

# Investigating the Barriers of ICT use in Teaching and Learning at Public Schools in South Africa

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## Abstract

Information and Communication Technology (ICT) has reshaped the field of pedagogy in many different ways. The increasing use of ICT tools in teaching and learning cannot be overlooked. Learners who are abreast with technology are independent and relieve overreliance on educators regardless of the geographical distance. ICT is important within the education sector as a means of enhancing the process of teaching and learning in a classroom. Despite the value of effective use of ICT tools, the South African government, having designed the curriculum to support effective ICT use in teaching and learning, and to some extent having provided ICT tools in public schools, there are still challenges in the effective adoption of ICT tools in teaching and learning.

The purpose of this study is to investigate the barriers of ICT tools use in teaching and learning and propose guidelines in teaching and learning at public schools. The study used a mixed-method and data was collected from public school teachers through a questionnaire composed of both qualitative and quantitative variables. To gain further insight, educationalists were also interviewed. It was discovered that there are multiple challenges that hinder the adoption of ICT in public schools. Key challenges identified in the study include a lack of ICT relevant skills, lack of ICT infrastructure, poor IT support, lack of efficacy from the level of teachers, and attitude were amongst many other influencers to non-compliance. The study recommends that the government adopt an ICT framework that will advocate for unison in ICT policy from all walks of government (district, provincial, and national) and also mandate and incentivize use of ICT by teachers in teaching and learning.

**Keywords:** ICT tools, Framework, South Africa, Public schools.

## 1. Introduction

There is an increased use of Information and Communication Technology (ICT), more so in the era of the fourth industrial revolution. As a result, (Mireku, 2016); Penprase (2018) suggests that with the advent of the Fourth Industrial Revolution, (ICT) becomes a sine qua non in the field of teaching and learning. Hence, training learners to adapt to the changes influenced by the fourth industrial revolution will play a vital role in driving effective use of ICT in teaching and learning (Gleason, 2018). ICT tools promote high-level communication despite space and time, and despite more cost-effective methods; ICT also increases productivity (Hernández-Bravo et al., 2016).

Furthermore, Sang et al. (2010) indicate that ICT tools promote improved and adequate learning settings to nurture flexible information construction in complex learning fields, and to provide for special individual differences. Moreover, Das (2019) alludes that ICT has the potential to have a significant impact on economies and communities by lowering information and transaction costs, creating new collaboration models to increase worker efficiency, encouraging innovation, facilitating access to essential services, and enhancing education. ICT use in classroom setting has been the subject of extensive research in recent years Arkorful et al. (2021); (Suleiman et al., 2020) (Dei, 2018); (Ojo & Adu, 2018). Dei (2020) suggests that implementing a well-designed ICT infrastructure in the education system can transform both teaching and learning practices. Arkorful, Barfil and Aboagye (2021) state that ICT enables more interaction between students and teachers, develops critical thinking skills, and enables students to better understand the material they are learning in class. Das (2019) further

suggests that the advancement of ICT influences quality education by increasing learner motivation and improving basic learning skills.

In addition, ICT tools support the process of teaching and learning; however, there are challenges associated with the effective use of ICT in the teaching and learning process (Jamil et al., 2016). According to Meyer and Gent (2016), ICT is important within the education sector as a means of enhancing the process of teaching and learning in a classroom. They further argue that while strategy and policy on information and communication technology exists in schools, implementation is slow, and capacity is limited. In a similar vein, the adoption objectives lack clarity and, as such, the strategy is poorly integrated. In support of this, Mireku (2016) argues that rural public schools face different challenges that do not occur in urban schools, such as a lack of teaching and learning software, ICT hardware devices, a paucity of infrastructure, etc. Furthermore, after the closure of educational institutions due to COVID-19, ICT was incorporated as a recovery plan in educational institutions, assisting them in transitioning from traditional learning techniques to e-learning, ensuring that learners continue their studies at home. (Maatuk et al., 2022), suggest that most South African public schools, especially in townships and rural areas, were negatively impacted by the school shutdown, as they were unable to integrate ICT in their teaching and learning, due to the unavailability of necessary ICT resources. These militate against the introduction of computer courses and incorporating ICT in the teaching and learning, which will lead to producing non-competitive youth in the fourth industrial revolution.

## 1.2 BACKGROUND AND CONTEXT

It is evident that initiatives, such as digital, mobile and online learning, are all supported by ICT tools. Providing public schools in South Africa with high-quality education is the Department of Education's responsibility, but it is not the only one; other stakeholders also have a role, such as non-governmental organizations (NGOs), academic institutions, and other educational activists. In South Africa, there is a growing use of ICT in education, according to (Meyer & Gent, 2016). A major role is being played by ICT in driving education, and this role should be well planned. The authors add that the measurement of progression must be explicit in the planning of the

process, and that there is a need to develop the skills and confidence of teachers to effectively use ICT, and to integrate ICT teaching and learning within the education system. Furthermore, the authors speak of increased focus on pedagogy in ICT to ensure strategic alignment for effective ICT use at all levels in the education system. The authors identify several role players in ICT use in education that include district, provincial and national levels. These role players are illustrated in the diagram below.

### Three spheres of governance and role players for ICT in education

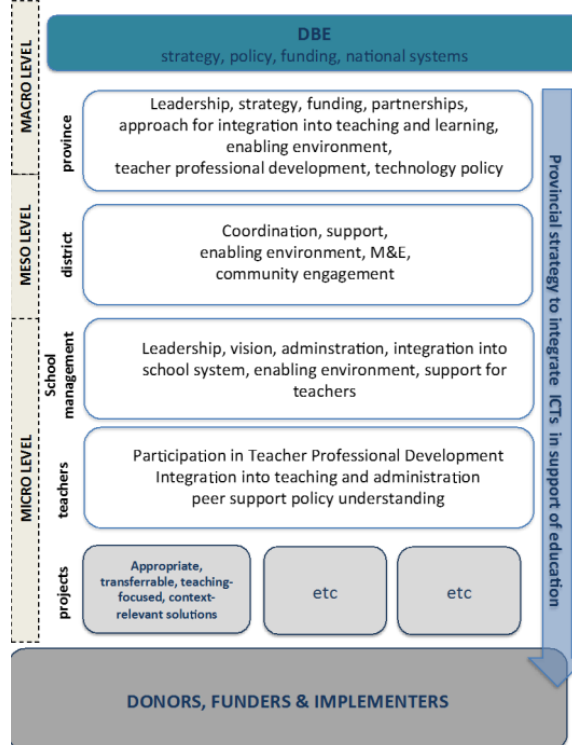


Figure 1. Three spheres of governance & role players for ICT in education (Meyer & Gent, 2016a)

These role players can influence the availability and effective use of ICT in education and it is suggested, therefore, that they be aligned from top to bottom at all levels. The authors touched on four key areas of effective use of ICT in teaching and learning that cover assessment, progression, participation and curriculum content. Elaboration of their importance was done, and these areas are vital to the effective use of ICT in education. In addition, the study identifies critical factors that should be incorporated across all levels of governance. These critical factors are illustrated in the diagram below, and include factors at macro, meso, and micro levels, as well as factors that would support alignment across all the levels.

<b>MACRO</b>	<p><b>National and provincial</b>  <i>Provide leadership and facilitate integration</i></p> <p>Leadership, vision, clear objectives, accountability, a strategy for ICT integration in support of pedagogy, a strategy for integrated teacher development, policy to ensure technology and content choices that are relevant to the context, enablement of other levels</p>
<b>MESO</b>	<p><b>Province and district</b>  <i>Create an enabling environment</i></p> <p>Capacity for support and enablement (teachers, technology, operations); community engagement; facilitate communities of practice</p>
<b>MICRO</b>	<p><b>School management, teachers, projects</b>  <i>Create an enabling environment, learn and apply, integrate with the context</i></p> <p>Create an enabling environment (systems, practices, scope for training); participate in appropriate professional development; learn from each other; develop and integrate context-specific, transferrable and affordable solutions; engage the community.</p>
<b>ACROSS</b>	<p><b>All levels of the educational system</b>  <i>Ensure alignment</i></p> <p>Ensure alignment from strategy through implementation. Align external stakeholders and ensure integration with the system before transfer of projects or programs.</p> <p>Also, recognise that different activities need to happen at different levels. Ensure that the right things are happening at the right places, in line with where the skills, scope and decision-making authority reside. For example, policies need to be developed and implemented to ensure that solutions are cognisant of the local realities; this needs to happen at the provincial rather than the national level. Furthermore, policies to ensure consistent standards need to be developed at national level, not provincial level.</p>

Figure 2. Spheres of governance & their roles)

### Conceptual Framework

The availability of ICT tools in schools does not automatically translate to their effective and efficient use in teaching, learning, administration and management. It is from an assessment of the current state of the effective use of ICT in teaching and learning, based on a framework that would support assessment, that guidelines may be proposed. Thus, stemming from the literature, six key elements for assessment are identified. These include government support, available ICT tools, security measures provided for the ICT tools, teacher efficacy, state of ICT tools, curriculum practices and use of ICT tools. Each of these elements is briefly discussed.

**Government:** The government's role in this framework is three-pronged: Formulation of ICT policies, provision of ICT tools and monitoring and control. Through the Department of Education (DoE), the government draws up ICT policies from the national government to be adapted and implemented by schools, which is in line with the mission and vision statement of the school. This will ensure uniformity across the Area Office (AO), provincial and national levels. Meyer and Gent (2016) observe that, currently in South Africa, a high misalignment of ICT policy exists. Furthermore, the role of ICT tools procurement should be a responsibility of the government (Bingimlas, 2009). It should not only provide financial relief, the government should

also see that the tools are delivered on time to schools, that they are supported adequately, and it should also ensure that each school has more than one qualified educator who can impart ICT knowledge to support the subjects' content

delivery. In addition, the policies drawn should also include targets in which performances, output and outcomes can be measured through proper monitoring and control.

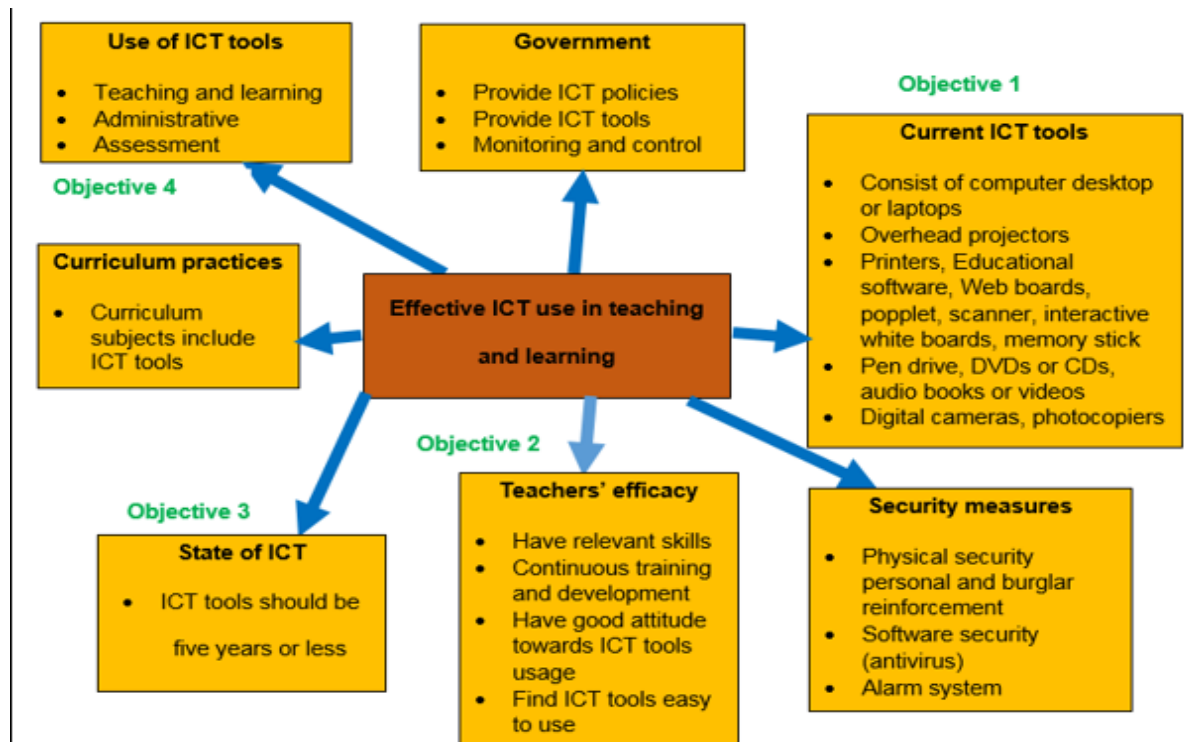


Figure 3. Hypothetical Model

**Current and relevant ICT tools:** There is a need to identify the ICT tools to be used in the school environment. This would be useful in terms of standardizing ICT tools in teaching and learning without being oblivious to the situation and locations of the respective schools. This will help the Department of Education to break barriers of a divide amongst learners; as such, learners from both urban and rural schools will be equally ICT savvy (Gillwald et al., 2018); (Mwapwele et al., 2019; Salam et al., 2018). **Security measures:** As a sequel to the provision of ICT tools, it is imperative to equally provide for adequate security to safeguard the equipment. This implies that the measures of ICT tools protection should not only cover the software, there should also be the presence of physical security such as burglary proof, closed-circuit television cameras, alarm systems, biometrics methods, etc., to protect the electronic devices. The importance of these measures cannot be overemphasized; it protects data and safeguards systems against infections and malware, which enables programs to run faster and smoother. In a similar vein, it also ensures that physical infrastructure is protected.

**Teacher efficacy and use of ICT tools:** One of the most important aspects in the framework is the teachers' skills and efficacy. The teachers will not teach what they do not know. Therefore, the Department of Education must ensure that the educators in the classrooms are knowledgeable on the usage of ICT tools; this would make it easier for its integration into teaching, learning, and evaluation. Furthermore, the status of skills and efficacy, as well as the relationship the two have would greatly impact the attitude of an educator towards their mindset about ICT tools and their usage in teaching and learning. If teachers have positive perceptions about ICT tools and are willing to use them, it would become the culture of teaching and learning in the school. This should be facilitated by the training arrangement for teachers, which should not be a once-off, but on a continuous basis as the ICT world is a rapidly evolving and is an emerging field.

**State of ICT tools:** The state or model of schools' ICT tools is of great concern. It is observed above that technologies are still emerging; therefore, government policies on ICT should accommodate the timely disposal and replacements of ICT tools that have become obsolete and outdated. This

would accommodate the dynamism in teaching and learning, irrespective of time and space.

**Curriculum practices:** The contents of the curriculum in the 21st century should include ICT tools. Currently, not all subjects integrate ICT tools in their curriculum. All subjects should incorporate ICT tools in teaching and learning to avoid creating a divide amongst learners. This will prepare learners towards the opportunities and challenges of the 4th industrial revolution.

**Use of ICT tools:** It has been emphasized how ICT tools can be multi-purposeful in educational activities. Aside from facilitating and enhancing teaching and learning, ICT tools are also integrated into learners' evaluation as well as schools' administration and management. Learners' assessments and grading are done online without recourse to time and space. In a similar way, teachers' and other staffs' punctuality to school and classes could be monitored through electronic devices; meetings are conducted through video conference, and presentation done through Skype, etc. The synergy of components of this framework, when harnessed properly, would enhance the effectiveness of ICT tools in teaching and learning at public schools. However, when any of the components of the framework are not taken into consideration in the formulation and implementation of ICT policies for the school, the chances of posing challenges are high, because they are inter-related and interconnected.

## 2. Related Works

The potential benefits for the effective use of ICT tools in teaching and learning are of interest to research. Byrom and Bingham (2001) highlights that the rise of technologies has complicated effective use of ICT tools and poses challenges for teachers. Moreover, Byrom and Bingham (2001) suggest for effective use of technology, it requires changes in teaching; in turn, the adoption of a new teaching strategy could be a catalyst for technology integration. However, Tondeur et al. (2017) found that there was a mismatch between the educational change and the meanings attached to that change by those involved in the instructional process. Previous research into the effective use of ICT tools in teaching and learning has examined related subjects such as barriers to successful ICT integration in teaching and learning and ways to overcome those barriers (Bingimlas 2009). Assessment of teachers' skill

and ICT integration in schools (Ramadan et al., 2018). The study found that teachers' adoption of ICT tools for teaching and learning is significantly influenced by age. When compared to their older colleagues, the younger teachers were more technologically savvy.

Furthermore, Erişti et al. (2012) examined teachers' views about the effective use of technology. This included processes, problems experienced and suggestions for the effective integration of ICT tools in teaching and learning. The relationship between teachers' pedagogical beliefs and their technology practices is critical (Ertmer, 2005). Teachers need to perceive the use of ICT tools in teaching is important for them to effectively use the tools (Ghavifekr et al., 2016).

Additional studies on the effective use of ICT tools in teaching and learning have explored the relationships among preservice teachers' conceptions of teaching using mobile devices and the quality of technology integration in lesson plans (Tsai & Tsai, 2019). Leadership stakeholders have an influential role in terms of the influence learning leaders have in the effective use of technology in the learning environment, and the types of professional development that best support learning for these leaders was described by Christensen et al., (2018). Regarding the assessment of ICT tools effectiveness, Kayisire and Wei (2016) assessed effectiveness through a case study approach using 40 African countries. Furthermore, Padayachee (2017), snapshot survey of ICT integration in South African schools found that teachers are uncertain with respect to the enforcement of effective use of ICT tools. This is confounded by poor infrastructure and a lack of skills, and it was recommended that future studies need to focus on implementation guidelines for use of ICT in class for both teachers and learners. Furthermore, it is no use in only identifying the barriers and recommending solutions without contextualizing the solution to the type of schools. Mireku (2016) stated that South African public schools do not have the same challenges as private schools when implementing ICT in teaching and learning; hence, this study examined the challenges that public schools encounter when implementing ICT in teaching and learning. This would make it easier to direct pertinent solutions toward the South African public schools' lack of effective ICT implementation.

### 3. Methodology

This study uses a mixed method to undergo the research process. The mixed method uses both qualitative and quantitative data to undergo a research study. The sampling method used for this study is purposive sampling; purposive sampling selects respondents based on their experience, role and knowledge (Etikan et al., 2016). Purposive sampling was used in this study to select the respondents, from 26 public schools, mostly villages and farm schools.

A sample size calculator was used to determine the sample of the study using Krejcie and Morgan's (1970) suggestion that an N of 130 is sampled to 97 respondents, and for this study, only 59 participants responded by means of a questionnaire. Furthermore, five education specialists were interviewed from the Mafikeng North-west Department of Education. Confirmatory factor analysis was used for the quantitative data, and coding was used for the qualitative data. Ethics clearance was obtained. Participants gave written consent to participate in the study, for the dissemination of findings in the form of thesis, conference presentations and manuscripts. All ethics requirements were adhered to.

### 4. Data Analysis and Results

This chapter presents the discussion of the findings from the data analysis. To achieve the objectives of the study, the results were analyzed and presented as they appear in the different sections of the questionnaire and from the interviews.

The Cronbach Alpha measures the internal consistence in the data where we have Likert scale variables as in the present study. In this study the Cronbach's alpha is 0.948, which indicates a high level of internal consistency for our scale as shown in Table 4.1 below. Nunnally (1978) states that instruments used in basic research should have reliability greater than or equal to 0.70.

Table 1. Reliability Coefficient Alpha

Reliability Statistics	
Cronbach's Alpha	N of Items
0.948	56

Table 2. Validity Analysis - KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.727
Bartlett's Test of Sphericity	Approx. Chi-Square	3938.197
	Df	990
	Sig.	.000

The table above displays the KMO and Bartlett's test which measure the validity of the Likert scale instrument used in this study. The KMO in the study is 0.727 and means the data is factorable. Exploratory factor analysis can be conducted.

The analysis began by analyzing the demographic information of the respondents. Regarding the distribution of age almost half (49%) of the respondents were between the ages of 41 and 50 years, 31 to 41 years (28%), less than 30 years (9%) and over 50 years was 15 per cent. More than half (62%) of the respondents were female and only (38%) were male. The majority of the respondents (96%) were black educators. Only a few principals took part in the study (16%). Most respondents (68%) spoke the Setswana language and only a few respondents spoke other languages. Regarding lab facilitation, almost 87 per cent of respondents indicated that there were no educators responsible for lab facilitation. However, 71 per cent of respondents indicated that they had computers for administrative purposes and printers at their schools (61%), and 94 per cent indicated that they did not have computers for their subjects. Regarding overhead projectors, 52 per cent of the respondents disagree with their availability. Meanwhile, 49 per cent of the respondents agree that there are computer laboratories in their schools.

### Confirmatory factor analysis

The confirmatory factor analysis (CFA) begins by testing for instrument validity and reliability using KMO and Bartlett's test and the Chronbach alpha respectively. The KMO in the study is 0.727 and means the data is factorable, while the Cronbach's alpha is 0.948, which indicates a high level of internal consistency. Instruments used in basic research should have reliability greater than, or equal to, 0.70 (Singh, 2017). The CFA seeks to confirm the factors that contribute to the effective

use of ICT tools in teaching and learning in public schools. The CFA starts with an unmodified measurement model, highlighting the four indices of interest namely, the Chi-square, Root mean square error of approximation (RMSEA), Comparative fit index (CFI) and Goodness of Fit Statistics (GFI) (Abraham et al., (2019). Figure 4.1 displays the best model using the SPSS Amos software version 25. The best model complies with one index. The cmin/df is between 1 and 3. Although the model does not comply with the rest of the fit indices, it can be used to identify the factors that influence ICT integration as ,Schermelleh-Engel et al. (2003) states that even though a model has a good fit it, does not mean it is the correct model. Table 1 displays the fit indices. The model identifies six factors, namely: use of ICT tool (UICTT), security measures (SEC), Teacher Efficacy (TE), Governance (GOV), Learner Efficacy (LEFF) and State of ICT (SICTT) as factors that drive ICT Integration in public schools.

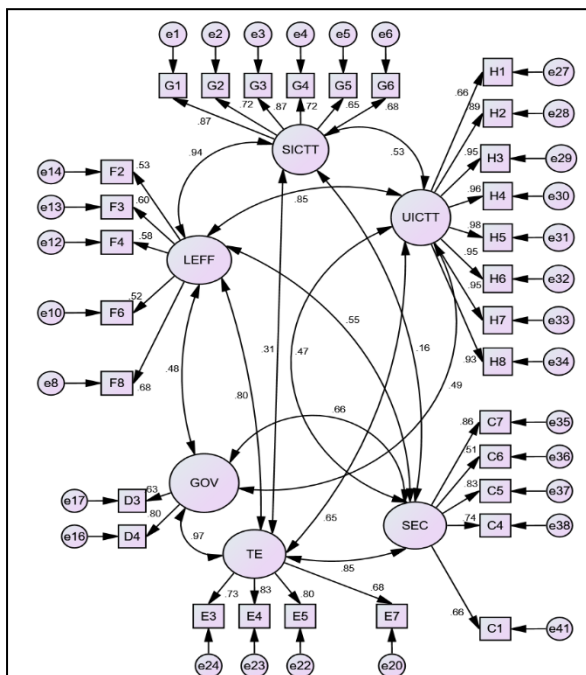


Figure 4. Best Measurement Model for ICT Integration

Table 3. Model Fit Indices

Metric	Observed Value	Recommended Value
cmin/df	2.616	Between 1 and 3
CFI	0.718	> 0.950

RMSE A	0.154	<0.060
PCLOS E	0.00	>0.050
GFI	0.551	>0.9

The best model complies with one index. The cmin/df is between 1 and 3. Although the model does not comply with the rest of the fit indices, it can be used to identify the factors that influence ICT integration. Schermelleh-Engel et al., (2003), state that even though a model has a good fit, it does not mean it is the correct model. A good fit model is regarded as plausible. This model is then used to identify factors that drive ICT Integration. The six factors are, namely: use of ICT tool (UICTT), Security measures (SEC), Teacher Efficacy (TE), Governance (GOV), Learner Efficacy (LEFF) and State of ICT (SICTT). All the mentioned variables are key in implementing a successful ICT tools integration in schools.

### Qualitative data analysis

For the qualitative data analysis ATLAS. ti version 8 was used for coding the open-ended questions from the questionnaire. Two themes were identified from the qualitative data, namely Challenges of ICT Integration and Solutions for overcoming challenges. Table 4.4 displays the identified codes.

Table 4. Model Fit Indices

Challenges Effective ICT Use	Solutions for Overcoming Challenges
Administrative support	Computers and computer labs
Attitude of teachers	Electricity
Computers	Government support and monitoring
Electricity	ICT policies
Government support	ICT resources
ICT resources	Security
Limited data	Train educators in ICT Skills
Low maintenance	WIFI network connectivity
Low salaries	
Motivation	

network connectivity	
Policy	
Poor infrastructure	
Provide resources	
Qualified and skilled teachers	
Security	
WIFI	

Respondents identified the availability of ICT resources as being the biggest challenge for effective ICT use in the schools followed by the availability of qualified and skilled teachers, the shortage of electricity, the shortage of computers in the labs, network connectivity and Wi-Fi connection. Low morale from teachers, lack of support from school administrators regarding the use of ICT resources, lack of Government support and poor government policies were also regarded as not being supportive of the effective use of ICT in schools.

Regarding solutions for overcoming the challenges of training educators in ICT technologies, they would be the provision of ICT resources to schools, an adequate supply of electricity, security in most schools, the provision of computer labs and computers, improving Wi-Fi connectivity, government support, the development of effective ICT policies, the training of educators in ICT technologies, and the provision of ICT resources. These would all help in improving ICT integration in the schools. Figure 4.2 displays a sematic diagram for the ICT integration for this study. A successful ICT integration is possible if there are strong and meaningful relations between “government support” and the “teachers” in using ICT Infrastructure.

Respondents from both the questionnaire and interviews indicated the same challenges regarding non-effective use of digital tools in teaching and learning in public schools.

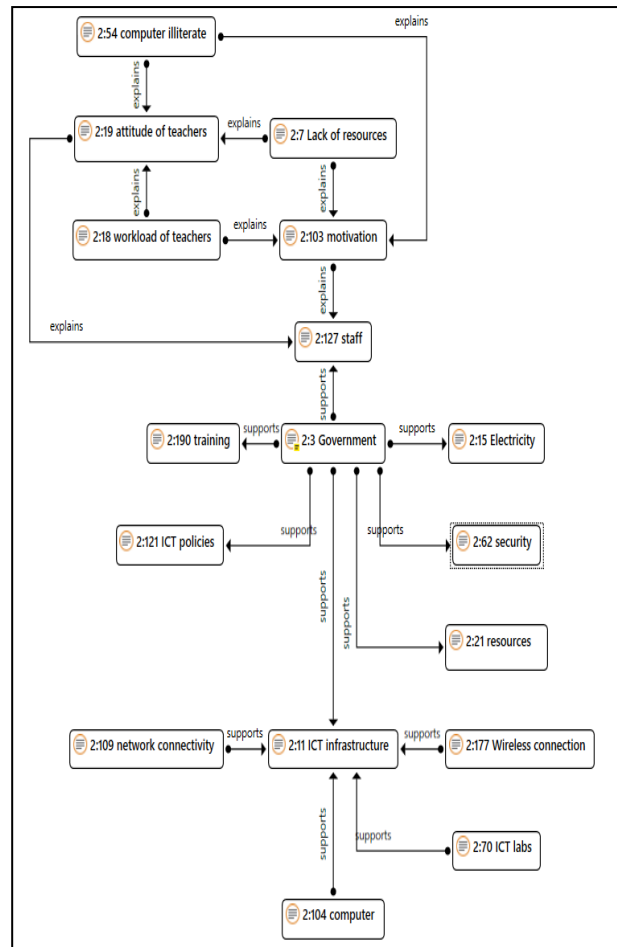


Figure 5. Semantic Analysis for ICT Integration

### 5. Evaluation and discussion

In this study, six factors were identified as being key in effective use of digital tools in teaching and learning. Government support, available ICT tools, security measures provided for the ICT tools, teacher efficacy, state of ICT tools, curriculum practices and use of ICT tools are the six factors that will promote the successful use of digital tools in teaching and learning once there is unison, understanding and collaboration. Meanwhile, there are challenges to the successful use of ICT tools in the classroom such as lack of resources, connectivity, electricity, and lack of support amongst many other reasons behind non-use by teachers. The DoE, as part of the government in public schools in the South Africa should mandate the use of ICT tools in teaching and learning of all subjects. ICT tools should not only be used for administrative purposes of the school but should also be part of a bigger practice. This move has shown rewards in developed nations. This move of integrating ICT in teaching and learning can only be made possible if there is a mandating policy from all levels of government; the national, provincial, and school levels.



Teachers will only integrate ICT tools into teaching and learning if they are guided by policy. Successful integration of ICT tools in teaching and learning will require the voice of teachers, educationalists, policy-makers, national government representatives and information technology scientists to sit in the planning of ICT policy to voice and address all the possible challenges and concerns. From this meeting, there must be a coherent policy and framework that can be used in public schools.

This framework must also be accompanied by a performance standard for teachers as this will add an aspect of motivation to educators. This can also help meet objectives and add a point of compliance from the level of teachers and those that will be doing monitoring and support in schools. The government must assign a task team, especially for reasons of monitoring and support, and this task team must consist of pedagogical and technology experts. The task team must provide technical support and quality assurance to teachers to achieve the successful implementation of ICT in the classroom. Within the policy issues, such as teacher training, disposal of ICT tools and replacement and security strategies, must also be addressed within the policy.

This would help all schools to have equal chances of teacher training; it should be outlined that in any school, more than one teacher be trained to avoid disappointments should the trained educator leave the school. Otherwise, schools should also organize in-house training to empower all teachers in the school, and appoint a designated teacher who will oversee all ICT tools within the school. The selected educator will need to be inducted from the level of the district on the ICT tools policy, developed together with school's management about the ICT policy for the school.

The ICT policy must address issues of security. South Africa has high crime rates in schools, as was the case of Western Cape and Gauteng provinces when they were the first to run with ICT integration in schools. From the evidence gathered, it indicated that most dilapidated laboratories were a result of theft; therefore, security should be ensured at schools. Full-time security and alarm system controls would be ideal as it would benefit the holistic safety of the school. Burglar doors, window and cameras would also help if thieves already had access to the school's premises. Regarding empowering all schools

equally, a development plan at the level of the province must be developed and adhered to. Another issue is one of electricity. Electricity in schools is important as the ICT tools need electricity to operate. Independent networks of the school's electricity must be revised to avoid possible disturbances from the community. Another issue of concern was connectivity; the government needs to invest in efficient connection tools for schools.

All the recommendations can be made, but there will be no growth without the financial injections from government. Therefore, it is the duty of government to ensure that financial muscle is being put in a school for the success of ICT tools integration. In addition, the most important resolution on ICT tool integration in teaching and learning is resource availability and teacher training; educators are the core implementers of ICT tools in teaching and learning and, if they are skilled, they will gain confidence and integration of ICT tools will, therefore, be a success. The South African development plans have the objective of developing ICT knowledgeable learners who can participate in the global economy. The success of this objective will depend on use in all provinces, and a coherent policy framework adoption.

## **6. Conclusion**

The goal of this study was to look into the challenges associated with using ICT technologies for teaching and learning in public schools. It was found that there are several obstacles to ICT adoption in public schools, and until all of these obstacles are addressed, ICT tool integration in public schools would not be successful. The study proposes that many areas can be studied with regard to effective use of ICT tools in teaching and learning at public schools. For example, future studies could explore barriers to effective use of ICT in public schools using longitudinal studies. Furthermore, studies may examine assessing the effectiveness of ICT policies in public schools as the pressure from the fourth industrial revolution increases. Future research may investigate relevant ICT facilities that should be made available for teaching and learning in public schools, and a comparison may also be made with how private or independent schools effectively use ICT tools in teaching and learning.

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