



ISSN: 2230-9926

Available online at <http://www.journalijdr.com>

IJDR

International Journal of Development Research

Vol. 15, Issue, 03, pp. 67937-67942, March, 2025

<https://doi.org/10.37118/ijdr.29293.03.2025>



RESEARCH ARTICLE

OPEN ACCESS

ICT INTEGRATION FRAMEWORK TO ENHANCE TEACHING AND LEARNING IN GAUTENG SCHOOLS

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ARTICLE INFO

Article History:

Received 17th January, 2025

Received in revised form

24th January, 2025

Accepted 19th February, 2025

Published online 30th March, 2025

Key Words:

ICT integration; Integration framework; Gauteng schools; Teaching and learning.

ABSTRACT

The Gauteng Department of Education (GDE) initiated the integration of ICT in curriculum delivery in 2014. This paper interrogates the low integration rate of ICT in teaching and learning in Gauteng public schools, despite the wide range availability of ICT resources in targeted schools, since. In a 2021 study, I focused on schools in three regions of the Gauteng province, and overarching question was an enquiry into how the integration of technology in pedagogy could enhance teaching and learning in Gauteng public schools. My secondary enquiry was broader and included an investigation of the factors that influence successful integration of technology to improve teaching and learning; the perceptions of educators and subject advisors on the use of ICT to improve curriculum delivery; the extent to which ICT training assists educators to integrate technology in the classroom; and the policy recommendations that could be tabled to the GDE to integrate ICT in public schools. The study gave rise to specific recommendations, which I drew on to formulate an ICT integration framework that would, firstly, be responsive to the challenges that led to low ICT integration; and secondly, that would be a model for effective ICT integration. The ICT Integration Framework consists of eight sequential as well as integrated steps, namely: Perceptions and Attitudes of User; ICT Teacher Training; ICT Integration in the classroom; Responsive ICT Integration; ICT Project Management Office; Pedagogical Value; and National Value. The framework represents a novel and responsive solution contextual to GDE circumstances. It is a contemporary extension of the Technology Acceptance Model (TAM) by Davies. Moreover, it offers an alternative to the Technology Acceptance Model (TAM) or Technology Diffusion Model by Rogers, 2015, which does not substantiate on other important factors to be considered when a teacher wants to integrate ICT in the classroom.

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Citation: Ntsohi, M.P and Nyamkure, B, 2025. "ICT integration framework to enhance teaching and learning in gauteng schools". *International Journal of Development Research*, 15, (03), 67937-67942

INTRODUCTION

Nowadays, in view of the changes that have been happening in the educational sector, it is crucial to pay attention to how information, knowledge and lessons are disseminated, says Cuban (2016). Therefore, it is crucial to have a variety of teaching styles incorporated into the curriculum to cater to the diverse learner needs with different learning methods. One of those teaching styles must therefore involve the use of technology, asserts Daniels (2015). Technological tools such as the internet and computers are inadequately used in Africa, South Africa included, while aggressively applied in European educational systems. For the past seven years, many emerging economies have been developing the appropriate ICT frameworks for their countries (Cuban, 2016; Hare, 2017; Moonen, 2017). ICT in the teaching profession is used for various reasons, including enhancing learners' abilities to solve

problems, provoking learner innovation, and promoting a culture of sharing among learners (Isaias, 2018). In 2021, I conducted a study titled "Pedagogical Integration of Technology as an Enhancement to Teaching and Learning in Gauteng Public Schools", which explores how technology can be integrated in the daily activities of public schools from the views of educators, Heads of Departments (HODs) and Subject Advisors, in the Gauteng province of South Africa. The context within which the study was done, was the department's objective to introduce technology in teaching and learning. This was envisaged as a game-changer to improve educational outcomes as well as learner attainment, rapidly and at scale. Additionally, it was envisaged to change classroom experience, and to introduce innovations that unlock administrative efficiencies. To this end, the Gauteng Department of Education (GDE) embarked on a transformational journey to infuse ICT in curriculum delivery. Its ICT rollout started in 2014 as a flagship project of the 4th political administration. It gained momentum in the 5th administration under

the auspices of the Operation Phakisa ICT programme, which was also linked to the National Development Programme (NDP). From this background, my study was particularly focused on the low integration rate of ICT in teaching and learning in Gauteng public schools, despite the wide range availability of ICT resources in targeted schools. The study sought to address the primary question: "How does integration of technology in pedagogy enhance teaching and learning in Gauteng public schools?" Secondary questions covered a broader scope, including: the factors that influence successful integration of technology to improve teaching and learning; the perceptions of educators and subject advisors on the use of ICT to improve curriculum delivery; the extent to which ICT training assists educators to integrate technology in the classroom; and the policy recommendations that could be tabled to the GDE to integrate ICT in public schools. The multifaceted study gave rise to specific recommendations, which further informed the responsive ICT integration framework that I subsequently developed, which is the main subject of this paper. In this presentation, firstly, I discuss the GDE landscape and the Operation Phakisa initiative; secondly, I outline the recommendations made in my study; and finally, I discuss the Responsive ICT Integration Framework for Teaching and Learning (RIIFTL) which I developed. The study adds to the body of knowledge by addressing the timing component. This is so because the study is timed against evaluating the implementation and integration of ICT in South Africa through the Gauteng province, as the pilot province of the national ICT Project. Therefore, the study's findings are current and thematic because they critique the evolution of the ICT implementation within Gauteng from 2015 to 2020. Those findings can be used as a point of reference for future rollout out of ICT in other provinces that had not started, or which had experienced a delay in the ICT rollout in schools.

GDE and Operation Phakisa

According to the National Development Plan, Vision 2030, South Africa as a country strives to become globally competitive with high standards and good quality of life for its citizens. The education sector is expected to drive this goal for the country. For this goal to be realised, it is imperative that ICT plays a critical and vital role so that the education sector can be able to attain these high standards (Department of Basic Education, 2013). For this reason, one of the main goals of the education sector is to embrace the characteristics of the new technological era (Silva, 2019). This, therefore, means that ICT in the education sector has an important role to play. Therefore, if the education sector does not embrace the new technology, most schools will be left behind using old teaching and learning methods. These outdated teaching ways will not auger well in the new millennium where there is a high level of education digitalisation (Hare, 2017). Further, the new generation of learners is obsessed with using technology; therefore, they should not be frustrated but be encouraged to harness their skills in education through ICT (Sherry & Gibson, 2015). Operation Phakisa is an initiative adopted by the South African Government in 2014 designed to fast track the implementation of projects and programmes on critical development issues. The roll-out of ICT in the education sector in South Africa was underpinned by this initiative under the cluster Education Lab. The focus is on the distribution of devices with content to schools, providing various forms of connectivity, professional development as well as monitoring and evaluation (Department of Basic Education, 2020). Policy issues are related to many aspects of the roll-out programme. At the same time, some issues are identified as gaps in this study. The main gap that needs to be addressed is the digital divide within Gauteng Province. Related to the digital divide is the material access gap, which refers to ICT infrastructure accessibility, maintenance and associated costs. A policy gap was also found concerning the training of educators on ICT. Operation Phakisa objectives are challenging to achieve without proper policy implementation guidelines as well as tracking progress on implementation. This explains why there is poor ICT integration in some township schools because Operation Phakisa has not made a strong impact at the operational level in schools. It remains an abstract concept at the level of the National Government without a

direct relationship with issues affecting the integration of ICT at the classroom level. Therefore, Operation Phakisa needs to be drawn closer to the district and classroom level to ensure that there are positive outcomes to enhance ICT integration in Gauteng Province classrooms. In the Gauteng Province, the government has focused on improving its education system to align it with the provincial development agenda in the context of transformation, modernisation and reindustrialisation. The emphasis on improving education is outlined in the first White Paper on Education and Training published in 1995. The policy provided a framework for a new system of education. The White Paper also highlighted the importance of Mathematics and Science subjects for all learners. The digitisation of the classroom also finds expression in the National Development Plan (NDP) vision 2030.

According to the GDE (2015), the department has embarked on a transformational journey by introducing Information Communication Technology (ICT) as an intended game-changer in curriculum delivery. The project was conceptualised in 2015 and was linked to the term of the 5th Political Administration. The vision was clearly outlined and driven by the Member of the Executive Council (MEC), who argued that "Technology is the future; you cannot use 20th Century Teaching Methods in the 21st Century". The Executive Management Team (EMT), under the leadership of the MEC, held weekly accounting sessions and made the necessary interventions where required. The Premier of the Gauteng Province and the Gauteng Provincial Government also provided guidance and support for the GDE ICT rollout. As a result, the project was profiled as one of the key deliverables of the 5th Gauteng Political Administration. Apart from being a priority project, the ICT rollout in Gauteng is also used as an incentive. Township schools that have achieved a hundred per cent (100%) pass in their matric results are adopted as full ICT schools (DBE, 2018). This implies that the schools get an end-to-end ICT solution from Grade 8-12. The ICT project is also used to promote social cohesion amongst schools that have been approved for twinning, therefore bringing schools from the suburbs and townships together to share resources and experiences.

Previous Recommendations

In the study's summary of contributions to gaps in the literature, generic interventions were recommended that could benefit the GDE as well as South African schools in general. A list of 25 specific recommendations were made, but due to time constraints, they cannot be engaged in this paper. However, a summary of notable recommendations includes:

- 1) Framework that is innovative and responsive
- 2) Realistic budgets made available for ICT rollout
- 3) Professional development to be prioritised
- 4) Change management to be introduced early in the rollout
- 5) Incentives for the use of ICT
- 6) Performance monitoring to be factored
- 7) Online assessments to be formalised to achieve maximum value
- 8) Appropriate security of ICT infrastructure and mobile device management
- 9) Strengthen and institutionalise onsite support (technical and curriculum support)

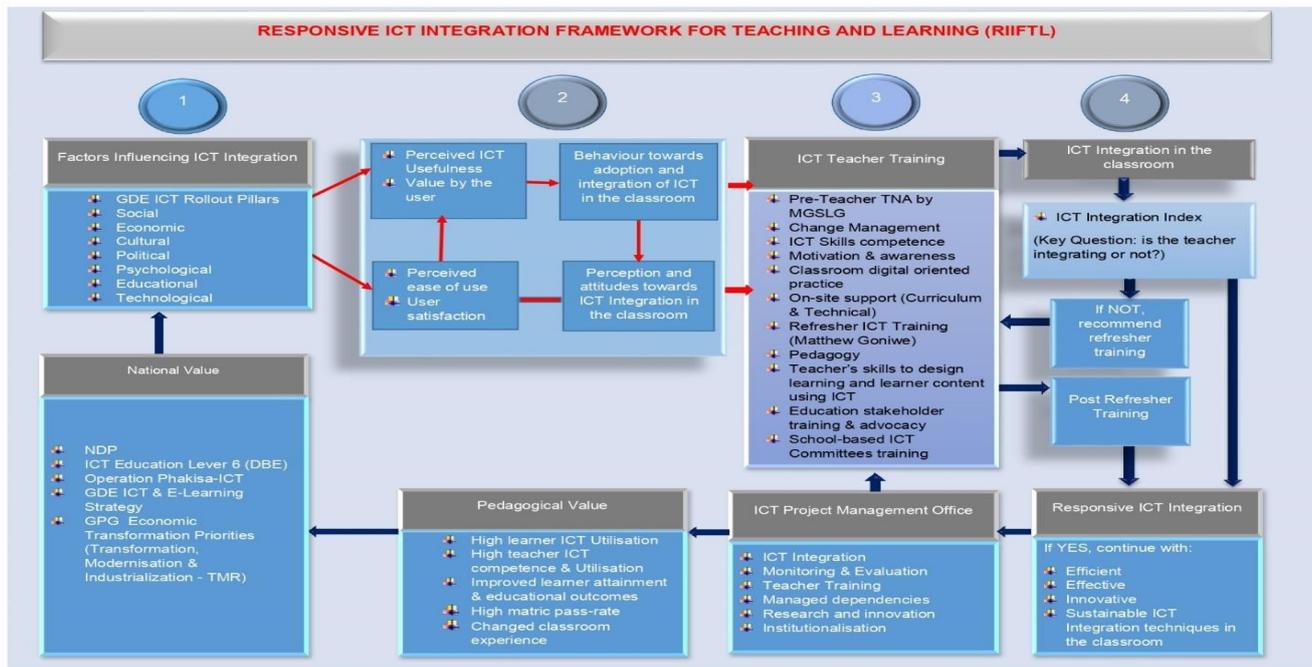
Responsive ICT Integration Framework for Teaching and Learning (RIIFTL)

The ICT integration framework has been developed based on the list of 25 recommendations, as well as the literature gaps identified. It is argued that this framework is particularly useful because it was developed after an empirical study identifying the specific low ICT integration challenges that the GDE faced. It therefore represents a unique and responsive solution contextual to GDE circumstances. In addition, this framework is an extension of the Technology Acceptance Model (TAM) by Davies (1989) that demonstrates how users relate to technology and what drives them to adopt or use it.

Moreover, the component parts of the ICT integration framework include other factors such as:

- 1) Training - Pre and post training initiatives
- 2) Change management - Orientation, adoption and utilisation
- 3) On-site support – Technical and content support
- 4) Pedagogy- Lessons preparations and classroom practice
- 5) Classroom digital set-up
- 6) School-based ICT committees
- 7) ICT Project management office to support the various workstreams
- 8) Monitoring and Evaluation – Performance monitoring and regular reporting
- 9) Research, policy development and innovation
- 10) Impact and outcome - Educator productivity and digital skills

time of the study, including the social, economic, cultural, political, psychological, educational and technological factors that have influenced the rollout. Effectively, this is an overview of the status quo. Pertaining to the rollout pillar, my study found that while past research covered the extent to which educators were ready to embrace ICT in learning, most of the research pre-dates 2014, which is the implementation date of ICT in Gauteng schools. More importantly, the roll-out of ICT is ongoing and existing research, while useful, is limited. Some of the under-researched challenges were that schools that had not received ample support from the government and those situated in previously marginalised areas continue to face multiple difficulties in embracing ICT. As a result, the digital divide in the country, which is the gap between those institutions that are benefitting from technology and those that are not yet benefitting from it, has continued to widen.



Source: Author

Figure 1. Responsive ICT Integration Framework

What makes this ICT Integration Framework unique, is that when it is compared with the Technology Acceptance Model (TAM) or Technology Diffusion Model by Rogers (2015), the latter does not practically show the other important factors that have to be considered when a teacher wants to integrate ICT in the classroom – as I do. For instance, the findings indicated educators' lack of ICT knowledge and skills as a major obstacle to implementation and consequently pointed to the need for further training for educators. Therefore, the training and re-training of educators should encompass a broad spectrum of ICT strategies so that educators' skills and knowledge of ICT are not limited to the educator directed, learner-centred repertoire. Training and refresher training requires all necessary resources and support from the education system and is an ongoing process. The RIIFTL has eight stages that are integrated:

- 1) Factors Influencing ICT Integration
- 2) Perceptions and Attitudes of User
- 3) ICT Teacher Training
- 4) ICT Integration in the classroom
- 5) Responsive ICT Integration
- 6) ICT Project Management Office
- 7) Pedagogical Value
- 8) National Value

Factors Influencing ICT Integration: Each stage is constituted of several factors that derived from the considerations that issue from the recommendations and the framework captures the integrated relationships between the stages. I now briefly discuss the framework. The first stage on the *Factors Influencing ICT Integration* interrogates the GDE ICT Rollout Pillars, offering an analysis of the status at the

Responses from the Senior Managers of the Gauteng Department of Education shared the view that, first, the programme will be successful if there is a will to implement a change project of such magnitude, by using current resources and acquiring more as the concept is proven. Second, a multi-stakeholder Project Team across disciplines and functions ensures support, buy-in and collaboration. As such, stakeholder buy-in is key to ensure that the implementation is supported. The team handling the infrastructure and devices requires the curriculum team to translate the enablers into actual teaching and learning practice. In addition, security and retrieval of the devices are key as continuous replacement of stolen, damaged and unreturned devices is not financially sustainable. Thirdly, there was unanimous response that identified training needs to be at the core of the ICT rollout and therefore, it is important to secure educator unions' support for intensive educator training that may be more than the agreed working hours. Moreover, the success of the ICT rollout hinges on enough ICT facilities, for instance, classroom, educator and learner devices. Educators should have access to devices to expand their knowledge. On a positive note, my2021 study found that most (99%) educators in full ICT and targeted schools for the ICT rollout have the necessary resources. From these findings, one could suggest that this phase of the rollout was a success.

Perception and Attitudes of User: The second stage relates to the *Perceptions and Attitudes of User*. The four steps of the second stage are the perceived usefulness and value of ICT to the user; behaviour towards adoption; perceptions and attitudes; and perceived ease of use and satisfaction. Together, these four steps create a feedback loop to each other, while the first stage informs value and

satisfaction aspects of the second stage. At an objective level the value of ICT is recognized in a number of areas. There seems to be a strong rationale for the increased use of ICT in the education sector, which can be social, economic, pedagogic and vocational. As such, using ICT in education has economic value in that it increases effectiveness and efficiency in performing educational tasks, which in turn reduce the labour costs incurred. On the other hand, the pedagogical value of ICT is that it can lead to substantial improvements in the quality of education provided, as it is able to make education more exciting, motivating and rich for the learner. The social value of ICT lies in the social benefits that can come as a result of the use of ICT in education. Successfully initiating and implementing educational technology in school programmes depends strongly on the teachers' support and attitudes. It is believed that if teachers perceived technology programmes as neither fulfilling their needs nor their students' needs, it is likely that they will not integrate the technology into their teaching and learning. Among the factors that influence the successful integration of ICT into teaching, are teachers' attitudes and beliefs towards technology. If teachers' attitudes are positive toward the use of educational technology, then they can easily provide helpful insight about the adoption and integration of ICT into teaching and learning processes.

According to the framework, the perceived usefulness and value to the ICT user informs the behaviour towards adoption and integration of ICT in the classroom. The behaviour is either positive or negative, which entrenches perceptions and attitudes towards ICT integration in the classroom. The attitudes of educators towards the use of ICT in teaching is a crucial aspect for its adoption and integration. Interestingly, the study found a correlation between sufficient training and a receptive attitude. The study noted that skill, perceived knowledge, level of computer competency, training, as well as experience, significantly influence educators' attitudes and perception of the value of ICT, as well as the manner in which they will use it for teaching and learning in the classroom. The study identifies five themes that emerged from the data analysis process, regarding perception which is around the meaning of ICT and its purpose; the benefits of ICT in education; the shortfalls of ICT in schools; the government's decision to introduce ICT in schools; and on ICT and educators' daily duties. However, perceptions and attitudes produce concrete responses based on the perceived ease of use of ICT in the classroom. For example, it was found in several studies that most female educators tend to avoid the utilisation of ICT for teaching and learning because it requires an understanding of how ICT gadgets work. They try to avoid embarrassing themselves in front of their learners hence their negative attitude towards it. It is further suggested that there is a likelihood that teachers with a poor attitude towards ICT integration in the classroom will not plan and teach using ICT resources at all. Computer attitudes of teachers are positively related to teachers' computer experience. Furthermore, positive computer attitudes are anticipated to foster computer integration in the classroom. Successful ICT integration in teaching and user satisfaction thus requires users to develop foundational affirmative attitudes regarding innovation. Recommendations on changing negative attitude of educators include exposing educators to technology; having seminars or workshops on ICT; the need for incentives (motivation) on the utilisation of information, communication and technology; informing educators on opportunities being brought by make use of technology; and onsite support covering technical and pedagogical support.

ICT Teacher Training: A positive outcome of the second stage leads to the third stage which is the actual ICT Teacher Training. This stage is multi-dimensional, and the GDE has thus partnered with the Matthew Goniwe School of Leadership and Governance (MGSLG), which provides the necessary comprehensive training. The third stage of the framework identifies 11 specific aspects of ICT Teacher Training, namely:

- 1) Pre-Teacher TNA by MGSLG
- 2) Change Management
- 3) ICT Skills Competence

- 4) Motivation and Awareness
- 5) Classroom Digital Oriented Practice
- 6) On-Site Support (Curriculum and Technical)
- 7) Refresher ICT Training (MGSLG)
- 8) Pedagogy
- 9) Teacher's skills to design learning and learner content using ICT
- 10) Education Stakeholder Training and Advocacy
- 11) School-Based ICT Committee Training

I will focus only on the change management aspect of the training, given that it has been proven to a source of inertia in the ICT integration process. There was unanimous response in the study that emphasised training needs to be at the core of the ICT rollout and implementation. The training approach adopted a whole-school, multi-stakeholder approach at the outset of the training programme design, and the online assessment to identify teachers' ICT training needs which was done initially by the MGSLG. Change Management was approached according to the GDE ICT Policy Strategy of Teacher Development, which was centred mainly on giving ICT training and support, by a delegation of ICT facilitators to various schools, using the tech empowered approach. These facilitators were mandated to provide onsite support and training on how to use digital devices, mediate the e-content image, and provide ICT integration training programmes bound to upgrade the skills of teachers who already had affluence on the use of ICTs. Prior to the introduction of ICT in 2014, the ICT training programmes were device oriented. This resulted in most teachers resisting or being slow in adopting and integrating ICT for teaching and learning. The development of teachers in the use and integration of ICT into subject-specific teaching and learning is a complex process that requires a differentiated approach that acknowledges that teachers are at different levels of integrating ICT into teaching and learning. Therefore, the Teacher Development Strategy utilises a combination of different strategies to deal with complexities around professional teacher development (DBE, 2019). The MGSLG ICT Change Management Training which is constituted eight steps sought to create an environment conducive to the transformation of identified Gauteng schools from traditional or conventional teaching schools into ICT schools. This was done by helping schools identify barriers to change and then equipping them with appropriate tools to either remove or manage the barriers, so that the ICT in schools' vision can be realised. Teachers are constantly trained every six months to ensure they understand and appreciate the value of using ICT for teaching and learning, which is the refresher training aspect of stage three.

ICT Integration in the Classroom: The fourth stage of the framework involves *ICT Integration in the Classroom* after the previous stage of ICT Teacher Training. Here, the objective is to develop what I refer to as an ICT Integration Index, that poses the Key Question: "Is the teacher integrating or not?" If the answer is negative, recommendation is made that the teacher should receive refresher training as per stage three. After successful refresher training, the question of whether they are integrating ICT in the classroom is asked again.

Responsive ICT Integration: In the case where the teacher demonstrates competence in ICT integration immediately after training, they proceed to the fifth stage, as does the teacher who successfully integrates ICT after refresher training. Stage five measures *Responsive ICT Integration* in the classroom and measures whether the process is efficient, effective, innovative and sustainable.

ICT Project Management Office: The *ICT Project Management Office* is tasked with oversight and management of various aspects that include ICT integration, monitoring and evaluation, teacher training, managed dependencies, research and innovation, institutionalisation. As I have already touched on the ICT integration and teacher training aspects, here I briefly substantiate on the monitoring and evaluation, research and innovation and institutionalisation components. By way for definition, this stage encompasses the continuous monitoring and evaluation processes and

systems that need to be implemented to ensure that the ICT roll-out stays on track and is delivered within the set timeframes. If this is not in place, serious challenges and implications can be expected. My study recommends in this respect, that the introduction and implementation of ICT will require the GDE to have a good monitoring and evaluation plan. This plan will assist in ensuring that results are evaluated, and performance is monitored. The roll-out is a prerequisite for full integration; therefore, a dedicated and strong team should focus solely on monitoring. Utilisation is one of the major components that needs to be reported on. ICT can be available and accessible, but integration will never happen if it does not get utilised. Therefore, it is recommended that each district have a monitoring and evaluation team focusing solely on ICT implementation. They should be equipped to make decisions and guide schools on best practices on ICT integration. Research and innovation imply that new methods that have been successful elsewhere should be followed. The department should always keep abreast with the technological innovations that occur in the ICT environment. It cannot afford to be using old and obsolete equipment. Research and innovation will assist the GDE in improving its performance in the ICT space. It will further ensure a high standard of professionalism amongst the educators and an adequate continuing training and knowledge management system. This is an important aspect when dealing with ICT since new technology is introduced frequently, and schools should at least know what exists. The already existing research unit at GDE should be strengthened further to ensure that the best advice is provided to the decision-makers on ICT. The Blended Model is presently being used to catalyse the institutionalisation of ICT in teaching and learning in Gauteng schools. An online professional teacher development training course on ICT integration was compiled on the Matthew Goniwe Online platform. The course has 13 modules and 56 units. The course is composed of three different tracks: a beginner track known as Technological Literacy, an intermediate track with knowledge deepening courses, and an advanced track that focuses on knowledge creation.

Pedagogical Value: The seventh stage of the framework pertains to the Pedagogical Value of ICT integration. I will not discuss this component and will instead, list what my study identified are five core sources of such value, namely:

- 1) High learner ICT utilisation
- 2) High teacher ICT competence and utilisation
- 3) Improved learner attainment and educational outcomes
- 4) High matric pass-rate
- 5) Changed classroom experience

National Value: The eighth and final National Value stage of my framework articulates the macro context and value of successful integration. This stage is important as it feeds back to the first stage of the framework, which is the Factors Influencing ICT Integration. In other words, the point of departure of the framework in stage one, is continually informed by the macro and policy considerations of national priorities from the last stage. The specific that contribute to the framework are:

- 1) NDP
- 2) ICT Education Lever 6 (DBE)
- 3) Operation Phakisa-ICT
- 4) GDE ICT & E-Learning Strategy
- 5) GPG Economic Transformation Prioritise (Transformation, Modernisation and Industrialisation – TMR)

I have already discussed the NDP and Operation Phakisa in the introduction, and here I only make mention of the imperative for transformation that undergirds national and provincial educations. As such, the legislative framework for Professional Teacher Development requires programmes to be developed as a response to the three priorities of the Gauteng 5th Political Administration, namely transformation, modernisation and re-industrialisation. It stresses the importance of the adoption of ICT as the flagship programme for schools in the province. It further proposes levers that should be considered for implementation, among others, public schools ICT,

twinning of schools, creation of schools of excellence and optimal utilisation of ICT. Such alteration levers were blended with the Integrated Strategic Planning Framework for Teacher Development, a national framework compiled by the government and the education sector policy planners to determine the rollout of Teacher Development in the nation. The major result of the plan is the betterment of the quality of teacher training and development for the purpose of upgrading the quality of teaching. The Teacher Development Strategy endeavours to develop programmes that motivated educators to adopt, apply and integrate ICTs in the teaching and learning process. The Gauteng Provincial Government's (GPG) ten-pillar plan speaks to the imperative for transformation, modernisation, and reindustrialisation. It aims to transform the Gauteng economy with a strong focus on townships revitalisation (Seedat, 2015). The Department of Basic Education (DBE) has supported the GPG strategy and has included its ICT elements in the national priorities. The DBE ICT Strategy espouses the importance of children learning ICT. It also aims to improve the quality of teaching and learning through ICT whilst ensuring credible and accountable outcomes-focused planning. The DBE has made it a public policy that all the schools in the country must be supported to acquire ICT resources (Department of Basic Education, 2019). Educators, therefore, emphasise optimally adopting, integrating, and utilising ICT resources while acquiring computer skills (DBE, 2019; Du Plessis & Webb, 2012). The project also aims at improving the entire school administration by unlocking efficiencies through digitisation.

CONCLUSION

The Suggested Responsive ICT Integration Framework developed, which consists of the eight stages that I have discussed, is intended to contribute to scholarship, while being mindful of its gaps and limitations. In terms of the contribution to scholarship, it proposes to develop a guide for policymakers for tailored intervention; its timing is envisaged to be as an updating the body of knowledge concerning the subject matter; and the framework and its methodologies are a novel contribution towards an ICT Integration Model. The gaps and limitations of the study include are that most of the available literature on ICT integration is based on European studies, the focus of the study was limited to only three regions in the Gauteng province; and the study only looked at integration but did not expand on other requirements for a successful rollout such as infrastructure, costing models, private sector involvement and funding. In sum, it is hoped that the study and particularly the framework developed from it will benefit the education sector and community through developing a benchmark for ICT adoption, utilisation and integration; a means to faster and effective adoption of ICT in Gauteng schools; integration of ICT as part of educators' training; more ICT training opportunities for education stakeholders; and changing classroom experience through ICT integration.

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