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TRANSFORMATION THROUGH LOW-COST ASSISTIVE TECHNOLOGIES FOR COMMUNICATION AND LITERACY DEVELOPMENT IN LEARNERS WITH AUTISM SPECTRUM DISORDERS(ASD)

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Abstract

Learners have the fundamental right to access education regardless of the condition one have, and this extends to the use of ICT tools. This study explored inclusive digital transformation through the use of low-cost assistive technologies to support literacy development among learners with Autism Spectrum Disorder (ASD) in selected mainstream primary schools in Kabwe District, Zambia. An intrinsic case study design was employed, involving 18 participants comprising teachers instructing learners with ASD, special education coordinators, and school administrators. Data were collected through structured semi-interview schedules and document analysis, and analysed using thematic analysis. Findings revealed limited but emerging availability of digital assistive technologies, largely dependent on teacher initiative rather than institutionalised procurement systems. Teachers demonstrated positive acceptance of digital tools, particularly where perceived usefulness and ease of use

were evident, although formal training remained inadequate. Commonly used free applications included Cardtalk, let me talk, Cboard, and Jellow, which supported communication and literacy development. The study further established that low-cost digital applications contributed to improved word recognition, enhanced reading engagement, and increased learner independence during literacy activities. The findings underscore the need for structured professional development, dedicated budgeting, and targeted policy alignment to sustain inclusive digital transformation in resource-constrained educational settings.

Keywords: *Inclusive digital transformation; Assistive technology; Autism Spectrum Disorder; Literacy development; Teacher acceptance*

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1.0 INTRODUCTION

The global shift toward inclusive digital transformation has intensified efforts to leverage technology to support learners with disabilities, particularly those with Autism Spectrum Disorder (ASD). Digital assistive technologies such as tablets, augmentative and alternative communication (AAC) applications, and speech-generating tools are increasingly recognised as effective mediators of communication and literacy development. Empirical evidence demonstrates that AAC applications with embedded literacy features can significantly improve single-word reading and expressive communication among learners with severe ASD (Caron et al., 2021; Chanda, et. al., 2024; Light et al., 2025). Similarly, emerging reviews on digital interventions for neurodevelopmental disorders highlight the growing efficacy of technology-based supports in enhancing communication outcomes (Zorzi et al., 2025; Kuyler et al., 2025; Chen, et. al., 2026). Despite this progress, access and structured implementation remain uneven, particularly in low-resource educational contexts.

In Sub-Saharan Africa, and specifically Zambia, the integration of assistive technologies into mainstream classrooms remains at a developmental stage. Studies conducted in Zambian schools reveal that while ICT tools are present, their application for learners with special educational needs is often inconsistent and constrained by limited training and infrastructure (Milimo et al., 2025; Kaulu, 2025). Furthermore, classroom management strategies for learners with ASD in Zambian mainstream settings frequently rely on traditional pedagogical approaches with minimal digital integration (Busiku and Matafwali, 2022; Chanda, et. al., 2025). These contextual realities underscore the necessity of exploring low-cost, scalable digital assistive technologies that can function effectively within resource-constrained environments such as Kabwe District.

Beyond availability, teacher acceptance and competence significantly influence successful technology adoption. The Technology Acceptance Model provides a useful lens for understanding educators' willingness to integrate digital tools into instructional practice (Chuttur, 2009). Recent studies confirm that teachers' perceptions of technology usefulness and ease of use directly affect their

implementation of language and communication applications for children with ASD (Khoshtaria et al., 2025; Muvombo et al., 2025; Chen, et. al., 2026). Moreover, literacy instruction for learners with ASD requires specialised pedagogical adaptation, and teachers often report uncertainty regarding effective strategies (Human et al., 2025; Mavritsakis, 2024). Therefore, low-cost digital assistive technologies must be accompanied by structured teacher training to ensure sustainable inclusive practice.

Against this backdrop, this study explores the role of low-cost digital assistive technologies in enhancing communication and literacy development among learners with ASD in selected schools in Kabwe District, Zambia. By focusing on affordable applications, speech-generating tools, and teacher preparedness, the study contributes to the broader inclusive digital transformation agenda while responding to local educational realities. This study bridged the gap between global evidence on AAC effectiveness and the contextual needs of Zambian schools, thereby proposing practical pathways for strengthening inclusive education through sustainable digital innovation.

1.1 Objectives

a) To explore the availability of low-cost digital assistive technologies for learners with ASD in selected schools in Kabwe District.
b) To understand teachers' acceptance of digital assistive technologies for learners with ASD in Kabwe District.
c) To establish the effectiveness of low-cost digital assistive technologies on literacy development among learners with ASD.

1.2 Contextual Scenario

Despite growing global evidence that low-cost digital assistive technologies, including AAC applications and speech-generating tools, can significantly enhance communication and literacy outcomes for learners with ASD, their structured integration in mainstream schools within Kabwe District remains limited (Busiku and Matafwali, 2022; Kuyler, et al., 2025; Chen, et. al., 2026). For the root cause, while policy frameworks and international scholarship advocate for inclusive digital transformation in education, many schools in resource-constrained Zambian contexts continue to rely on traditional instructional approaches, with minimal teacher training and inconsistent technology adoption (Moono, et. al., 2024; Banda, et. al., 2023; Chikopela, et. al., 2022; Chanda, et. al., 2024; Kaulu, 2025). As a consequence, this gap between global technological advancements and local classroom realities results in persistent communication barriers, restricted literacy development, and limited participation of learners with ASD in inclusive settings. Therefore, there was a critical need to explore how low-cost digital assistive technologies can be effectively implemented, accepted by teachers and sustainably integrated to enhance communication and literacy development among learners with ASD in Kabwe District.

2.0 METHODS

This study adopted an intrinsic case study design, appropriate for gaining an in-depth understanding of a contemporary phenomenon within its real-life context. The intrinsic case study was selected because the investigation focused specifically on how low-cost digital assistive technologies are implemented to support learners with ASD in selected schools in Kabwe District, Zambia. The design enabled a contextualised

exploration of practices, teacher experiences and institutional realities influencing inclusive digital transformation within a bounded educational setting.

In this study, the target population comprised teachers instructing learners with ASD, special education coordinators and school administrators in selected mainstream primary schools with special units in Kabwe District. A purposive sampling strategy was employed to select participants who had direct experience with digital assistive technologies or were involved in instructional decision-making. Data saturation was reached at 18 participants, at which point no new themes or substantive insights were emerging from the interviews. This sample size is consistent with qualitative case study research standards, where depth of information and thematic redundancy determine adequacy rather than numerical representation (Banda, et. al., 2017).

Data were collected using semi-structured interview schedules and document analysis. The use of semi-structured interviews ensured consistency across participants while also allowing flexibility to probe deeper into participants' experiences, thereby enhancing the richness and depth of the data. Document analysis included school ICT policies, lesson plans, Individualised Education Plans (IEPs), and records of assistive technology usage to triangulate findings and strengthen credibility.

Data were analysed using thematic analysis following the six-phase framework proposed by Braun and Clarke (2006). The process involved familiarisation with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes and producing the report. This analytic approach was suitable for identifying patterned meanings related to technology use, teacher acceptance and literacy outcomes within the case context.

To ensure trustworthiness, several strategies were employed. Credibility was enhanced through member checking and triangulation of interview and document data. Dependability was ensured by maintaining a detailed audit trail of data collection and analysis procedures. Confirmability was achieved through reflexive journaling and transparency in data interpretation. These procedures strengthened the rigour and reliability of the qualitative findings.

Ethical considerations were strictly observed. Approval was obtained from Nkrumah University ethics committee (NUEC) and gate keepers at the province, district and participating primary schools. Participants were provided with informed consent forms detailing the purpose of the study, voluntary participation, confidentiality and the right to withdraw at any stage without penalty. Pseudonyms were used to protect identities and all data were securely stored in password-protected files accessible only to the researcher. These measures ensured adherence to ethical standards in educational research involving professionals working with learners with ASD (Mpolomoka, 2024).

3.0 RESULTS

The findings of this study were derived from interviews conducted with participants in selected schools in Kabwe District, Zambia. The results are presented thematically,

focusing on availability, teacher acceptance, and effectiveness of low-cost assistive technologies in supporting learners with ASD.

4.1 Availability of Low-Cost Digital Assistive Technologies for Learners with ASD

During the collection of information in the field, the data saturation was reached at 18 participants, comprising teachers instructing learners with ASD, special education coordinators, and school administrators. Analysis of interview data revealed four dominant themes regarding availability: limited but emerging digital resources, reliance on personal devices, inconsistent institutional procurement and absence of structured allocation policies. Below were the analysed findings under this objective in line with themes that emerged:

3.1.1 Limited but Emerging Digital Resources

The findings indicate that digital assistive technologies are present in schools but remain limited in quantity and sustainability.

Participant T3 (Teacher):
*"In our special unit, we have two tablets… they are shared among several learners, so usage time is very limited, and not every learner benefits consistently"*The narrative from T3 indicates that although digital assistive devices exist, their quantity and sustainability are insufficient. Availability appears symbolic rather than functionally adequate to meet learner needs.

(A Special Education Coordinator indicated:

> *Similarly, a coordinator noted: "The school does not have a dedicated budget for assistive technology… availability depends more on teacher initiative than institutional planning" (SEC1).*

These findings suggest that although digital resources exist, their availability is insufficient to meet learner needs. The reliance on shared and aging devices limits consistent access, while the absence of dedicated funding indicates that provision remains fragmented rather than systematically institutionalised.

3.1.2 Reliance on Personal Devices

Teachers frequently rely on personal devices to support learners with ASD due to limited institutional provision. Examples of commonly used free applications reported by teachers included LetMeTalk, Cboard, and Jellow, which support symbol-based communication, phonics development, and interactive literacy engagement.

Participant T7 (Teacher):

> *"I use my personal smartphone to download free communication apps… without it, some learners withdraw from activities" (T7).*

T7's statement demonstrates that availability is frequently mediated through teacher sacrifice rather than school provision. This reliance on personal devices suggests fragility in the sustainability of digital inclusion.

Another teacher T11 explained

> *"I sometimes bring my own tablet… if I am absent, learners do not access those tools" (T11).*

These findings indicate that access to digital assistive technologies is largely dependent on individual teacher initiative. This reliance on personal devices raises concerns about sustainability, consistency, and equity, as access varies depending on teacher availability and personal resources.

3.1.3 **Inconsistent Institutional Procurement**

Institutional procurement of assistive technologies is inconsistent and not prioritised within school systems.

Participant ADM2 (School Administrator):

> *"As a school, we prioritise textbooks and infrastructure… assistive technologies are important, but funding is limited" (ADM2).*

ADM2's response situates the problem within broader resource constraints. Assistive technology is acknowledged conceptually but remains marginal in budgetary prioritisation.

In addition:

"There is no formal inventory for AAC tools… we operate more on improvisation than structured provision" (SEC3).

These findings suggest that assistive technologies are not systematically integrated into school procurement frameworks. Competing priorities and lack of formal tracking mechanisms limit strategic planning and expansion, resulting in ad hoc and inconsistent provision.

3.1.3 **Unequal Learner Access**

Findings reviewd that limited availability of devices results in unequal access among learners with ASD.

Participant T15 (Teacher):

"In a class of eight learners, maybe two can access the tablet… the rest wait, which creates frustration and limits progress" (T15).

T15's narrative illustrates that device scarcity directly influences learner engagement and instructional continuity. Availability constraints translate into reduced pedagogical impact.

The document analysis included review of ICT inventories, lesson plans, IEPs, and school development plans from participating schools. The findings are summarised below.

Table 1: Analysis of the Availability and Integration of Assistive Communication Technologies in Institutional School Documents

Document Reviewed	Key Findings on Availability	Interpretation
School ICT Inventory Records	Devices listed under general ICT category; no specific AAC classification	Lack of targeted tracking for assistive technologies
Lesson Plans	Occasional mention of tablet use for phonics or picture communication	Integration present but not routine
IEPs	Minimal reference to digital AAC tools as formal intervention strategies	Assistive technology not systematically embedded in learner planning
School Development Plans	Broad ICT improvement goals; no dedicated assistive technology budget	Strategic commitment to ICT exists but lacks ASD-specific focus

The documentary evidence supports the interview findings, indicating that teachers generally hold positive attitudes toward digital assistive technologies. However, the absence of structured ASD-specific professional development and inconsistent documentation of AAC usage suggest that acceptance remains largely attitudinal rather than fully institutionalised.

3.2 Teachers' Acceptance of Digital Assistive Technologies for Learners with ASD

Data saturation was reached at 18 participants, and analysis revealed four central themes related to teachers' acceptance: perceived usefulness, perceived ease of use, professional confidence, and contextual constraints influencing sustained adoption.

3.2.1 Perceived Usefulness of Digital Assistive Technologies

The findings indicate that teachers perceived digital assistive technologies as highly useful in supporting learner participation and literacy development.

Participant T2 (Teacher):

> *When I introduced a free AAC application during literacy lessons, I noticed immediate improvement in participation. One learner who rarely responded verbally began selecting symbols to answer comprehension questions. The tool reduced frustration and improved engagement in reading activities."*

T2's narrative reflects strong perceived usefulness of digital assistive technologies. The teacher associates technology integration with improved learner engagement and instructional outcomes, indicating positive acceptance.

Similarly, another teacher T9 (Teacher) noted:

> *"Using phonics apps has helped learners recognise letter sounds faster compared to traditional methods. The audio repetition and animations capture their attention longer, and I have seen progress in blending simple words."*

These findings suggest that teachers associate digital tools with improved instructional effectiveness and learner outcomes. The observed improvements in participation and literacy skills reinforce strong perceived usefulness, which is a key determinant of technology acceptance.

3.2.2 **Perceived Ease of Use**

Teachers reported that low-cost digital applications were generally easy to use and integrate into classroom practice.

Participant T6 (Teacher):

> *"Most of the low-cost apps are simple to download and operate. Even "Most of the low-cost apps are simple to download and use. Even without advanced ICT training, I can navigate and customise features for learners. Once you understand the basics, it becomes part of daily teaching."*

T6's statement suggests that ease of use contributes positively to acceptance. Simplicity reduces resistance and promotes routine classroom integration.

A special education coordinator SEC2 further explained

> *"Teachers initially feared that assistive technologies would be complicated, but after demonstrations, they realised the applications were manageable. Some even began training their colleagues informally."*

These findings indicate that ease of use reduces resistance to technology adoption. Familiarity and peer support further enhance confidence, enabling teachers to integrate digital tools into routine instructional practices.

3.2.3 **Professional Confidence and Training Gaps**

Although teachers expressed positive attitudes toward digital assistive technologies, they reported limited confidence in their effective use due to a lack of formal training.
Participant T12 (Teacher):

> *"Although I believe in the benefits of digital tools, I feel I am not using them to their full potential. We have not received formal training on AAC integration, so I rely on trial and error."*

The participant, T12 reveals conditional acceptance positive attitudes exist, yet confidence is constrained by limited formal training. Acceptance does not automatically translate into optimal implementation.

From an administrative perspective:

> *"Teachers are open to innovation, but structured professional development on assistive technology has not been prioritised. Most rely on self-learning, and systematic training would strengthen adoption."* (ADM1).

These findings suggest that acceptance is conditional rather than fully developed. While teachers are willing to adopt digital tools, limited professional training constrains effective implementation. This highlights the need for structured capacity-building initiatives to translate positive attitudes into practice.

3.2.4 **Contextual Constraints Affecting Sustained Acceptance**

Teachers' continued use of digital assistive technologies is influenced by contextual challenges, including infrastructure limitations and workload pressures.

Participant T14 (Teacher):

> *"Technical challenges sometimes discourage consistent use. When the internet is slow or devices malfunction, lessons are disrupted, and I revert to traditional methods."*

Aditionally, participant, T14's narrative suggests that acceptance is dynamic rather than fixed. Infrastructure limitations can weaken sustained technology adoption despite positive attitudes.

Participant SEC4 (Special Education Coordinator):

> *"Teachers appreciate digital assistive technologies, but workload pressures reduce regular use. Preparing digital content takes time, and without support, integration remains inconsistent."*

These findings indicate that teacher acceptance is dynamic and influenced by environmental factors. Despite positive attitudes, infrastructural challenges and workload demands limit sustained integration. This suggests that systemic support is essential to ensure consistent use of digital assistive technologies.

Document analysis focused on professional development records, staff meeting minutes, ICT policy documents, lesson observation records and internal training reports from participating schools. The aim was to triangulate interview findings regarding teachers' acceptance of digital assistive technologies.

Table 2: Evidence of Teacher Acceptance and Support for Assistive Technology Use in ASD Instruction

Document Reviewed	Evidence Related to Teacher Acceptance	Interpretation
Staff Development Plans	General ICT workshops recorded; no ASD-specific assistive technology training	Acceptance exists but lacks specialised capacity-building structures
Staff Meeting Minutes	Discussions encouraging technology integration in teaching	Positive institutional attitude toward digital tools
Lesson Observation Records	Inconsistent documentation of AAC or literacy app usage	Acceptance present but not consistently practiced
Internal Training Reports	Peer-led demonstrations of free apps noted in two schools	Informal support mechanisms promoting confidence
School ICT Policy Documents	Broad commitment to digital learning; no explicit reference to ASD-specific applications	Strategic support for ICT exists but not targeted to assistive technology

From the documentary evidence supports interview findings that teachers generally hold positive attitudes toward digital assistive technologies. School records demonstrate encouragement of ICT integration and some informal peer-driven training initiatives. However, the absence of structured ASD-focused professional development and limited documentation of routine AAC application usage suggest that acceptance is more attitudinal than systematised. The findings indicate ways in institutional rhetoric supports digital innovation, formal frameworks to strengthen teacher competence in assistive technology remain underdeveloped.

The findings indicate generally positive teacher acceptance of digital assistive technologies for learners with ASD in Kabwe District. Teachers perceive these tools as useful, relatively easy to use and beneficial for literacy engagement. However, acceptance is moderated by limited formal training, infrastructure challenges, workload pressures and inconsistent institutional support. Even if attitudinal readiness is strong, sustained adoption requires systematic professional development

and improved technological infrastructure to consolidate inclusive digital transformation efforts.

3.3 Effectiveness of Low-Cost Digital Assistive Technologies on Literacy Development among Learners with ASD

Under the third objective data saturation at 18 participants revealed three dominant themes regarding effectiveness: improved word recognition, enhanced reading engagement and increased independent task completion. The findings are presented using thematic narrative supported by verbatim excerpts summarised in tables.

3.3.1 Improved Word Recognition

Participants consistently reported noticeable progress in letter identification, phonics acquisition and single-word reading when low-cost digital applications were integrated into literacy instruction.

Table 3: Participant Perspectives on the Effectiveness of Digital Literacy and AAC Tools in Improving Reading Skills

Participant Code	Verbatim Excerpt
T1 (Teacher)	After introducing a phonics app with audio prompts, I observed that learners could identify letter sounds more accurately. The repetition function helped them practise independently. Within weeks, some learners began blending simple consonant-vowel-consonant words. This progress was faster compared to previous terms without digital support.
T8 (Teacher)	The visual-symbol pairing in the AAC app strengthened word-picture association. Learners who struggled with flashcards responded better when the word was pronounced by the device. It reinforced memory retention. I saw improvement in recognising familiar classroom vocabulary.
SEC1 (Coordinator)	From lesson observations, we noticed measurable improvement in word recognition among learners exposed to literacy apps regularly. The digital repetition and interactive elements appeared to support phonemic awareness. Although progress varied, the trend was positive.

The data suggest that low-cost digital assistive technologies contribute meaningfully to foundational literacy skills, particularly phonemic awareness and word recognition. Repetition, audio-visual reinforcement and interactive feedback emerged as critical mechanisms supporting literacy development.

3.3.2 Enhanced Reading Engagement

Participants emphasised that learners demonstrated increased attention span and willingness to participate in literacy tasks when digital tools were incorporated.

Table 4: Participant Perspectives on Digital Tools Enhancing Learner Engagement in Reading Activities

Participant Code	Verbatim Excerpt
T4 (Teacher)	Previously, learners would disengage quickly during reading sessions. With the tablet, they remain focused for longer periods. The animations and sound effects sustain attention. Even reluctant learners show curiosity when the device is introduced.
T10 (Teacher)	The digital stories motivate learners to attempt reading aloud. The app highlights each word as it is read, which supports tracking. I have seen learners attempt independent reading because they feel supported by the audio feature.
ADM1 (Administrator)	During monitoring visits, I observed higher participation levels when digital tools were used. Learners appeared more confident attempting reading activities. Engagement levels were visibly different compared to traditional chalkboard instruction.

The findings indicate that digital assistive technologies function as motivational tools that enhance learner engagement. Increased attention and participation create conducive conditions for literacy acquisition among learners with ASD.

3.3.3 **Increased Independent Task Completion**

Another significant finding of the study relates to improved learner autonomy during literacy activities.

Table 5: Participant Perspectives on Digital Tools Promoting Learner Independence in Reading Tasks

Participant Code	Verbatim Excerpt
T13 (Teacher)	With the speech-generating app, learners can follow instructions without constant adult prompting. They select symbols to construct simple sentences related to reading tasks. This has reduced dependency on teacher mediation. I notice greater independence during literacy sessions.
T16 (Teacher)	Some learners now complete matching-word exercises on the tablet without assistance. The immediate feedback feature corrects errors instantly. This has improved their confidence. They no longer wait passively for guidance.
SEC3 (Coordinator)	Digital tools appear to empower learners to attempt literacy tasks independently. Even those with limited verbal skills participate

	through symbol-based communication. This increases meaningful involvement in classroom reading activities.

The evidence demonstrates that low-cost digital assistive technologies enhance learner autonomy. Features such as immediate corrective feedback, symbol-based communication and guided audio support reduce overreliance on teacher prompting, fostering independent literacy engagement.

With regard to the supplementary document analysis findings were analysed. The document analysis of learners' IEPs, literacy progress records and lesson plans revealed measurable patterns associated with digital tool integration.

Table 6: Evidence of Literacy Improvement Linked to Digital Learning Interventions in School Documentation

Document Reviewed	Observed Literacy Outcomes	Interpretation
IEP Progress Reports	Incremental gains in letter recognition and word identification noted after introduction of digital apps	Supports reported improvements in foundational literacy skills
Literacy Assessment Records	Increased frequency of completed reading tasks among learners using tablets	Indicates improved task engagement
Lesson Plans	Structured inclusion of phonics apps in weekly schedules in three schools	Suggests intentional integration linked to literacy goals
Classroom Monitoring Reports	Observations of independent symbol selection during reading tasks	Confirms enhanced learner autonomy

Documentary evidence aligns with interview narratives, indicating that low-cost digital assistive technologies positively influence literacy development among learners with ASD in Kabwe District. Improvements are particularly evident in word recognition, engagement during reading sessions and independent task execution. Even though gains vary across learners, the convergence of interview and documentary data strengthens the conclusion that digital tools play a facilitative role in literacy advancement within resource-constrained inclusive settings.

The findings demonstrate that low-cost digital assistive technologies are effective in strengthening literacy development among learners with ASD. As evidenced by the above findings, this normally happens through enhancing word recognition, sustaining engagement and promoting independent participation. However, the extent

of effectiveness is influenced by frequency of use, teacher competence and device availability, reinforcing the need for structured institutional support to maximise impact.

4.0 DISCUSSION

4.1 Availability of Low-Cost Digital Assistive Technologies

The findings revealed limited but emerging availability of low-cost digital assistive technologies in selected schools in Kabwe District. Although tablets and free AAC applications were present in some classrooms, access was inconsistent and often dependent on teacher initiative rather than institutional provision. This aligns with findings by Milimo et al. (2025), who reported that ICT usage among learners with special educational needs in Zambia remains uneven and largely constrained by infrastructure and resource limitations. Similarly, Busiku and Matafwali (2022) observed that mainstream schools with special units often operate under resource strain, which affects the consistent implementation of specialised interventions for learners with ASD. The present findings therefore reinforce the persistent structural gaps in assistive technology availability within Zambian inclusive settings (Moono, et. al., 2024; Banda, et. al., 2023; Chanda, et. al., 2025).

The reliance on personal devices by teachers further confirms systemic procurement challenges. School administrators acknowledged the importance of assistive technologies, yet competing priorities limited targeted budget allocations. This pattern reflects broader access concerns shown by Ntalindwa et al. (2019), who noted that technology use among children with ASD in low-resource contexts is often informal and not institutionally structured. Additionally, Kaulu (2025) emphasised that assistive technology access in Zambian institutions serving learners with disabilities remains constrained by inadequate infrastructure and funding. The current study extends this evidence by demonstrating that even where devices exist, the absence of formal categorisation and inventory systems undermines sustainable planning (Chikopela, et. al., 2022; Chanda, et. al., 2025; Chen, et. al., 2026).

Document analysis further revealed that ICT policies emphasised general digital development without explicit reference to ASD-specific assistive technologies. This finding aligns with the United States Department of Education (2017), which argues that inclusive digital transformation requires deliberate policy alignment to ensure equitable access for learners with disabilities. Without targeted integration within school development plans, availability remains fragmented. Therefore, the findings suggest that foundational ICT frameworks exist, but structured institutionalisation of low-cost assistive technologies for learners with ASD is still evolving in Kabwe District.

4.2 Teachers' Acceptance of Digital Assistive Technologies

The study found generally positive teacher acceptance of digital assistive technologies, particularly in terms of perceived usefulness and ease of use. Teachers associated AAC and literacy applications with improved learner engagement and communication. This finding aligns with Khoshtaria et al. (2025), who reported that teachers' perceptions of usefulness significantly influence their willingness to integrate language skill applications for learners with ASD. Similarly, Chuttur (2009) emphasised that perceived usefulness and ease of use are central determinants of technology acceptance. The current study confirms that when teachers observe tangible learner progress, acceptance strengthens.

However, acceptance was moderated by limited formal training and professional development opportunities. Teachers expressed willingness but reported uncertainty regarding optimal pedagogical integration. This resonates with Human et al. (2025), who found that teachers often feel underprepared to implement specialised literacy strategies for learners with ASD. Likewise, Kuyler et al. (2025) emphasised the importance of structured training in augmentative and alternative communication strategies within African schools. The present findings therefore suggest that acceptance alone is insufficient without systematic capacity-building initiatives.

The contextual barriers such as workload pressures and infrastructure limitations influenced sustained adoption. Although attitudes were positive, inconsistent device functionality and limited internet connectivity occasionally reduced motivation. These findings correspond with Ntalindwa et al. (2019), who identified infrastructural challenges as critical barriers to sustained ICT integration for children with ASD. Thus, teacher acceptance in Kabwe District is largely favourable, yet it remains vulnerable to systemic constraints that affect long-term implementation.

4.3 **Effectiveness of Low-Cost Digital Assistive Technologies on Literacy Development**

The findings demonstrated that low-cost digital assistive technologies positively influenced word recognition, reading engagement, and learner independence. Teachers reported accelerated phonemic awareness and improved single-word reading through interactive literacy applications. These findings strongly align with Caron et al. (2021), who established that AAC applications with embedded literacy features significantly improved single-word reading among individuals with severe ASD. Similarly, Light et al. (2025) emphasised that digital AAC tools can reduce literacy barriers by providing multimodal support that enhances decoding and comprehension skills. The present study therefore corroborates international evidence within a Zambian context.

Increased learner engagement during reading sessions also emerged as a significant outcome. Participants observed extended attention spans and higher participation rates when digital tools were used. This finding supports Zorzi et al. (2025) and

Chanda, et. al. (2025), who concluded that digital technology interventions enhance communication engagement among individuals with neurodevelopmental disorders. Mavritsakis (2024) further demonstrated that transitioning to tablet-based AAC systems can increase functional communication participation for learners with ASD. The current study extends these findings by showing that engagement benefits translate into literacy-related activities within mainstream Zambian classrooms.

The enhancement of learner independence represents another important contribution. Features such as immediate feedback and symbol-based sentence construction reduced reliance on teacher prompting. This aligns with Light et al. (2025), who highlighted autonomy as a key outcome of effective AAC implementation. Moreover, Kuyler et al. (2025) emphasised that AAC strategies promote meaningful classroom participation among learners with diverse educational needs. Therefore, the findings suggest that low-cost digital assistive technologies not only improve literacy performance but also strengthen learner agency, reinforcing their relevance within inclusive digital transformation initiatives in resource-constrained environments.

5.0 CONCLUSION

The study concludes that low-cost digital assistive technologies play a significant role in advancing inclusive education for learners with ASD in Kabwe District. Although availability remains limited and inconsistently institutionalised, teachers demonstrate strong acceptance based on perceived usefulness and observed learner progress. Digital tools such as AAC applications contribute to improved word recognition, reading engagement, and learner independence. However, sustained effectiveness requires structured procurement systems, targeted professional development, and stronger policy alignment to ensure equitable and consistent implementation.

5.1 Recommendations

a) The schools should establish dedicated budget lines for low-cost digital assistive technologies to ensure consistent availability and structured procurement for learners with ASD.
b) There is need to implement targeted professional development programmes on AAC and literacy-focused digital tools in order to strengthen teacher competence and sustained technology integration.
c) The school ICT policies should explicitly incorporate ASD-specific assistive technology strategies to institutionalise inclusive digital transformation practices.

5.2 Acknowledgements

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5.3 Conflict of Interest

The authors declare no conflict of interest regarding the publication of this study.

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