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The Evolution of Teaching Resources in South African Schools : A Quest for Adaptive Teaching Strategies

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Abstract: This study aims to examine teachers' usage and perceived value of 40 technology tools in order to enhance student learning outcomes. The study seeks to propose feasible approaches concerning the transition from traditional methods of teaching, towards technology-enhanced teaching in the classroom. This study employed the mixed method approach with embedded mixed methods research design. The data collection techniques were questionnaire, and open-ended questions. Face and content validity was assessed before the administration of the questionnaire. Descriptive statistics were used for quantitative variables. Quantitative data were analyzed by thematic analysis. The results of this study show that only 11% of the teachers are utilizing technology tools in the classroom with learners to support their instructional practices. This study provides valuable insights that will help teachers, principals, and policy makers move toward more technology-enhanced teaching and learning.

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Introduction

There is a growing need in educational settings to incorporate innovative teaching resources in order to improve student engagement and learning outcomes. For instance, Bravo and Gamez (2021) stress that a large proportion of educators who make use of cutting-edge teaching strategies bolstered by technological resources enable students to acquire new information and have meaningful learning experiences. This aligns with the findings of Avdiu and Holzinger (2021) who argue that allowing students to interact with technological tools can enhance student motivation and foster creative learning. In this study, innovative teaching resources refer to technological tools that can be utilized in educational settings to enhance student learning and learning outcomes in various ways. These tools include data projectors, virtual labs, search engines among others.

Effective teachers in the 21st century are those who welcome change and innovation. They exhibit compatible adaptive strategies for students learn at different rates and levels thereby providing support for their learners in order to succeed. Amalia and Ramdhani (2018) posit that teaching in the 21st century necessitates a shift from traditional pedagogical methods to more collaborative and technologically enhanced approaches. This transformation is driven by the need to equip students with essential skills such as critical thinking, collaboration, and adaptability, which are vital in today's interconnected world (Jason.

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Söllner, and Leimeister, 2017). Collaborative learning, as a pedagogical strategy, has come to light as a key component in fostering these skills among students (Jason et al, 2017).

The integration of Information and Communication Technology (ICT) tools in South African schools has been the focal point of educational reform, aimed at enhancing teaching and learning (Nonyan et al., 2024; Padayachee, 2017). Despite the government's commitment the integration of ICT tools, challenges persist that hinder effective implementation across various educational contexts, particularly in predominantly black schools (Mestry, 2017). Recent studies indicate that many township schools face significant challenges due to insufficient facilities and resources, which are critical for successful implementation of ICT initiatives (Oki, Uleanya, & Mbanga, 2023; Mwapwele, Marais, Dlamini, & Biljon, 2019). The department of education's failure to adequately fund these initiatives exacerbates the situation, leading to a disparity in ICT access between urban and township schools (Padayachee, 2017, Oki et al, 2023).

This study therefore has two primary goals: first, to examine the extent to which primary school teachers in township schools engage in technology-based teaching by utilizing technology tools in order enhance learner engagement ang learner outcomes. Second, to determine teachers' perceived value of technology tools in teaching and learning. The study highlights the contextual challenges teachers in township schools are facing with adopting technology-based teaching and identifies key strategies to address the changes that hinder the transformation of teaching strategies and effective use of technology to enhance learning outcomes.

Research Method

This study employed a mixed methods research approach with embedded mixed methods design. According to Delport (2011) in using the embedded design, one data set provides a supportive, secondary role in a study based primarily on other data type. In this study, quantitative data collected through questionnaires was supported by qualitative data from open-ended questions.

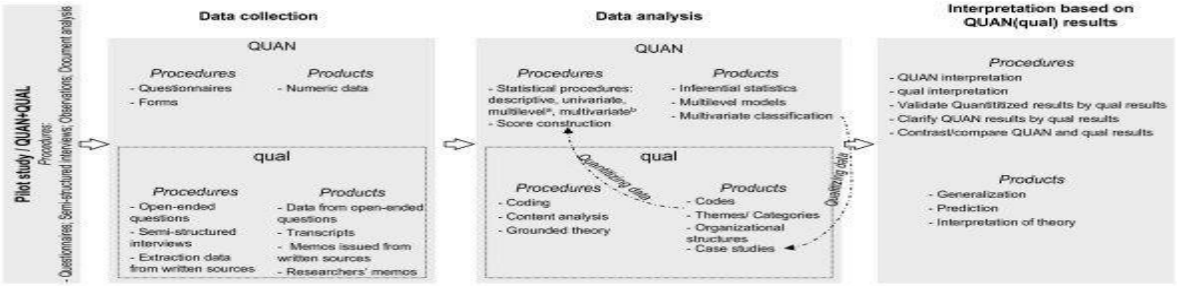

Figure 1. The Embedded Design (Jourdan, Pommier & Guevel, 2015)

The data for the main study was collected over a period of one month with a questionnaire and open-ended questions. questionnaire have been used previously in studies of ICT integration (Padayache, 2017, Alex, 2021). The first visit to schools was to submit the questionnaires. After three weeks the researcher visited the schools to collect the questionnaires. There were no incentives provided to respondents to complete the questionnaire. Thematic analysis was employed to interpret and reduce qualitative data collected, discussing these according to emerging themes. On the other side, descriptive analysis was utilized to interpret quantitative data.

The tests for validity encompass both face validity and content validity. Content validity is the concept that a test should encompass a range of behaviors that are

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representative of the theoretical concept being measured (McBurney and White, 2012). On the other hand, face validity suggests that a test should superficially appear to measure what it is intended to measure. In terms of content validity, the survey items should identify specific ICT technologies that teachers could potentially utilize (Indrayadi, 2021). To ensure content validity, the resulting survey underwent a review by a statistician and a subject matter expert to assess clarity and correlation with research objectives (McBurney and White, 2012). Additionally, the experts also assessed the survey for face validity. However, it is important to note that the survey used in this research is a combination of two previously published instruments, thus it has already been validated by previous researchers. To further ensure validity, multiple sources of evidence were employed, including a quantitative Likert scale questionnaire and an open-ended questionnaire, in order to determine how teachers utilize ICTs in the teaching and learning process.

Results and Discussion

This section presents the findings from the questionnaire and open-ended questions on the integration of technology tools in teaching and learning.

The substitution of digital tools

The table 2 provides information about the teachers' substitution levels or frequency of digital tools usage as a replacement for traditional tools. The table includes

Table 2. Teachers' substitution frequency and perceived value of technology tools

Spreadsheet software	9%	59%
Search engines	61%	63%
Audio software	20%	60%
Podcasts	7%	26%
Self-created websites	0%	44%
Online library services	11%	59%
Video/ record lessons	11%	59%
Downloadable e-books	26%	70%
File sharing	15%	52%
Presentation software	7%	67%
Word-processing programs	3%	70%
Virtual worlds	7%	48%
Class wiki	11%	67%
Online sharing community	11%	56%
Blogs/ vlogs	4%	44%
Collaborative project tools	26%	63%
Mailing lists	19%	52%
Social media	33%	52%
Mobile learning tools	55%	76%
Data projectors	5%	80%
Bring your own device (e.g smart phones)	60%	90%
Direct access	8%	62%
Remote access	0%	40%
Interactive white boards	0%	56%
Video editing	3%	45%
Online library	0%	65%
3d virtual worlds	0%	30%

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Online internal forums	0%	58%
Software referencing packages	2%	65%
Internet-based learning platform	5%	67%
Free media-based learning platform	10%	60%
News groups	0%	44%

The substitution frequency indicates that the number of educators who use technology tools as a replacement for traditional methods. The results show extremely poor substitution of technology tools where very few teachers use some technology tools, and most tools remain underutilised or not utilized at all. It has been two decades since the white paper on e-Education was promulgated in 2004, but a majority of teachers are in this study are yet to utilise technology to enhance teaching and learning.

The tools such as virtual labs, self-created websites, remote access, interactive whiteboards, online library, 3D virtual worlds, online internal forums, and news groups at 0% remain unutilised. Are teachers not using these tools because they have no value in teaching and learning? That is unlikely, for instance the study by Astiti, Muriti, and Hakiki (2023) shows that the development of web-based digital libraries has been recognized as a significant advancement in providing accessible learning materials tailored to school curriculum. These researchers emphasize that digital libraries can serve as essential learning resource facilities. This is particularly true in elementary schools, where they offer books that are aligned with the educational standards, thereby facilitating both teaching and learning process (Astiti et al, 2023). In rural and township schools, where physical libraries are lacking, digital libraries can bridge this gap by proving alternative access to educational resources.

Digital libraries are not the only useful, yet unutilized tools. Virtual labs are also one of the tools not utilised by teachers. The adoption of virtual labs has been shown to enhance student engagement and learning outcomes as evidenced by various studies (Alhashee, 2023). Therefore, not utilising these tools deprives learners of meaningful educational experiences, and this may have a negative effect as they progress to higher grades. However, results also show that there are tools that are utilised by a small fraction of teachers. These include tools such as E-portfolios, statistical software, computer simulations, educational computer games, graphic software, virtual worlds, data projectors, direct access, video editing, software referencing packages, and the internet-based learning platforms. All these tools are below 10% respectively. Despite being underutilised by teachers, these devices can be invaluable when utilised effectively. As Pasricha (2023) posit that computer simulations have emerged as transformative educational tool across various disciplines, enhancing the learning experience by providing interactive and engaging learning environments for learners. Whereas data projectors serve as a vital tool for educators, allowing for display of multimedia content, which can also facilitate a more engaging and interactive learning environment (Graham, Stols & Kapp, 2021).

Similarly, educational computer games have emerged as significant tools in enhancing learning experiences across various educational settings. Research indicates that these games can effectively motivate students to learn and enhance their learning experience by incorporating elements such as play into educational contexts (Yu, Ming-Le, and Wang, 2020). Furthermore, the implementation of E-portfolios in elementary a secondary schools

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offers numerous advantages including enhanced student engagement, improved assessment practices, and facilitating of self-directed learning (Prihandoko, Wahab, and Wilujeng, 2020).

Despite the underutilization of most technology tools, a few technology tools are utilized by most teachers, these include search engines like Google at 61%, Bring Your Own Devices like smart phones at 60%. The use of these tools for educational purposes is crucial and can be deemed as innovative. However, teachers may be using these tools due to their accessibility and ease of usage. Most teachers today have smartphones and have access to search engines. According to Banini (2020) the conscious use of search engines in the classroom fosters active learning and metacognition among students, thereby enhancing their educational experience. This is supported by Ntuli & Kyei-Blankson (2016) who note that teachers often rely on general search engines like Google for preliminary information gathering before utilizing more specialized resources, such as library databases. Despite the value of these tools in educational settings, they represent a significantly small fraction of several technology tools that can have a profound impact on learner engagement and learning outcomes where integrated in to teaching and learning processes.

This study also examined the perceived value of technology tools by teachers. In this regard teachers are polarised. This study found that 56% of the teachers find technology tools essential, and 44 % of the teachers perceived them as not important. This disparity among teachers' perceptions about technology can lead to inconsistent integration practice. Al-Ansi and Fatmawati (2023) argue that the divergence in perceptions can create a fragmented educational environment where the intergration of ICT is not uniformly applied, ultimately affecting student engagement and learning outcomes. The quantitative results of this study highlight two things about teachers' integration of technology in their teaching practices. First, most teachers are not ready to implement technology in their teaching, and second, the fact that technology is key to effective teaching in the 21st century is not universally accepted by teachers. The sext section looks into the qualitative data collected in this study. The following themes emerged from the data collected and the findings are now presented.

The use of technology to search information

While there are several ways to use technology in the teaching and learning process, teachers tend to use it to search for information. They use technology tools mainly to search for information and prepare for lessons, not to engage learners in class. They use tools such as such as laptops and smartphones. This finding implies that teachers understand the value of these devices and use them for preparation. However, using them to engage learners in the classroom remains a puzzle to be solved.

> TMA1-5 "Mostly I use it for preparations and to conduct notes and cascade them to learners."
>
> Tma1-2 "I presently use my cell phone and laptop to search for relevant information. They are also effective when I want to present my lesson, there are multiple of websites which have been useful in my lesson preparations."

The findings show that teachers' knowledge of digital tools is mostly limited to contextual tools such as projectors, smart boards, and computers. They show little to no appreciation of unpopular tools such as virtual labs, E-portfolios, collaborative project tools among others. This finding correlates with lower substitution levels, as demonstrated in quantitative data.

ICT usage in the classroom

Teachers show little awareness for most technology tools and use a few to prepare for lessons. When teachers were asked about how they use technology in the classroom, most teachers came out clear to state that they are not using it:

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Tf4-2: "we do not use digital technology."
Tf5-4: "we do not have or use digital technology as it is not introduced in our school."
Tm1-3: "I never used it."

The problems concerning the use of technology in schools

The principal barrier to effective ICT integration as perceived by teachers is a lack of resources. To successfully integrate digital tools in teaching and learning, you need to have them in the first place. The next great barrier is connectivity. Lack of connectivity of poor internets access prevents teachers from accessing the internet to support their teaching process. These are some of the comments teachers made with regards to the barriers to ICT integration.

Tf1-7: "we do not have computer labs and fibre cables."
Tf3-4: "not all learners have access to technological gadgets."
Tm3-2: "lack of resources and network coverage."
Interventions for technology integration in the future

Teachers believe they need more training to be able to integrate ICT in the classroom. When teachers were asked about the recommendations, they can make about the kind of support they need for ICT integration in teaching and learning, this is what they said:

TM1-1 "Teachers need to be work shopped on how to integrate ICT in their teaching and learning."
TF1-4 "I recommend that the government supply schools with smart board, white boards and projectors and also provide learners with tablets."
TM2-2 "computer labs should be fixed and functional first, introduce it to teachers, familiarise teachers through workshops."

The results of this study show lower levels of technology integration the classroom and higher usage of technology outside the classroom to support other aspects of teaching such administrative and management tasks that teachers do as a result of their work. To solve this problem, teachers suggest the provision of digital tools and training on how to employ ICT in the classroom. For technology to be integrated in South Africa, it is not all barriers that need to be addressed, but it is the key barriers such as lack of relevant skills and knowledge of using different digital tools to facilitate teaching and learning and access to digital tools. These are barriers that must be prioritized in all the intervention efforts of improving the integration of ICT in teaching and learning.

School districts have acquired and implemented the necessary equipment to facilitate effective instructional practices thereby supporting educators in their integration of technology (Tamang & Reddy, 2023). Despite advancements in infrastructure and encouragement for educators to incorporate technology into classroom assessments, numerous schools across the country are still utilizing instructional devices for assessment purposes only on a limited basis (Morel, 2022). Mthembu (2022) notes that township schools in South Africa, established during the apartheid era, continue to suffer from underfunding and inadequate infrastructure, which hampers the effective integration of technology. This is echoed by Msila (2015), who discusses the global push towards digital classrooms and the South African government's initiatives to introduce tablets in education. However, the reality in many township schools is that such initiatives are often poorly implemented due to a lack of teacher readiness and infrastructural support (Msila, 2015). Furthermore, Ramaila (2021) highlights the necessity of a mixed-method approach to assess technology integration in elementary schools, emphasizing that teachers often lack the necessary skills and resources to

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implement technology effectively in their classrooms This requires investigating teachers' integration of technology in township schools and their perception thereof.

This study sought to examine the frequency of the extent to which teachers use technology to enhance teaching and learning in township schools. More precisely, the study aimed to determine the degree and the regularity with which teachers employ technology in teaching and learning processes in Tshwane North primary schools. Furthermore, this study sought to explore teachers' perceptions of technology usage in educational settings. The results of the study reveal that the number of teachers who utilize technology in township primary schools is significantly low. Specifically, the number of teachers who utilise technology for teaching and learning is 11%. Meaning that 27 teachers only three integrate technology in their teaching practices. Moreover, since this study employed the mixed methods research approach, the qualitative data supported the quantitative data. The qualitative data aligned quantitative data where teachers expressed responding to open-ended questions that they're not utilizing technology in their teaching practices. To account for this teachers, point to lack of resources and lack of training to integrate technology in teaching and learning.

This finding aligns with the work of Barakabitze et al, (2019) who argue that the challenges of integrating ICT in South African schools include issues such as inadequate infrastructure, lack of training for teachers, and insufficient access to technology devices. Furthermore, other researchers indicate that many educators struggle to incorporate technology into their teaching practices due to insufficient training and support (Gcabashe, 2024; Ramaila, 2022). This gap in skills is exacerbated by the digital divide that exists between well-resourced and under-resourced schools, which further complicates the equitable distribution of educational technology (Nhlumayo, 2024; Mwapwele et al., 2019).

Nevertheless, the effectiveness of ICT integration is also contigent upon teachers' perceptions and preparedness. Ohei (2023) assert that negative attitudes towards technology integration among educators can significantly hinder its adoption in the classroom. This sentiment is further supported by Ghavifekr, and Rosdy (2015) who points out that teacher preparedness and access to ICT tools are crucial for successful technology-based teaching and learning. Without addressing these fundamental issues, the potential benefits of technology integration in township schools remain largely unrealized.

This study also investigated teachers' perceptions about the use of technology tools in teaching and learning. The findings suggest that the usefulness of technology tools is not universally accepted. 44% of the teachers perceive technology tools as less valuable in teaching and learning. This indicates teachers' ignorance about many digital tools that can be utilised to enhance teaching practices and learner engagement. This ignorance has a negative impact, not only on the perceived value of technology tools, but also in their usage. As this study found that, teachers use a handful and neglect the rest regardless of their potential to transform the quality of education. Teachers use search engines such as Google (60), and Bring Your Own Devices (BYOD) tools such as smartphones (61%). Tools such as virtual labs, self-created websites, remote access, and interactive whiteboards are not utilized at all.
The low substitution levels of technology integration indicate that teachers are still underprepared to utilize technology to enhance learning outcomes.

The SAMR framework provides four stages of technology integration, from the simple to the complex. The substitution stage is the first stage and the most basic stage of technology integration. Yet, the findings of this study show that few teachers engage in this level of technology integration. These findings are supported by the work of Shilenge, and

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Ramaila (2020) who found that many South African schools, particularly in township areas, face considerable challenges in implementing technology-based education. Chomunorwa (2023) contend that teachers often struggle with integrating technology in their teaching practices.

However, the results of this study challenge the fact that the South African government has recognized the need for technology in education, aiming to provide digital workbooks and digital textbooks to all learners (Shilenge, and Ramaila, 2020). This is contrary to the findings of this study which indicate that teachers don't use digital text books and workbooks. Chomunorwa (2023) maintain that the reality remains that many schools lack necessary infrastructure, such as reliable internet access. This lack of technology integration in township schools have enduring consequences on the youth and the societies at large.

The implications of poor technology integration have a negative impact on learner engagement, and learner outcomes (Boateng, 2024). However, the consequences extend beyond the classroom to the broader socio-economic landscape. Nyahodza, and Higgs (2017) articulate that the lack of technology integration contributes to persistent inequalities, as those without access to digital tools and skills are further marginalized. This situation perpetuates the cycle of poverty, as individuals and communities unable to engage with the digital economy miss out on opportunities for employment and advancement (Hawthorne, and Grybowski, 2019). The South African National Development plan highlights the critical role of technology in addressing the educational challenges and improving the overall quality of life (Mokotjo & Mokhele, 2021). However, the sluggish advancement in infrastructure development and skills acquisition remains a significant obstacle to achieving these goals.

Conclusion

Drawing from the findings and limitations, several recommendations can be formulated for future research and. These recommendations include:

1) Assess the impact of targeted professional development programs designed to enhance teachers' proficiency and confidence in utilizing various technological resources for instructional purposes.
2) Explore the influence of cultural and contextual factors on educators' perceptions of technology, as these elements may significantly affect their readiness to incorporate technological tools.
3) Investigate the implementation of specific technology integration frameworks, such as the SAMR model, and their influence on the effectiveness of technology-enhanced assessments.
4) Policy makers should involve teachers in the decision making processes to ensure that policies are conducive to actual classroom practices.

Recommendation

1) This research supports the improvement of internet connectivity and technological infrastructure in township schools to tackle the challenges posed by unreliable internet access.
2) Provision of a standard yearly ICT integration program with focus on latest ICT tool and innovative methodologies for all teachers employed by the department of basic education.
3) Establish collaborative networks and online communities tailored for educators in township schools. These platforms will facilitate the sharing of best practices, resources, and innovative ideas among teachers, aimed at effectively tackling the challenges related to technology integration within their unique environments.

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