, parents, and teachers. This mixed-methods approach ensured both numerical trends and experiential insights were systematically examined.

Specifically, the structured survey generated quantitative metrics on participant demographics (age, gender, role) and frequency of digital tool usage, while the semi-structured interviews provided qualitative narratives that were thematically analyzed to capture intergenerational dynamics and cultural perspectives. First, the demographic data (age and gender) were summarized using descriptive statistics and represented in bar and pie charts. These survey metrics established measurable usage patterns and provided a baseline profile of participants. Next, the interview data were analyzed using thematic analysis to identify deeper insights into the experiences and perceptions of learners, family members, and educators. The transcripts were carefully read and coded to identify recurring themes and patterns related to the research objectives. Braun and Clarke's six-phase framework guided the thematic analysis, ensuring rigor in coding, theme development, and interpretation. The themes that emerged from the data were then interpreted in relation to the theoretical framework and research questions.

The quantitative (survey metrics) and qualitative (thematic analysis) findings provided a comprehensive understanding of the role of digital platforms in promoting intergenerational Sign Language learning. The findings were also compared with existing literature to identify areas of convergence and divergence. This process allowed for a nuanced understanding of the complex issues surrounding the use of digital platforms for Sign Language learning and their potential to promote intergenerational learning and cultural continuity.

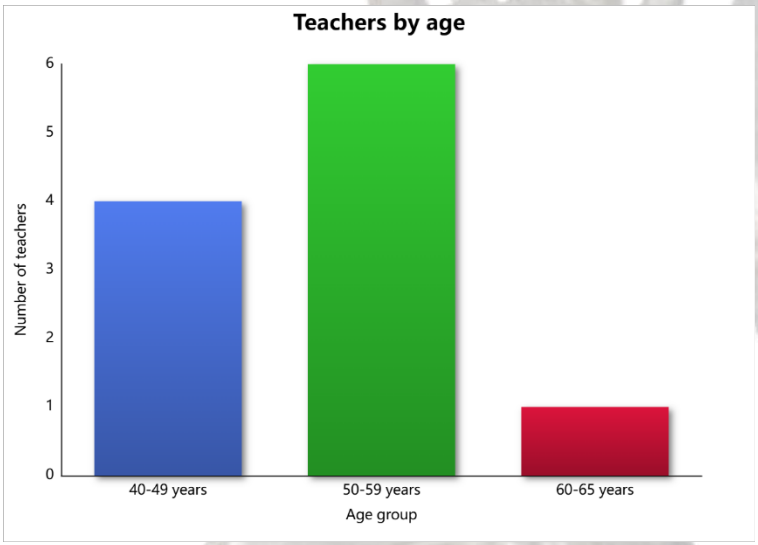
5. Findings

5.1. Demographics

These demographic results emerged from the structured survey metrics, which captured participant age, gender, and frequency of digital tool usage.

Participant Demographics Overview

Survey metrics revealed the demographic composition of participants, including age, gender, and role, as well as frequency of digital tool usage. A total of 33 core participants (11 teachers, 11 students, and 11 parents). When extended family members present during interviews are included, the total number of individuals engaged rises to 70. For consistency, demographic reporting in this section focuses on the 33 primary participants. The demographic details of the participants are represented in Figure 1 to Figure 4.



Teachers by age

Teachers' Daily Use of Digital Tools

The majority of teachers reported using digital tools daily (9 out of 10 respondents) to learn and teach sign language. This suggests that digital tools have become an integral part of their teaching practices. The frequent use of digital tools may be attributed to their accessibility, flexibility, and ability to provide interactive and engaging learning experiences. This dynamic aligns with foregoing research findings that the proliferation of digital technologies has impacted on educational practices, offering innovative tools to enhance learning experiences across diverse contexts,[45] and that in the field of special education, these technologies are increasingly recognized for their potential to address the unique needs of learners with disabilities, including hearing impairments.[46]

5.2 Teachers by gender

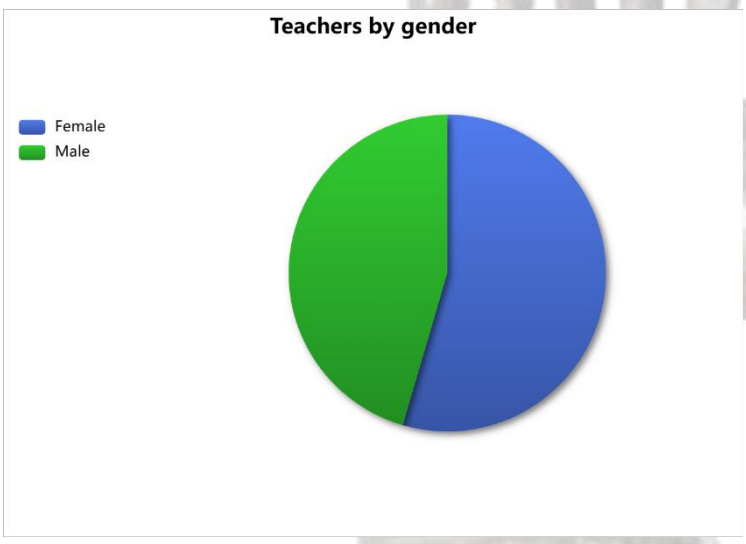
The following insights are drawn from qualitative thematic analysis of semi-structured interviews with teachers, highlighting perceived benefits, challenges, and intergenerational practices.

Teachers' Integration of Digital Platforms

Teachers reported using various digital tools and resources, including videos, apps, online platforms, and social media.

[45] Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S. V., Giannoutsou, N., Cachia, R., Monés, A. M., & Ioannou, A. (2023). Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. Education and Information Technologies, 28(6), 6695–6726. https://doi.org/10.1007/s10639-022-11431-8

[46] Bryant, D.P., Park, J., Shin, M., Choo, S. (2025). Assistive Technologies in Special Education: Strategies for Success. In: Bakken, J.P. (eds) Handbook for Educating Students with Disabilities. Springer International Handbooks of Education. Springer, Cham. https://doi.org/10.1007/978-3-031-60258-0_50



Interview narratives highlighted teachers' experiences with digital platforms, including benefits, challenges, and intergenerational practices.They incorporated these tools into their teaching practices in different ways, such as using videos to demonstrate signs, apps for interactive practice, and online platforms for sharing resources and feedback.

Some teachers also reported using digital tools to facilitate intergenerational learning and community engagement. Although most of the literature reviewed for this study focused more on individual learning rather than inter-generational dynamics, leaving a critical gap in understanding collaborative applications across age groups, Muth[47] has emphasized how proliferation of digital technologies can positively impact educational practices. Furthermore, digital technologies were found to offer innovative tools to enhance learning experiences across diverse contexts, with potential to address the unique needs of learners with disabilities, including hearing impairments.[48]

Benefits and Challenges of Digital Tools

Teachers also reported various benefits of using digital tools, including their ability to provide interactive and engaging learning experiences, facilitate uniformity in teaching, and offer accessible and adaptable learning resources, again, confirming above arguments by Muth.[49] Some teachers also appreciated the ability to use digital tools to connect with other sign language learners and teachers, promoting a sense of community and collaboration. Teachers reported using various platforms, including laptops, projectors, phones, and smart-boards. Some teachers also mentioned using social media, Google Classroom, and YouTube. The effectiveness of these platforms was attributed to their ability to provide interactive and engaging learning experiences, facilitate collaboration and feedback, and offer accessible and adaptable learning resources.

[47] See Footnote 22
[48] See Footnote 5
[49] See Footnotes 22 and 47

On the other hand, the main challenges reported by teachers included connectivity issues, expensive data, and limited access to devices. Some teachers also mentioned the lack of localized content, cultural disconnect, and difficulties in interpreting sign language in digital formats. These challenges highlight the need for more accessible, affordable, and culturally relevant digital tools and resources for sign language learning. These teachers reported facing various challenges, including inconsistent internet access, limited availability of sign language-specific platforms, and varying levels of student comfort with technology. Some teachers also mentioned the need for more training and support to effectively integrate digital platforms into their teaching practices. This finding challenges the received reality revealed in the reviewed literature, where digital technologies are portrayed superficially as having solved the challenges of learning disparities among children with disabilities, for example when UNESCO[50] emphasized the role of technology in promoting inclusive education, enabling learners with disabilities to access customized resources, and also when indicating that platforms like YouTube, mobile apps, and virtual classrooms facilitate interactive Sign Language learning.[51] Much of this literature focuses on individual learning rather than inter-generational dynamics, leaving a critical gap in understanding collaborative applications across regional, class and age divides. As Sharma[52]rightly observes, when the benefits of digital technologies in transforming education are overstated, while overlooking the importance of equitable access, a biased narrative emerges. The literature found that In Sub-Saharan Africa, the potential of digital platforms for inclusive education is tempered by infrastructural challenges, such as limited internet access and digital illiteracy cannot be over-emphasized.[53]

Intergenerational Learning Practices

Furthermore, teachers reported using various approaches to incorporate inter-generational learning, including inviting deaf adult resource persons, encouraging students to engage with older family members and community members, and using digital platforms to facilitate practice and feedback. Some teachers also reported using group work, peer teaching, and mentorship programs to promote intergenerational learning and community engagement. This finding echoes Bandura's social learning theory has been widely applied to understand the role of technology in learning environments,[54] that digital platforms can replicate social interactions by enabling learners to observe and model behaviour virtually.[55] The challenge with this finding is also that it points only to specific cases, making generalizability difficult, as the extent to which such platforms can foster the deep interpersonal connections necessary for intergenerational learning is not well-documented, pointing to a critical research area this study addresses.[56]

Strategies for Digital Literacy Support

Teachers also reported using various strategies to address varying levels of digital literacy, including providing step-by-step guidance, using simple and intuitive platforms, and ensuring peer support or one-on-one assistance. Some teachers also reported using group work, pair work, and mentorship programs to promote digital literacy and confidence. Additionally, the

[50] See Footnote 7
[51] See Footnote 8
[52] See Footnote 7
[53] See Footnote 8
[54] See Footnote 1.
[55] See Footnote 2
[56] See Footnote 3

teachers reported involving families in the learning process in various ways, including communicating about progress and homework, sharing learning resources, and encouraging families to participate in digital lessons. Some teachers also reported using digital tools to facilitate communication and collaboration between families and the school.

Success Stories in Community Engagement

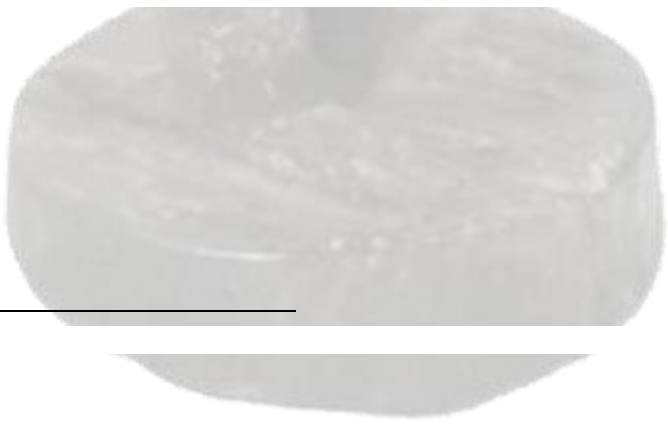
Teachers reported various success stories, including students teaching their elderly parents and community members how to utilise digital platforms to learn sign language, as well as students producing co-learning videos with elders. These success stories highlight the benefits of intergenerational learning and community engagement in promoting sign language learning and cultural exchange. Through learning from elderly community members, students tap into indigenous knowledge and cultural nuances, moving beyond Western-dominated sign languages and recorded videos. This approach counters linguistic colonialism, helping preserve local linguistic heritage.[57] This argument also sustains the finding by Sharma, on how researchers have developed home-grown tools to support Deaf adult learners in computer literacy classes using sign language videos.[58] Teachers reported gathering feedback in various ways, including surveys, one-on-one discussions, and reporting back sessions. Some teachers also reported using digital tools to facilitate feedback and communication, including social media and online platforms.

Resource Needs and Suggested Improvements

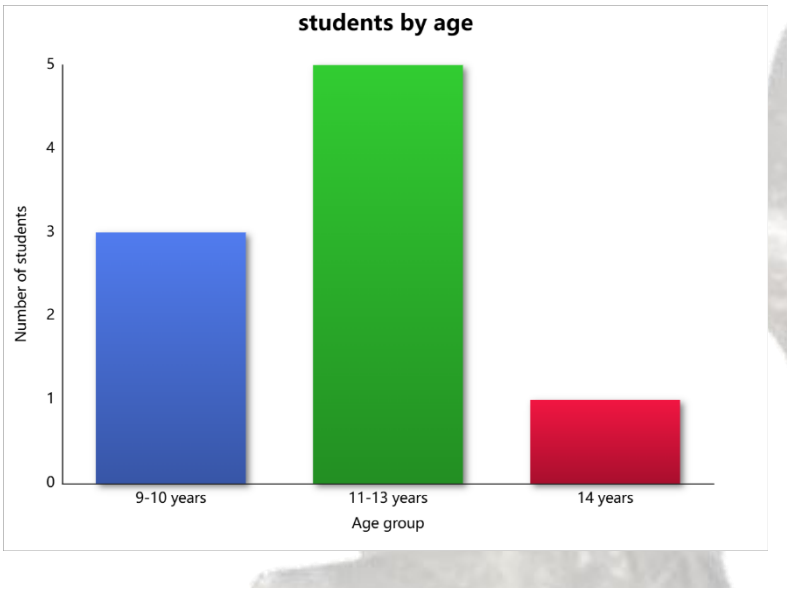
Teachers reported needing additional resources and training, including access to more advanced sign language apps, training in using emerging digital tools, and resources specifically designed for Deaf education. Some teachers also mentioned the need for more support and guidance on how to effectively integrate digital tools into their teaching practices. Teachers also suggested various improvements, including developing more user-friendly apps with culturally relevant content, providing better internet access, and creating family-oriented learning modules, a finding supported by the reviewed literature.[59] Some teachers also mentioned the need for more training and support to effectively integrate digital tools into their teaching practices.

5.3. Students by age

Survey metrics confirmed daily use of digital tools among students, while interview narratives revealed enthusiasm, challenges, and collaborative practices.



[57] See Footnote 14
[58] See Footnote 15
[59] See Footnote 15



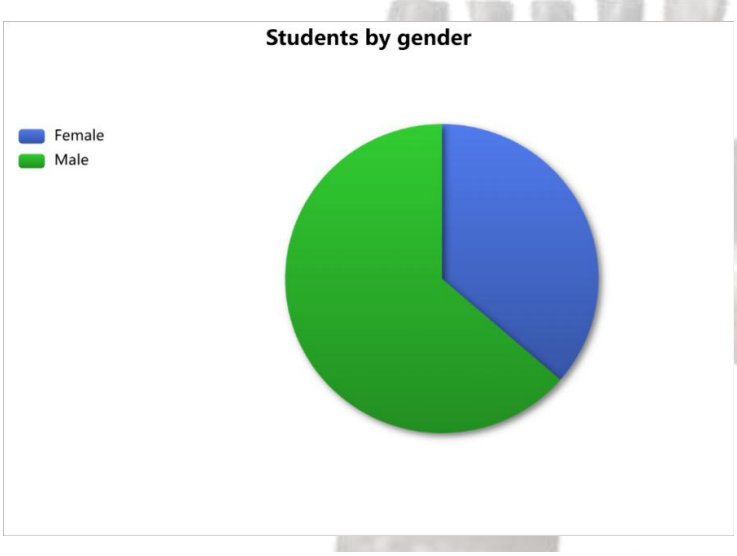
Students' Enthusiasm for Digital Tools

The students who participated in this study were enthusiastic about using digital tools for sign language learning. All of them reported using digital tools daily, and they enjoyed the interactive and engaging nature of these tools, proving the literature finding that Digital platforms play a crucial role in promoting sign language learning, offering innovative solutions to address educational challenges faced by deaf and hard-of-hearing individuals.[60] The students liked that digital tools provided them with access to a variety of learning resources, including videos, games, and interactive boards. However, the students also reported facing some challenges when using digital tools. These challenges included limited access to devices, internet connectivity issues, and lack of localized content. Despite these challenges, the students were optimistic about the benefits of using digital tools for sign language learning. They reported that learning sign language was easier with technology, and they enjoyed the flexibility and autonomy that digital tools provided.

5.4. Students by gender

Survey metrics showed that both male and female students used digital devices for sign language learning, while interview narratives emphasized collaboration, peer sharing, and community engagement.

[60] See Footnote 17



Gender Perspectives on Digital Learning

Both male and female students reported using various digital devices to learn sign language, including phones, computers, and tablets. They also reported sharing information with their peers using digital platforms, which helped to promote collaboration and community engagement. Overall, the students were positive about their experiences with digital tools for sign language learning, despite their gender. They appreciated the interactive and engaging nature of these tools, and they recognized the benefits of using technology to support their learning.

Families' Supportive Role in Digital Learning

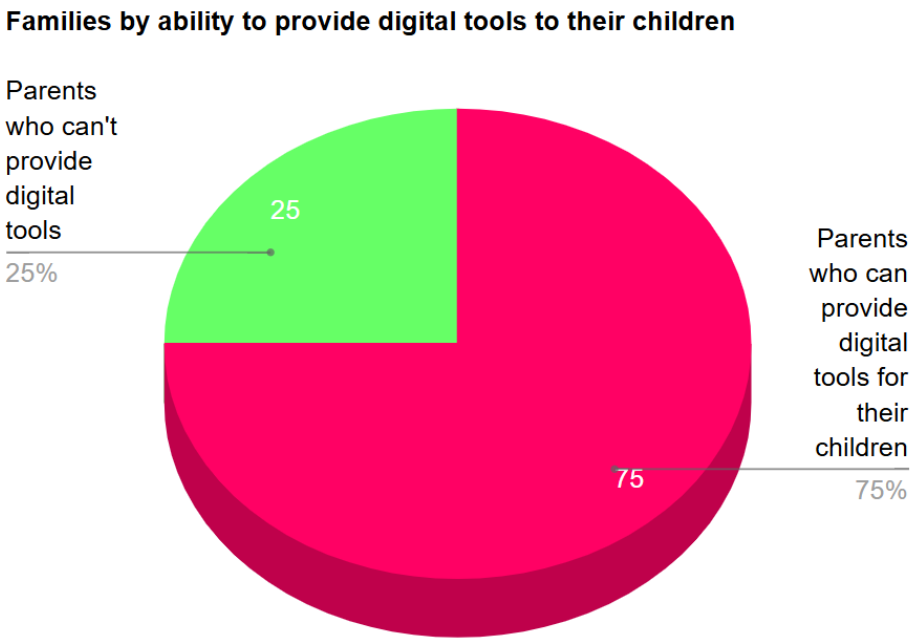
The families who participated in this study, reported that they played a supportive role in helping their children use digital tools for sign language learning. The majority of the parents, 75% reported providing data and devices for their children to use, and they helped their children to navigate the digital tools and resources. However, 25% also reported facing some challenges when supporting their children's use of digital tools. These challenges included limited access to devices and internet connectivity issues, as well as a lack of localized content and support for sign language learning. In line with this finding, Anderson et al[61] underscore the need for context-specific instructional resources, noting how the adoption of digital platforms is limited to affluent families in urban areas, creating disparities in educational access. Despite these challenges, the families were optimistic about the benefits of using digital tools for sign language learning. They reported that digital tools helped to motivate and engage their children, and they appreciated the flexibility and autonomy that these tools provided.

5.5 Families by ability to provide digital tools to their children

Survey metrics captured families' provision of devices and data, while interview narratives revealed cultural continuity, parental involvement, and disparities in support. Family support data was derived from survey responses on provision of devices and data, complemented by interview narratives on cultural continuity and parental involvement.

[61] See Footnote 24

Families' Provision of Digital Resources



5.6 Summary of Findings

This synthesis integrates survey metrics (demographics and usage patterns) with interview narratives (themes of intergenerational learning, cultural preservation, and challenges), ensuring analytical depth.

Consolidated Insights and Recommendations

The teachers, students, and families who participated in this study shared a common enthusiasm for using digital tools to support sign language learning. They appreciated the interactive and engaging nature of these tools, and they recognized the benefits of using technology to promote collaboration, community engagement, and inter-generational learning. The teachers reported using digital tools to enhance their teaching practices, including using videos, apps, and online platforms to provide interactive and engaging learning experiences. They also reported facing challenges such as limited access to devices and internet connectivity issues, as well as a lack of localized content and support for sign language learning.

The students reported enjoying the interactive and engaging nature of digital tools, and they appreciated the flexibility and autonomy that these tools provided. They also reported facing challenges such as limited access to devices and internet connectivity issues, as well as a lack of localized content and support for sign language learning.

The families reported playing a supportive role in helping their children use digital tools for sign language learning. They provided data and devices for their children to use, and they helped their children to navigate the digital tools and resources. They also reported facing challenges such as limited access to devices and internet connectivity issues, as well as a lack of localized content and support for sign language learning. While the proliferation of

digital learning tools for learning sign language across generations has enhanced the practice in Africa, intergenerational knowledge transfer is a cornerstone of cultural continuity in African families, and should be done in a way that upholds the preservation of local values. In view of this, the arguments raised by Chabata [62] remain key. Chabata has argued for the need to explore how African communities can integrate technology for use in storytelling and traditional practices to sustain linguistic and cultural heritage. However, integrating technology into this framework raises concerns about losing the authenticity of these practices. Research must therefore address how digital tools can complement rather than replace traditional methods.

Despite the highlighted challenges, all three groups recognized the benefits of using digital tools for sign language learning. They reported that digital tools helped to motivate and engage learners, and they appreciated the flexibility and autonomy that these tools provided.

To address the challenges reported by the teachers, students, and families, it is recommended that educators and policymakers should provide access to devices and internet for all learners, develop digital tools and resources that are specific to the local sign language and culture, provide additional support and resources, such as more sign language specialists and community learning platforms and promote intergenerational learning and community engagement through the use of digital tools.

6. Recommendations

Based on the study's findings, the following recommendations are proposed to enhance the use of digital tools for sign language learning and promote intergenerational learning:

To address the challenge of limited localized content, it is recommended that educators and policymakers prioritize the development of digital resources that incorporate cultural nuances and context-specific sign language content. This could involve collaborating with local Deaf communities and sign language experts to create relevant and engaging learning materials.

Furthermore, efforts should be made to improve internet accessibility and affordability, particularly in rural areas, to bridge the digital divide and ensure equitable access to digital sign language learning resources. This could involve investing in infrastructure development and exploring innovative solutions such as mobile internet access or community-based internet initiatives.

Teachers would benefit from comprehensive training and support programs that focus on effectively integrating digital tools into sign language instruction. This could include workshops, mentorship programs, and peer-to-peer support networks to enhance teachers' digital literacy and confidence in using digital tools.

The development of user-friendly sign language apps and platforms with culturally relevant content is also crucial. These resources should be designed in consultation with Deaf

[62] Chabata, F. M. (2016). Exploring Zimbabwe's liberation heritage: An assessment of the potential of "protected villages" as a significant heritage typology. In M. Mawere (Ed.), Colonial heritage, memory and sustainability in Africa: Challenges, opportunities and prospects (pp. 259–280). Langaa Research & Publishing CIG.

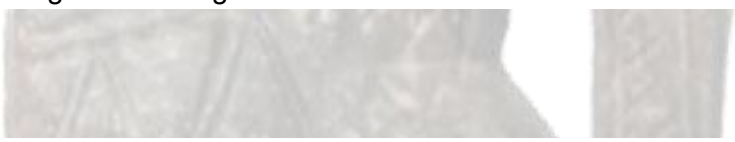
communities and sign language experts to ensure that they meet the needs of learners and promote cultural authenticity.

To foster intergenerational learning and community engagement, educators and policymakers should develop family-oriented learning modules that encourage collaboration between schools, families, and communities. This could involve creating digital resources that families can use together, as well as organizing community-based sign language learning initiatives.

Moreover, it is essential to address disparities in access to digital tools and resources, ensuring that all learners have equitable opportunities to benefit from digital sign language learning. This could involve initiatives such as device donation programs, internet subsidy schemes, and community-based digital literacy programs.

Finally, researchers and educators should explore ways to complement traditional sign language teaching methods with digital tools, preserving cultural authenticity and promoting the preservation of local linguistic heritage. This could involve investigating the role of digital tools in supporting intergenerational knowledge transfer and cultural continuity in African families. These recommendations can assist educators and policymakers to harness the potential of digital tools to enhance sign language learning, promote intergenerational learning, and preserve local linguistic heritage.

Conclusion



This study's findings underscore the transformative potential of digital tools in enhancing sign language learning, promoting intergenerational learning, and preserving local linguistic heritage. The enthusiasm and optimism expressed by teachers, students, and families towards digital tools highlight their value in providing interactive and engaging learning experiences, flexibility, and autonomy.

The benefits of digital tools in sign language learning are multifaceted. They offer a range of interactive and engaging learning resources, facilitate collaboration and community engagement, and provide opportunities for intergenerational learning. The use of digital tools also enables students to access a variety of learning materials, including videos, games, and interactive boards, which can cater to different learning styles and needs.

However, the study also highlights the challenges associated with the use of digital tools in sign language learning. Limited access to devices, internet connectivity issues, and a lack of localized content are significant barriers that need to be addressed. Moreover, the importance of cultural sensitivity and preservation of local values cannot be overstated, particularly in the African context where intergenerational knowledge transfer is a cornerstone of cultural continuity.

The findings suggest that digital tools can complement traditional methods of sign language learning, but careful consideration is needed to maintain authenticity and ensure that technology enhances rather than replaces traditional practices. To harness the potential of digital tools for sign language learning, there is a need for context-specific digital resources, infrastructure development, and teacher support.

Ultimately, the study concludes that digital tools have the potential to revolutionize sign language learning, but their effective integration requires a nuanced understanding of the complex interplay between technology, culture, and community. By addressing the challenges and harnessing the benefits of digital tools, educators and policymakers can create more

inclusive and effective sign language learning environments that promote linguistic and cultural heritage.

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