Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.15, No.10, 2024

The Integration of ICT in Primary Education – Examination of the Global African Southern African Contexts

Mfanelo Patrick Ntsobi* Kholekile Herbert Ntsobi

1. Sci-Bono Discovery Centre, Johannesburg
2. Davinci Business School, 16 Park Ave, Modderfontein, Lethabong, 1609

* E-mail of the corresponding author: ntsobikzn@gmail.com

Abstract

This paper examines the integration and uses of information and communication technology (ICT) in primary school education over the past decade – globally, continentally, nationally and regionally. An analysis of ICT educational public policy in the global, African, and South African contexts at the primary or foundation level is undertaken. A regional case study of the Gauteng province ICT rollout is also evaluated. The paper aims to provide a synopsis of efforts employed by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the African Union (AU), the South African Department of Basic Education (DBE) and the Gauteng Department of Education (GDE), towards integrating ICT in education. The case study of the GDE rollout of ICT aims to demonstrate the progress and persistent challenges of this endeavour. While it is accepted that ICT in education has administrative, curriculum and pedagogical value, the socio-economic and socio-cultural factors that influence and inhibit access, adoption, use and integration are explored.

Keywords: ICT; education; e-education; technology; integration; primary schools
DOI: 10.7176/JEP/15-10-09
Publication date: September 30th 2024

1. Introduction

Generally, people associate information communication technology (ICT) with computers or the internet. However, ICT is not limited to these two kinds of technology. The term "information communication technology" has traditionally been used to refer to opaque, overhead and slide projection hardware, two-way radios, closed-circuit television (CCTV), demonstration media, small format videos and live broadcast radio and television (Ntsobi, 2021). Flor (2018:48) explains that it is becoming common knowledge that ICT includes personal computers, smartphones, satellite television, videography, digital photography and imaging technology. However, ICT is also not limited to the above-mentioned platforms (Hare, 2017). Howie, Muller and Patterson (2015) further clarify that there is a wide range of technologies available, ranging from basic first-generation to more complex and advanced third, fourth and fifth-generation technology.

First-generation technology is called 1G and consists of mobile telecommunications or telephone technology. It is analogue, and it first came into use from the 1980s to the 1990s and was subsequently replaced by 2G telecommunications. The difference between 1G and 2G is that 1G mobile telephone systems are analogue, while for 2G networks use digital signals (Howie *et al.*, 2015). The third-generation telecommunications (3G) has since succeeded the 2G networks, and 3G mobile networks transfer information at a much faster rate than their predecessors, at a rate of 200 kilobits per second (kbit/s), at the minimum level. According to the International Telecommunications Union-Radio communications sector (ITUR), these 3G networks are mostly used in mobile internet connections, wireless voice connections, video calls, Wi-Fi internet, and mobile TV (ITUR, 2016). More recently 4G, which is a fourth-generation mobile telecommunications, surpassed the 3G network standards and provides ultra-broadband internet connection. For example, 4G is used in wireless USB modems, laptops and smartphones (ITUR, 2016). Furthermore, this platform is also compatible with high-definition mobile TV, mobile web access, gaming services, IP (Internet Protocol), 3D television, cloud computing and video conferencing. Cloud computing is for storing files, infrastructure and applications on the internet (Mell & Grance, 2011). Currently, ICT is enabled to operate on fifth-generation technology (5G), which is the most advanced generation so far.

In tandem with each generation of ICT, the public sector globally has sought to mandate and implement the use of ICT in education, starting from the primary or foundation phase. This imperative aligns with the

socio-economic goals of the Fourth Industrial Revolution (4IR) that seeks to cultivate citizens who are well-versed in the use of technology for practical professional and innovation purposes. In the domain of education, the aim is to revolutionise the approach and culture of teaching and learning in a way that will have a social, economic and innovative impact on society. Thus e-education is intended to teach, train and equip educators, scholars and students with the proficiency to use digital tools for teaching and learning, starting from primary education.

Global Context of ICT in Education

The United Nations Educational, Scientific and Cultural Organization (UNESCO) asserts that ICTs are crucial to the attainment of the 2030 Agenda for Sustainable Development, which also speaks to the building of inclusive Knowledge Societies. Concerning education, UNESCO has formulated competencies that are required for teaching ICT as articulated in the UNESCO ICT Competency Framework for Teachers (ICT CFT). The current Version 3 of the ICT CFT builds upon the previous 2008 and 2011 versions and each update is influenced by the prevailing thinking about technology and education, to ensure its continued relevance (UNESCO, 2018b:7). The latest version also incorporates the socio-cultural competencies that will help students to be more collaborate, creative and innovative thinkers, who can in turn become engaged members of society (UNESCO, 2018b:7).

Pertaining to teachers' professional development, the framework promotes a lifelong learning process which takes place in three phases: pre-service, in-service, and ongoing formal and informal pedagogical and technical support (UNESCO, 2018b:8). The pre-service phase focuses "on initial preparation on pedagogy, subject matter knowledge, management skills and use of various teaching tools including digital tools and resources" (UNESCO, 2018b:8). The in-service phase includes "structured face-to-face and distance training opportunities building upon pre-service programmes and directly relevant to teaching needs in classrooms and beyond" (UNESCO, 2018b:8). The third phase involves the "teachers' innovative use of ICT to address daily needs and to facilitate students' higher-order learning" (UNESCO, 2018b:8).

Given that the framework focuses on the cultivation of competencies for the delivery of quality education using technology, 18 competencies are organised according to six aspects of teaching professional practice, allocated along three levels or stages. The six aspects are: "1. Understanding ICT in Education Policy; 2. Curriculum and Assessment; 3. Pedagogy; 4. Application of Digital Skills; 5. Organization and Administration; and 6. Teacher Professional Learning" (UNESCO, 2018b:8).

The aspects are further allocated to three levels, which are: Knowledge Acquisition, Knowledge Deepening, and Knowledge Creation. Knowledge acquisition relates to the development of basic ICT competencies, understanding the potential benefits of using ICT in the classroom, and introduction to national policies and priorities related to the management and organisation of ICT investments (UNESCO, 2018b:8). Knowledge deepening enables teachers to facilitate student-centred learning environments that are collaborative and cooperative, and it also includes the linkage of policy directives to classroom activities, as well as the connection to national and global teacher networks (UNESCO, 2018b:9). Finally, in the level of knowledge creation, teachers have acquired necessary competencies to model good practice and can set up learning environments that encourage students to create new knowledge that is beneficial for society (UNESCO, 2018b:9).

To lend practical support to digital skills development for teachers, UNESCO adopted the Recommendation on Open Educational Resources (OER) in 2019. This instrument facilitates the open license access to OER learning, teaching and research materials that may be re-used, re-purposed, adapted and distributed (UNESCO, 2022:4). International cooperation is advocated by the policy in five areas of action: "(i) building capacity of stakeholders to create, access, re-use, adapt and redistribute OER; (ii) developing supportive policy; (iii) encouraging inclusive and equitable quality OER; (iv) nurturing the creation of sustainability models for OER, and (v) facilitating international cooperation" (UNESCO, 2022:3).

Effectively, UNESCO has cultivated a combination of ICT-related education tools that are accessible to all member countries and that facilitate the implementation of the ICT framework. These tools include the ICT

CFT; the Recommendation on Open Educational Resources (OER); the ICT CFT OER Project; the ICT CFT/OER Hub; and the community of practices network (UNESCO 2022:4). The efforts of UNESCO to encourage and facilitate ICT in education are apparent in its policy documents. However, the actual ICT integration process as the implementation level is more complex, slower and lags, mainly because of socio-economic and socio-cultural factors, as discussed below.

Integration and Use of ICT in Global Education

A variety of technologies are available for use in the education sector. Conventional gadgets that can be used range from audio tapes, videos, television, and radios to present-day latest technologies such as smartphones, tablets, and laptops. Smartphones are mobile phones which can perform the same functions as computers. They usually have a large touch screen and a powerful operating system that is designed to run a wide range of applications. The technologies also vary from expensive to inexpensive, analogue to digital, and low-end to high-end (Abdul-Salaam, 2017).

Learners and educators can benefit from the expected rapid use of mobile learning tools, as these are expected to be more prevalent than other ICT tools (Kruger, 2017). In addition, mobile technologies will have a heavy impact on the education sector as they will be expected to provide content to previously inaccessible and remote areas (Kruger, 2017). Moreover, the UNESCO (2018) report states that smartphones have a greater advantage for schooling purposes as compared to computers because they are already used by many educators in the Middle East and Africa (UNESCO, 2018). Smartphones also enjoy widespread personal use among educators and are present in remote and marginalised areas (UNESCO, 2018).

The International Telecommunication Union (ITU)predicted that in 2017 there were approximately 5.3 billion mobile users globally, and over 930 million people had access to 3G services (ITUR, 2016). In 2018, the National Planning Commission (NPC) further noted that over 90% of the people around the globe had access to mobile networks, while nearly three-quarters of those people were in developing countries. According to the NPC, mobile technology has enabled a substantial number of Africans to move away from the fixed-line telephone, bringing communications access to many people who previously did not have it (NPC, 2012).

Despite the availability of smartphones in rural areas, UNESCO reports that the unfortunate part is that most educators are yet to realise the potential of these smartphones in the education sector (UNESCO, 2018). Even with the rapid spread of ICT technology among educators and learners in developing countries, learners still have limited use of smartphones at school (Howie *et al.*, 2015). It has been found that most schools forbid learners from bringing smartphones to school premises, as they fear their misuse, and because of a lack of knowledge of the educational value of these mobile phones. Another fear is learners will access unauthorised content (Salmon, 2016). Learners can easily abuse mobile phones in many ways at school, including gaining access to pornographic material on the internet, cheating during exams by forwarding each other answers via text, bullying other learners, as well as using phones to send each other sex chats, thereby disrupting the learning process altogether (UNESCO, 2018). These reports have had a significant effect on South African schools' perceptions of the use of mobile phones on school premises. They have resulted in educators endorsing the ban on mobile phones in schools in the past years. This is a cultural hurdle and problem that hampers the use of technology (mobile phones) that is already accessible to learners.

Since 2013, an extensive literature has been cultivated to explain the importance of ICT in the education sector (Summak & Samancioglu, 2016; Hare, 2017; Goyal, Purohit & Bhaga, 2015). It has been accompanied by the rapid spread of the use of technological tools in the education sector for both developing and developed countries (Allan, Yuen & Wong, 2017). In a study conducted by Kozma (2019) and carried out across the USA, the findings were that the rapid use of computers in American schools led to a decline in school achievement (Kozma, 2019). Similarly, more global research conducted by Pelgrum and Plomp (2018) and Plomp, Anderson, Law and Quale (2019) discovered the same results. However, a study by Hare (2017) found contrary results, which determined that the increased use of ICT in schools was the only way access and quality of secondary school education could be improved in the short term (Hare, 2017).

Recent studies in the United States have shown that the use of computer learning games positively impacted the learners' performance in science subjects for 4th-grade learners. In turn, for 8th-grade learners, computer simulations led to improved performance in science subjects; while for 12th-grade learners, the use of computers to analyse and download data led to an improvement in science subjects.
Passey and Rogers (2018) carried out extensive research on the different types of media and likely areas of impact, and made the following findings about how the different media types increase motivation to learn a subject, as presented in Table 2.1 below:

Table 2.1: Forms of media and probable high-impact subject fields

Subject Area	Media type
Mathematics	interactive whiteboard, presentational software, Illinois Learning Standard (ILS), interactive courses
English	word processing, Internet, interactive whiteboard
Science	interactive whiteboard, simulation and modelling software
ICT	Internet, interactive whiteboard
Design and technology	3D design modelling software, Computer-Aided Design (CAD)/Computer-Aided Manufacturing (CAM) software, email, Internet, subject-specific software, digital cameras, scanners, interactive whiteboard, presentational software
Geography	Interactive whiteboard
History	Interactive whiteboard
Modern foreign languages	Presentational software, audio cassettes
Art and design	Interactive whiteboard, Internet

Source: (Passey & Rogers, 2018)

Despite the differing findings, there is a strong rationale for the increased use of ICT in the education sector, which can be social, economic, pedagogic and vocational (Peter, 2017). The use of ICT in education has economic value in that it increases effectiveness and efficiency in performing educational tasks, which in turn reduces the labour costs incurred (Ghavifekr & Rosdy, 2015). Additionally, the pedagogical value of ICT is that it can lead to substantial improvements in the quality of education provided because it is able to make education more exciting, motivating and rich for the learner (Beyers, Blignaut & Herselman, 2016). The social value of ICT lies in the social benefits that come from the use of ICT in education (Van Ark, 2016). Uhomoibhi (2006) finds that there is a general agreement that the use of technological tools and eLearning has various positive consequences for both educators, learners, parents and leaders.

African Context of ICT in Education

The eTransform Africa Report, also known as the "ICTs for Education in Africa" report, which was produced by the World Bank and the African Development Bank, with the support of the African Union, is aimed at identifying best practice in the use of ICTs in key sectors of the African economy (Souter, Adam, Butcher, Sibthorpe & Tusubira, 2012). Even though it might be dated, many of its insights are still relevant in explaining and understanding Africa's e-education landscape, more than a decade later.

Souter et al. (2012), the authors of the report, recognise that many African governments have indeed focused on developing their own national ICT policies in order to support their socio-economic development efforts and policies for ICT in education. However, Africa, which is constituted of developing countries has experienced many challenges with adapting its policies and regulations in sync with the rapid changes in technology and market structure (Souter et. al., 2012). This is in large part due to instances

where ICT and education policies are not complemented by other relevant or sectoral policies. In addition, the implementation of ICT policies is not accompanied by detailed implementation plans or government commitment. Furthermore, there seems to be no direct correlation between increased ICT spending on ICT and improved educational performance (Souter et. al., 2012). The authors identified South Africa and Egypt as examples of countries that have created an enabling policy environment for ICT integration in education, through policy and the support of appropriate institutional and regulatory structures. In contrast, the majority of African countries are advised to conduct the review and updating of their ICT in education policies.

There were specific challenges identified regarding ICTs in education on the African continent, which for the most part persist. These challenges are many and include: "the absence of comprehensive policies which enable and support interventions and which are supported by clearly defined and resourced strategies for implementation at national level as well as at the level of educational institutions"; "lack of financing and prioritization of ICT investments"; "limited infrastructure of the kind required to support the use of ICT in education"; "lack of capacity at all levels to integrate and support the use of ICT in education effectively"; "lack of necessary ICT skills among teachers, and of the specific training needed to be able to use ICT appropriately in the classroom"; "lack of appropriate content"; "lack of accurate, comprehensive, up-to-date data on education"; and "the tendency of ICT to accentuate social, cultural and economic disparities" (Souter et. al., 2012,15). All these challenges can be grouped as funding; infrastructure; training, skills and capacity; and socio-economic and socio-cultural factors, which reinforce the challenges identified at the global context level.

Integration and Use of ICT in African Education

An overarching challenge for ICTs in education is that there is limited data on its implementation, its tangible benefits and evidence of effective integration and impact. However, more recently, studies indicate positive, although still slow, shifts in the use and integration of technology in teaching and learning, in Africa. Technological tools such as the internet and computers are still inadequately used in Africa, while they have been adopted more aggressively and used in more developed nations. Over the past decade, many emerging economies have been developing the appropriate ICT frameworks for their countries (Cuban, 2016; Hare, 2017; Moonen, 2017).

ICT is used increasingly in teaching and for various purposes, such as enhancing learners' abilities to solve problems, provoking learner innovation and promoting a culture of sharing among learners (Isaias, 2018). Together with the necessary changes in the educational sector, how information, knowledge and lessons are disseminated has become crucial (Cuban, 2016). These changes allow for a variety of teaching styles incorporated into the curriculum to cater to the diverse learner needs with different learning methods. The use of technology is becoming an important teaching style (Daniels, 2015). Another benefit of ICT in education is that it facilitates efficient administration, which enables the school to achieve its vision, mission, goals and objectives (Makewa, Meremo, Role, & Role, 2015).

Some studies undertaken by Balanskat (2017) have, however, argued that it is not conclusive that the use of ICT in schools reduces the amount of time taken by educators to achieve some of their teaching objectives. On the contrary, Myers (2018) argues that the benefits of using ICT are considered greater than the disadvantages and the costs incurred by the school during the implementation of these technologies. Makewa *et al.* (2015) offer an additional perspective derived from studying educator perceptions regarding the importance of ICT in secondary school administration in Kenya. The study concluded that the educators and administrators of the schools studied, who are involved in the schools' daily administrative duties, which included principals and the heads of departments, perceived the use of ICT for administration in secondary school as critical. Additionally, educators and administrators perceived ICT to be an essential tool for learner administration and regarded it as a helpful tool for learner supervision (Makewa *et al.*, 2015).

According to Balanskat (2017), 89.3% of African schools that use ICT for management and administrative purposes have high confidence and high expectations of ICT tools to complete their tasks successfully (Balanskat, 2017). A further study in Cyprus by Makewa *et al.* (2015) indicated that secondary schools in the country used ICT for several administration purposes, including learner administration, personnel

administration, financial management, general management, and resource administration. Moreover, educators in schools are frequently using ICT for planning their work and administration. ICT also enables many people to easily access administration through a consolidated school website, and it is also easy to maintain, exchange and update school records (Eroha & Ekweme, 2017). As a result, many schools from both developed and developing countries have been using ICT for management duties (Myers, 2018). Typically, members of the school administration department, teaching staff, and managerial staff frequently use computers for administrative tasks (Prince, 2017). The most common administrative tasks performed by computers are as follows:

> Creating lesson plans and worksheets; typing official school documents; designing school documents such as reports, timetables and typing tests; creating a consolidated database containing educator's and learner's information; for storing records and assessments and creating a school budget in spread-sheet format. Where good internet connection is available at a school, computers are used to receive and send emails and for creating and updating the school website (Hare, 2017:61).

It is critical to note is that most school educators and members of the administration department have an overall positive perception regarding the use of ICT for performing administrative tasks. Some of the positive results of using ICT for administration tasks are that it saves time for carrying out administration duties. For instance, computers calculate learner marks and averages faster and more accurately, and as a result, the risk of human error is reduced during the calculation of learner marks. (Miller, Naidoo & Van Belle, 2016: 61). Thus, ICT also plays a role in organising school administration, which improves the quality of education to a certain extent. This comes with the assumption that where the administration is well organised, the educators have much time to concentrate on improving their teaching skills rather than spending much time carrying out administrative duties (Cairncross & PÖysti, 2003).

South African Context of ICT in Education

The White Paper on e-Education in South Africa was promulgated in September 2004 and since then it has remained the most comprehensive policy on the use of ICTs in the education system. It covers an extensive scope to facilitate the implementation, which includes, among others: the use of ICTs in society and education; the digital divide; the definition of e-Education and information and communication technologies; e-school development; increasing the efficiency and effectiveness of management and administration; equity and access to ICT infrastructure; capacity building; professional development for management, teaching and learning; electronic content resource development and distribution; access to ICT infrastructure; connectivity; community engagement; research and development; funding and resourcing; implementation strategies; co-ordination and collaboration; monitoring and evaluation; and planning cycles (Department of Education, 2004).

The Department of Basic Education (DBE) acknowledges that ICT has a central role to play for the education sector to be completely transformed (DBE, 2019). In support of this idea, the DBE has decided to make technological tools available to all learners in South Africa, thereby ensuring that it is no longer a privilege only enjoyed by elite schools, to have the latest ICT tools at their disposal (DBE, 2018). Evoh (2017) supports this imperative and indicates that deploying the latest ICT in schools and also adequately training educators to use this technology would enable educators to effectively achieve their goal of improving the quality of secondary education, even with limited resources at their disposal.

As a contribution to the Basic Education Matters issue of the Department of Basic Education (DBE) research journal, Ostrowick (2018) asserts that the DBE has been striving to introduce ICTs into teaching and learning nationwide since publishing the White Paper on e-Education in 2004. By 2018, it became apparent that the DBE was experiencing several challenges with the ICT rollout. One of these challenges is that the Return on Investment (ROI) of ICTs in education is very low, and thus expense is not justified. In addition, he discusses four specific challenges: "competing priorities; the OECD Report; learner distraction and competence; and the threat of crime and bullying" (Ostrowick, 2018:66). He subsequently considers a number of interventions, which include: the acknowledgment that ICTs offer too much value to be discounted; that the (UNESCO) OECD report contradicts South African findings; that learner distraction can be mitigated; and that threats of crime and bullying can be mitigated (Ostrowick, 2018:66). The mentioned challenges are found within a greater context of both progress and impediments to the objectives of the DBE e-education policy.

Integration and Use of ICT in South African Public Schools

The basic education ICT roll-out programme was introduced in compliance with several policies, namely the objectives of the White Paper 7 of 2004, the South Africa National Development Plan, the Action Plan 2019 towards the Realisation of Schooling 2030, and the SA Connect Policy of the Department of Telecommunications and Postal Services (DTPS), aimed at providing learners and teachers with connectivity for teaching and learning. By 2020, the ICT rollout in the basic education sector had made some progress that was presented at a parliamentary briefing.

The briefing revealed that one major implementation strategy of the DBE's ICT rollout was the Universal Service and Access Obligations (USAO) framework of 2014, which required that cellular network operators provide 5 250 public schools with internet connectivity and ICT equipment, as part of their obligations (PMG, 2020). It was reported that the three major network operators (MTN, Cell C, and Vodacom) had made significant progress concerning providing connections and the allocation of devices to schools. At the time, they had provided 4 697 data projectors and servers, 9 394 laptops and 112 728 tablets, to 4 697 schools across all the provinces (PMG, 2020).

The ICT-participating schools would also receive appropriate ICT solutions and assistance, as well as training for teachers, and by 2020, 298 620 teachers had been trained (PMG, 2020). The teacher training was conducted under the Learner Teacher Support Material (LTSM) which would be implemented from 2019 to 2024. A total of 147 teacher centres were established in all provinces, and 104 were connected, 110 had the necessary infrastructure and 118 had operational programmes (PMG, 2020)

In terms of learner access to ICT learning, the challenge of access to devices remains. As discussed above, by 2020 only several thousands of devices had been dispensed by partner organisations to ICT-schools. Yet the DBE caters to millions of learners. This digital divide problem raises the argument for the use of mobile phone devices in teaching and learning, as a more accessible alternative. Growing evidence suggests that many people, even in rural parts of developing economies, have more access to mobile phones than computers (Statistics South Africa, 2019). Therefore, the use of smartphones for e-learning appears to be an easier and faster alternative method for spreading e-learning services in the education sector, irrespective of the location, whether rural or urban areas.

Whereas it is acknowledged that using ICT has the potential to impact on performance and different aspects of everyday life, including pedagogic, economic and social, more research is required on how technology can be successfully integrated into public school education. This informs the focus on the status quo in South African public schools. More specifically an audit is required of the various types of information communication and technology tools currently available for teaching and learning (Beyers *et al.*, 2016).

The practical access challenge is that only phones with good internet connectivity can download content, and can be useful for online learning curricula, as well as for planning lessons (Taylor & Silver, 2019). These phones are usually high-end user smartphones. Myers (2018) gives the minimum specifications for these high-end user mobile devices or smartphones as follows: "They should possess a dual-core processor, the latest version, high-definition display (AMOLED, HD and Super LCD) they must possess a 4G capability, high-quality camera, 1080p HD video recording, at least 1 GB RAM and the latest Android or IOS version" (Myers, 2018:66).

It is common knowledge that high-end user smartphones are not cheap devices to acquire, as compared to ordinary phones without internet access. The consequence is that the more expensive the smartphone device is, the more difficult it will be for learners and educators to acquire them. By implication, for these devices to be used in a school curriculum, there is a need to have them available to everyone (Yunus, Salehi, Sigan & John, 2014). Thus, an increase in access to these high-end mobile devices is required for them to be utilised in schools (Newton & Rogers, 2016). Nevertheless, in South Africa and other African countries, there has been an increase in the use of mobile devices for learning as well as in the educational system in recent years. This is despite the negative cultural and social perceptions regarding increased use of phones in education.

Kruger (2017) found the use of smartphones for learning to have many advantages. Primarily, the mobility

of smartphones is more advantageous as compared to the use of desktop computers. Learning through using smartphones also has the advantage of reducing the need to carry materials such as bags and laptops to school. In addition, Naidoo (2017) noted that using mobile phones for learning is more cost-effective as it requires less infrastructure than that needed for traditional learning (Naidoo, 2017). Furthermore, learning content and courses can be easily forwarded to learners' mobile phones, which is a quicker mode to share information. Also, various software is compatible with both computer and mobile learning platforms, which is used to share and forward information between educators and learners.

Moreover, social networks and instant messaging platforms enable learner users to access information and communicate from anywhere (Beyers *et al.*, 2016). Social networking platforms also undergo constant improvement and updates to incorporate new educational content and make information for learners and educators available. Mobile learning platforms are also not limited by distance and can be accessed by the end-user from anywhere (Kozma, 2019). In South Africa, leading mobile network operators such as Telkom, Vodacom and MTN offer promotions for free access of data content to customers, which is also beneficial when it comes to accessing educational content for free.

Amuchie (2018) notes that applications that allow end-users to access educational content at no extra cost are critical in that they are cost-effective, and also increase the motivation to use such technologies in African countries. However, the use of mobile devices for learning still has its associated challenges, despite the enormous educational value that mobile devices carry. The main challenge pertains to the expense of acquiring a mobile device for the utilisation of ICT infrastructure for education.

Some schools have developed websites dedicated to learning to complement the existing mobile learning platforms. A single school website has the advantage of connecting educators and learners on a single platform and monitoring learner activity and progress on the internet. Naidoo (2017) also finds that having a single website for learning enables educators to easily assign tasks and monitor work progress with less effort. This mode of teaching also enables educators to easily identify struggling learners and to take note of the critical problem areas. As such, the theory and practical lessons in classrooms will not be completely abandoned but will complement what has already been provided on learner mobile devices in preparation for exams, and will also cater for learners without mobile phones (Bahati, 2018).

In light of the ICT interventions mentioned, for ICT to be successfully integrated into schools in South Africa, a combination of educator factors should also be considered. The critical factors include the educator's level of knowledge in the subject area; the educator's ICT competence; the educator's ability to use technological equipment for a lesson and; the availability of appropriate ICT infrastructure for each subject being taught at a school (Ntsobi, 2018). These are all requirements for the successful use of ICT in teaching and learning.

Integration and Use of ICT in Gauteng Public Schools

The Gauteng Provincial Government (GPG) has developed a ten-pillar plan which includes the transformation, modernisation, and reindustrialisation of the Gauteng economy with a strong focus on township revitalisation (Seedat, 2015). The Department of Basic Education (DBE) has in turn supported the GPG strategy and included its ICT elements in the national priorities. The DBE ICT Strategy highlights the importance of children learning ICT and 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 for all the schools in the country to be supported to acquire ICT resources (Department of Basic Education, 2019). Educators, on their part, are encouraged to adopt, integrate, and utilise ICT resources while acquiring computer skills (DBE, 2019; Du Plessis & Webb, 2012). The project is aimed at improving the entire school administration by unlocking efficiencies through digitisation.

Further to the policies and programmes initiated at the national level by the DBE in South Africa, the provincial Gauteng Department of Education (GDE) has taken additional initiative with technology integration and innovation in education that will be more suitable for Gauteng public schools. Its rationale for how technology will support educational outcomes is articulated through six pillars, namely: connectivity (all schools are to be linked to a GDE portal); content (digital content is pre-loaded on devices); capacity (training of teachers on ICT, curriculum and pedagogy); infrastructure (technical support

and physical pre-requisites such as power and secure environment of ICT); support (IT-based services including South Africa Administration and Management System (SA-SAMS) at all schools); and innovation (inter-branch management and monitoring of the study, and an innovation group to foster implementation of best practice) (Ntsobi, 2018).

Despite the efforts at the national education policy level, some educators in the public schools situated in the province of Gauteng public schools have not fully integrated technology into their curricula and pedagogy. Gauteng was the flagship province for the rollout of ICT and boasts the availability of modern, state-of-the-art ICT resources at some of its schools. There is no concrete reason why technology is not being fully utilised in these public schools (Clark, 2018). However, there is a socio-cultural impediment between traditional teaching and ICT-enabled teaching that has to be surmounted. As a result, learners in Gauteng public schools may not be able to fully reap the benefits of having modern ICT infrastructure at their schools. Interventions are required to close the poor ICT integration gap in these schools that will enable teaching and learning activities to be streamlined to allow educators space to freely embrace new technology. Change management and sound pro-active strategies that necessitate effective ICT integration in Gauteng Public schools are also required (Crotty, 2003).

In a recent study by Dlamini (2022) on the progress of ICT uptake in selected Gauteng schools, 837 randomly selected participants responded to the questionnaire. Dlamini's (2022) findings were that the context within which the ICT integration takes place is key to its uptake. As many studies have found, ICT integration is not merely a technological exercise, but it also has economic, social and cultural implications. In this regard, the ICT rollout in Gauteng is also used as an incentive for township schools that achieve a one hundred per cent (100%) pass in their matric results, to be adopted as fully-funded and resourced ICT schools (DBE, 2018). The incentive implies that the schools get an end-to-end ICT solution from Grades 8-12. The ICT project is also used to promote social cohesion amongst schools that have been approved for twinning, which brings schools from the suburbs and townships together to share resources and experiences, which bridges the social and cultural gaps between public and private schools.

Ntsobi (2022) also conducted a study that explores the degree of ICT integration within Gauteng public schools, the challenges preventing the optimum utilisation of ICT towards curriculum delivery, and the conditions that enable the ICT rollout in the province. The study focused was on the degree to which individual qualities impact the educator's preparedness in using ICT for teaching, and how preceding ICT skills and computer training affect the preparedness of educators in their teaching environment (Ntsobi, 2022:18). Some of the study's key findings were that most of the professional development support from the GDE focuses on utilising information communication technology, and not enough on how to effectively integrate the technology into the curriculum. In addition, despite the resources and training provided by the GDE, the educators were not adequately equipped to develop their own teaching and learning approaches with the use of ICTs. Furthermore, educators did not use technological tools to develop their lesson plans and curriculum delivery. Effectively, educators did not demonstrate the ability to integrate ICT in teaching to develop and deliver effective education that can prepare learners for higher learning, work, and life in the 21st century (Ntsobi, 2022:18). However, Dlamini (2022) cautions that teachers should not be solely blamed for the inadequate integration of ICT in education as they too need adequate support and ongoing professional development.

Conclusion

ICT in education is an extremely vast undertaking and this paper has provided a snapshot of how it is approached at the global, continental, national and regional levels, by exploring the economic, social and cultural dimensions of the endeavour. In terms of the global context of ICT in education, UNESCO has continuously updated its policies to account for the immense technological innovations and progress in all sectors of society. Its flagship ICT Competency Framework for Teachers (ICT CFT) is already in its third version and provides a comprehensive guide to member countries on how to integrate and use ICT in education. Furthermore, its toolkit of instruments and programmes including the Recommendation on Open Educational Resources (OER); ICT CFT OER Project; the ICT CFT/OER Hub; and the community of practices network, are aimed at providing tangible support and assistance.

While there is a strong rationale for the increased use of ICTs in the global education system, there is also a marked discrepancy between ICT adoption in developed and developing countries. The African context discussed in this study demonstrates that not many African countries have cohesive, complementary and enabling policies for integrating ICT in teaching and learning, that can support planning and implementation. The African Union, in partnership with the African Development Bank, commissioned an e-education study in 2012 that helped to shed some light in terms of the challenges to this endeavour. Among many, the most prominent pertain to financing and funding, appropriate infrastructure, lack of training, skills, and content; and an ever-prevalent socio-economic and socio-cultural digital divide. There has, however, been an encouraging uptake of the use of ICTs in educational administration on the continent, which is proving beneficial for the efficient operations of African schools. At the same time, there is an ongoing challenge of access to suitable devices for learners to use in the classroom. Thus, there is a strong case for allowing teachers and learners to utilise their own mobile phone devices, while there is an acknowledgement that not all learners can afford 3G or 4 G-enabled devices.

In the discussion of the South African context, it was noted that its ICT in education policy dates back to 2004, which indicates that the country is arguably one of the continental pioneers in this undertaking. Since then, the country's e-education policies are approached with adherence to the White Paper 7 of 2004, the South Africa National Development Plan, the Action Plan 2019 towards the Realisation of Schooling 2030, and the SA Connect Policy of the Department of Telecommunications and Postal Services (DTPS). From a funding perspective, which is an acknowledged challenge on the continent, the SA Connect policy has facilitated partnerships with cellular network providers to supply both connectivity and devices to schools that are part of the ICT rollout. Furthermore, hundreds of thousands of teachers have been trained to integrate ICTs in teaching and learning for the benefit of thousands of schools.

The case study of the Gauteng public schools where a robust ICT rollout has taken place over the last decade demonstrates that while much progress has been made to equip schools with the necessary ICT infrastructure, the uptake is still too low. Various recent studies indicate that even with the required training on how to use ICTs, the integration of these skills into curriculum implementation and pedagogy is still very limited. As such, some schools are equipped with high-tech tools, but in terms of return on investment, they are not adequately utilised.

In sum, it is evident that not only is there a need for ICT integration in schools, but there are also crucial aspects of integration required between political, economic, social and cultural sectors. The public sector may be responsible for developing policies, plans and programmes, however, the education of children takes place in the context of culture and society. Thus, the socio-economic and socio-cultural contexts of learners and teachers significantly influence their ability to adapt, develop and transform.

References

Abdul-Salaam, A., 2017. Assessment of Secondary School Educators' Use of Information and Communication Technology (ICT) in Oyo Metropolis of Oyo State. *American-Eurasian Journal of Scientific Research.* Volume 5 (4) pp.56-59.

Allan, H., Yuen, N. & Wong, 2017. ICT Implementation and School Leadership: Case Studies of ICT Integration in Teaching and Learning. *Journal of Educational Administration,* Volume 41(2), pp. 158-170.

Amuchie, A.A., 2015. Availability and Utilization of ICT Resources in Teaching and Learning in Secondary Schools in Ardo-Kola and Jalingo, Taraba State. *Journal of Poverty, Investment and Development.* Volume 8, pp. 94-100.

Bahati, B., 2018. *Is ICT being integrated pedagogically into teaching and learning events at Kigali Institute of Education (KIE)?* Johannesburg: Wits University.

Balanskat, A., 2017. *Study of the Impact of Technology in Primary Schools. Final Report. Steps contributory paper.* UNESCO Institute of Education. Volume 1, pp. 1-54.

Beyers, R., Blignaut, S. & Herselman, M., 2016. The Young Engineers and Scientists of Africa; Initiating the STEMI Pipeline. *Acta Academica Supplementum,* Volume 4(1) pp.105-126.

Cairncross, F. & PÖysti, K., 2003. *International Telecommunication Union.* [Online] Available at: http://www.itu.int/osg/spu/visions/education/index.html.

Clark, V., 2018. *Advanced Mixed Methods Research Designs.* Thousand Oaks: Sage.
Crotty, M., 2003. *The Foundations of Social Research: Meaning and Perspectives in the Research Process.* London: Sage.

Cuban, L., 2016. *Oversold and Underused: Computers in the classroom.* Cambridge, MA: Havard University Press.

Daniels, J., 2015. *"Foreword" in Information and Communication Technology in Education– A Curriculum for Schools and Programme for Educator Development.* Paris: UNESCO.

Department of Basic Education, D., 2018. *Educator Laptop Initiative,* Pretoria: Government Gazette No. 32207.

Department of Basic Education., 2019. *Draft White Paper on e–Education. Transforming Learning and Teaching through ICT,* Pretoria: Department of Education.

Dlamini, R., 2022. Factors Constraining Teacher Integration of ICT in Gauteng Schools. The Independent Journal of Teaching and Learning, Volume 17(2), pp.28-43.

Du Plessis, A. & Webb, P., 2012. Teachers' Perceptions about their Own and their Schools' Readiness for Computer Implementation: A South African Case Study. *Turkish Online Journal of Educational Technology,* Volume 11(3), pp. 312-325.

Eroha, K. & Ekweme, C., 2017. *Assessment of Educators Level of Literacy and Attitude Towards Information and Communication Technology (ICT) Application in STM Education.* s.l., STAN 44th Annual Conference Proceedings on Information and Communications Technology.

Evoh, C. 2017. Policy Networks and the Transformation of Secondary Education Through ICTs in Africa: The Prospects and Challenges of the NEPAD e-Schools Initiative. *International journal of Education and Development Using Information and Communication Technology,* Volume 3(1), pp. 64-84.

Flor, A., 2018. A Policy and Planning Framework on Information and Communication Technology for Basic Education in the Phillipines. *International Journal of Education and Development using ICT,* Volume 4 (3), pp. 19-44.

Ghavifekr, S. & Rosdy, W., 2015. Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. *International Journal of Research in Education and Science,* Volume 1 (2), pp. 175-191.

Goyal, E., Purohit, S. & Bhaga, M., 2015. Study of Satisfaction and Usability of the Internet on Learners' Performance. *International Journal of Education and Development Using Information and Communication Technology,* 11 (1), pp. 94-98.

Hare, H., 2017. ICT education in Tanzania. In: FarrellG, I. S & M. Trucano, eds. *Survey of ICT and education in Africa: 53 Country Reports.* Washington DC: World Bank.

Howie, S., Muller, A. & Paterson, A., 2015. *Information Communication Technologies in*

South African Secondary Schools. Cape Town: Sites HSRC Press.

International Telecommunication Union, 2016. International Telecommunications UnionRadio communications sector (ITUR) regulations. Available at https://www.itu.int/en/myitu.

Isaias, P., 2018. Model for The Enhancement of Learning in Higher Education Through the Deployment of Emerging Technologies. *Learning in Higher Education,* Volume 16(4), pp. 401-412.

Kozma, R., 2019. Technology and Classroom Practices: An International Study. *Journal of Research on Technology in Education,* Volume 36(1), pp.8-9.

Kruger, J., 2017. *University of Pretoria.* [Online] Available at: http://web.up.ac.za/ecis/SACLA2017PR/SACLA2017/Papers/SACLA029.pdf.

Makewa, L., Meremo, J., Role, E. & Role, J., 2015. ICT in Secondary School Administration in Rural Southern Kenya: An Educator's Eye on its Importance and Use. *International Journal of Education and Development Using Information and Communication Technology,* Volume 9(2), pp. 48-63.

Mell, P. & Grance, T., 2011. *The NIST Definition of Cloud: Recommendations of the National Institute of Standards and Technology,* Gaithersburg: National Institute of Standards and Technology.

Miller, L., Naidoo, M. & van Belle, J., 2016. *Critical Success Factors for ICT Interventions in Western Cape Schools.* Cape Town: Department of Information Systems, University of Cape Town.

Moonen, J., 2017. The Efficiency of Tele-learning. *Journal of Asynchronous Learning Networks,* Volume 1(2), pp. 68-77.

Myers, S., 2018. *What defines a phone as high-end, mid-rangeor low-end.* [Online] Available at: http://www.phonedog.com.

Naidoo, O., 2017. *School Net.* [Online] Available at: http://www.schoolnet.org.za/reports/1108_nokia.pdf.

Newton, L. & Rogers, L., 2016. *Teaching Science with ICT.* New york: Continuum.
National Planning Commission, 2012. *National Development Plan 2030: Our Future – Make it Work,* Pretoria: National Planning Commission.

Ntsobi, M.P., 2018. ICT in Education. *CPSI Public Sector Innovation Awards Presentation*. [Online] Available at: https://www.researchgate.net/publication/370596138_GDE_ICT_rollout_model_2018.

Ntsobi, M. P., 2021. Pedagogical Integration of Technology as an Enhancement to Teaching and Learning in Gauteng Public Schools [Doctoral Thesis, Da Vinci Institute for Technology Management].

Ntsobi, M.P., 2022. Educator's Perceptions and Influences regarding ICT Integration into teaching and learning in Gauteng Public Schools. *Medicon Engineering Themes*, Volume 3(4), pp. 18-32.

Ostrowick, J., 2018. Challenges in Introducing ICTs in Teaching and Learning in South Africa. *Journal of the Department of Basic Education*. Volume1. [Online] Available at: https://www.researchgate.net/publication/324080145_Challenges_in_introducing_ICTs_in

_teaching_and_learning_in_South_Africa

Parliamentary Monitoring Group., 2020. ICT Roll-Out: Department of Basic Education Briefing; Coronavirus measures. [Online] Available at: https://pmg.org.za/committee-meeting/30052/.

Passey, D. & Rogers, C., 2018. *The Motivational Effect of ICT on Pupils (Research Report RR523),* Lancaster: Department of Education Research: Lancaster University.

Pelgrum, S. & Plomp, T., 2018. An Evaluation of the Implementation of the National ICT Policy for Education in Namibian Rural Science Classrooms. *African Journal of Research in MST Education,* Volume 6(1), pp. 4-17.

Peter, O., 2017. Learning with New Media in Distance Education. In: M. M & AndersonW, eds. *Handbook of Distance Education.* . Mahwah, NJ: Lawrence Erlbaum Associates, Volume 7, pp. 87-127.

Plomp, T., Anderson, R., Law, N. & Quale, A., 2019. *Cross-national information and communication Technology: Policies and Practices in Education.* Charlotte, N.C.: Information Age Publishing.

Prince, G., 2017. *Implementation of Computers in Schools: A Case Study of Five Schools in the Makana and Somerset East Districts.* s.l.: Unpublished Master's Thesis, Rhodes University.

Salmon, D., 2016. *Computer and Educator Training: A Practical Guide.* New York: Haworth Press.

South African Government News Agency., Process Made in ICT Roll Out in Gauteng Schools. 2016. [Online] Available at: https://www.sanews.gov.za/south-africa/progress-made-ict-roll-out-gauteng-schools.

Seedat, R., 2015. *Transformation, Modernisation and Reindustrialisation (TMR) of the Gauteng City Region,* Johannesburg: Gauteng Provincial Government.

Souter, D., Adam, L., Butcher, N., Sibthorpe, C., & Tusubira, T., 2012. ICTs for education in Africa. *eTransform AFRICA*. [Online] Available at: https://openknowledge.worldbank.org/server/api/core/bitstreams/8bc41e21-18ac-5095-bfce-7fd5902f82fd/content

StatsSA, 2019. *Statistics South Africa.* [Online] Available at: http://www.statssa.gov.za/Census2018/Products/Provinces pdf.

Summak, M. & Samancioglu, M., 2016. Assessment of Technology Integration in Vocational Education and Training Schools. *International Journal of Education and Development Using Information and Communication Technology,* Volume 1(1), pp.17.

Taylor, K. & Silver, L., 2019. *Smartphone Ownership is Growing Rapidly Around the World but Not Always Equally,* s.l.: Pew Research Centre.

Uhomoibhi, J., 2006. Implementing E-learning in Northern Ireland: Prospects and Challenges. *Campus-Wide Information Systems,* Volume 23(1), pp. 4-14.

United Nations Educational, Scientific, and Cultural Organization (UNESCO), 2018a. *Empowering the Next generation.* Geneva: United Nations.

United Nations Educational, Scientific and Cultural Organization (UNESCO), 2018b.

UNESCO ICT Competency Framework for Teachers.

United Nations Educational, Scientific and Cultural Organization (UNESCO), 2022. *The ICT Competency Framework for Teachers Harnessing OER Project Digital Skills Development for Teachers.*

Van Ark, B., 2016. *Economic and Social Benefits of ICT: Presentation for Conference on "Fibre networks: Demand and Analyses of Costs and Benefits.* s.l., The Conference Board.

Yunus, M., Salehi, H., Sigan, D. & John, A., 2014. Using Visual Aids as a Motivational Tool in Enhancing Students' Interest in Reading Literary Texts. Recent advances in Educational technologies, *The English Journal,* Volume 195(3) 2014, pp. 32-38.