The integration of ICTs in marginalized schools in South Africa: Considerations for understanding the perceptions of in-service teachers and the role of training

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Abstract

It is well documented that Information and Communication Technologies (ICTs) play an important role in education and that their use is associated with improving student learning and adding value to the curriculum. However, despite the opportunities that ICTs offer, there are still many schools in countries such as South Africa that do not have access to ICTs. Moreover, many of the schools that do have access to ICTs tend to use it in a limited manner and only focus on learning about computers or acquiring ICT skills. In such cases, ICTs are implemented *without* integration as opposed to implementation *with* integration, where students use ICTs to learn and where ICTs are an integral part of teaching and learning practices. In this paper the authors explore the complex and challenging concept of ICT integration in marginalized schools. A number of theoretical considerations for ICT integration are discussed. These include barriers to integration, teachers' pedagogical beliefs, teacher self-efficacy, and knowledge areas for ICT integration. The authors also reflect on ICT integration in a particular project in a rural district in the Eastern Province of South Africa. The paper contributes by offering a framework on essential factors for ICT integration in education in developing situations. This framework incorporates both theoretical considerations and themes that emerged from preliminary fieldwork and the context discovery phases of the project.

Keywords
Representational Use, Generative Use, Pedagogical beliefs

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Background to ICTs in Education

While ICTs are not a panacea for educational problems, they offer the potential to advance student knowledge and skills, to foster co-operative and autonomous learning (Krishner and Selinger, 2003; Wilson-Strydom and Thomson, 2005; Madumere-Obike and Imgbi, 2012), and to encourage students to move away from learning characterized only by memorisation of facts towards a process of knowledge creation (Naicker, 2010; UNESO, 2011). The use of ICTs in education has the potential to add value to curricula and transform students into knowledge constructors. According to Dede (2009), ICT enabled skills prepare students for a workplace where they will be required to collaborate with peers across the world, produce new intellectual work that will add value to society, and communicate new knowledge (Dede, 2009; UNESCO, 2011; Madumere-Obike and Imgbi, 2012; Martinovic and Zhang, 2012). In South Africa, the Department of Education (DoE) confirmed the importance of ICT use in education, suggesting that all students should be computer literate by 2013 (Wilson-Strydom, Thomson and Hodgkinson-Williams, 2005; Department of Education, 2003).

However, despite the opportunities of ICT in education, there are still schools in South Africa that do not have access to ICTs. Moreover, those schools that do have access to ICTs, tend to use it in a limited manner and only focus on learning about computers or acquiring ICT skills rather than integrating ICTs into the classroom (Ertmer, 1999; Mueller, Wood, Willoughby, Ross and Specht, 2008; Goktas, Gedik and Baydas, 2013). The concept of integration is, however, complex and challenging. The South African White paper on e-Education even identified the integration of ICTs into learning and teaching as one of the three main challenges associated with ICT adoption in South African schools. Nonetheless, national curricula require learners to become computer literate and for schools to integrate ICTs across curricula (DoE, 2004; Du Plessis and Webb, 2012).

Literature suggest that the idea of ICT use and integration emerged as a response to the limitations of computer programmes in schools which focus only on developing computer literacy or technical skills rather than putting emphasis on using ICTs to learn (Wilson-Strydom et al., 2005). Wilson-Strydom and Thomson (2005) refer to the acquisition of technical skills and learning about computers as implementation without integration, whereas learning through or using a computer is referred to as implementation with integration. Implementation with integration is where students use ICTs to learn and where ICTs are at the centre of teaching and learning in the classroom. ICT implementation with integration encourages cross-curricular use of ICTs rather than having it only as a separate subject (Flanagan and Jacobsen, 2003). Therefore, since ICT adoption and integration serves as a challenging and complex process, it is important that the concept of ICT integration is unpacked (Wilson-Strydom and Thomson, 2005; Tondeur, van Keer, Valcke and van Braak, 2008).

This paper contributes in this regard as the authors put forward a conceptual framework (see Figure 1) for understanding ICT integration, teacher training for ICT integration, barriers to integration, and some contextual considerations that emerged from initial field observations and the researchers' preliminary understanding of a particular project context. This paper thus addresses the problem of limited ICT integration in education across Africa (Unwin, 2005).

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The paper is structured as follows. The next section introduces the reader to ICT integration in the classroom. This is followed by sections on the impact of teacher pedagogical beliefs on ICT integration in the classroom, barriers to integration, the role of teacher training, and teacher self-efficacy. The authors then reflect on the TPACK framework as a way of thinking about knowledge needed for ICT integration. The paper concludes with reflections and a discussion of a particular ICT for rural education (ICT4RED) project in South Africa and its context discovery phases.

ICT Integration into the Classroom

ICT integration does not simply refer to the placing of computers in the classroom; nor does it refer to the use of technology to support traditional teaching methods (Smaldino, Lowther and Russel, 2008 cited in Du Plessis and Webb, 2012). Integration implies that technology is used to facilitate teaching and learning, i.e. where students learn with or through ICTs. Wilson-Strydom et al. (2005) suggest that integration can be described in two ways; the first is associated with ICT adoption, while the second is associated with ICT use. Hokanson and Hooper (2000) furthermore define two types of ICT use, namely, learning *about* computers (or representational use) and learning *with* or *through* computers (or generative use).

According to Hokanson and Hooper (2000), generative use encourages students to generate knowledge and practise new skills as ICTs are interwoven into curricula, whereas representational use on the other hand, focuses on the mastery of skills through learning how to use computers (Hokanson and Hooper, 2000; UNESCO, 2004, Wilson-Strydom and Thomson, 2005; Maholwana-Sotashe, 2007). Even though representational use is essential in providing students with the basic computer skills, generative use allows students to learn independently. Bialobrzeska and Cohen (2005) state that generative use (i.e. implementation with integration) is not a norm in South African schools, mainly because many teachers lack the skills required to integrate ICTs into teaching and learning activities. Unwin (2005) supports this and states that this as a problem across Africa and in many developing countries. Teachers lack the computer skills necessary for effectively integrating ICTs into learning. As a result, computers are often set aside for use only on special occasions and they remain an object of curiosity, fear, uncertainty, and mystery rather than an enabling tool (Pelgrum, 2001; Unwin, 2005; Hew and Brush, 2007; Sherman and Howard, 2012). In addition to the need for computer skills to effectively integrate ICTs into teaching and learning (Song, Hannafin and Hill, 2007; Naicker, 2010), teachers' attitudes and pedagogical beliefs also plays a critical role in the adoption and integration of ICTs in the classroom. Hew and Brush (2007) emphasize that teacher attitudes and beliefs towards technology can be a major barrier to integration.

Teacher Attitudes and Pedagogical Beliefs

According to Hermans et al. (2008) and Lui (2011), each teacher enters the teaching setting with their personals theories about teaching and learning, i.e. they each have their own personal interpretations of the instructional situation and a set of beliefs on how students learn. Teachers may view and perceive teaching situations differently and based

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on their beliefs, they make judgements and decisions on how to act, which strategies to implement, and which materials to use. The decision to use and how to use technology in the classroom depends on the teachers' beliefs about teaching and learning and the role of technology (Ertmer, 2005; Hew and Brush, 2007; Hermans et al., 2008; Chen, 2008; Lui, 2011). Several studies suggest that teachers with constructivist pedagogical beliefs (i.e. student-centred learning) are associated with high-level use of computers, whereas low computer use is associated with traditional pedagogical beliefs (or teacher-centred practices) (Ertmer, 2005; van Braak, 2008; Naicker, 2010; Sang, Valcke, van Braak, Tondeur and Zhu, 2010). These studies also indicate that teacher beliefs about teaching and learning are essential indicators in determining ICT use in the classroom, and hence essential for getting a better understanding of whether teachers will use ICTs in the classroom or not (Hermans, Tondeur, van Braak and Valcke, 2008).

Traditional pedagogical beliefs (or Instructivism) require the teacher to provide information to the students. It implies a teaching practice where the teacher becomes the main source of information and the main transmitter of information in the classroom. It is where technology is used to represent information or to practice ICT skills (Hermans et al., 2008; Lui, 2011), hence, it is believed to be teacher-centered. Traditional pedagogical beliefs are associated with lower levels of ICT use in the classroom. Constructivist pedagogical beliefs, on the other hand, are associated to higher ICT use in teaching and learning (Hermans et al., 2008). Literature refers to Constructivism as a teaching practice that encourages students to access resources and structures that will support and assist them. Constructivism encourages students to learn independently and to tackle complex and difficult authentic problems. Teachers with constructivist pedagogical beliefs tend to design activities that require the student to solve authentic challenging problems as a way to motivate them (Pelgrum, 2001; Wilson-Strydom and Thomson, 2005; Chen, 2008; Baeten, Kyndt, Struyven and Dochy, 2010; Naicker, 2010).

Despite the notion of constructivist pedagogical beliefs being positively associated to ICT integration, Lui (2011) points out that even though teachers may have constructivist beliefs, they may still use technology in a traditional orientated manner. i.e. they require students to learn about the computers or to perform drill and practice exercises that are associated with representational use and traditional pedagogical beliefs (Ertmer et al., 2001; Lui, 2011). Literature identifies different reasons for these disparities in beliefs and practices. Li (2007), for example, found that teachers resorted to abandoning their constructivist practices in order to ensure a high exam score, especially if they are teaching an unfamiliar subject. Chen (2008), on the other hand, identified the influence of external factors, such as a limited understanding of constructivist teaching practices. Further external factors include lack of access to computers, insufficient time to plan, and lack of technical support (Chen, 2008). There are therefore, barriers to ICT integration which may affect teachers' ability practice Constructivism. In the following section the authors explore two types of barriers to ICT integration.

Barriers to ICT integration

Ertmer (1999) provides a model that describes two types of barriers that hamper teacher ICT implementation efforts in the classroom, namely, first-order barriers (i.e. extrinsic to the teacher) and second-order barriers (i.e. intrinsic to the teacher). Ertmer's (1999) model

also encompasses factors that cause teachers to abandon constructivist practices for more instructivist approaches. First-order barriers typically refer to resources that are missing or inadequately provided. These barriers according to Donnelly, McGarr and O'Reilly (2011) are easily removed when money is provided. Hence these barriers are concentrated on initially. They include technical support, lack of access to appropriate resources (software, hardware, and internet access), inadequate training, and lack of time. Having to deal with first-order barriers may frustrate teachers before they can start the integration process (Ertmer, 1999). Building on earlier work by Ertmer (1999) on first and second order barriers, Hew and Brush (2007) provide an analysis of barriers documented over ten years (1995-2006). They identify six main categories of barriers limiting integration, where four compromised of first-order barriers (i.e. resources, support, subject, and culture) and two compromised of second-order barriers (i.e. teacher attitudes and beliefs and teacher knowledge and skills). The authors described resources, teacher knowledge and skills, and teacher attitudes and beliefs as the three most frequently cited barriers impacting technology integration.

Lack of access to resources has been cited as one of the main barriers to ICT integration (Ertmer, 2005; Hew and Brush, 2007). Resources may refer to either; 1) access to ICTs, 2) access to available ICTs, 3) time, or 4) technical support. Access refers to the correct amount and type of ICTs in places where teachers and students can use them, in order to ensure that ICTs are integrated into lessons (Wilson-Strydom and Thomson, 2005; Hew and Brush, 2007). Increased access to resources, however, does not necessarily mean that integration will be guaranteed. Schools with limited hardware and software, have limited chances to integrate ICTs. On the other hand, increased access to ICTs does not necessarily lead to increased integration of ICTs (Wilson-Strydom et al., 2005). This goes to show that other factors influence integration, apart from the obvious first-order barriers. Technical support is a barrier mentioned frequently. According to Ertmer et al. (2012) there are different types of support that are needed to ensure effective integration. These include administrative, technological, professional, and peer support. Teachers need support to deal with different technologies and technical difficulties. Lack of support in schools hinders ICT integration. Most teachers complain about time required to prepare for using ICTs, i.e. they need time to review websites, content, etc. (Hew and Brush, 2007; Ertmer et al., 2012).

The most cited barrier to integration is lack of **professional development** or **teacher training** (Ertmer, 2005; Evoh, 2007; Du Plessis and Webb, 2012). Ertmer (1999) emphasizes that teachers need access to multiple types of training where technology and pedagogical needs are addressed. This is because teachers' ability to use ICTs affects their willingness to integrate them into the classroom. If teachers do not have the knowledge and skills to use ICTs they will not integrate them (Ertmer, 2005; Hew and Brush, 2012; Eteokleous, 2008). Literature does, however, state that even though some teachers have received training on ICT use and they have the knowledge on integration, they may still not integrate ICTs. This subsequently highlights the need for addressing second-order barriers.

Second-order barriers are intrinsic to the teacher and are often rooted in the teachers' beliefs about teaching and learning. They are associated with teachers' ways of seeing and doing things and with changes in pedagogy, personal preferences, teacher attitude,

and philosophy about teaching and learning (Ertmer, 2005; Eteokleous, 2008; Sang, Valcke, Braak and Tondeur, 2010; McGarr et al., 2011; Du Plessis and Webb, 2012). These barriers are more difficult to overcome than first-order barriers, mainly because they are more tacit and personal (Ertmer, 1999).

Regarding ICT use in the classroom, **teacher attitudes and beliefs** may pose difficulties (Demetriadis et al., 2003; Martinovic and Zhang, 2012). According to a study conducted by Sang et al., (2010), successful integration is related to the teachers' thinking process rather than the skills they possess. Sang et al. (2010) emphasize the importance of understanding the teachers' thinking processes and also encourages teacher training to challenge teacher thinking processes. The level of ICT skills possessed by teachers is a factor in the integration of ICTs. However, the level of ICT skills is not the only factor that is influential in ICT integration. Second-order barriers such as self-efficacy, pedagogical beliefs (discussed above), and teacher attitudes also play an important role (Albion, 1999). Inadequate training, therefore, produces teachers with limited ICT skills, and subsequently teachers who lack confidence in teaching with ICTs (Albion, 1999; Hew Brush, 2007; Eteokleous, 2008). Adequate teacher training is therefore the primary way to address second-order barriers.

The role of teacher training

Teacher training should be conducted in the same manner that the teachers are expected to integrate ICTs (Davis et al., 2009). Training needs to go beyond simple computer skills such as word-processing. It needs to provide support for educators and to prepare them. Training should therefore also focus on addressing second-order barriers. Teacher perceptions and attitudes are important in determining how teachers will use ICTs in the classroom (Ertmer, 2005; Evoh, 2007; Davis et al., 2009; Naicker, 2010; Martinovic and Zhang, 2012). Training should therefore challenge teachers' beliefs regarding teaching and learning and address teacher perceptions and attitudes towards ICT use and integration in education. Training programs should prepare and provide support for the teachers and challenge their pedagogical beliefs regarding the way they teach and how they can use ICTs to enhance and support the way students learn (Cox and Marshall, 2007 cited in Naicker, 2010). Sang et al. (2010), furthermore, suggest that teacher training should be carried out in a constructivist manner as this will provide a non-threatening environment where teachers will be able to experience success in computers and gain confidence in using computers (Teo, 2008).

However, as mentioned before, even though training might be provided, some teachers may still not integrate ICTs due to first-order barriers or especially because they do not feel confident enough to do so (a second-order barrier) (Ertmer, 1999; Hennessy et al., 2010).Hence it is essential to understand the importance of second-order barriers, even though they are intrinsic and are not as easily solved as first-order barriers.

Teacher pedagogical beliefs

As mentioned before the teachers' beliefs about teaching and learning plays a role in determining whether the teacher will use technology in the classroom. Literature theorises that teachers with instructivist (teacher-centred) beliefs are most likely to use ICTs in a

representational manner whereas teachers with a constructivist (student centred) belief are most likely to integrate ICTs and use them in a generative manner. It is however essential to understand that teacher beliefs are influenced by various factors. Hermans et al., (2008) state that a teachers' earlier experiences and their professional context impact their beliefs. In most cases you will find that teachers enter the teaching setting with beliefs of teaching based on how they were taught.

Teacher-centered pedagogical belief is associated with traditional methods of teaching where the focus lies on knowledge reproduction (Liu, 2011). Literature describes traditional pedagogical beliefs (instructivism) as a teaching practise that requires the teacher to provide information to the students where the teacher becomes the main transmitter of information in the classroom (Lui, 2011). Teachers with this teaching belief are believed to have little interaction with their students mainly because they impart knowledge through "chalk and talk" mode (Naicker, 2010).

On the other hand student-centered beliefs (constructivist teaching practices) allow teachers to become facilitators within the classroom. Constructivism encourages students to learn independently and to tackle complex and difficult authentic problems. Teachers with constructivist pedagogical beliefs are believed to design activities that require the student to solve authentic challenging problems as a way to motivate them, these teachers with this belief encourage students to use ICTs to construct knowledge rather than being passive learners (Pelgrum, 2001; Wilson-Strydom and Thomson, 2005; Chen, 2008; Baeten, Kyndt, Struyven and Dochy, 2010; Naicker, 2010).

Literature does however identify inconsistencies between beliefs and teaching activities. Sandholtz and Reilly (2004) states that teachers with constructivist beliefs may not necessarily translate those beliefs into practice in the classroom, Ertmer et al., (2001) adds on to this notion by pointing out that some teachers with constructivist beliefs often do not align beliefs with practise. Some teachers either teachers with constructivist pedagogical beliefs use technology in a traditional orientated manner. They require students to learn about the computers or to perform drill and practise exercises that which are associated with representational use and traditional pedagogical belief (Ertmer et al., 2001; Lui, 2011). Literature identifies different reasons for these disparities in beliefs and practices. Such as: influence of external factors: According to Chen (2008) and Li (2007) some pressures such as pressure from parents may cause teachers to go back to lecture-based instruction. Limited understanding of constructivist practices: Chen (2008) explains that some teachers lack a theoretical understanding. It is therefore essential to ensure that there is buy-in from parents and a mutual understanding of constructivist practices.

Teacher self-efficacy

Beyond the teachers' pedagogical beliefs, teacher self-efficacy is an intrinsic factor that refers to the teachers' perceptions of their ability to teach (Hennessy et al., 2010). Teachers with higher self-efficacy are often open to new ideas and willing to experiment in their classrooms as they seek to improve their teaching methods (Sang et al., 2010). Teachers with high beliefs in their abilities to teach are therefore most likely to adopt, implement, and integrate ICTs in their classrooms. Teacher computer efficacy refers to their belief and perceptions of their capability to apply computers (Sang et al., 2010). Teachers with higher self- efficacy about computers tend to use computers more often and

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they experience less computer related anxiety, whereas teachers with lower self-efficacy related to computers tend to experience frustration and hesitate to use computers when they encounter problems (Sang et al., 2010). Ropp (1999) cited in Sang et al., (2010) states that many teachers have a positive attitude towards ICT use in the classroom, but do not believe in their ability to use ICTs in the classroom.

Huang and Liaw (2005) also identify teacher attitudes as a barrier to towards ICTs being used. A study conducted by Khine (2001) of 184 pre-service teachers found a relationship between computer attitudes and use. Fisher (2000) points out the importance of understanding factors that affect attitudes towards computers. Ertmer et al., (2012) suggests that the best way to encourage teachers to implement and integrate ICTs is through increasing their knowledge and skills which in turn can change the attitudes and beliefs of the teachers.

Without a doubt teachers are essential in the integration of ICTs and as they are the ones who decide how to use ICTs in the classroom it is essential that they are trained and well equipped to integrate ICTs. The TPACK framework presented by Koehler and Mishra (2009) is a model that offers a way of thinking about technology integration the different types of knowledge required by teachers to ensure integration.

The TPACK framework

The TPACK framework draws attention to the knowledge needed by teachers for effective technology integration (Polly and Brantley-Dias, 2009). The model builds on Schulman's (1987) work that resulted in the idea that for effective integration, teachers should have content and pedagogical knowledge and that training should provide the opportunity for teachers to develop these skills. The model is presented in a Venn diagram (see Figure 1) with three core categories, namely; Pedagogical Knowledge (PK), Technological Knowledge (TK) and Content Knowledge (CK) (Graham, 2011).

Technological Knowledge (TK) according to Koehler and Mishra (2009) refers to knowledge about the different types of technology, ranging from low-tech to high-tech. It involves understanding various kinds of technology that the teacher can use. Content Knowledge (CK) refers to knowledge about the subject being taught, which more of a second-order consideration. With CK teachers are expected to know the content they are going to teach as this will allow them to choose the correct technology in order to achieve communicating the content to the students. Pedagogical Knowledge (PK) requires teachers to have deep knowledge about processes and teaching methods. They need to be able to understand how students learn and have classroom management skills. Additionally, they are required to be able to plan lessons and assess students.

These three core categories of knowledge overlap and result in four additional types of knowledge required by teachers for integration. Technological Content Knowledge (TCK) refers to knowledge on how technology can change learner practices and how learners understand concepts in a specific content area due to technology integration. Technological Pedagogical Knowledge (TPK) involves understanding how technology can change the way of teaching (pedagogy). It includes knowing the constraints and affordances that relate to certain ICTs and the disciplinary contexts within which they

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function (Koehler and Mishra, 2009; Graham, 2011). Technological Pedagogical Content Knowledge (TPCK) refers to the knowledge required by teachers to integrate ICTs into any subject. It focuses on the interaction of the three main bodies of knowledge rather than observing them in isolation.

The TPACK framework emphasizes the importance of providing teachers with technological skills and pedagogical skills to use the provided technology. This is because the teachers' ability to bring together content knowledge, pedagogy skills, and technology skills highly affects ICT implementation and integration (Evoh, 2009; Hennesy et al., 2010). Becta (2004) and Balanskat et al. (2006) emphasize the importance of providing teachers with pedagogical training mainly because teacher training tends to focus on ICT skills acquisition rather than technology integration strategies or assisting teachers to use ICTs in lesson preparation and using ICTs in the classroom. The TPACK framework can be adopted in the training of teachers as it encourages training that provides practical examples on how technology can be used to conduct lessons.

However, literature mentions that the framework has several weaknesses. Firstly, Graham (2009) points out that TPACK lacks theoretical development, because it is built on Shulman's (1987) Pedagogical Content Knowledge (PCK) framework, an existing framework that lacks theoretical clarity. Secondly, the framework has a high degree of parsimony. It is over simplified and does not take into account factors beyond content, pedagogy, and technology, such as teacher beliefs and context. Thirdly, the framework is made of different categories that do not have precise definitions. According to Cox (2008) cited in Graham (2009), there are 13 distinct definitions for TCK, 10 definitions for TPK, and 89 for TPACK. Nonetheless, this framework provides insight on the skills that teachers need for integration.

Further work on the TPACK framework is therefore required, and although the framework provides insight on the kind of skills that the teachers need to ensure integration, literature continually points out the importance of looking at first-order and second-order barriers. All of these factors need to be considered together to address increased ICT integration.

A Proposed Framework for ICT Integration

In the framework in Figure 1, the authors propose how ICT integration in education could be considered from different perspectives, thus incorporating the discussions presented in earlier sections. The proposed framework firstly provides a lens to understand ICT integration at schools by explaining the different types of ICT uses associated with teacher pedagogical beliefs. It indicates that teachers with constructivist beliefs are most likely to use ICTs in a generative manner, whereas teachers with traditional pedagogical beliefs are most likely to use ICTs in a representational manner. Moreover, it shows that first-order and second-order barriers, such as teacher self-efficacy, are factors that impact teacher decisions to integrate. The framework also creates a relationship between ways of thinking about teacher knowledge and effective integration (TPACK), teacher pedagogical beliefs, and first-order and second-order barriers. This indicates that there is a relationship of interdependence between these aspects. The teacher's skills to integrate can be put to best use when the teachers pedagogical beliefs are aligned and when first-order barriers

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have been dealt with. The framework also considers contextual factors for marginalized schools in South Africa. These contextual factors are based on the first researcher's observations from being part of the ICT4RED project and will be discussed in the following sections.

The framework in Figure 1 thus merges the different aspects that need to be considered when integrating ICTs. It brings attention to the 1) the importance of having the skills to integrate, 2) dealing with first-order and second-order barriers, 3) aligning teacher pedagogical beliefs to practice in order to ensure integration, and 4) the importance of considering the context when introducing and integrating ICTs. The final version of the framework was a result of juggling inductive and deductive reasoning (Schultze, 2000). The researchers first used deductive reasoning, where literature serves as the conceptual framework, for data collection and observations. This was alternated with inductive reasoning as the researchers continued to explore themes from fieldwork observations.

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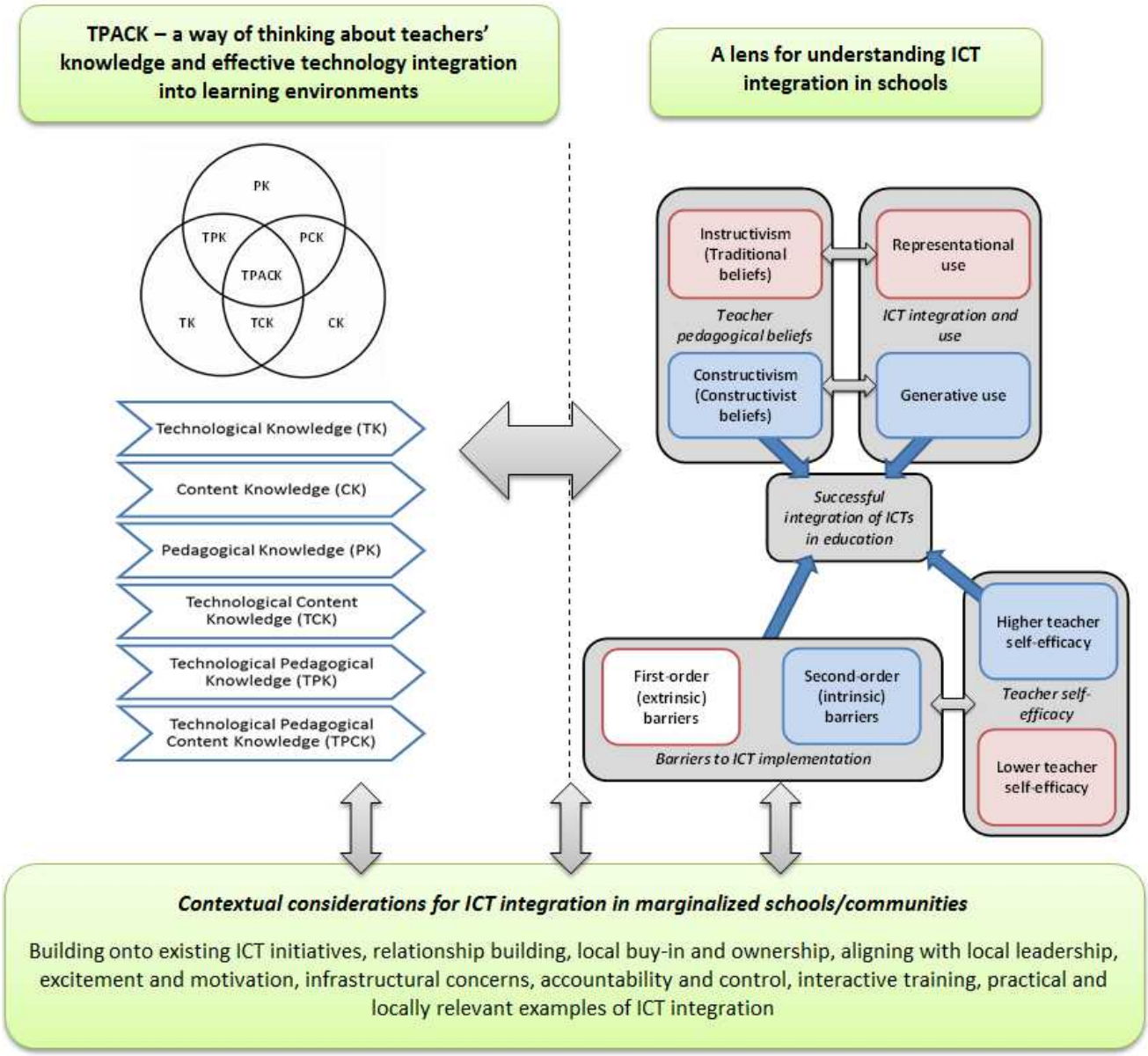

Figure 1 – A Framework on Essential Factors for ICT Integration in Education in Developing Contexts

Overview of the Project Context

The *ICT for Rural Education Development* (ICT4RED) project forms part of the larger TECH4RED (*Technology for Rural Education Development*) research initiative by the South African Department of Science and Technology (DST) in collaboration with the South African Department of Basic Education (DBE), the Eastern Cape Department of Education (ECDoE), and the South African Department of Rural Development and Land Reform (DRDLR) (Botha, Herselman and Ford, 2013). TECH4RED is an initiative that aims to improve rural education through technology. Within TECH4RED, ICT4RED aims to

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explore how the application of new and existing technologies at schools in the Cofimvaba town in the Eastern Cape Province can assist in the development of a framework which can be replicated and scaled to other provinces in South Africa and across the rural education system (Botha et al., 2013). ICT4RED supports rural teachers to integrate tablets in teaching with the aim of assisting in addressing the challenge of quality education in rural areas. The Council for Scientific and Industrial Research's (CSIR) Meraka Institute supports and implements this initiative and Cofimvaba in the Eastern Cape served as the pilot district. The initiative targets 25 schools where various models are tested. These models address ICT infrastructure, connectivity, and integration into the school environment. Once the research has occurred, learning and models will be shared and disseminated, and a wider-scale rollout will follow (Botha and Herselman, 2013).

The TECH4RED project targeted 3 senior secondary schools (Arthur Mfebe, Siyabalala and Kwahza) and 6 junior schools (St. Marks, Bangilize, Mvuzo, Gando, Mtimbini, and Zamuxolo) for Phase 1. These schools were selected in collaboration with Cofimvaba School District officials. The project is currently on Phase 1 which consists of the five steps discussed below. These steps have been completed at other schools i.e. Arthur Mfebe.

> *Step 0:* This step focuses mainly on explaining the project to the Principals and Deputies, school governing bodies, and district official, in order to create buy-in. This stage mainly consists of meetings.
> *Step 1A:* Upon buy-in the Principals, Deputies, and allocated ICT champions attend a workshop focused on ways to support the roll out of the tablets in order to ensure integration and sustainably.
> *Step 1B:* This step builds on creating buy-in and support from the top, and consists of a course on ICT support for District Officials.
> *Step 2:* This step focuses on continued Teacher Professional Development where teachers are equipped with skills on how to use ICTs in teaching. Teachers are expected to complete homework and show how they would integrate the tablets in their classroom. Teachers who graduate and complete their courses earn technology for their schools. This model is known as "Learn to earn".
> *Step 3:* This step consists of the installation of Mobi-kits (kits where tablets are charged and kept for safety), Mobi-hub, local Wi-Fi, and local content.
> *Step 4:* After Step 3, the learners are given tablets while their teachers continue with training. At this stage, once Wi-Fi is installed in the school, the school is linked with other schools. This will allow the teachers to share content. Technical support is also appointed within the school as well as pedagogy support.
> *Step 5:* This step expands the project to other schools.

All the schools are based in Cofimvaba, a small town located in the Chris Hani District Municipality. The town was established in 1877 and is situated about 200 kilometers from the bigger and more affluent Queenstown. The population of Cofimvaba is estimated at 8,793 people. Cofimvaba is surrounded by villages where unemployment and poverty are prevalent. Moreover, it is based in a province (Eastern Cape) which is known for its' low matric pass rate and poor education. Xhosa is the main language spoken in the Eastern Cape and in Cofimvaba. The first researcher, also a Xhosa speaking individual, was offered the opportunity to observe parts of Step 3 and 4 (above), i.e. the installing of Mobi-kits and handing out of tablets to students at four different schools. Additionally, the first researcher

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had the opportunity to visit the first pilot school, Arthur Mfebe, and attend the workshop for District Officials. This paper is based on these observations and the discovery of the context.

Context Discovery and Reflections

As mentioned before, the first author visited four different schools where tablets were handed to students and where Mobi-kits were delivered. Part of the handing over of the tablets included inviting parents and the School Governing Bodies (SGB) to witness the event. This was a strategy to facilitate buy-in and ownership from the community.

School A (in this section pseudonyms are used to protect the identity of schools), like the other schools in the project, received 15 tablets. This school is a primary school and more well-off compared to other schools. The school has a highly secure computer lab with desktops and an air conditioner installed. According to the teachers, the computers are used for computer lessons mainly for Grade 7 to 9. The concept of implementation without integration is illustrated here, where ICTs are used in a representational manner only, rather than in a constructivist manner (Hermans et al., 2008; Lui, 2011). Even though constructivism is encouraged, Bialobrzeska and Cohen (2005) state that generative use (implementation with integration) is not a norm in South African schools, like with School A.

School A had a strict headmaster who showed ownership and initiative when it came to the project. The headmaster himself was involved in the training. He expressed technical problems that the staff had with the tablets and instructed them to also take action and report any additional technical difficulties. The headmaster and the teachers showed excitement. Like all the other schools, School A involved their SGB and parents. This confirms the importance of school leadership. Hew and Brush (2007) mention that school leadership has the potential to hinder or support the integration of ICTs. If the headmaster does not understand and support ICT use, teachers are likely not to integrate. Principals are seen as managers and change agents who should work with the staff to create a vision for technology implementation and an environment that promotes integration (Flanagan and Jacobsen, 2003; Hew and Brush, 2007; Eteokleous, 2008).

School B, like School A, was one of the schools that had better facilities. However, School B compared to School A had fewer teachers attending the handing over. Even the headmaster was not present. According to one of the team members, this school normally has a high rate of absenteeism and the headmaster was not very supportive of the programme. Despite the absenteeism of teachers and the headmaster, the parents and SGB showed support and enthusiasm. This school even conducted a session for the parents and SGB to show them how the tablets would be used. At this school the researcher observed the involvement of the SGB and parents.

School C did not have the best infrastructure. Classrooms were dusty with very little furniture and the students were from a more isolated area. The headmaster at this school took initiative of the project and was the one heading the handover. Like School A, the headmaster was using the tablet and instructed his staff to take initiative in not only reporting any technical problems but also in encouraging the students to use the tablets

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right there. The important theme of leadership and creating buy-in from parents also emerged from this visit.

School D, unlike the other schools, was extremely underdeveloped. The school had a total of three teachers, including the headmaster. Teachers at this school are responsible for three different grades. The concept of multi-grading is applied at this school, i.e. teachers have students of different grades in one class. The school is extremely isolated and has problems with electricity and managing the large number of students. The headmaster mentioned that they plan to use the tablets to manage the classroom and encourage the students to work independently. Here the concept of constructivism and generative use is indicated. Barriers such as lack of infrastructure (electricity) are evident. Parents and SGB at this school showed a united front as they indicate that they would go to the provincial office to discuss the problems concerning electricity in the area.

As indicated in the proposed framework (Figure 1) on *Essential Factors for ICT Integration in Education in Developing Contexts,* the following are essential in the particular context and need to be considered for further work. Although there are some similarities, first-order and second-order barriers differ from place to place. Based on this case and preliminary context discovery, the following themes can be deduced:

- Principals play an important role in ensuring the acceptance of ICTs. They are responsible for steering the team and creating an environment where ICTs can be used, despite the facilities and availability of resources (Flanagan and Jacobsen, 2003; Hew and Brush, 2007 Eteokleous, 2008).The attitude and drive of the principal is important in ensuring integration. Therefore, in the framework, **leadership within the school** has been highlighted as an important theme to consider when introducing or integrating ICTs into new developing environments.
- Creating **ownership** and **buy-in** from not only staff members, but from parents and the SGB also, is another theme that emerged. Ballantyne (2003) states that it is one of the critical success factors that need to be considered as it plays a significant role in ensuring local buy-in and the sustainability of projects. Ownership was created from Step 0 and extended to Step 3 when the tablets were handed over. During the hand-over the team emphasized that the students should hold their teachers **accountable** and ask them where the tablets were if they were not using them. The project team encouraged the parents to ask their children if they were using the tablets to learn. The **essential** factors for Integration highlight this theme.
- A common barrier cited in literature is **infrastructure** (Ertmer, 1999). Electricity in School C served as a challenge. However, despite the electricity issue, the school showed **initiative** and **enthusiasm**.
- At all the schools the presence of the parents and SGB indicated the importance of **relationship building** within the school and outside the school. It also emphasizes the importance of teacher-parent relationships in ensuring successful education.

The first researcher was also presented with the opportunity to visit Arthur Mfebe, the pilot school (the school has been using tablets for two years). This school has a satellite set-up and prides itself in agriculture. At this school, each Grade 12 student has their own tablet that they can take home. Similarly, the Grade 11's also have their own tablets that they can

take home on Fridays. During the visit the researcher observed matric students who were using their tablets to do an Economics assignment. They expressed that they found learning more interesting now that they are using tablets to learn. The students were working in groups without the supervision of the teacher. This indicates that ICTs can be used to encourage autonomous learning where the teacher is the facilitator rather than the main transmitter of knowledge. Literature discusses this in depth (Pelgrum, 2001; Wilson-Strydom and Thomson, 2005; Baeten, Kyndt, Struyven and Dochy, 2010; Naicker, 2010).

The researcher also had the opportunity to interact with the ICT4RED technician at the school who provided background information on the project and challenges that the school experienced. Lack of technical support is discussed in literature as one of the main barriers to integration (Chen, 2008; Goktas et al., 2013). The technician mentioned problems concerned with the inability to use the tablets throughout the whole day due to battery life. Another problem mentioned by the technician is not being able to see what each student does on the tablet, as some students tend to do other things. Keeping control of what the students are doing on the tablets serves as a huge problem. However, benefits such as student independent learning and the ability to share content with peers and teachers were mentioned. This indicates that ICTs in schools can bring change and improve education. The following can be deduced from the visit:

- **Technical support** is essential, as this will allow teachers to focus on teaching rather than having to deal with technical problems (Chen, 2008; Goktas et al., 2013).
- **Control** is essential. Teachers need to be able to see what the students are doing on the tablets.
- **Infrastructure** issues include that battery life of the tablets serve as a challenge in the classroom and this limits use and integration.

Besides the observations at the schools, the researcher also had the opportunity to observe training provided for subject advisors and district managers. This training is the same training provided for all teachers and headmasters. The project team emphasizes that they do not teach *how* to use ICT but they provide strategies on how to teach *with* ICTs. The training is designed in a manner that teachers are provided with the skills that will allow them to integrate ICTs into their subjects. Training allows teachers to work through applications available on the tablet and the exercises that they can go through. Training encourages group work and independent learning. Literature emphasizes the importance of providing training in the same way that teachers are expected to conduct the lessons. It emphasizes that the training must address local needs and particulars of a specific country (Unwin, 2005; Hennessy et al., 2010). Training needs to be conducted in a constructivist environment where teachers are encouraged to interact during learning. Important aspect to consider in training is the importance of having interactive training that will provide practical examples on how to integrate ICTs. Literature also highlights this (Unwin, 2005; Davis et al., 2009).

The Framework for ICT integration in education (Figure 1) proposed in this paper highlights important factors that affect successful integration. The framework is based on literature and preliminary observations from the field. It creates relationships between the main factors and considerations that impact ICT integration, i.e. teacher pedagogical

beliefs, barriers to integration, teacher skills (TPACK), and context.

Conclusions

In this paper the concept of ICT integration in marginalised schools in South Africa is unpacked. Literature explains that ICT integration, or learning *with* or *through* ICTs, is not common in many schools. The authors subsequently encourage a shift from implementation *without* integration towards integration *with* integration, by discussing 1) skills for integrating ICTs, 2) barriers to ICT integration, 3) aligning teacher pedagogical beliefs to practice, and 4) the importance of considering the context when introducing and integrating ICTs. A conceptual framework (Figure 1) that illustrates these suggested themes are put forward. In addition, considerations such as relationship building, leadership, local buy-in, and ownership emerged as important themes impacting integration. The framework thus serves as a suggestion for factors to consider when integrating ICTs. Although this framework is applicable to rural marginalised schools, further work is necessary to adequately explore the proposed themes and to more rigorously collect data.

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