

Factors constraining teacher integration of ICT in Gauteng schools¹

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ABSTRACT

This article reports on research undertaken as part of a provincial government initiative to transform education practices through the integration of digital technologies. A case study was done in the Gauteng province to understand the factors constraining the uptake of ICT in schools instead of peddling a unified globalist account. It was also an effort to understand why some teachers integrate ICT and others do not. There were 1 330 questionnaires distributed to 133 randomly selected schools, and 837 respondents returned their questionnaires. The response rate was 63%. It is within these methodological constraints and parameters that the results and related discussion should be viewed. Data analysis using descriptive statistics and Pearson correlation analysis revealed that teachers' limited technological pedagogical knowledge and low experience in integrating computers into the classroom has had impact on ICT uptake. There is a dearth of practices for ICT integration in the classroom; however, there was congruence with the global perspective that context is key. The recommendations are to ensure ongoing technical and pedagogical support, to increase ICT professional development opportunities for teachers, and to conduct a systematic longitudinal study to provide a better understanding of various technologies in teaching and learning.

Keywords: ICT integration, digital technologies, Information and Communication Technology (ICT), Gauteng schools, ICT in education

INTRODUCTION AND HISTORICAL PERSPECTIVE

Over the years, many South African studies (Dlamini & Mbatha, 2018; Livingstone, 2012; Mofokeng & Mji, 2010; Moll & Matshana, 2006; Wilson-Strydom, Thomson, & Hodgkinson-Williams, 2005) agreed with Waller (2015) on the need to prepare teachers to use Information and Communication Technologies (ICTs) for teaching and learning. It has been argued that digital technologies are the principal driver of economic development, educational change and pedagogical innovation. ICTs have slowly become an integral part of the educational ecosystem. Though the integration of ICT in education has been a contentious issue, there is no way to ignore it because of the pedagogical benefits in the classroom and the policy statement that 'every South African will be information and communication technology capable

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by 2013' (Department of Education [DoE], 2003: 17). Therefore, the realisation of this policy means all schools in South Africa will be equipped with ICT infrastructure and computer literate educators and in the process, learners develop their digital fluency.

The presence of ICT in education started an unparalleled transformation in knowledge representation and pedagogical practices. Indicators show that South Africa has the most modern and best developed telephone system in Africa and a vibrant ICT sector, with massive capital investments by mobile operators alone amounting to ZAR 23.8 billion (Gillwald, Mothobi & Rademan, 2018). However, the implementation of ICT in schools is not an easy task because of the challenges related to context, technology and competencies. There is evidence that 'the intersections of class, gender, race or ethnicity—are unable to harness the Internet to enhance their social and economic well-being' (Gillwald et al., 2018: 8). Thus, beyond the digital divide is the issue of affordability and access, which remain essential in the implementation of digital education and the pedagogical integration of ICT in the classroom.

In 2004, a National ICT Strategy Policy was formulated and the Department of Education (DoE) responded with the e-Education policy and the motif of 'transforming learning and teaching through information and communication technologies' (DoE, 2004: 3). In 2007, the *Guidelines for Teacher Training and Professional Development in ICT and Training* (DoE, 2007) was developed as an instrument to enable the National ICT Strategy Policy. These two documents framed ICT in the education policy environment in an effort to provide 'modern technologies to schools in order to enhance the quality of learning and teaching' (DoE, 2004: 6). In the process, what transpired was the development of teachers' technological knowledge. This was an effort to align with the White Paper on e-Education (DoE, 2003), which states that every educator and learner should be ICT capable by 2013. In order to realise the gazetted policy stipulated in the White Paper it became a requirement to train and develop educators' digital fluency. The reality is that in a 'knowledge-society', a classroom is not complete without access to digital pedagogies. However, there are complexities in the education ecosystem that demands more than digital technologies, and especially innovation and creativity are needed to improve learners' attainment.

The key is to position ICT based on educational needs instead of technological possibilities. In the Gauteng Department of Education's (GDE) strategic priorities, pillar number 6 is 'ICT in Education' and is intended to bridge the ICT access and integration gap in schools to transform education. The GDE priorities is also in line with a broader national government economic, social and development strategy on ICT. At the highest level in government, ICT has a role in promoting economic growth, job creation, social development and global competitiveness. There are two dedicated policy documents on the integration of ICT in education (DoE, 2004, 2007) to inform the agenda on integrating ICT tools into teaching and learning. The GDE has made progress in the process and a considerable amount of ICT resources have been procured and made available to schools, which justifies the place of ICT tools and applications in education. However, the GDE's knowledge of the impact the use of digital technologies has on teaching and learning is still insufficient.

While technological affordances are well documented, it requires preparation in terms of ICT skills and innovative pedagogical practices supported by ICT. Thus, this work investigated the factors constraining teachers to pedagogically integrate ICT in their classrooms. The study is premised on the argument that 'situational and personal-social contexts' contribute towards certain behaviours and beliefs, especially in the process of integrating digital technologies in teaching (Li, Yamaguchi & Takada, 2018: 106). The research questions that guided the study are:

- What factors are constraining teachers' integration of ICT in Gauteng schools?
- To what extent have schools adopted, appropriated and integrated ICTs into teaching and learning?

The gaps in the conceptual understanding of the extent of ICT uptake in teaching and learning, school-level conditions, and pedagogical practices must be closed. This research was an attempt to examine the factors constraining the uptake of ICT in schools in Gauteng. The DoE (2004) explained that computers will improve how educators teach and learners learn. This was premised on the ICT affordances, and especially, on how tablets make the learning process more exciting, motivating and creative.

THEORETICAL AND CONCEPTUAL FRAMEWORK

The purpose of this study was to conduct an in-depth analysis of the factors constraining the uptake of ICT in schools given the huge investment made by the GDE to resource schools. In 2015, the GDE piloted a project tagged 'The Big Switch On'. The project aimed for a paperless education system to give pupils access to learning material, workbooks and other subject matter through ICT (Dlamini & Na'Allah, 2015). To develop a deeper understanding of the dynamics of 'capitals' as resources to pedagogical ICT integration and access to ICT affordances, we adopted the cultural capital theory as the lens through which to conduct the study (Bernstein, 1990; Clark, 2005). Cultural capital is defined as 'the accumulation and knowledge, behaviours, and skills that one can tap into to demonstrate one's cultural competence' (Cole, 2020: 1). In essence, teachers enter the education system with different levels of cultural capital and ICT know-how based on their social background (Tondeur et al., 2011). The notion of cultural capital is viewed as 'a theoretical hypothesis which makes it possible to explain the unequal scholastic achievement ...' among teachers from different social classes (Bourdieu, 1986: 243). Therefore, the level of teachers' preparedness and the school ICT environment have the potential to influence the uptake of ICT in teaching.

According to Bernstein (2000), all pedagogical practices are generated from the same fundamental rules but may vary in strength in relation to knowledge boundaries and boundaries between teachers and learners. These are invisible structures that continue to create barriers to ICT affordances and the transformative digital pedagogies. In this research it became clear that digital literacy is privileged in the invisible structures making it difficult for those with limited social and cultural ICT capital to have access to digital pedagogies. Through Bernstein's theoretical lens we were able to engage with structural variables at school level, teacher level and systems level. Thus, there was no way in the analysis to ignore the incongruence among teachers' socioeconomic divide as it became obvious that some schools were fully ICT equipped but the uptake was poor. In those invisible structures people become acquainted with digital literacies and skills that may not be accessible to teachers coming from more disadvantaged socioeconomic backgrounds.

Bernstein's theory of pedagogic discourse provided a language of description that worked very well with the Second Information Technology in Education Study (SITES) (Law, Pelgrum & Plomp, 2008; Carstens & Pelgrum, 2007). The analytical framework for SITES was used to investigate teachers' characteristics, pedagogical practices and ICT use; school factors; and system and other external factors. The aim was to document factors contributing to the state of ICT integration in schools and the conditions on the ground influencing the adoption and appropriation of new technologies into teaching and learning. Using the SITES 2006 framework, the focus was on four domains, namely school factors, system factors, teacher factors, and pedagogical practices in the classroom. The decision to focus on these four domains was informed by the statement in the *White Paper on e-Education* (DoE, 2004) which avers that the introduction of ICTs in education represents an important part of the government's strategy to improve the quality of learning and teaching across education and training environments. However, it was not clear how ICT infrastructure provisioning alone will result in the attainment of higher levels of cognition, given teachers' ICT skills and curriculum limitations (Dlamini & Na'Allah, 2015). This research aimed to develop an understanding of teachers' knowledge about using ICT, their ICT pedagogical practices and the school conditions to enable change.

RELATED LITERATURE REVIEWED

Ubiquitous computing has created an environment where access and interaction with a variety of computers are inevitable. This has enabled ubiquitous learning - the new mantra - making it a must for educators to develop the skills and competencies to use ICT to promote continuous learning (Macià & García, 2016; Sheninger, 2019). In Singapore (Ng, 2010), South Korea (Kim, 2010; Choi, An & Lee, 2015; Jang, Yi & Shin, 2016) and Malaysia (Razak et al., 2018), for example, schools are using cutting edge technologies in an effort to link schools to society in order to fuel innovative and creative teaching and learning and to improve school management and administration capacity. South Africa has made similar efforts, and projects such as the Gauteng Paperless Classroom (Motshekga, 2015) and ICT for Rural Education Development (ICT4RED) (Botra, Rerselman & Ford, 2014) were undertaken to promote the dissemination and use of digital technologies in the South African school. It is hoped that teachers will use these to implement digital pedagogies that fit the 21st century. With current learners immersed in the world of digital technologies and with properly planned ICT rollout projects, this could provide 'educators with a valuable resource to support teaching and learning' (Harrell & Bynum, 2018: 13). The opportunity to engage broadly allows teachers to develop their social networks, which is critical to professional development growth, especially in the development of best practices in the integration of ICT in the classroom.

However, there is evidence that simply providing teachers with professional development opportunities related to ICT does not translate into high levels of integration in the classroom (Wilkerson et al., 2016; Harrell & Bynum, 2018). The distribution of digital infrastructure and ICT resources in schools must be backed with support to increase its uptake and effects on teaching and learning (Kempkey, 2016; Ozerbas & Erdogan, 2016). Laurillard (2008: 144) argued that technology could be part of the education solution but argues that 'the solution has to be responsive to the teaching community's perceptions of what they need'. Hence the need for teachers to understand the 'complex relationship between three knowledge bases that include technological knowledge, pedagogical knowledge and content knowledge' (Kempkey, 2016: 10). There is no doubt about the technology affordance; however, teachers must adjust their practices and embrace the constructivist pedagogical approach, which are intertwined with the integration of technology in the classroom (Kempkey, 2016; Dlamini & Ndzinisa, 2020). Teachers' understanding of the three knowledge bases is critical as they must manage various technologies while adjusting their pedagogical approaches.

There is confirmation that 'ICTs greatly facilitate the acquisition and absorption of knowledge' (Aktaruzzaman, Shamim & Clement, 2011: 116). However, the GDE's ambition needs to respond to the teaching community's perceptions of what they need in order to meet their educational aim. As such, technology can provide resources to transform instructional activities and broaden learners' engagement in their learning. Learners can now use social tools to participate in knowledge production and to share this with a wider networked community of learning (McLoughlin & Lee, 2007, 2008). Capitalising on these opportunities may help ensure that learning becomes a participatory and social activity.

There is also a discourse focusing on globalisation and the internalisation of national economies with technology at the forefront (Voogt et al., 2013). Therefore, to fully live and participate in the complex global economy, learners will have to be conversant with 21st century skills such as collaboration, communication, digital literacy, digital citizen, problem solving, critical thinking, creativity, and productivity skills (Voogt et al., 2013). Voogt et al. (2013) argued that these skills are not well implemented in current pedagogical practices because of a lack of competent teachers. Hence the demand for the school system to change so that learners have the right ingredients to live and succeed in the global economy. Interestingly, the implementation of digital learning platforms in schools is 'creating a transformational shift in how institutions architect their learning ecosystems for learners and instructors' (Brown et al., 2020: 9).

For this reason, many school systems around the world are making an innovative paradigm shift to turn traditional classrooms into digitally enabled smart classrooms. However, a systematic approach informed by instructional design principles is central to the paradigm shift (Dlamini & Ndzinisa, 2020).

Mere access to technology and the implementation of digital learning platforms will not translate into fundamental changes in teachers' teaching (Cuban, 2009). Teachers also need to be equipped with 21st-century skills and be trained for pedagogical approaches that leverage the use of digital tools (Aktaruzzaman et al., 2011; Voogt et al., 2013; Brown et al., 2020). Digital technologies have the potential to help teachers meet the needs of their learners and provide them with the best learning experiences. The gap in ICT knowledge between the digital native learners and their teachers should not be a deterrent to the adoption process. However, the gaps should be met with ICT teacher development opportunities with robust computational learning resources. Aktaruzzaman et al. (2011: 117) regarded ICTs as tools that can 'enhance the quality of education' by increasing 'learner motivation and engagement'. However, these can only be achieved if ICTs are used appropriately. Thus, digital literacy is an essential precondition for equitable access to digital pedagogies to transform the classroom. Teachers' self-efficacy needs to be increased through extended support and professional development opportunities (Barbour et al., 2017). According to Dlamini & Ndzinisa (2020: 56), in order to realise the potential of digital technologies there is a need to engage with the 'invisible structural variables at curriculum level, societal level and institutional level' that create barriers to digital fluency and pedagogies.

Context is another reason why ICT initiatives collapse, since the educational benefits of ICTs are not automatic. This was supported by Aktaruzzaman et al. (2011: 118) who suggested that there should be an

understanding of the potentials of different ICTs when applied in different context for different purposes, and an awareness of priority education needs and financial and human resource capacity and constraints within the country or locality.

Lai (2011: 1269) insisted that 'the potential of digital technology lies in its capacity for supporting a more interactive and communicative process'. A UNESCO (2010) report established that ICT tools are used in the education system to communicate, collaborate, and manage and deliver subject content knowledge fruitfully. This suggests that teachers, as key administrators of the classroom, are no longer a source of knowledge but a facilitator of knowledge; their role has changed. The pedagogical affordances of ICT resources and the adoption of technology driven pedagogies that support ICT integration and promote ubiquitous learning depend on the social and economic realities of the teachers, learners and schools.

RESEARCH METHODOLOGICAL APPROACH

The research used a quantitative research approach with a survey of 1 330 teachers from 133 randomly selected schools. Quantitative research is useful to indicate what may be happening and may provide statistical evidence of activities taking place on the ground. Within the 15 districts in the Gauteng province, a simple random sample of schools was drawn from a list of 370 schools characterised as ICT equipped schools. We distributed 1 330 questionnaires, and only 837 respondents returned their questionnaires. The study achieved a response rate of 63%.

Questionnaire

The questionnaire completed by teachers from the Further Education and Training phase Grade 10 to 12 included 15 main questions. Six of the main questions had multiple sub-questions that were measured on a Likert-type scale. The scales were as follows: (1) *Strongly Agree* (2) *Agree* (3) *Neutral* (4) *Disagree* (5) *Strongly Disagree* (6) *No Opinion*; (1) *Most Important* (2) *Important* (3) *Neutral* (4) *Least Important*

(5) *Not Important*; and (1) *Well Experienced* (2) *Experienced* (3) *Neutral* (4) *Not Experienced* (5) *Not Well Experienced*. The first part of the questionnaire provided a description of the research study with instructions for completing the questionnaire. The second part of the questionnaire included questions about the demographic information of the participants, and the rest of the questionnaire had multiple dimensions, including items on the experience, professional development needs for various technologies, their understanding of technology in their profession, and their thoughts on what it is for educators to successfully integrate ICT in teaching. The data generated provided general information of how individual-level and school-level characteristics influence teachers' pedagogical integration of ICT in their classrooms.

Reliability of the Instrument

The reliability of the instrument was tested by calculating Cronbach's alpha (α) coefficients. This was to ensure that the study contributes acceptable findings and insights. Cronbach's alpha coefficient was calculated to check the internal consistency of the items in the questionnaire (Taber, 2018). The overall instrument had acceptable reliability of $\alpha = 0.79$, which is higher than 0.7, and therefore, it can be considered valid.

Data Processing and Analysis

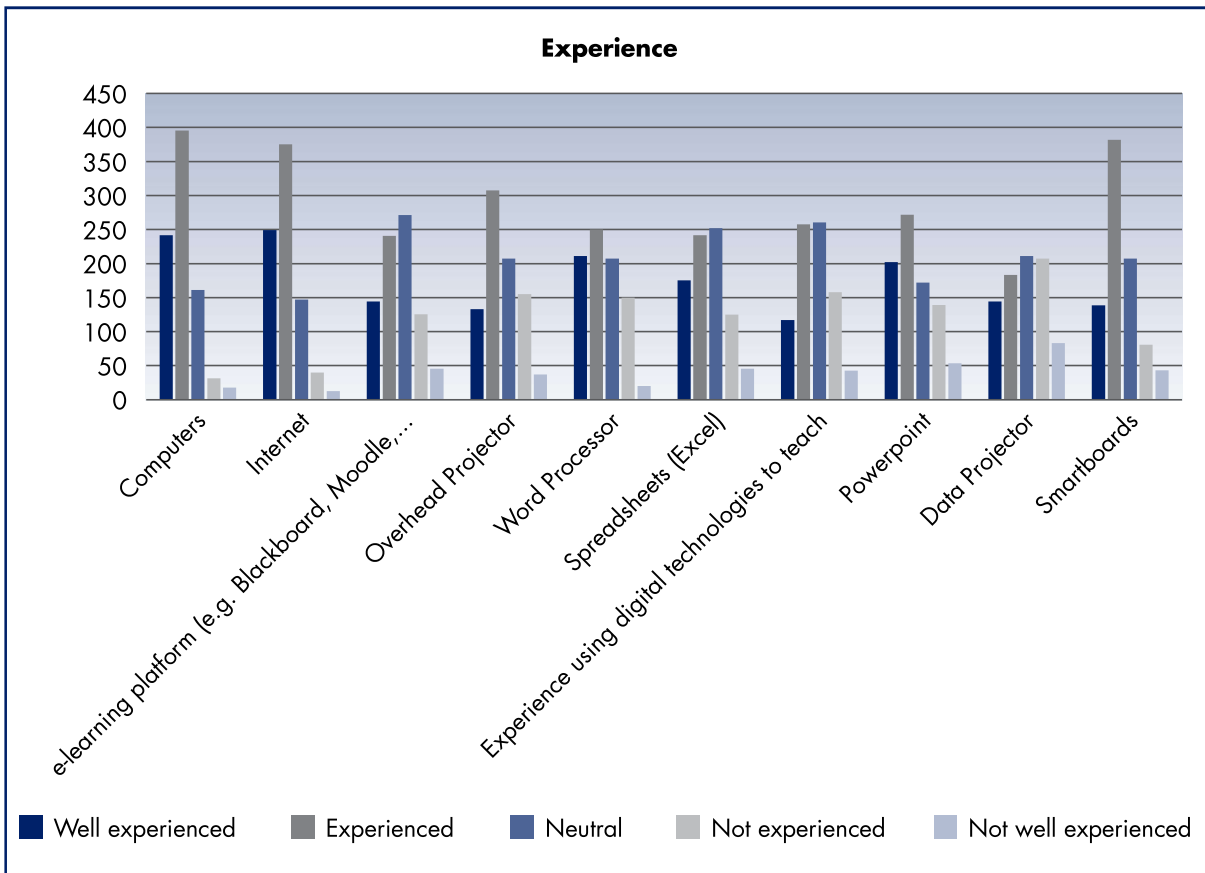
After data cleaning and coding, the data were processed and mean and standard deviation calculated. We used the Pearson correlation analysis to understand the relationship between variables. Peck, Olsen and Devore (2015: 228) stated that 'the Pearson correlation coefficient only measures the inherent strength of the linear relationship between two numerical values'. In this case, we used Evans and Karras's (1996) guide on strength of correlation to determine whether the relationship of the correlation is positive, negative or no correlation in the following way:

- .00–.19 "very weak"
- .20–.39 "weak"
- .40–.59 "moderate"
- .60–.79 "strong"
- .80–1.0 "very strong".

RESULTS

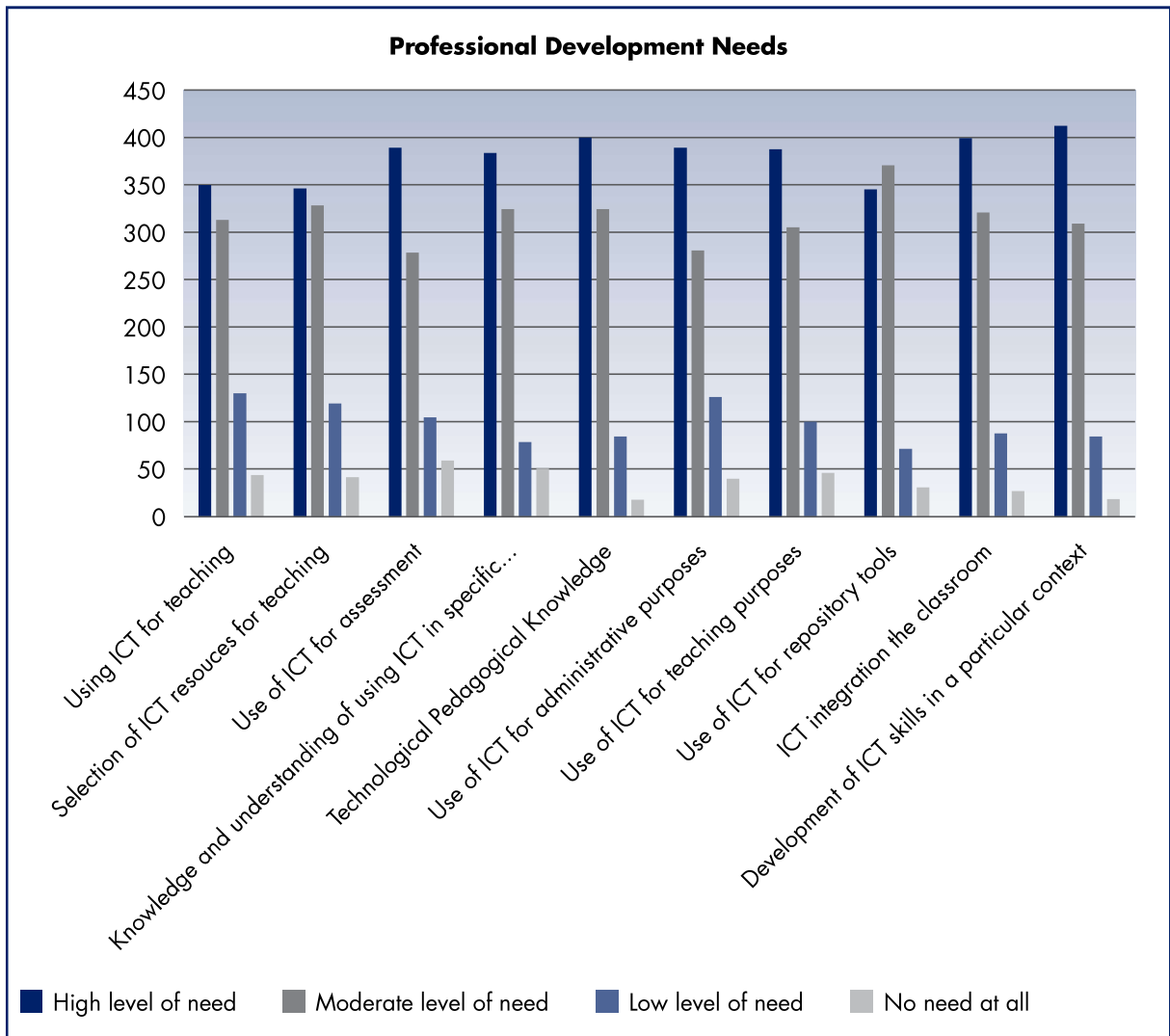
This research provides insights into the factors constraining ICT integration in schools. The findings presented shows varying understandings of ICT and preparedness to integrate ICT into teaching. There is lack of a conceptual understanding and awareness of ICT in schools, and there is a considerable diversity in the apparent understandings of ICT tools. The wide range of ICT conceptual understanding and interpretations are problematic. Figure 1 provides an overview of teachers' experience with different technologies.

Figure 1:
Teachers' experience with different technologies



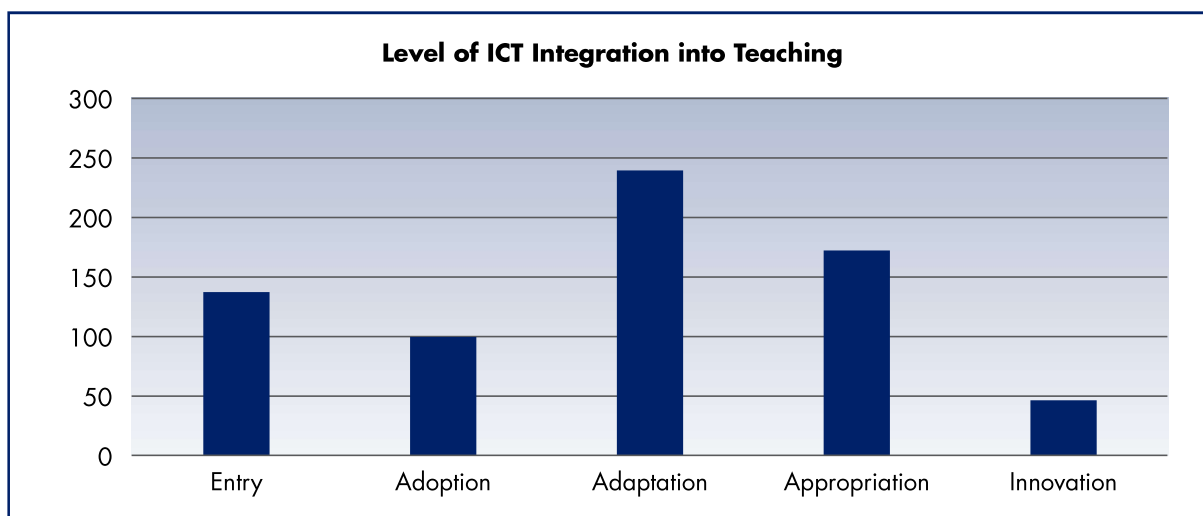
It is evident that teachers' use of technologies is skewed. This is because of the wide variations in their skills and competencies. There is no doubt that teachers know how to use the internet and computers, but the issue is that they do not know how to use these to teach. Figure 2 provides a clear view of the professional development needs of teachers in order to increase the uptake of various technologies to enhance teaching and learning.

Figure 2:
Professional development needs in specific areas



Teachers' levels of ICT professional development needs (Figure 2) correlate with their various experiences with different technologies (Figure 1). Although Figure 3 demonstrates that the situation is not all bad as teachers are fairly distributed in the different levels of integration. This data must be viewed as a 'snapshot' of one province.

Figure 3:
Level of ICT Integration



The findings demonstrate fairly distributed teacher proficiency levels (Figure 3) on the use of ICT in the classroom. Clearly, the integration trend is almost hierarchical with the innovation level at the top. Teachers must go through the stages as shown in Figure 3 in order to develop both skills and creativity for the meaningful integration of ICT into teaching and learning. In Figure 3 there is evidence that 20% of teachers are computer literate at the entry level; however, these participants need proper training and development on the use of various ICT tools, especially for pedagogical integration in the classroom. The dominant technology used by teachers at all the levels was PowerPoint presentations. Only 9% of the teachers were at the innovation level, which means that these teachers leverage the power of digital devices to enhance learners' classroom experience. This should be a concern for the GDE because access to technology might not be a major concern, but the investment does not correlate with the uptake.

It is critical that we leverage emerging technologies' affordances to transform teaching and learning, but we also must understand the context of the teachers, especially their level of ICT integration. Technology knowledge gaps among teachers varied, suggesting that social and cultural capital remain the biggest issues. According to Bourdieu (1986), cultural capital can be a source of social inequality, especially in an unequal society. Dlamini and Dewa (2021) asserted that teachers' social standing and contextual factors are not homogenous, and therefore, there is a great need for a variety of ICT teacher development opportunities to expand their technological pedagogical knowledge. Figures 1, 2 and 3 provide evidence of varied technological knowledge and skills. The fact is that teachers in South Africa live in an unequal society where access to digital knowledge is very limited in some places and their interaction and networking happens within their surroundings.

FACTORS CONSTRAINING ICT USE IN EDUCATION IN GAUTENG

While there have been success stories in other parts of the world, South Africa, is confronted with varied technological knowledge gaps as presented in Figures 1, 2 and 3. In order to achieve ICT integration in the classroom, the development of digital fluency should not be divorced from the realities of the provinces' socio-cultural context. The level of ICT integration in teaching (Figure 3) revealed that all teachers are using some form of technology in the classroom, demonstrating the willingness of teachers to appropriate digital tools in their classrooms. However, Table 1 demonstrates a moderate correlation between ICT skills and confidence, so it is important to boost teachers' confidence through continuous training. Notably, there is weak correlation between ICT skills and attitude, signifying that ICT skills development is not dependent

on attitude. Moreover, there is a strong correlation between confidence and attitude. Therefore, there is a need to provide upfront training before teachers develop a negative attitude towards ICT tools or digital devices.

Table 1:
Pearson Correlation Analysis

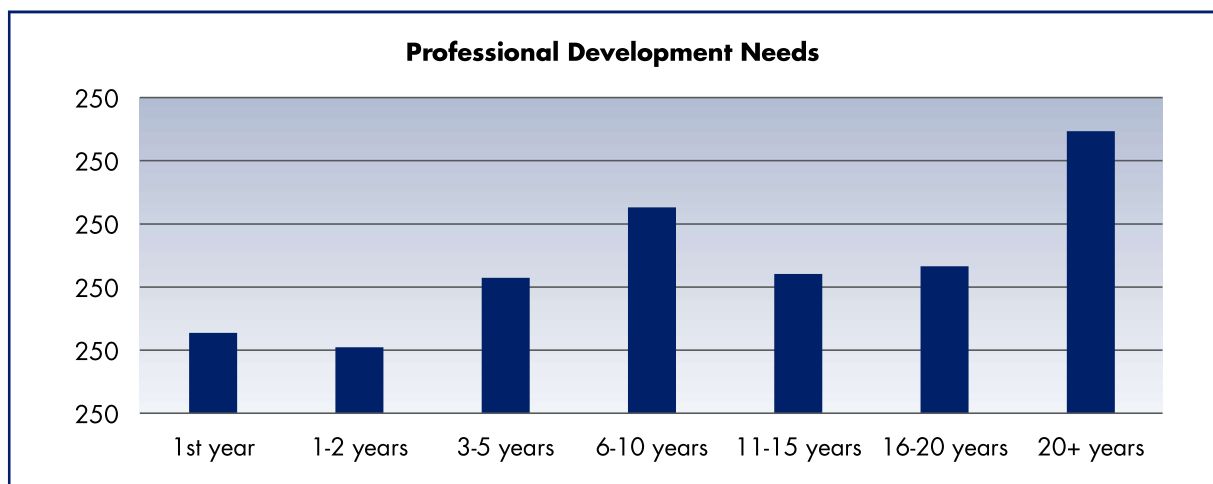
| Pearson Correlations | | | | | | |
|-------------------------------------|---|------|-------|---------|---------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Technological Pedagogical Knowledge | 1 | .020 | .028 | .033 | .117** | -.098** |
| Use of Computers | | 1 | .079* | -.112** | -.107** | .010 |
| Skills | | | 1 | .499** | .386** | .054 |
| Confidence | | | | 1 | .618** | .134** |
| Attitude | | | | | 1 | .079* |
| Use eLearning to Teach | | | | | | 1 |

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

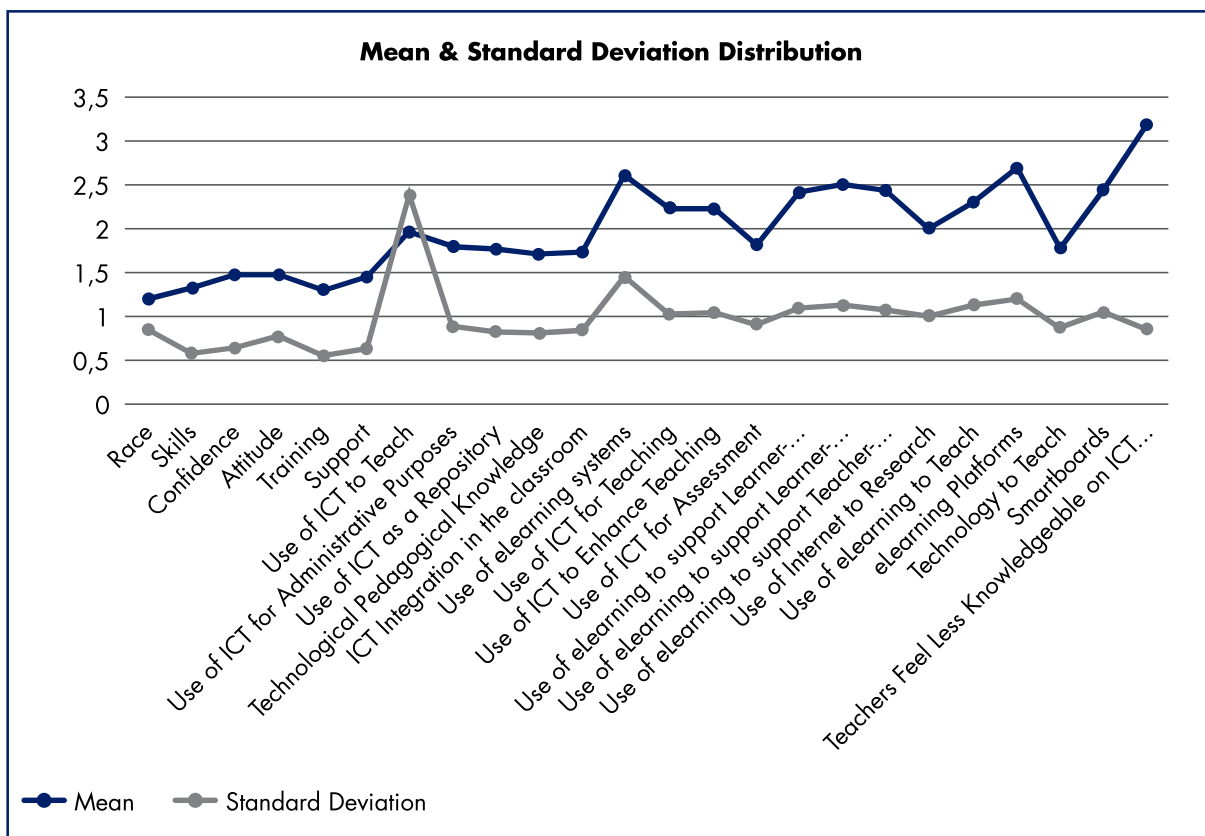
In a context where teachers refer to themselves as BBTs (Born Before Technology), confidence plays an important role in ICT integration, especially as it has a strong correlation with attitude. For teachers to develop confidence in the use of ICT in their profession, they must have access to development opportunities. It is clear that if confidence is low, they easily develop a negative attitude towards ICT tools. In Figure 4, the participant teachers' years of service are shown in the graph and most teachers have more than 20 years of working experience. This is an indicator that continuous professional development must be central to all ICT initiatives because the push to pedagogical ICT integration is new. This profile confirms access to multidimensional insights on the conceptualisation of ICT in teaching, and thus, provides a rich ICT pedagogical landscape that shows what it means to go for a system-wide adoption and integration of ICT in schools.

Figure 4:
Teachers' working experience



To improve ICT skills among teachers, there must be a systematic approach to ignite teachers' passion for digital pedagogies, which are invaluable in the 21st century classroom. This could help put teachers within a controlled environment where their progress can be monitored and evaluated as they go through the development levels outlined in the White Paper on e-Education (DoE, 2004). As shown in Figure 2, the education system needs to provide continuous support to bridge the gaps in the development levels. Figure 5 clearly shows the variability of the mean and the standard deviation.

Figure 5:
Mean and Standard Deviation Distribution



It seems there is progression in the use of ICTs as teachers are distributed across the different levels. Most are at the 'Adaptation Level', where they are using ICT to support their everyday classroom activities. Figure 5 shows that the data are very spread out and even the distance between the mean and standard deviation is large. Within a highly resourced constrained environment there must be a balance between ICT infrastructure availability and ICT professional development opportunities; this highlights the need to have an in-depth understanding of the key factors that influence the integration of ICT into teaching and learning. Standard deviation is the summary measure of the differences of each observation from the mean. The use of ICT is widely spread out, which tells us that there is a lot of work needed to achieve a normal distribution in the use of ICT in the classroom.

There are gaps in the coordination of ICT implementation in the province as some teachers have acquired ICT skills through training activities, but they are working in schools that do not have ICT infrastructure in place. At the same time, some teachers feel digitally 'bankrupt' as they are not on par with their learners. There is a need to move teachers' ICT skills and their conceptual understanding of digital tools in their profession to an acceptable level. Bringing teachers to the adoption level will be a good start and bringing

them to the acceptable level will help them develop a deeper understanding of the contribution of ICT to teaching, learning and transformational pedagogies.

RECOMMENDATIONS

- Teachers need meaningful and well-coordinated ICT development activities to increase their technological knowledge and, in the process, develop technological pedagogical knowledge in order to integrate ICT tools into teaching and learning.
- This research provides a snapshot through which government officials can develop an understanding that successful implementation of ICT in the classroom warrants careful planning as it is a complex and multidimensional process.
- Future research could undertake a more in-depth longitudinal study. The view as a 'snapshot' is synonymous with Dewey's (1938) concept of continuity; in this case the process of ICT integration is incremental and iterative.
- From these findings a comprehensive strategy could be developed to inform the ICT-based teaching and learning environment in every school.
- There is a need for the provincial government to develop a responsive approach informed by the following variables:
 - A scalable scenario-led design process for developing digital pedagogies
 - An ICT classroom toolkit accessible through an online & offline platform
 - Case scenarios of ICT teacher pedagogical practices in specific subjects.

CONCLUSION

The experience of teachers' use of different technologies was distributed across the levels of ICT integration as shown in Figure 3, demonstrating that teachers do have access to basic computing infrastructure in their schools. There is clear evidence that digital fluency regulates how teachers respond to the adoption of ICT into teaching and learning. Arguably, access to ICT infrastructure is crucial, but developing confidence and solid digital skills have the potential to inform how teachers use ICT tools to enhance their instructional delivery. Klopfer et al. (2009) said that technology can have a reciprocal relationship with teaching. Hence it is important for educators to develop the necessary skills and competencies to adopt these technologies to enhance learners' classroom experience and learning beyond the physical boundaries. On the issue of ICT integration in Gauteng, there are considerable disparities between availability of ICT infrastructure in schools and the availability of digital skills among teachers. There are instances where schools have access to ICT resources, while teachers in those schools lack the ICT skills to pedagogically integrate ICT into teaching and learning. In some instances, the computing hardware is available while there are no appropriate educational software and technical support on the ground.

At a broader conceptual level, the findings expand on the little that is known from various mini-studies conducted mostly by postgraduate students to contribute knowledge and insights on technology usage, infrastructure and technological knowledge among teachers across the school system. Lack of information on the enabling and constraining factors in the adoption and utilisation of technology in teaching and learning is a major challenge in the province. Thus, this research has the potential to inform strategy and planning initiatives related to the use of ICT in education and confirms the need for coordinated activities to prevent the duplication of efforts.

There is evidence that the preparation of teachers for pedagogical ICT integration in the classroom is complex and multidimensional, as ICT skills among teachers do not solve the problem of ICT infrastructure

inadequacies, and the availability of ICT infrastructure does not guarantee ICT integration into teaching and learning. In order for teachers to develop digital pedagogies, they must have access to professional development opportunities to move them through the stages in Figure 3. Although most teachers still lack the needed creativity and innovation for pedagogical integration of ICT in their teaching, there is light at the end of the tunnel as most of them were using some form of technology. However, technical competencies and confidence must be achieved in order for teachers to adopt and appropriate technology in their classrooms. Evidently, ICT integration is not prescriptive, as it comprises different interlinked professional and technical activities.

Teachers have been 'blamed for the failure of technology to fulfil its promise' (Convery, 2009: 25), and yet, they have not been given adequate support, especially in the early stages of rolling out of ICT projects. Teachers as the 'pedagogical crafts persons' must be given continuous professional development opportunities to transform their teaching approach. Furthermore, through effective leadership, training and continuous support, teachers' mind-sets could be changed so that they adopt and appropriate ICT in the classroom to enhance teaching and learning. Table 1 confirms that teachers' confidence and attitude is dependent on their ICT competencies. There is a need for best practices for the integration of ICT in various subjects so that teachers have access to these guidelines. Those at the forefront could model to other teachers the creative ways to integrate ICT to enhance their teaching and learning experiences. Social structures to collectively support teachers at the different stages of the ICT integration continuum also need to be introduced.

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