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Inadequate Teacher Training as a Barrier to ICT Integration in Early Childhood Education: A Case of Selected Primary Schools in Tshwane West District Circuit 4

Zandile Mathebula*
Tshwane University of Technology
Pretoria, South Africa

Olika Moila
Walter Sisulu University
Mthatha, Eastern Cape, South Africa

Simeon Maile
Tshwane University of Technology
Pretoria, South Africa

Sibongile Mnisi
Tshwane University of Technology
Pretoria, South Africa

Abstract. The integration of information and communication technology (ICT) in education is essential for fostering digital literacy and preparing learners for future employment. However, many regions, particularly in developing countries, continue to face challenges in incorporating ICT effectively into early childhood education (ECE). This study investigates the impact of inadequate teacher training on ICT integration within South Africa's Gauteng region, focusing on schools in the Winterveldt Circuit 4. Guided by Rogers' diffusion of innovation theory, the study employed a quantitative research approach, collecting data from 200 Foundation Phase teachers to assess their attitudes towards ICT, the challenges they face, and the availability of digital resources. The data analysis that was conducted using descriptive and inferential statistics, revealed that while teachers acknowledge the benefits of ICT in education, integration efforts are hindered by insufficient training in pedagogical applications, limited access to digital tools, unreliable internet connectivity, and inadequate institutional support. The findings highlight the urgent need for comprehensive professional development, increased access to digital

*Corresponding author: Zandile Mathebula; *mtungwanz@gmail.com*

infrastructure, and stronger policy interventions to bridge the digital divide. The study recommends targeted teacher training programmes, equitable resource allocation, and policy reforms to ensure the effective implementation of ICT in early learning environments. By addressing these systemic barriers, the education sector can promote inclusive and technology-driven learning, equipping young learners with essential digital skills for academic and professional success.

Keywords: Early childhood education; Technology integration; Educational technology; Information and communication technology; Pedagogical training

1. Introduction

The integration of information and communication technology (ICT) in early childhood education is a crucial step towards preparing young learners for a digital-driven future. However, inadequate pedagogical training remains a significant barrier to effective technology adoption in classrooms. Numerous studies indicate that a lack of proper training leaves educators ill-equipped to utilise ICT tools effectively. Habibu et al. (2012) assert that without adequate professional development opportunities, teachers face difficulties in adopting and applying technology in their teaching. Prasad et al. (2015) further highlight systemic barriers such as insufficient training time, inadequate professional development programmes, and limited technical support, all of which contribute to teachers' reluctance or inability to integrate ICT effectively. Educational robotics, for instance, has been recognised as a valuable tool for enhancing problem-solving skills and creativity. However, various challenges hinder in-service teachers from incorporating robotics into their teaching practices. Papadakis et al. (2021) identify factors such as a lack of training, limited resources, and teachers' reluctance to adopt new technologies as key barriers to its implementation. Despite various educational initiatives, such as the Gauteng Department of Education's Five-Year ICT Programme, technology integration continues to be limited. This limitation primarily stems from educator training programmes that emphasise basic technical skills rather than pedagogical applications of ICT. As a result, many revert to traditional teaching methods, struggling to incorporate digital tools effectively into their lessons (Habibu et al., 2012; Prasad et al., 2015).

Moreover, the perception that technology use increases the workload without significantly improving teaching outcomes further discourages adoption. Ghavifekr et al. (2015) argue that many professional development initiatives fail to address the pedagogical integration of ICT, providing teachers with basic technical knowledge but without the necessary skills to incorporate technology into lesson planning or enhance learner engagement.

This issue is particularly prevalent in early childhood education, where ICT integration requires a specialised approach that aligns with young learners' developmental needs. The increasing exposure of young children to media and screen-based technologies has raised concerns among educators and caregivers. Sharkins et al. (2015) discuss the perspectives of caregivers on children's media

consumption, highlighting both the educational potential and the risks associated with excessive screen time. In the South African context, balancing the use of digital tools in life skills education while addressing socio-economic challenges requires a nuanced approach that considers both the benefits and limitations of technology.

Rogers' diffusion of innovations theory (2003) explains that technology adoption involves progressing through the stages of awareness, persuasion, decision-making, and implementation. However, inadequate training prevents teachers from moving beyond the initial awareness, limiting their ability to integrate ICT meaningfully into their pedagogy. Consequently, the transformative potential of technology in education remains unrealised. The historical context of South African education exacerbates these challenges. Legacy systems, such as Bantu Education, has left many educators underqualified and ill-prepared for modern teaching methodologies.

Although the Department of Basic Education (DBE) has implemented workshops and training sessions to address these gaps, logistical and resource constraints hinder their effectiveness. Most programmes focus on operational skills rather than on deeper pedagogical knowledge, leaving teachers without the necessary competencies to integrate ICT meaningfully into their instruction. Resource limitations further complicate efforts to enhance ICT use in classrooms. Prasad et al. (2015) note that inadequate access to essential technological tools, such as computers and high-speed internet, poses significant barriers, particularly in underprivileged schools. Overcrowded computer laboratories and shared resources reduce meaningful engagement with technology, reinforcing reliance on traditional teaching methods.

Teachers' attitudes and confidence in using ICT also influence its adoption to a large extent. According to Ghavifekr et al. (2015), teachers' confidence in technology integration is linked directly to the quality of their training. Teachers with minimal training often lack confidence in using digital tools, even when the resources are available (Muweesi et al., 2021). To bridge this gap, training programmes must extend beyond the basic technical skills and provide a strong foundation in pedagogical applications, thereby ensuring that teachers are equipped to leverage ICT effectively in early childhood education.

The study aims to investigate the impact of inadequate teacher training on ICT integration in early childhood education. By examining the challenges teachers face and the gaps in current professional development initiatives, this research aims to provide insights into effective strategies for enhancing teacher training programmes. The study also seeks to explore the role of pedagogical competence in improving ICT adoption and its influence on learning outcomes in early childhood education settings. While several studies have explored ICT integration in education, there is limited research that focuses specifically on early childhood education in South Africa. The existing research addresses ICT adoption at the secondary and tertiary levels primarily, leaving a critical gap in understanding how early childhood teachers navigate technology integration. This study aims to

fill this gap by identifying specific barriers faced by early childhood teachers and proposing targeted recommendations to enhance teacher training and ICT implementation at this foundational stage. By addressing these critical gaps in teacher training, South Africa can improve ICT integration in early childhood education, ultimately enhancing the learning outcomes and fostering digital literacy from an early age.

2. Literature Review

The integration of ICT in education is dependent on teachers' ability to a great extent to incorporate technology into their pedagogical practices. However, inadequate training continues to hinder effective ICT adoption in classrooms. Habibu et al. (2012) emphasise that many teachers lack the necessary skills due to limited opportunities for professional development. Most training programmes focus narrowly on basic computer literacy, such as operating word processors, rather than equipping teachers with pedagogical strategies that enhance teaching and learning. This gap between technical capability and pedagogical application fosters a reluctance among teachers to adopt ICT tools, thereby reinforcing the reliance on traditional and less interactive teaching methods.

Importantly, Ghavifekr et al. (2015) argue that the root of this issue lies in insufficient teacher training programmes. Workshops and short courses rarely focus on curriculum alignment, effective lesson planning, or strategies for engaging learners through technology. Consequently, teachers who undergo these programmes are technically proficient but struggle to translate their ICT knowledge into meaningful instructional practices. ICT use in classrooms is often restricted to basic functions, such as presenting slides or conducting internet searches, rather than fostering active learning, problem-solving, or collaboration. Furthermore, Prasad et al. (2015) highlight additional systemic barriers to effective ICT integration, such as inadequate professional development support, insufficient time for skills practice, and minimal technical assistance within schools. These challenges are particularly pronounced in under-resourced institutions where teachers face infrastructure deficits and overcrowded classrooms. Without ongoing training and support, teachers in such environments struggle to incorporate ICT effectively, thereby depriving learners of the benefits of a technology-enriched educational experience. Mlilo (2019) further emphasises the need for sustainable professional development programmes that continuously support educators in their ICT adoption journey.

Moreover, Kalogiannakis and Papadakis (2019) stress that ICT integration requires more than technical proficiency; teachers must understand the interplay between technology, pedagogy, and subject content. This aligns with the Technological Pedagogical Content Knowledge (TPACK) framework, which guides teachers in developing ICT-enhanced learning experiences. However, many existing training programmes fail to incorporate such comprehensive approaches, limiting the transformative potential of ICT in education.

The legacy of South Africa's apartheid-era education system has exacerbated the issue of inadequate teacher training. Historically, disparities in resource allocation

and teacher education have left many educators underqualified and ill-equipped to meet the demands of modern teaching, including ICT integration (Munje & Jita, 2020). While initiatives by the Department of Basic Education (DBE) aim to bridge these gaps, many efforts focus on the basic technical skills rather than equipping teachers with the pedagogical knowledge required for meaningful technology use in classrooms (Mashile, 2017; Umugiraneza et al., 2018).

Van Zyl and Sabiescu (2016) note that schools in underprivileged areas face additional hurdles, including limited access to ICT resources, outdated technology, and a lack of qualified trainers. Without structured guidance and mentorship, teachers in these settings must navigate ICT integration independently, leading to the inconsistent application of and missed opportunities for learner engagement through digital tools. The digital divide between urban and rural schools further exacerbates these inequalities, making equitable access to high-quality education a persistent challenge.

These issues are not unique to South Africa. Studies from other developing nations reveal similar trends. For instance, research in Kenya by Murithi and Yoo (2021) indicates that inadequate teacher training and resource limitations hinder ICT integration significantly. Such findings underscore the necessity for systemic reforms that enhance both teacher training and resource availability in underprivileged schools.

The COVID-19 pandemic exposed and intensified existing gaps in ICT integration. The abrupt transition to online learning revealed significant shortcomings in teachers' preparedness to deliver effective instruction using digital platforms. Hodges, Moore, Lockee et al. (2020) observe that many educators not only lacked the technical skills but also the pedagogical strategies essential for engaging learners in virtual classrooms. This lack of preparedness contributed to decreased learner participation, reduced academic performance, and widening educational inequalities.

Mhlanga and Moloi (2020) argue that the pandemic emphasised the urgent need to equip teachers with a holistic understanding of ICT integration. Beyond technical competency, teachers require training in digital pedagogy, including fostering interactivity, collaboration, and critical thinking in online settings. Tools, such as virtual whiteboards, discussion forums, and collaborative document editing platforms, when used effectively, can transform online lessons into engaging learning experiences.

Furthermore, the pandemic highlighted the need for adaptability in teacher training programmes. With technology evolving rapidly, professional development must be ongoing and responsive to emerging challenges. Mynarikova and Novotny (2021) advocate for modular, flexible training approaches that allow teachers to build their skills progressively while staying adaptable in terms of adopting new digital tools and instructional methodologies. Munje and Jita (2020) also emphasise the importance of peer mentorship

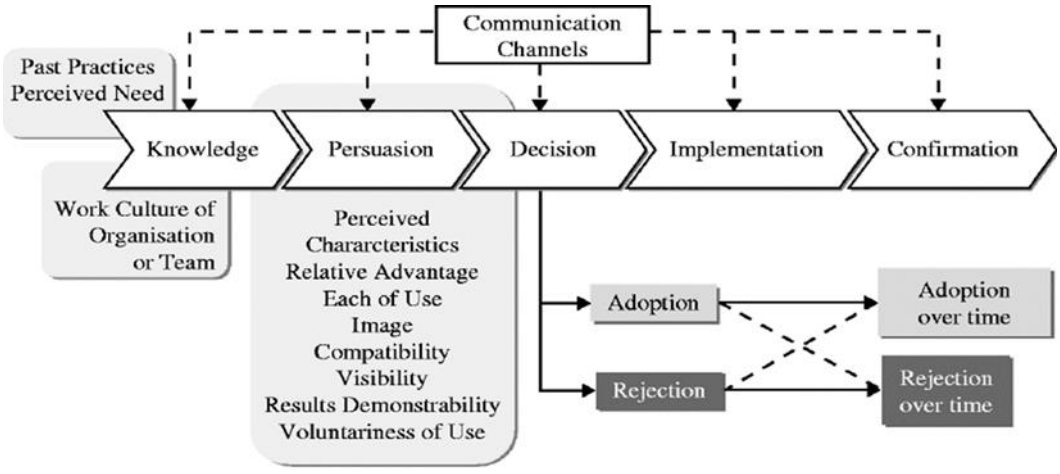
programmes that enable teachers to learn from each other and refine their ICT integration practices.

The lessons from the pandemic extend beyond immediate digital adoption challenges to broader policy implications. Governments and educational institutions must prioritise developing robust digital ecosystems that encompass both teacher training and access to reliable technology infrastructure. Public-private sector collaborations can help bridge resource gaps and ensure that teachers are adequately supported in their ICT integration efforts. Mashile (2017) further suggests that national policies must mandate continuous ICT training as part of teacher professional development to sustain long-term digital adoption in education.

By addressing these fundamental training and infrastructure gaps, South Africa can work towards a more equitable and effective ICT-integrated education system. The experiences from the COVID-19 era provide valuable insights into the critical need for teacher capacity-building initiatives that are both sustainable and responsive to technological advancements.

3. Theoretical Framework: Rogers' Diffusion of Innovations Theory

Rogers' diffusion of innovations theory (2003) presented in Figure 1 below, offers a valuable framework for analysing the processes and challenges of adopting new ideas, practices, or technologies within a social system. This theory is particularly relevant for understanding the barriers associated with inadequate teacher training in ICT integration. Rogers identifies five sequential stages in the adoption process: knowledge, persuasion, decision, implementation, and confirmation. Each stage represents a critical step in the journey towards the full adoption, and failures at any stage can significantly hinder progress.



Source: Rogers (2003)

Figure: Rogers's five-stage model of the adoption process

3.1. Knowledge

The first stage involves awareness and understanding of the innovation. Teachers must acquire both technical and pedagogical knowledge about ICT tools to

recognise their potential to enhance teaching and learning. This stage emphasises the importance of comprehensive training programmes that equip teachers with foundational skills while demonstrating the practical applications of technology in the classroom (Ghavifekr et al., 2015).

However, many training programmes fall short of providing this dual focus, instead they offer superficial exposure to ICT tools without exploring their integration into the curriculum delivery (Habibu et al., 2012). Without an adequate understanding of how technology can align with their teaching objectives, teachers are unlikely to progress to the subsequent stages of adoption.

3.2. Persuasion

At this stage, individuals develop attitudes towards the innovation based on its perceived benefits and ease of use. For teachers, positive attitudes can be cultivated through hands-on, experiential training that highlights the effectiveness of ICT in engaging learners and improving outcomes. According to Ertmer and Ottenbreit-Leftwich (2010), the perceived value and ease of use are critical factors influencing teachers' willingness to adopt technology.

Negative attitudes, on the other hand, often stem from previous unsuccessful experiences with ICT or a lack of confidence in their technical abilities. Training programmes that incorporate peer collaboration and success stories from fellow educators can help mitigate these barriers and foster a culture of openness toward innovation (Mertala, 2019).

3.3 Decision

This stage involves a conscious choice to adopt or reject innovation. Teachers evaluate the relevance of ICT to their instructional needs and weigh the potential benefits against the perceived risks. Adequate training can play a decisive role in reducing uncertainty and building confidence, ultimately encouraging adoption.
Rogers (2003) notes that individuals are more likely to adopt innovations when they perceive compatibility with existing values, simplicity in implementation, and observable benefits. For example, when teachers see clear improvements in learner engagement and academic performance resulting from ICT use, they are more likely to commit to its adoption. Conversely, inadequate training and a lack of institutional support can lead to rejection, as teachers may view ICT as an unnecessary or burdensome addition to their workloads.

3.4. Implementation

The implementation stage marks the practical application of ICT in the classroom. At this point, teachers require ongoing support to address the challenges and refine their use of technology. This could include technical assistance, access to instructional resources, and mentorship from experienced colleagues (Kalogiannakis & Papadakis, 2019).
Rogers emphasises that trialability—the ability to experiment with the innovation on a limited basis—can enhance its adoption at this stage significantly. Teachers who are given opportunities to explore ICT tools in low-stakes environments are more likely to integrate these tools confidently into their lessons.

3.5. Confirmation

In the final stage, teachers assess the outcomes of ICT use and decide whether to continue or discontinue its application. Positive experiences, such as improved learner engagement and efficiency in lesson delivery, can reinforce adoption and lead to sustained use. However, this stage also requires reflection and adaptability. Teachers must be able to evaluate what works and adjust their strategies accordingly.

Ghavifekr et al. (2015) argue that without sufficient training and support during the earlier stages, teachers may not achieve the desired outcomes, leading to discontinuation of ICT use. This underscores the importance of a holistic approach that addresses all stages of the adoption process.

3.6. Enhancing the Framework with Contextual Factors' Relative Advantage

Relative advantage refers to the perceived superiority of the innovation compared to the existing methods. In the context of ICT, teachers are more likely to adopt tools that demonstrate enhanced teaching efficiency and learner outcomes (Rogers, 2003). For example, interactive whiteboards and educational applications that simplify lesson planning or increase student engagement can serve as compelling motivators for adoption.

3.7. Complexity

The complexity of innovation can hinder the adoption if teachers perceive ICT as difficult to use or implement. Kalemoglu Varol and Erdem (2019) highlight the importance of simplifying technological interfaces and providing step-by-step guidance to reduce the perceived complexity.

3.8. Compatibility

Compatibility with the existing practices and values is another critical factor. Teachers are more likely to adopt ICT tools that align with their teaching philosophies and curricular goals. Training programmes must emphasise how technology can enhance, rather than disrupt, traditional pedagogical approaches (Van Zyl & Sabiescu, 2016).

3.9. Trialability and Observability

Opportunities to experiment with ICT tools (trialability) and observe their successful application by peers (observability) can enhance their adoption significantly. Peer mentoring programmes and classroom demonstrations can provide teachers with tangible examples of how ICT can transform teaching and learning (Muweesi et al., 2021).

3.10. Broader Implications

The application of Rogers' diffusion of innovations theory provides a comprehensive understanding of the systemic barriers to ICT adoption in education. Addressing these barriers requires a multi-pronged approach:

3.10.1

3.10.2

3.10.3

3.10.4 Policy interventions: Educational policies must prioritise teacher training that spans all stages of the adoption process, from initial awareness to sustained implementation.

3.10.5 Community engagement: Building a supportive community of educators who share resources and experiences can foster positive attitudes towards ICT.

3.10.6 Resource allocation: Ensuring equitable access to ICT tools and technical support can mitigate challenges at the implementation stage.

By addressing the challenges highlighted at each stage of Rogers' framework, policymakers and educators can create an environment that supports the seamless integration of ICT into teaching practices.

3.11. Research Method

This study employed a quantitative research design, in terms of which a survey method was used to collect the data. The survey research approach is widely recognised for its ability to gather measurable and generalisable information, allowing for an objective analysis of trends and relationships in technology use among educators (Creswell & Creswell, 2022). The structured nature of this design facilitated an in-depth investigation into the extent and characteristics of ICT integration in teaching practices within selected schools in the Tshwane West District.

3.12. Population and Sampling

The target population comprised approximately 1,250 Foundation Phase teachers (Grades R–3) across primary schools in Circuit 4 of the Tshwane West District, in the Gauteng Province, in South Africa. These educators were chosen due to their critical role in fostering early learning and technological skills among young learners (Ramafi, 2022). A non-probability purposive sampling technique was employed, ensuring that participants were actively engaged in early childhood education and ICT use. From this population, 200 teachers were selected, representing diverse school environments, teaching experiences, and levels of ICT exposure. This sampling method ensured relevant and rich data collection from educators who directly influence early digital literacy development (Murris et al., 2022).

3.13. Data Collection Instrument

Data were collected using a self-designed questionnaire, consisting of closed-ended questions. The questionnaire was aligned with the study's research objectives, covering a comprehensive range of topics related to technology integration, teacher attitudes, and ICT training exposure (Chisango & Marongwe, 2021). Likert-scale questions were included to measure teachers' perceptions, challenges, and the frequency of ICT use, ensuring standardised responses for a comparative analysis (Ghavifekr et al., 2015).

3.14. Validity and Reliability

The questionnaire underwent expert review and pilot testing with a small sample of Foundation Phase teachers to ensure its validity. Content validity was established by aligning the questionnaire items with existing literature and ICT integration frameworks (Hunde et al., 2024). Construct validity was enhanced through factor analysis, confirming that the questionnaire measured distinct dimensions of ICT integration accurately (Mnisi et al., 2024).

For reliability, Cronbach's alpha coefficient was calculated, yielding a score of 0.85, indicating high internal consistency among questionnaire items (Safonov et al., 2022). The test-retest reliability procedure was conducted by administering the questionnaire to the pilot group twice within a two-week interval, ensuring the stability and consistency of the responses (Ertmer & Ottenbreit-Leftwich, 2010).

The sections included:

3.14.1 Demographics: Captured details such as the participants' age, gender, qualifications, and teaching experience.

3.14.2 Digital training: Examined the nature and scope of the ICT training teachers had received, including workshops and professional development programmes.

3.14.3 Technology use: Focused on how teachers incorporated technology into lesson planning, teaching, and assessments.

3.14.4 Challenges: Addressed obstacles such as limited resources, inadequate training, and insufficient institutional support.

3.14.5 Attitudes towards ICT: Explored teachers' perceptions of the usefulness and impact of technology in education.

Questionnaires were distributed directly to the participating schools, ensuring easy access for teachers while minimising disruption to their daily routines. After the collection processes, the responses were coded and entered into statistical software for precise and consistent data management.

Descriptive statistical methods were employed to summarise the data, offering insights into trends and distributions:

- **Frequency distributions** illustrated how often specific responses occurred.
- **Measures of central tendency** (mean, median, mode) provided an overview of the main data points.
- **Measures of dispersion** (standard deviation and range) highlighted variations within the data.

Additionally, inferential statistics were used to explore the relationships and patterns between variables. These analyses examined factors such as the influence of teacher training on attitudes towards technology and the correlation between school resources and technology usage. Conclusions drawn from this analysis offered insights applicable to the broader population. The findings were presented using tables, graphs, and charts for clear and effective communication. The study adhered to strict ethical guidelines to ensure that participants' rights were safeguarded and the research integrity upheld. Approval was obtained from

the Tshwane University of Technology (TUT) Ethics Committee, guaranteeing compliance with academic and ethical standards. Permission was also secured from the Gauteng Department of Education (GDE), the Tshwane West District Office, and individual school principals, ensuring the study had appropriate institutional authorisation.

The participants were provided with information leaflets and consent forms, which explained the study's purpose, their rights, and the voluntary nature of their participation. Teachers were assured that they could withdraw at any point without repercussions. Privacy was a top priority, all the data were anonymised, and identifying information was excluded. Data security was maintained by limiting access to the researcher. Furthermore, participation was entirely voluntary, with no coercion, and the questionnaires were distributed at times that minimised disruptions to school activities.

4. Findings and Discussion

This section explores the key findings of the study, interpreting their significance in relation to existing literature and theoretical frameworks, while also examining their practical implications and potential limitations.

4.1 Results and Findings

Teachers' demographic background

The demographic data of the teachers in this study were collected through the initial sections of the survey questionnaire. This approach aimed to provide the context for the study's findings. Figure 1 below presents the profiles of the participants.

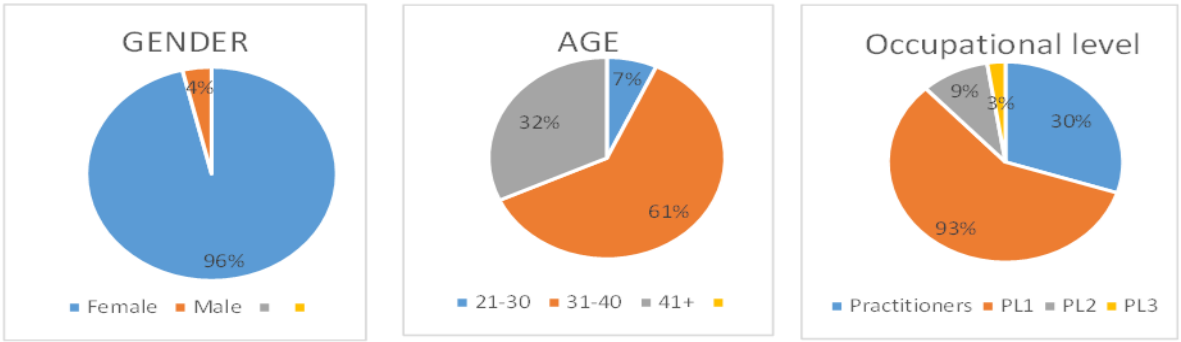


Figure 1: Teachers' demographic backgrounds

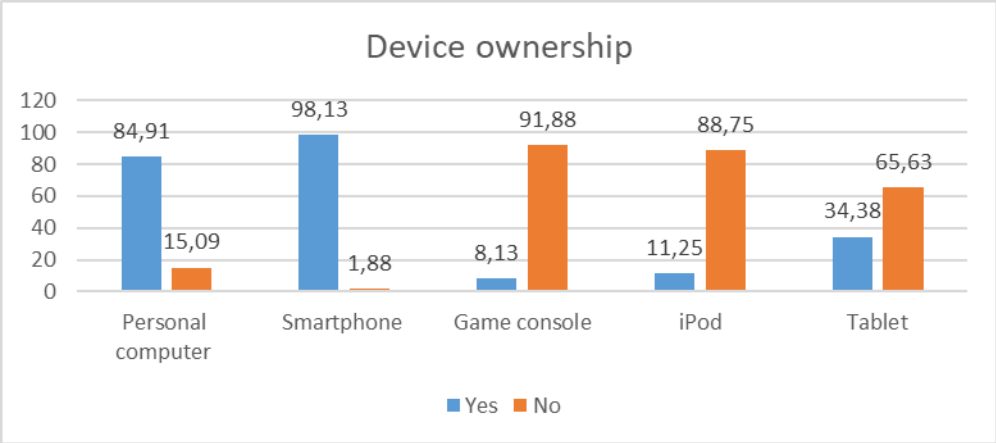


Figure 2: Device ownership

The data presented in Figure 2 illustrates teachers' familiarity with and ownership of technology and technological devices outside the classroom. A high percentage of respondents, namely, 98.13%, possessed smartphones. In contrast, only 8.13% of the respondents owned gaming systems, and 11.25% had iPods. Tablets were owned by 34.38% of the respondents. Given the considerable exposure that educators have had to technology, the researcher believes that integrating technology into education should not pose a significant challenge with proper planning and pedagogical training for educators.

Table 1: Teachers' digital training

Statements	No	Yes
I have received training on integrating ICT tools in the classroom environment	50.63	49.38
I am self-taught in terms of using Presentations, e.g., PowerPoint in the classroom	47.50	52.50
I have received training on lesson planning where ICT tools are used in the classroom environment	80.00	20.00
My training has taught me how to use apps in the classroom	80.63	19.38
My training has equipped me to plan strategies using technology to enhance learning	79.38	20.63
My teacher training has taught me how to design lesson plans that support ICT, are developmentally appropriate and support the needs of diverse learners	78.13	21.88
I have received training in creating/updating websites	91.25	8.75
I have been trained to locate educational websites for student learning	61.88	38.13

It was critical to evaluate whether teachers had received technology implementation training in the classroom. Eight questions with "yes/no" answers were asked.

The data presented reveal that the majority of educators (52.50%) were self-taught in presentation skills, while 49.38% received training on integrating ICT tools in the classroom. It appears that the training mainly focused on using and integrating digital technologies rather than specific programmes within these tools. According to Rogers (2003:21), ICT integration typically commences at the knowledge level, indicating that teachers were already aware of and actively engaged with this innovation. Over 80% of respondents indicated that they had not received training on lesson planning with digital tools, leading to feelings of unpreparedness in devising strategies to enhance learning with technology. Additionally, 78.13% disagreed that their training had equipped them to develop lesson plans that support digital technology effectively, are suitable for learner development, and cater to diverse learner needs. A small percentage, only 8.75% of the respondents, reported that they had received training on website development, whereas 38.13% acknowledged that they had received training on finding informative websites for student learning.

The study also used correlational analysis to investigate the relationships among different variables, such as the correlation between teachers' attitudes towards ICT and the frequency of digital training received, or between teachers' access to technology and their perceptions of its usefulness. Pearson's correlation coefficients were calculated to determine the strength and direction of these relationships, which provided insights into how various factors might support or hinder technology integration in ECE settings.

Cronbach's Alpha is a way of measuring the internal consistency of a questionnaire or survey. Cronbach's Alpha ranges between 0 and 1, with higher values indicating that the survey or questionnaire is more reliable.

Table 2: Cronbach's Alpha to measure consistency and reliability

Questionnaires	**Item**	**Average interitem**	**Alpha**
Challenges of implementing ICT tools	17	.1985657	0.8297
Teacher attitudes	20	.192132	0.8380
Institutional digital barriers	15	.2692591	0.8839

Cronbach's Alpha (α) measures the internal consistency or reliability of a set of items (questions) that are supposed to measure the same underlying construct. The higher values of Cronbach's Alpha indicate that the items are highly correlated and consistently measure the same construct. A breakdown of how α values are typically interpreted is provided next:
$\alpha \geq 0.9$: Excellent reliability (ideal but rare in practice). $0.8 \leq \alpha < 0.9$: Good reliability (suggesting that the items have strong internal consistency). $0.7 \leq \alpha <$

0.8: Acceptable reliability (adequate for exploratory research or the early stages of scale development). $0.6 \leq \alpha < 0.7$: Questionable reliability (may require revision to improve consistency). $0.5 \leq \alpha < 0.6$: Poor reliability (items may not be cohesive in measuring the construct). $\alpha < 0.5$: Unacceptable reliability (scale is not consistently measuring the intended construct).

4.1.1 Conclusions reached based on the above discussion:

4.1.1.1 Lack of pedagogical training

Many teachers lack the training to integrate information and communication technology (ICT) effectively into their teaching practices. This is primarily due to inadequate initial training programmes that fail to emphasise pedagogical strategies specific to technology use in education.

4.1.1.2 Barriers to training access

Training opportunities are often limited, especially for teachers in underprivileged areas, leading to low confidence and competency levels in ICT integration. The absence of targeted, ongoing professional development exacerbates this gap.

4.1.1.3 Mismatch between training content and classroom needs

Existing training programmes often focus on basic technical skills rather than how to integrate ICT into the curriculum to improve teaching and learning outcomes. Teachers are left without practical strategies for applying these tools in real classroom settings.

4.1.1.3 Impact of COVID-19

The pandemic exposed significant gaps in teacher readiness for digital teaching, highlighting the critical need for comprehensive training in online teaching and digital pedagogy.

4.2 Discussion

4.2.1 Systemic Challenges to ICT Integration in Early Childhood Education

The limited prioritisation of ICT in early childhood education (ECE) highlights systemic gaps in educational policies, particularly in developing nations such as South Africa. Despite the recognised benefits of ICT in fostering digital literacy, critical thinking, and problem-solving skills in young learners, ECE is often overlooked in national ICT policies (Mathevula & Uwizeyimana, 2014). In South Africa, ICT integration in education remains uneven, with under-resourced schools struggling to provide technological tools for foundational learning (Ramafi, 2022). Similarly, studies in other developing contexts reveal that ICT policies often prioritise secondary and tertiary education, leaving early learning institutions inadequately equipped (Hunde et al., 2024). Addressing these systemic deficiencies requires intentional policy revisions to ensure that ECE is included in national ICT strategies.

4.2.2 Necessity for Comprehensive Training Programmes

Effective ICT integration in early education extends beyond the provision of technological devices; it demands a pedagogically sound approach that aligns technology with curriculum goals. The Technological Pedagogical Content Knowledge (TPACK) framework provides a model for integrating subject matter with digital tools to create engaging and meaningful learning experiences (Chai

& Kong, 2016). In South Africa, teachers often lack adequate ICT training, limiting their ability to incorporate digital resources into their teaching (Ramafi, 2022). A global study by Ghavifekr (2015) found that teacher preparedness plays a crucial role in successful ICT implementation, emphasising the need for structured training programmes. To ensure that teachers become skilled facilitators of digital learning, professional development programmes must focus on both the technical and pedagogical aspects of ICT use in the classroom.

4.2.3 Addressing Resource Constraints

One of the primary barriers to ICT adoption in underprivileged schools is inadequate access to digital devices and unreliable internet connectivity. In South Africa, rural and township schools often lack the necessary infrastructure to support ICT-enhanced learning (Mnisi et al., 2024). This digital divide is further exacerbated by disparities in funding between urban and rural areas, where schools with a high quantile are better equipped with digital tools (Chisango & Marongwe, 2021). Globally, similar challenges persist, with low-income countries struggling to acquire the technological resources required for equitable ICT access (Safonov et al., 2022). Policymakers must prioritise investments in ICT infrastructure, ensuring that all schools—regardless of their geographical location—have access to essential digital resources, including high-speed internet, computer laboratories, and well-maintained digital learning devices.

4.2.4 Influence of teacher attitudes and confidence

The successful integration of ICT in ECE is heavily influenced by teacher attitudes and confidence in using digital tools. Studies show that teachers who perceive technology as difficult or intimidating are less likely to incorporate it effectively in their classrooms (Costa & Ntsobi, 2022). In South Africa, resistance to ICT adoption often stems from inadequate training, leading to a lack of confidence in using digital tools (Ramafi, 2022). International research supports this finding, emphasising the importance of hands-on training and peer collaboration in building teacher confidence (Hunde et al., 2024). By providing structured mentorship programmes and fostering a supportive learning environment, educational institutions can help teachers embrace ICT as a valuable pedagogical tool.

4.2.5 Implications of the COVID-19 Pandemic

The COVID-19 pandemic underscored the urgency of equipping teachers with digital competencies to ensure learning continuity during school closures. In South Africa, the sudden shift to remote learning revealed significant gaps in ICT preparedness, particularly in disadvantaged communities where access to digital learning tools was limited (Mnisi et al., 2024). Similar challenges were observed globally, with many educators struggling to transition to online platforms due to a lack of prior training (Zhong, 2020). The pandemic has highlighted the need for ongoing professional development in digital pedagogy, virtual classroom management, and the use of interactive e-learning tools (Ghavifekr & Rosdy, 2015). Moving forward, education systems must integrate ICT training into teacher preparation programmes to enhance digital resilience in the face of future disruptions.

Broader implications for educational equity

ICT has the potential to bridge educational divides by providing learners with access to high-quality resources and global learning opportunities. However, systemic barriers such as unequal resource distribution, lack of training, and digital infrastructure challenges continue to hinder progress (Murris et al., 2022). In South Africa, digital inequality remains a pressing concern, with rural learners at a significant disadvantage compared to their urban counterparts (Chisango & Marongwe, 2021). Globally, studies indicate that countries with well-developed ICT policies tend to achieve higher levels of educational equity (Safonov et al., 2022). To harness the full potential of digital learning, governments and stakeholders must collaborate to implement inclusive policies that ensure all learners, regardless of their socio-economic backgrounds, benefit from technology-enhanced education.

5. Conclusion

Inadequate teacher training remains a major barrier to effective ICT integration in early childhood education. Despite various government and institutional initiatives, many teachers continue to lack the pedagogical skills necessary to effectively incorporate technology into their teaching practices. The historical context of South African education has further exacerbated this issue, creating a gap between policy intentions and practical implementation.

The COVID-19 pandemic has highlighted the urgent need for continuous professional development and teacher support. It has shown that teachers struggle to facilitate meaningful online learning experiences without adequate training in digital pedagogy. Additionally, the disparities in ICT resource distribution between urban and rural schools continue to hinder equal access to quality education.

To bridge these gaps, it is essential to implement targeted training programmes that go beyond technical proficiency and focus on pedagogical application. Policies must be developed to ensure that ICT training becomes mandatory in teacher education curricula. Furthermore, governments and stakeholders must invest in infrastructure improvements to provide equitable access to technology for all educators.

By addressing these challenges, South Africa can enhance the quality of early childhood education and ensure that learners are adequately prepared for a technology-driven future. The integration of ICT, when supported by comprehensive teacher training, has the potential to transform education and create a more inclusive and effective learning environment.

6. Recommendations for Policy and Practice

6.1 Policy reforms: Include explicit provisions for ICT integration in ECE within national education policies. Develop a comprehensive strategy that addresses the unique needs of young learners and their educators.

6.2 Resource allocation: Ensure equitable distribution of digital tools and infrastructure, focusing on underprivileged schools.

6.3 Customized training programmes: Develop context-specific training modules that align with the curriculum and address the challenges faced by teachers in diverse settings.

6.4 Ongoing professional development: Establish continuous learning opportunities for teachers to stay updated on emerging technologies and pedagogical approaches.

6.5 Community involvement: Engage parents and local communities in ICT initiatives to foster a supportive environment for digital learning.

7. Future Research Directions

Future studies could explore the long-term impact of ICT integration in ECE on learners' academic trajectories and socio-economic mobility. Additionally, comparative research across different regions could provide insights into the best practices and scalable solutions for ICT implementation in resource-constrained environments.

8. References

Chai, C. S., & Kong, S. C. (2016). Professional learning for 21st-century education. *Journal of Computers in Education, 4*(1), 1-4. https://doi.org/10.1007/s40692-016-0069-y

Chisango, G., & Marongwe, N. (2021). The digital divide at three disadvantaged secondary schools in Gauteng, South Africa. *Journal of Education, 82*, 155-173. https://doi.org/10.17159/2520-9868/i82a09

Costa, K., & Ntsobi, M. (2022). The role and potential of information communication technology (ICT) in early childhood education in South Africa. a theoretical perspective. https://doi.org/10.1007/978-3-031-04680-3_23

Creswell, J. W., & Creswell, J. D. (2022). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551.

Ghavifekr, S. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science (IJRES), 1*(2), 175-191. https://doi.org/10.21890/ijres.23596.

Ghavifekr, S., Kunjappan, T., Ramasamy, L., and Anthony. A. (2015). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. Malaysian Online Journal of Educational Technology, 4, 38-57. https://www.semanticscholar.org/paper/Teaching-and-Learning-with-ICT-Tools%3A

Habibu, T., Al-Mamun, S., & Clement, C. K. (2012). Barriers to the successful integration of ICT in teaching and learning environments: A review of the literature. *International Journal of Education and Development Using ICT*, 8(1), 136-155.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*. https://www.researchgate.net/publication/340535196.

Hunde, M., Berhanu, A., & Gendo, K. (2024). Review on practice and challenges of ICT integration as pedagogical tools in Ethiopian primary school curriculum implementation. *Discover Education, 3*, 1-15. https://doi.org/10.1007/s44217-024-00184-w

Kalemoglu Varol, Y., & Erdem, M. (2019). Teachers' perceptions of educational technology integration in education. *Education and Information Technologies*, 24(4), 2369–2387.

Kalogiannakis, M., & Papadakis, S. (2019). Evaluating pre-service kindergarten teachers' intention to adopt and use tablets into in teaching practice for natural sciences. *International Journal of Mobile Learning and Organisation, 13*(1), 113-127. https://doi.org/10.1504/IJMLO.2019.096479

Mashile, T. (2017). *Technology integration and the digital divide: Understanding factors that impact on educators' ability to integrate technology in South African classrooms*. MBA research project, University of Pretoria. http://hdl.handle.net/2263/59868

Mathevula, M., & Uwizeyimana, D. E. (2014). The challenges facing the integration of ICT in teaching and learning activities in South African rural secondary schools. *Mediterranean Journal of Social Sciences, 5*(20), 1087-1097. https://doi.org/10.5901/mjss.2014.v5n20p1087

Mertala, P. (2019). Paradoxes of participation in the digital era: Teachers' attitudes towards technology integration in education. *Teaching and Teacher Education*, 86, 102933.

Mhlanga D., & Moloi, T. (2020). COVID–19 and the digital transformation of education: What are we learning on 4IR in South Africa? *Education Sciences, 10*(180), 1–11. https://doi:10.3390/educsci10070180

Mnisi, B., Mtshali, T., & Makgato, M. (2024). Moving beyond the challenges of learning through technologies: The current status of ICT integration in South African schools. *Journal of Education and e-Learning Research, 11*(1), 128-134. https://doi.org/10.20448/jeelr.v11i1.5396

Munje P.N., & Jita, T. (2020). The impact of the lack of ICT resources on teaching and learning in selected South African primary schools. *International Journal of Learning, Teaching and Educational Research*, *19*(7), 263–279. https://doi.org/10.26803/ijlter.19.7.15

Murithi, S., & Yoo, J. (2021). Barriers to ICT implementation in Kenyan primary schools. E*ducational Technology & Society*, 24(3), 90-101.

Murris, K., Scott, F., Stjerne Thomsen, B., Dixon, K., Giorza, T., Peers, J., & Lawrence, C. (2022). Researching digital inequalities in children's play with technology in South Africa. *Learning, Media and Technology, 48*(3), 542–555. https://doi.org/10.1080/17439884.2022.2095570

Muweesi, C., Lou, S., Nakonde, J., Jerome, K., Tomusange, R., & Sserwadda, L. (2021). Discourses in ICT integration: Pedagogical orientations in selected city primary schools in Uganda. *Educational Research and Reviews, 16*(4), 172–180. https://doi.org/10.5897/ERR2020.4103

Mynarikova, L., & Novotny, J. (2021). Building resilience in education: Lessons from the COVID-19 pandemic. *European Journal of Education*, 56(4), 569-585.

Papadakis, S., Vaiopoulou, J., Sifaki, E., Stamovlasis, D., Kalogiannakis, M., & Vassilakis, K. (2021). *Factors that hinder in–service teachers from incorporating educational robotics into their daily or future teaching practice*. [Conference proceedings] 13th International Conference on Computer Supported Education. https://doi.org/10.5220/0010413900550063

Prasad, P. (2015). Barriers to ICT integration in education: A global perspective. *Journal of Educational Technology & Society*, 18(1), 45-56.

Prasad, V.V.S.N.N., Lalitha, P., & Srikar, P.N.N. (2015). Barriers to the use of information and communication technology (ICT) in secondary schools: Teachers'perspective. *Journal of Management Research, 7*(2), 190–208.

Ramafi, P. (2022). Investigating the barriers of ICT use in teaching and learning at public schools in South Africa. *Proceedings of the International Conference on Intelligent and*

Innovative Computing Applications (ICONIC 2022), 92-102. https://doi.org/10.59200/ICONIC.2022.010

Rogers, E.M. (2003). *Diffusion of innovations.* (5th ed.). Free Press.

Safonov, Y., Usyk, V., & Bazhenkov, I. (2022). Digital transformations of education policy. *Baltic Journal of Economic Studies, 8*(2), 127–136. https://doi.org/10.30525/2256-0742/2022-8-2-127-136

Sharkins, K.A., Newton, A.B., Albaiz, N.E.A., & Ernest, J.M. (2015). Preschool children's exposure to media, technology, and screen time: Perspectives of caregivers from three early childcare settings. *Early Childhood Education Journal*, *43*(6). https://doi.org/10.1007/s10643-015-0732-3

Umugiraneza, O., Bansilal, S., & North, D. (2018). Exploring teachers' use of technology in teaching and learning mathematics in KwaZulu–Natal schools. *Pythagoras, 39*(1), a342.

Van Zyl, I., & Sabiescu, A. (2016). The digital divide in education: Insights from SouthAfrican primary schools. *International Journal of Education Development Using ICT*, 12(2), 93-105.

Zhong, R. (2020). The coronavirus exposes education's digital divide. *The New York Times*. https://www.nytimes.com/2020/03/17/technology/china-schools-coronavirus.html

Appendix 1

TABLE 1: DEMOGRAPHIC INFORMATION

1	Gender	1	Female	
		2	Male	
2	Age	1	21-30	
		2	31-40	
		3	41+	
3	Post level	1	Practitioner	
		2	Teacher PL 1	
		3	Teacher PL 2	
		4	Teacher PL 3	
4	Highest educational qualification	1	Grade 12/Matric	
		2	National Diploma/ Diploma	
		3	Bachelor's degree/Advanced diploma/B. Tech	
		4	Honours degree/ Post graduate diploma	
		5	Master's degree	
		6	Doctoral degree	
5	Length of service	1	1-5 years	
		2	6-10 years	
		3	11-15 years	
		4	16+	

TABLE 2: DEVICE OWNERSHIP

No.	Do you own/have regular access to the following devices?	Yes	No
1	Personal computer (PC) or laptop		
2	Smartphone		
3	Game console/ video game		
4	iPod (or other mp3 player)		
5	iPad or other tablet		

TABLE 3: DIGITAL TRAINING TEACHER

No.	Statements:	**Yes**	**No**
1	I have received training on integrating ICT tools in the classroom environment		
2	I am self-taught in terms of using presentations, e.g., PowerPoint in the classroom		
3	I have received training on lesson planning where ICT tools are used in the classroom environment		
4	My training has taught me how to use apps in the classroom		
5	My training has equipped me to plan strategies using technology to enhance learning		
6	My teacher training has taught me how to design lesson plans that support ICT, are developmentally appropriate and support the needs of diverse learners		
7	I have received training on creating/updating websites		
8	I have been trained to locate educational websites for student learning		