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Teacher digital competence and confidence for Assistive Technology integration: A case study of a selected school in the Eastern Cape Province

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ABSTRACT

The integration of assistive technologies in special needs education is pivotal for fostering inclusive teaching and learning, particularly for visually impaired learners. However, the effectiveness of such integration is contingent on teachers' digital competence and confidence. This study investigates teachers' digital competence and confidence in implementing assistive technology (AT) at a selected special school in the Eastern Cape Province, South Africa. Guided by the Technological Pedagogical Content Knowledge framework and Self-Efficacy Theory, the research explores how teachers' technological knowledge and self-belief intersect to influence their instructional practices. Using a qualitative case study design, the data were gathered through semi-structured interviews with seven teachers, non-participant classroom observations, and document analysis. Braun and Clarke's thematic analysis was employed to identify patterns and themes. Findings indicate that while teachers exhibit basic proficiency in traditional assistive tools such as braille writers and tactile materials, they encounter significant challenges in utilising advanced digital technologies, including screen readers, refreshable braille displays, and accessible e-learning platforms. Barriers include inadequate training, limited professional development, poor infrastructure, and insufficient institutional support. Nevertheless, teachers demonstrated readiness to adopt AT when provided with opportunities for peer collaboration and context-specific training. The study concludes that enhancing teachers' digital competence and confidence requires integrated strategies that encompass continuous professional development, sufficient resources, and supportive policies. These findings advance inclusive education by emphasising the need for systemic interventions that empower teachers to leverage AT effectively, thereby promoting equitable, high-quality education aligned with Sustainable Development Goal 4 (SDG 4).

Keywords: Assistive Technologies, Digital Competence, Self-Efficacy, Inclusive Education, Visually Impaired Learners.

INTRODUCTION

The integration of assistive technologies (AT) in teaching and learning is a critical component of inclusive education globally. Assistive technologies, ranging from low-tech devices such as braille

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slates and magnifiers to advanced digital solutions like screen readers, refreshable braille displays, optical character recognition (OCR) software, and accessible learning management systems, enable learners with visual impairments to access curricula, participate in learning activities, and achieve educational outcomes on par with their peers.[1] These technologies are particularly vital in supporting equitable access to education as mandated by the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) and Sustainable Development Goal 4 (SDG 4), which calls for inclusive and equitable quality education for all.[2]

In South Africa, the policy framework for inclusive education is articulated through the *Education White Paper 6 on Special Needs Education: Building an Inclusive Education and Training System*[3] and the *Policy on Screening, Identification, Assessment, and Support (SIAS)*.[4] According to Talafhah and Bataineh, these policies emphasised that learners experiencing barriers to learning, including those with visual impairments, must be provided with appropriate support through assistive devices and technology.[5] Special schools are mandated to serve as resource centres, providing specialist support to learners and supporting full-service schools in the wider community. Despite these policy commitments, the effective integration of assistive technology remains uneven, particularly in resource-constrained contexts such as the Eastern Cape Province, where rurality, infrastructure deficits, and limited human capacity hinder meaningful inclusion.[6] Central to the successful integration of AT is the competence and confidence of teachers who plan, facilitate, and assess learning. Building on Gulzoda's assertion that digital competence encompasses teachers' ability to select, adapt, and use digital tools effectively to support pedagogy, create accessible learning resources, and align technology use with curriculum requirements, it becomes evident that developing such competence is not merely a technical skill but a pedagogical imperative, requiring ongoing professional development, critical reflection on technology-enhanced teaching strategies, and institutional support to ensure that digital integration meaningfully enhances learner engagement, equity, and curriculum alignment.[7] Confidence, often linked to self-efficacy, refers to teachers' belief in their capacity to use such technologies effectively in their classrooms.[8] Evidence from international and South African contexts indicates that teachers with higher levels of digital competence and confidence are more likely to integrate technology innovatively and sustainably, thereby improving learning opportunities for learners with special needs.[9] Conversely, limited competence and low confidence can result in a superficial or inconsistent use of assistive devices, leaving learners with visual impairments without the supports they need to fully engage in learning.

Although South African policy frameworks provide a strong foundation for inclusive education, a persistent gap remains between policy intent and classroom practice in the integration of assistive technologies. Studies in South Africa have largely focused on the availability of assistive devices or on systemic barriers such as funding and infrastructure,[10] with comparatively little attention paid to the *human factors* underpinning successful implementation, specifically, teacher digital competence and confidence in using AT for learners with visual impairments. In the Eastern Cape, where many special

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1 Anya S Evmenova and Cathy Bodine, "Assistive Technology Outcomes and Benefits," 2025.

2 UNESCO, *Reimagining Our Futures Together: A New Social Contract for Education* (Paris: Educational and Cultural Organisation of the United Nations, 2021).

3 Petra Engelbrecht, "Inclusive Education: Developments and Challenges in South Africa," *Prospects* 49, no. 3 (2020): 219–32.

4 Angie Motshekga,"Department of Basic Education." (2022).

5 W. F. Talafhah and Ruba Fahmi Bataineh, "Breaking Barriers: Assistive Technology for Visually Impaired EFL Educators," *International Journal of Learning, Teaching and Educational Research* 24, no. 4 (2025): 813–29.

6 Sydney Edwards, "Accessibility of Resource-Constrained Urban Communities for Female Wheelchair Users in the South African Context" (University of the Witwatersrand, 2022).

7 Tashmatova Gulzoda, "Enhancing the Methodology for Developing Professional Pedagogical Competence of Future Teachers in Digital Technologies," *American Journal of Pedagogical and Educational Research* 21 (2024): 28–33.

8 Li Cheng, Pavlo D Antonenko, and Albert D Ritzhaupt, "The Impact of Teachers' Pedagogical Beliefs, Self-Efficacy, and Technology Value Beliefs on 3D Printing Integration in K-12 Science Classrooms," *Educational Technology Research and Development* 72, no. 1 (2024): 181–208.

9 Reuben Dlamini, "Digital Equity in Schools: A Multilevel Analysis of in-Service Teachers' Technological Knowledge Competencies," *Journal of Educational Studies* 21, no. 2 (2022): 40–60.

10 Dlamini, "Digital Equity in Schools: A Multilevel Analysis of in-Service Teachers' Technological Knowledge Competencies"; Tashlynne Naidoo, "An Evaluation of Teachers' Digital Learning Competencies to Integrate Technology-Supported Materials in the Teaching-Learning Process" (University of the Witwatersrand, 2020).

schools operate in rural and under-resourced settings, there is a scarcity of empirical evidence on how teachers' skill levels, self-efficacy, and contextual constraints influence the actual use of assistive technologies in teaching and learning. This gap limits policymakers, teacher educators, and school leaders' ability to design targeted interventions that build teacher capacity and ensure that AT investments translate into improved learner outcomes. This study aims to explore teachers' digital competence and confidence in integrating assistive technologies in a selected special school in the Eastern Cape Province.

This study is significant in three key respects. First, it addresses a critical knowledge gap in the literature by focusing on the interplay between competence and confidence in AT integration within a South African rural context, an area that has received limited scholarly attention. Second, it provides practical insights that can inform the design of professional development programmes tailored to the needs of teachers working in under-resourced special schools. Ultimately, it contributes to policy debates on inclusive education by providing evidence on the conditions necessary for the meaningful implementation of AT, as outlined in national and international frameworks.

LITERATURE REVIEW

The successful integration of AT in special needs education depends on teachers' ability to effectively and confidently utilise these tools to enhance teaching, learning, and inclusion. Globally, assistive technologies are recognised as critical enablers of equitable education for learners with disabilities, aligning with SDG 4 on inclusive and quality education for all.[11] In the South African context, particularly in rural provinces such as the Eastern Cape, the adoption of AT remains a pressing challenge due to systemic barriers, including inadequate infrastructure, limited teacher training, and gaps in policy implementation.[12] This literature review examines existing scholarship on teachers' digital competence and confidence, and their role in integrating AT for visually impaired learners, while situating the study within the broader framework of inclusive education policy, technological-pedagogical models, and empirical evidence.

Conceptualising Assistive Technology in Inclusive Education

Assistive technologies encompass a broad range of tools designed to enhance the functional capabilities of learners with disabilities, including screen readers, refreshable braille displays, magnification software, OCR tools, and accessible learning management systems.[13] For learners with visual impairments, AT facilitates access to the curriculum, participation, and independence.[14] Research highlights that effective AT integration requires not only device availability but also pedagogical adaptation, teacher training, and ongoing support.[15] In South Africa, policies such as Eucation White Paper 6 on Special Needs Education: Building an Inclusive Education and Training System[16] and the

[11] Farid Saber Nassar, Ahmed Osman Abbas, and Hassan Al-Sify, "Enhancing Quality of Learning Experiences for Students with Disabilities in Higher Education Institutions in Alignment with Sustainable Development Goals," *Journal of Ecohumanism* 3, no. 7 (2024); Suraj Singh Senjam and Souvik Manna, "Assistive Technology and Disabilities in the Context of Sustainable Developmental Goals," in *The Palgrave Encyclopedia of Disability* (Springer, 2024), 1–12; Wasswa Shafik, "SDG 4: Quality Education—Digital Platforms for Inclusive Learning," in *Factoring Technology in Global Sustainability: A Focus on the Sustainable Development Goals* (Springer, 2025), 163–93.

[12] Department of Basic Education. *Policy on Screening, Identification, Assessment and Support (SIAS)*. Pretoria: Government Printer, 2014; Walton, Elizabeth, and Petra Engelbrecht. "Inclusive education in South Africa: Path dependencies and emergences." *International Journal of Inclusive Education* 28, no. 10 (2024): 2138-2156..

[13] Sunil Kumar Agrahari, "The Crucial Role of Accessibility Tools and Software in Meeting the Needs of Individuals with Learning Disabilities," *Cutting Edge in Special Education* 121 (2023); Rachid Ed-dali, "Bridging the Gap: The Role of Assistive Technologies in Enhancing Translation Accessibility for Visually Impaired Learners in Moroccan Higher Educational Institutions," *Journal of Interdisciplinary Studies in Education* 14, no. 3 (2025): 121–48.

[14] Karen E Koehler and Tiffany A Wild, "Students with Visual Impairments' Access and Participation in the Science Curriculum: Views of Teachers of Students with Visual Impairments," *Journal of Science Education for Students with Disabilities* 22, no. 1 (2019): 8.

[15] Joachim K Krauss et al., "Technology of Deep Brain Stimulation: Current Status and Future Directions," *Nature Reviews Neurology* 17, no. 2 (2021): 75–87.

[16] Department of Basic Education, *White Paper 6: Special Needs Education: Building an Inclusive Education and Training System* (Pretoria: Government Printers, 2001).

Policy on Screening, Identification, Assessment, and Support (SIAS)[17] emphasise the provision of AT as part of reasonable accommodation. However, studies show that while AT devices are sometimes provided, their underutilisation stems from teachers' limited digital skills and confidence in integrating them into lessons.[18]

Teacher Digital Competence: Frameworks and Relevance to AT Integration

Teacher digital competence refers to educators' ability to use digital tools effectively to enhance teaching, learning, and assessment, including the capacity to adapt digital resources to meet diverse learner needs.[19] The European Framework for the Digital Competence of Educators (DigCompEdu) identifies six key competence areas: (1) Professional engagement, (2) Digital resources, (3) Teaching and learning, (4) Assessment, (5) Empowering learners, and (6) Facilitating learners' digital competence.[20] Msimango argues that these competences are directly applicable to assistive technology (AT) integration, particularly in designing accessible learning environments and supporting learners with disabilities; however, South African research highlights significant gaps in teacher digital competence, especially in under-resourced rural schools where ICT integration remains minimal.[21] For special needs educators, digital competence must extend beyond general ICT literacy to include knowledge of specialised AT devices, software, and accessibility standards, highlighting the importance of targeted training.[22]

Teacher Confidence and Self-Efficacy in Technology Integration

Teacher confidence, often conceptualised as self-efficacy, is a key predictor of technology adoption and sustained integration in classrooms.[23] Self-efficacy in technology integration reflects a teacher's belief in their ability to effectively use digital tools to enhance learning outcomes. Studies by Hall et al. and Gomez Jr et al. have consistently shown that teachers with high self-efficacy are more likely to experiment with technology, adapt to new tools, and persist in overcoming challenges.[24] In the context of AT, low confidence can lead to underuse or abandonment of devices, even when they are available.[25] Factors influencing confidence include prior experience, access to professional development opportunities, peer support, and the availability of technical support systems. For teachers in rural South African special schools, confidence is often undermined by limited exposure to AT during pre-service training and inadequate in-service opportunities.[26]

Pedagogical Knowledge Models: TPACK and UDL for AT Integration

The TPACK framework provides a useful lens for understanding how teachers integrate AT into teaching practices. TPACK emphasises the intersection of technological knowledge, pedagogical

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[17] Department of Basic Education, *Policy on Screening, Identification, Assessment and Support (SIAS)* (Pretoria: Government Printer, 2014).

[18] Renée R. Rousey, "Teachers' Attitudes, Beliefs, and Confidence Levels and Technology Integration in Urban Schools" (Walden University, 2020); Katerina Tzafilkou, Maria Perifanou, and Anastasios A Economides, "STEM Distance Teaching: Investigating STEM Teachers' Attitudes, Barriers, and Training Needs," *Education Sciences* 12, no. 11 (2022): 790.

[19] A E Adeshina, "The Transformative Role of Digital Resources in Teaching and Learning," *Open Journal of Educational Development (ISSN: 2734-2050)* 5, no. 1 (2024): 1–9.

[20] Y. Punie, *European Framework for the Digital Competence of Educators* (DigCompEdu. Publications Office., 2017).

[21] Welile Ntombifuthi Msimango, "Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology: Digital Pedagogy as a Catalyst for Empowering South African Pre-Service Teachers," *Empowering Pre-Service Teachers to Enhance Inclusive Education Through Technology*, 2025, 59–86.

[22] Abdul Jalil Toha Tohara et al., "Exploring Digital Literacy Strategies for Students with Special Educational Needs in the Digital Age," *Turkish Journal of Computer and Mathematics Education* 12, no. 9 (2021): 3345–58.

[23] Frank C Gomez Jr et al., "Exploring Teachers' Technology Integration Self-Efficacy through the 2017 ISTE Standards," *TechTrends* 66, no. 2 (2022): 159–71.

[24] Allison Hall, Lida Uribe-Flórez, and Kerry Rice, "Studying Teachers' Self-Efficacy and Experience While Empowering Technology Use through Personalized Professional Learning," *Journal of Technology and Teacher Education* 27, no. 3 (2019): 373–413; Gomez Jr et al., "Exploring Teachers' Technology Integration Self-Efficacy through the 2017 ISTE Standards."

[25] Alhadi M Jahan, Paulette Guitard, and Jeffrey W Jutai, "Assistive Devices Non-Use, Abandonment, or Non-Adherence? Toward Standard Terminology for Assistive Devices Outcomes," *Assistive Technology* 37, no. 5 (2025): 388–98.

[26] Dorita Du Toit, "Service-Learning within Field Experience of Physical Education Teacher Education in South Africa: Experiences of Pre-Service and in-Service Teachers," *South African Journal for Research in Sport, Physical Education and Recreation* 41, no. 1 (2019): 13–29.

knowledge, and content knowledge as essential for effective technology use in classrooms.[27] For visually impaired learners, this means selecting AT that aligns with curriculum goals, adapting pedagogical strategies to leverage AT affordances, and ensuring accessibility in content delivery. Complementing TPACK, Universal Design for Learning (UDL) advocates for multiple means of representation, engagement, and expression, aligning closely with inclusive practices facilitated by AT.[28] Research underscores that teachers who internalise TPACK and UDL principles are more adept at integrating AT to address diverse learning needs.[29]

Policy and Systemic Influences on AT Integration in South Africa

While South Africa's inclusive education policies advocate for the use of AT, systemic barriers impede effective implementation. Challenges include inadequate funding for procurement and maintenance, insufficient teacher training, unreliable technical support, and weak monitoring and evaluation systems.[30] Studies in the Eastern Cape reveal that rural schools often lack basic infrastructure such as electricity and internet connectivity, further hindering digital and AT integration.[31] These systemic constraints highlight the need for capacity-building initiatives that address not only teacher skills and confidence but also institutional readiness and sustainability.

Empirical Studies on AT Integration for Visually Impaired Learners

Empirical evidence from sub-Saharan Africa shows that AT effectively integrated into teaching improves academic performance, independence, and social inclusion for visually impaired learners.[32] However, utilisation rates remain low due to teacher-related barriers. A South African study by Starks and Reich found that while most special schools had access to basic AT, fewer than half of the teachers used it regularly due to a lack of confidence and technical expertise.[33] Another study by Akinyemi et al. revealed that ongoing professional development, mentorship, and collaborative communities of practice significantly increased teachers' competence and confidence in AT use.[34] These findings underscore the critical interplay between digital competence, confidence, and institutional support.

THEORETICAL FRAMEWORK

This study is underpinned by two complementary theoretical perspectives: the TPACK framework[35] and Self-Efficacy Theory.[36] These frameworks collectively provide a robust lens for understanding the interplay between teachers' knowledge domains, confidence, and practice in integrating AT for learners with visual impairments. While TPACK focuses on the *knowledge base* required for effective technology integration, Self-Efficacy Theory explains the *beliefs* that motivate and sustain such

[27] Punya Mishra and Matthew J Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teachers College Record* 108, no. 6 (2006): 1017–54.

[28] Kimberly Jackson, "Universal Design for Learning (UDL) and Technological Pedagogical and Content Knowledge (TPACK): Content and Technology Integration," in *SITE Interactive Conference* (Association for the Advancement of Computing in Education (AACE), 2020), 689–96.

[29] Tendai Charles and Ayesha Alshamsi, "Navigating Challenges in Technology Integration for Inclusive Classrooms: Insights for Pre-Service Teachers," in *Empowering Pre-Service Teachers to Enhance Inclusive Education through Technology* (IGI Global Scientific Publishing, 2025), 87–126.

[30] Abdul Razak Musah, Derick Vosloo, and Wayne Draai, "Influencing Building and Infrastructure Poor Performance to Inadequate Maintenance Budget and Funding," in *Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster, Development: Proceedings of the 15th Built Environment Conference* (Springer, 2022), 345–62.

[31] Kehinde Aruleba and Nobert Jere, "Exploring Digital Transforming Challenges in Rural Areas of South Africa through a Systematic Review of Empirical Studies," *Scientific African* 16 (2022): e01190.

[32] Guy Le Fanu, Elena Schmidt, and Bhavisha Virendrakumar, "Inclusive Education for Children with Visual Impairments in Sub-Saharan Africa: Realising the Promise of the Convention on the Rights of Persons with Disabilities," *International Journal of Educational Development* 91 (2022): 102574; Mathabo Joalane Catherine Lebona, "Enhancing Teachers' Skills to Improve Academic Performance among Learners with Visual Impairment: A Case of Selected Primary Schools in Maseru, Lesotho" (University of the Free State, 2024).

[33] Allison C Starks and Stephanie M Reich, ""What about Special Ed?": Barriers and Enablers for Teaching with Technology in Special Education," *Computers & Education* 193 (2023): 104665.

[34] Adeola Folasade Akinyemi et al., "Collaboration and Mutual Support as Processes Established by Communities of Practice to Improve Continuing Professional Teachers' Development in High Schools," *Cogent Education* 6, no. 1 (2019): 1685446.

[35] Matthew Koehler and Punya Mishra, "What Is Technological Pedagogical Content Knowledge (TPACK)?," *Contemporary Issues in Technology and Teacher Education* 9, no. 1 (2009): 60–70.

[36] Albert Bandura, "Self-Efficacy: Toward a Unifying Theory of Behavioral Change.," *Psychological Review* 84, no. 2 (1977): 191.

integration. Together, they enable an in-depth exploration of both the cognitive and affective dimensions of teacher preparedness in resource-constrained special education settings.

The conceptual framework illustrates the theoretical foundations guiding this study on teacher digital competence and confidence in integrating AT for visually impaired learners. It synthesises the TPACK framework and Self-Efficacy Theory[37] to highlight the interrelationship between teachers' knowledge domains, their confidence in using AT, and the contextual factors influencing effective implementation within a rural South African special education setting.

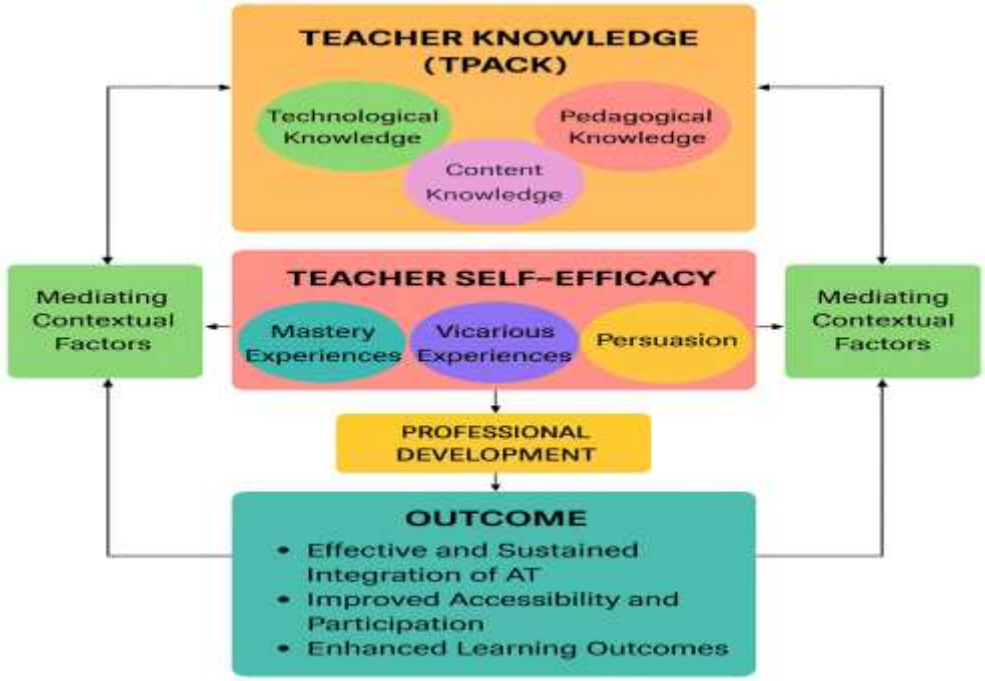

Figure 1: Conceptual Framework of Teacher Digital Competence and Confidence for Assistive Technology Integration.

Figure 1: Conceptual Framework of Teacher Digital Competence and Confidence for Assistive Technology Integration. The framework integrates TPACK and Self-Efficacy Theory to show how teacher knowledge (technological, pedagogical, and content), self-beliefs (mastery, vicarious experiences, persuasion, and affective states), and contextual factors (infrastructure, professional development, and leadership support) collectively contribute to the effective integration of AT, resulting in improved accessibility, participation, and learning outcomes for visually impaired learners.

This framework emphasises that successful AT integration is not solely a function of technical proficiency, but rather emerges from the dynamic interplay of knowledge, confidence, and systemic support. By situating teacher practice within these interrelated domains, the study provides a holistic lens for analysing current challenges and identifying targeted strategies to enhance inclusive, technology-supported education in resource-constrained environments.

Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework, building on Angeli and Valanides's concept of Pedagogical Content Knowledge (PCK), incorporates technological knowledge as a critical domain for contemporary teaching.[38] It emphasises the integration of Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) to support effective and inclusive instruction. In the context of assistive technology (AT) for learners with visual impairments, TPACK highlights teachers' ability to

[37] Bandura, "Self-Efficacy: Toward a Unifying Theory of Behavioral Change."
[38] Charoula Angeli and Nicos Valanides, *Technological Pedagogical Content Knowledge: Exploring, Developing, and Assessing TPCK* (Springer, 2014).

select appropriate AT aligned with curriculum goals, adapt pedagogical strategies to utilise AT effectively, and embed technology-driven accessibility measures into everyday teaching. This holistic approach ensures that technology is not treated as an add-on but as an integral component of inclusive, curriculum-driven learning.[39]

Self-Efficacy Theory

Self-Efficacy Theory, a core element of Bandura's Social Cognitive Theory, emphasises an individual's belief in their ability to perform actions required to achieve specific outcomes, influencing their effort, persistence, and resilience.[40] In the context of technology use, teacher self-efficacy is a critical determinant of effective AT integration, as it shapes how educators perceive and address challenges in adopting and sustaining new practices.[41] Bandura identifies four key sources of self-efficacy relevant to AT integration: mastery experiences, where successful use of AT builds confidence; vicarious experiences, where observing peers effectively integrating AT enhances self-belief; verbal persuasion, where positive feedback strengthens motivation; and physiological and affective states, where emotional responses to technology tasks impact engagement. Together, these factors determine not only whether teachers will adopt AT but also the quality and persistence of their integration efforts, particularly in resource-constrained rural contexts.

Integration of TPACK and Self-Efficacy Theory

The integration of TPACK and Self-Efficacy Theory offers a comprehensive lens for understanding teacher digital competence in AT use by linking knowledge with motivation. While TPACK identifies the essential knowledge base for AT integration, Self-Efficacy Theory explains the confidence and motivation needed to apply this knowledge effectively. Teachers may have the requisite TPACK knowledge, but without strong self-efficacy, they might hesitate to implement it, particularly in resource-constrained settings. Successful application of TPACK-based skills enhances self-efficacy through mastery experiences, creating a positive feedback loop that fosters sustained and innovative AT use. Conversely, low confidence can hinder engagement with AT and limit the development of competence. Contextual factors, including infrastructure, professional development, leadership, and collaboration, further influence both competence and confidence. In this study, TPACK will inform the evaluation of teachers' knowledge and integration capacity, while Self-Efficacy Theory will frame the analysis of their confidence, motivation, and resilience in overcoming barriers to the use of AT.

METHODOLOGY

Research Approach

This study employed a qualitative research approach, which is particularly well-suited for exploring complex social phenomena, such as the integration of AT in inclusive education settings. A qualitative approach is grounded in interpretivist paradigms, which emphasise understanding participants' lived experiences, perspectives, and the contextual factors influencing their practices.[42] A qualitative research approach is highly suitable for this study, as it enables an in-depth exploration of the complex contextual realities influencing the integration of AT in South African schools, including resource disparities, policy implementation challenges, and socio-cultural perceptions of disability.[43] It prioritises understanding the lived experiences, attitudes, and perceptions of teachers and support staff, providing authentic insights into the challenges and enablers of AT use. Its iterative and flexible nature

[39] Evrim Baran and Erdem Uygun, "Putting Technological, Pedagogical, and Content Knowledge (TPACK) in Action: An Integrated TPACK-Design-Based Learning (DBL) Approach," *Australasian Journal of Educational Technology* 32, no. 2 (2016); Koehler and Mishra, "What Is Technological Pedagogical Content Knowledge (TPACK)?"

[40] Bandura, "Self-Efficacy: Toward a Unifying Theory of Behavioral Change."

[41] Armando Leon Gilkes, "Teachers' Knowledge and Self-Efficacy Beliefs as Factors Affecting Technology Integration Practices" (Walden University, 2020).

[42] Nasrin Pervin and Mahani Mokhtar, "The Interpretivist Research Paradigm: A Subjective Notion of a Social Context," *International Journal of Academic Research in Progressive Education and Development* 11, no. 2 (2022): 419–28.

[43] Isaac Tuffour, "A Critical Overview of Interpretative Phenomenological Analysis: A Contemporary Qualitative Research Approach," *Journal of Healthcare Communications* 2, no. 4 (2017): 52.

allows the researcher to adapt to emerging issues, ensuring responsiveness to participants' contexts.[44] Furthermore, the approach generates rich, contextually grounded findings that can inform professional development, resource allocation, and policy interventions, aligning directly with the study's aim of understanding and improving AT integration in inclusive, under-resourced rural schools in South Africa.

Research Design

This study adopted a qualitative case study research design to explore the integration of AT in inclusive education within under-resourced rural schools in South Africa. The case study approach, as defined by an empirical inquiry, is an investigation of a phenomenon within its real-life context, particularly when the boundaries between the phenomenon and its context are not clearly evident. This design enables an in-depth examination of teachers' digital competences, school-level practices, and systemic challenges influencing AT integration in inclusive classrooms.

Sampling Strategy

The study employed purposeful sampling to select 10 teachers who are most knowledgeable and experienced in the integration of AT for learners with visual impairments at the selected special school.[45] Participants were chosen based on specific criteria, including a minimum of one year's teaching experience in special education, direct use of AT in their instructional practices, and willingness to provide detailed insights into their experiences, ensuring a diverse range of perspectives while maintaining the feasibility of in-depth data collection.

Data Collection Method

The data was collected through semi-structured interviews, focus group discussions, and document analysis involving teachers and school administrators. Semi-structured interviews allowed the participants to express their experiences and insights regarding AT integration in their own words while enabling the researcher to probe for depth and clarity. Focus group discussions foster interaction among participants, generating richer data through the exchange of experiences and collaborative reflections.[46] Document analysis, including policy documents and school support records, provided contextual background and helped triangulate the findings.

Data Collection Procedure

The data collection process involved obtaining ethical clearance from the relevant university ethics committee, as well as permission from the Provincial Department of Education, and subsequently receiving formal approval from the school principal. Participants were provided with informed consent forms that outlined the purpose of the study, their rights, and the confidentiality measures. Interviews were scheduled at times convenient to participants and conducted in a quiet, private space within the school to ensure comfort and confidentiality. All interviews were transcribed verbatim to accurately capture participants' voices, and data were securely stored on password-protected devices with participants anonymised through the use of pseudonyms.

[44] Weng Marc Lim, "What Is Qualitative Research? An Overview and Guidelines," *Australasian Marketing Journal* 33, no. 2 (2025): 199–229.
[45] Samuel J Stratton, "Purposeful Sampling: Advantages and Pitfalls," *Prehospital and Disaster Medicine* 39, no. 2 (2024): 121–22.
[46] Tobias O. Nyumba et al., "The Use of Focus Group Discussion Methodology: Insights from Two Decades of Application in Conservation," *Methods in Ecology and Evolution* 9, no. 1 (2018): 20–32.

Data Analysis

Data was analysed using thematic analysis, a systematic process of identifying, coding, and interpreting patterns within the data to generate themes that provide a nuanced understanding of barriers, opportunities, and practices in AT integration.[47] The analysis involved repeated reading of transcripts for familiarisation, systematic coding of significant data features, collating codes into potential themes, reviewing and refining themes for coherence, clearly defining and naming each theme in relation to the research questions, and finally integrating the thematic findings with relevant literature to produce a comprehensive report.

Trustworthiness of the Study

To ensure trustworthiness, this study applied Lincoln and Guba's (criteria by enhancing credibility through prolonged engagement, data triangulation, and member checking; ensuring dependability via a transparent audit trail of research decisions and processes; maintaining confirmability through reflexivity, including a researcher journal and the use of verbatim participant quotations to ground findings; and promoting transferability by providing thick, detailed descriptions of the research context, participants, and findings to enable applicability to other settings.[48]

Ethical Considerations

Ethical clearance was obtained from the university's Research Ethics Committee, and permission will be sought from the Provincial Department of Basic Education and the school principal. Participants were fully informed about the study's purpose, procedures, potential risks, and benefits. Informed consent was obtained prior to participation. Confidentiality was maintained by anonymising all data and ensuring that no identifiable information was disclosed in reports. Participation was voluntary, and participants were informed that they could withdraw from the study at any stage without penalty.

PRESENTATION OF FINDINGS

Theme 1: Conceptualising Assistive Technology in Inclusive Education

Teachers in rural schools conceptualised assistive technology (AT) primarily through the lens of what is physically available to them, often limited to low-tech solutions. While some recognised the broader potential of AT, their understanding was constrained by inadequate exposure to advanced tools due to poor resource provision:

> *"Assistive technology here is mostly the braille machine and sometimes large print books. We don't have the talking computers or the screen readers we hear about in workshops."* (Teacher A)

> *"AT is supposed to make learning equal for all children, but without the proper devices and resources, we can only do so much."* (Teacher C)

This reveals a conceptual gap influenced by resource scarcity, where teachers equate AT with basic devices rather than a comprehensive suite of digital solutions that could transform inclusive education.[49]

Theme 2: Teacher Digital Competence: Frameworks and Relevance to AT Integration

Teachers demonstrated limited digital competence, shaped by a lack of access to both training and infrastructure. They often reported insufficient ICT resources, outdated equipment, and non-functional facilities, hindering the development of skills required for integrating AT:

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[47] Virginia Braun and Victoria Clarke, "Using Thematic Analysis in Psychology," *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101.

[48] Yvonna Lincoln and Egon G Guba, *Naturalistic Inquiry* (Beverly Hills, CA: Sage Publications, 1985).

[49] Farhat Naureen Memon and Sarwat Naureen Memon, "Digital Divide and Equity in Education: Bridging Gaps to Ensure Inclusive Learning," in *Impact of Digitalization on Education and Social Sustainability* (IGI Global Scientific Publishing, 2025), 107–30.

"We have a computer lab, but only three computers are working, and they don't have the software for visually impaired learners. So even if I wanted to learn, there is nothing to practice on." (Teacher B)

"Without internet, we cannot download teaching materials or updates for assistive software. It's like we are cut off from the world." (Teacher F)

The **DigCompEdu framework**, as highlighted by Falloon (2020), emphasises that digital competence encompasses not only skills but also access to digital tools and environments.[50] In rural contexts, limited resources severely restrict teachers' ability to engage with AT beyond theoretical knowledge, resulting in a significant skills gap.

Theme 3: Teacher Confidence and Self-Efficacy in Technology Integration

The lack of infrastructure and reliable resources directly affected teachers' confidence and willingness to integrate AT into their teaching practices. Many expressed frustration over trying to implement AT in environments where basic necessities were missing:

"Sometimes I feel like giving up. You prepare to use technology in your lesson, but then there is no electricity or the device doesn't work. It makes you feel like you are failing the learners." (Teacher D)

"How can I be confident with these tools when we have no internet to test them or get support? We are left on our own here." (Teacher E)

These sentiments illustrate Bandura's assertion that self-efficacy is influenced by environmental conditions.[51] Even when teachers are motivated, repeated negative experiences, such as broken equipment, a lack of connectivity, and a lack of support, erode their belief in their ability to succeed with AT integration.

Theme 4: Pedagogical Knowledge Models: TPACK and UDL for AT Integration

Teachers' ability to integrate AT pedagogically was undermined by inadequate infrastructure and resources. Although they understood the need to adapt teaching to meet learners' needs, they struggled to operationalise inclusive approaches without the necessary tools:

"I want to make tactile diagrams for maths, but we don't have the machines or materials. I just describe the shapes, but I know the learner needs more." (Teacher C)

"We cannot fully apply what we learn in workshops because our school lacks the devices and internet needed to support Universal Design for Learning. We end up improvising with what little we have." (Teacher B)

The TPACK framework emphasises that effective technology integration requires a synergy between knowledge domains supported by functional tools.[52] Similarly, UDL principles rely on varied representations and resources, which are unachievable without adequate infrastructure.

Theme 5: Policy and Systemic Influences on AT Integration in South Africa

Teachers repeatedly cited systemic challenges insufficient funding, unreliable infrastructure, and poor connectivity, as barriers to implementing policies such as the Education White Paper 6 and the SIAS Policy**:**

"We are told that every learner must have equal access, but the reality is we cannot meet these policies without proper support. We don't even have Wi-Fi at the school." (Teacher A)

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[50] Garry Falloon, "From Digital Literacy to Digital Competence: The Teacher Digital Competency (TDC) Framework," *Educational Technology Research and Development* 68, no. 5 (October 29, 2020): 2449–72, https://doi.org/10.1007/s11423-020-09767-4.

[51] Albert Bandura, *Self-Efficacy: The Exercise of Control* (Macmillan, 1997).

[52] Koehler and Mishra, "What Is Technological Pedagogical Content Knowledge (TPACK)?"

"The government sends policies but no equipment. Without resources, these policies stay on paper and don't reach the learners." (Teacher F)

These statements highlighted a critical policy, practice gap where policy intent is undermined by a lack of systemic investment in infrastructure, particularly in rural areas.[53] The absence of reliable electricity, internet connectivity, and device maintenance systems perpetuates exclusion despite formal commitments to inclusion.

DISCUSSION

The findings of this study reveal that the integration of ATs in rural special schools is significantly influenced by teachers' digital competence, confidence, and the systemic context within which they operate. Teachers' understanding of AT was largely shaped by the resources available in their immediate environment.[54] Their conceptualisation tended to focus on low-tech solutions, such as braille machines and large-print materials, with limited awareness or utilisation of advanced digital tools, including screen readers, refreshable braille displays, and specialised software. This restricted understanding aligns with existing literature indicating that resource constraints in rural settings often limit teachers' exposure to the full spectrum of AT, thereby narrowing their perceptions of what constitutes inclusive technological support.[55]

The study further demonstrates that teachers' digital competence in AT integration remains underdeveloped, primarily due to insufficient training opportunities, inadequate infrastructure, and a lack of functional ICT resources. Although educators possessed basic computer literacy, they lacked the advanced skills required to adapt digital tools to meet the needs of learners with visual impairments. This finding corroborates the DigCompEdu framework of Belachew et al., which posits that digital competence encompasses not only technical proficiency but also the ability to design and implement inclusive, technology-supported pedagogy.[56] To Nhlumayo, the absence of sustained professional development specific to AT in the study context underscores a critical gap between policy intentions and practical implementation, particularly in rural South African schools where professional learning opportunities are sporadic and generalist in nature.[57]

Teachers' confidence and self-efficacy in using AT were also found to be limited, a factor that further constrains integration efforts. Participants often reported feelings of uncertainty and apprehension when required to use digital tools, particularly in environments characterised by unreliable infrastructure and minimal technical support. This aligns with Self-Efficacy Theory which emphasises that an individual's belief in their ability to succeed directly impacts their performance and persistence in undertaking tasks.[58] The lack of mastery experiences, inadequate peer support, and repeated encounters with technical failures appear to have eroded teachers' confidence, resulting in a reliance on traditional teaching methods despite their awareness of the potential benefits of AT. Similar trends have been reported in studies where low self-efficacy was identified as a major barrier to

[53] Tochukwu S Ezeudu and Taofiq James Fadeyi, "Examining the Influence of Infrastructure Deficit on Economic Activities, Education, and Healthcare in Rural Areas of Nigeria," *Nnamdi Azikiwe Journal of Political Science* 9, no. 1 (2024): 155–76.

[54] José Luis Lupiáñez, Daniela Olivares, and Isidoro Segovia, "Examining the Role Played by Resources, Goals and Orientations in Primary Teachers' Decision-Making for Problem-Solving Lesson Plans," *ZDM–Mathematics Education* 56, no. 6 (2024): 1153–67.

[55] Yaw Ofosu-Asare, "Developing Classroom ICT Teaching Techniques, Principles and Practice for Teachers in Rural Ghana without Access to Computers or Internet: A Framework Based on Literature Review," *The International Journal of Information and Learning Technology* 41, no. 3 (2024): 262–79; Saga Stenman and Fanny Pettersson, "Remote Teaching for Equal and Inclusive Education in Rural Areas? An Analysis of Teachers' Perspectives on Remote Teaching," *The International Journal of Information and Learning Technology* 37, no. 3 (2020): 87–98.

[56] Meberate Belachew et al., "The Impact of Digital Empowerment Training on the Awareness of Assistive Technologies and Digital Competence Skills among Students with Visual Impairment," *Disability and Rehabilitation: Assistive Technology* 20, no. 8 (2025): 2872–84.

[57] Buhle Stella Nhlumayo, "The Dynamics of Implementing School-Based Teacher Professional Development in South Africa: A Case Study of One Rural Education Circuit in KwaZulu-Natal" (University of KwaZulu-Natal, 2020).

[58] Bandura, *Self-Efficacy: The Exercise of Control*.

educational technology adoption, especially in resource-limited settings.[59] The interplay between pedagogical knowledge and technological integration emerged as another critical area of concern. Teachers struggled to combine their subject knowledge with technology and inclusive teaching strategies effectively, reflecting the limited application of frameworks such as TPACK[60] and UDL.[61] Although they recognised the need to differentiate instruction for learners with visual impairments, they lacked the tools, materials, and pedagogical models necessary to do so in a meaningful and sustainable way. This resulted in ad hoc adaptations rather than comprehensive, inclusive lesson design, further perpetuating inequities in access and learning outcomes.[62]

Systemic and policy-related challenges emerged as overarching constraints to AT integration. Despite South Africa's progressive, inclusive education policies, including Education White Paper 6 and the Policy on SIAS, the study revealed a persistent gap between policy and practice.[63] Chronic underfunding, unreliable electricity supply, the absence of internet connectivity, and a lack of technical maintenance support all undermine the implementation of these policies in rural contexts. Technical maintenance support deficiencies undermine the implementation of these policies in rural contexts, as White and Fletcher contend that such structural barriers effectively neutralise the transformative potential of AT, leaving educators to navigate inclusive education with minimal support.[64] Prior research similarly highlights the disconnect between policy frameworks and ground-level realities in South Africa's rural education landscape, emphasising the need for coherent systems of support and resource allocation.[65]

Overall, the findings illustrate that teacher digital competence and confidence cannot be viewed in isolation but must be understood within a broader ecosystem of infrastructural readiness, professional development, and systemic support. Without targeted interventions addressing both individual-level capacity and structural constraints, the integration of AT in rural special schools will remain fragmented and ineffective. These results reinforce the need for context-specific solutions, including continuous professional development focused on AT, investments in infrastructure and connectivity, and the establishment of school-based support systems to foster educators' competence and confidence.

RECOMMENDATIONS

- **Enhancing Conceptualisation of Assistive Technology in Inclusive Education:** Teachers in rural schools require broader exposure to modern assistive technologies, extending beyond basic, low-tech tools. This requires structured professional development, access to diverse AT devices through demonstration centres, and integration of AT education into pre-service teacher training. Partnerships with universities, NGOs, and technology providers can further build teachers' skills and promote AT as a transformative tool for inclusive education.
- **Strengthening Teacher Digital Competence for AT Integration :** There is an urgent need for sustained capacity-building in teachers' digital skills through competency-based CPD aligned with frameworks such as DigCompEdu. This should include modular training on integrating AT, supported by improved ICT infrastructure, specialised software, and reliable connectivity in rural schools. Additionally, district-level technical support and peer-led professional learning

[59] David Ansong et al., "The Importance of Self-Efficacy and Educational Aspirations for Academic Achievement in Resource-Limited Countries: Evidence from Ghana," *Journal of Adolescence* 70 (2019): 13–23; Jiyuan Feng et al., "Key Factors Influencing Educational Technology Adoption in Higher Education: A Systematic Review," *PLOS Digital Health* 4, no. 4 (2025): e0000764.

[60] Jun-Jie Tseng et al., "A Critical Review of Research on Technological Pedagogical and Content Knowledge (TPACK) in Language Teaching," *Computer Assisted Language Learning* 35, no. 4 (2022): 948–71.

[61] Laura Rusconi and Myriam Squillaci, "Effects of a Universal Design for Learning (UDL) Training Course on the Development Teachers' Competences: A Systematic Review," *Education Sciences* 13, no. 5 (2023): 466.

[62] M. Sharma, *Inclusive Education and Parental Involvement: Mainstream School and Integration of Disabled Children* (Laxmi Book Publication, 2024).

[63] Mantheme Florina Matolo and Awelani M Rambuda, "Factors Impacting the Application of an Inclusive Education Policy on Screening, Identification, Assessment, and Support of the Learners at Schools in South Africa," *International Journal of Learning, Teaching and Educational Research* 20, no. 9 (2021): 207–21.

[64] Robert White and Grace Fletcher, "Navigating Inclusive Education in Mainstream Primary Schools: A Phenomenological Study of Teachers' Perceptions and Experiences," *International Journal of Inclusive Education*, 2025, 1–29.

[65] Dana Donohue and Juan Bornman, "The Challenges of Realising Inclusive Education in South Africa," *South African Journal of Education* 34, no. 2 (2014).

communities (PLCs) can promote ongoing collaboration and effective AT implementation to advance inclusive education.

- **Building Teacher Confidence and Self-Efficacy in Technology Integration:** Teachers' self-efficacy is crucial for sustained AT integration and must be developed alongside competence. This can be achieved through hands-on training, mentorship, constructive feedback, and reliable infrastructure, which help build confidence and reduce the fear of failure. These strategies align with Bandura's Self-Efficacy Theory by enhancing mastery, modelling, encouragement, and positive experiences that promote ongoing AT use.
- **Improving Pedagogical Integration through TPACK and UDL Approaches:** For assistive technology (AT) to foster genuine inclusion, teachers need pedagogical frameworks that integrate technology, content, and pedagogy. This requires TPACK-based professional development, UDL-informed lesson planning, and accessible teaching resources to address diverse learner needs. Action research and reflective practice will further ensure that AT becomes an integral and effective component of teaching and learning.
- **Addressing Policy and Systemic Barriers to AT Integration :** Closing the policy–practice gap in inclusive education requires dedicated funding for AT, improved infrastructure in rural schools, and robust monitoring mechanisms. It also demands multi-stakeholder collaboration to mobilise resources and expertise for AT integration. Ultimately, updating and supporting policy implementation will create an enabling environment for effective AT use, ensuring inclusive education for learners with visual impairments.

CONCLUSION

The study focused on teacher digital competence and confidence in integrating assistive technologies for visually impaired learners in a rural special school in the Eastern Cape Province. It found that teachers have a limited understanding of AT due to scarce resources and exposure to low-tech solutions, hindering their ability to use technology effectively for inclusive education. Infrastructure limitations, lack of professional development, and low digital skills further impede teachers' integration of AT, eroding confidence and hindering innovation in their teaching practices. The study concludes that support for teachers in AT integration must include enabling environments, functional infrastructure, targeted training, and systemic commitment to ensure inclusive and quality education in rural South African schools. The research highlights the need for context-specific interventions to empower teachers and facilitate the use of AT in schools for visually impaired learners. It emphasises the importance of combining teacher capacity-building with resource investment and policy enforcement to unlock the potential of assistive technology in promoting educational equity. Future research could explore scalable models of professional development, assess the long-term impact of infrastructure improvements on inclusive practices, and evaluate collaborative partnerships to enhance AT integration. Overall, the study underscores the significance of a holistic approach to AT integration, incorporating pedagogical, infrastructural, and systemic elements to achieve sustainable and inclusive education for all learners.

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