Teachers' perceptions, experiences and challenges related to using ICTs in teaching Social Sciences in marginalised classrooms in the Eastern Cape Province, South Africa

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By

Fortunate Takawira Gunzo

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Declaration

I, Fortunate Takawira Gunzo, the undersigned, hereby declare that the contents of this dissertation constitute my own original work, which has not previously been presented to another institution, either in part or as a whole, for the purposes of obtaining a degree. Where use has been made of the work of others, this has duly been acknowledged and referenced.

Signature: …………………… Date:……………………………

Abstract

This study seeks to examine teachers' perceptions and experiences of using Information and Communication Technology (ICT) in teaching as the basis for actual use in the classroom. I conducted an eclectic study with a multidisciplinary theoretical viewpoint combining theories from Information Technology (IT) and education to examine how perceptions and prior experiences with ICT influence cross-curriculum ICT integration. Specific aspects of five theories and models were used in different phases of this study. I drew on the Technology Acceptance Model (TAM) and Teacher Cognitions theory to understand teachers' perceptions towards ICT in general and towards ICT in the classroom. The classroom observations were conducted using an observation guide informed by Activity theory. I then utilised the Adoption of Innovation and the Diffusion of Innovation theories to explain why and how ICT was utilised in the classrooms. A mixed methods research approach located within a pragmatic paradigm was chosen. Three data sets were collected. First, a questionnaire of attitudes and perceptions towards ICT was conducted with 183 teachers (mainly working at marginalised schools in the Eastern Cape Province of South Africa). Questionnaire data was analysed using descriptive statistics and a chi-square correlations test. Second, teachers enrolled in an in-service Advanced Certificate in Education specializing in ICT (ACE-ICT) at Rhodes University were supported in planning and implementing an intervention involving the use of a mobile computer lab in rural and peri-urban schools. Three key participants were observed while teaching in class using ICT for the first time and they were subsequently interviewed. Third, drawing from lessons learnt from this experience, students in the in-service education bachelor's degree in ICT (BEd-ICT) – which replaced the in-service ACE-ICT – were supported and encouraged to experiment with cross-curriculum integration using ICT already at their disposal. Planning and reflections by three in-service BEd-ICT teachers were subjected to theory-based document thematic analysis. Findings indicate that the vast majority of the teachers had positive attitudes towards ICT and perceived ICT as useful, mainly as a productivity tool in teaching. ICT was used mostly for administration, planning and preparation of lessons and not for teaching or as a cognitive tool. Despite all key participants having access to similar ICTs and support, their experiences of teaching with ICT were different based on their personal commitment, access to and frequency of use of ICTs in their personal lives. Teachers who were self-motivated to use ICT in their teaching made efforts to do so regardless of infrastructure and resource challenges they faced at their schools. The main barriers to the use of ICT in the classroom appear to be lack of technical support and time constraints.

Dedication

This work is dedicated to my late parents who were always proud of my every achievement. I am sure if they had had a chance to see the completion of this work they would have been very proud.

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Firstly, I give all the glory, praise and honour to God for helping me do this work. I would have never been able to finish this without my faith in the unconditional love of God and in His perfect timing.

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List of Abbreviations

ACE-ICT	Advanced Certificate in Education (specializing in Information and Communication Technology)
BEd-ICT	Bachelor of Education (specializing in Information and Communication Technology)
CAT	Computer Application Technology
DBE	Department of Basic Education
DoE	Department of Education
FET	Further Education and Training
FP	Foundation Phase (Lower primary – Reception year to grade 3)
ICT	Information and Communication Technology
IP	Intermediate Phase (Higher primary – grades 4 to 6)
IT	Information Technology
SLL	Siyakhula Living Lab
SRI	Stimulated Recall Interview
SS	Social Sciences
SP	Senior Phase (Lower secondary grade 7 to 9)

CHAPTER ONE: INTRODUCTION

In this chapter, I introduce a study that examined teachers' perceptions and experiences of using computers in teaching Social Sciences in marginalised classrooms in the Eastern Cape Province of South Africa. In this study the words 'computers' and 'Information and Communication Technology' (ICT) are used interchangeably. The chapter starts by providing a background to the research, which is followed by a brief outline of the context within which the research was undertaken and of the research sites. The goals of the research and the research questions that guided the research process are then stated followed by a definition of key concepts. The chapter ends with an overview of the thesis by chapter.

1.1 BACKGROUND TO THE STUDY

Since the introduction of computers in education, scholars and policy makers have expected that computers would revolutionise education as has happened with other aspects of society (Sawyer & Rosenbaum, 2000; Heemskerk, Brink, Volman, & TenDam, 2005; Attwell & Hughes, 2010). In the 1980s, many scholars and policy makers strongly believed that computers would dramatically improve education and be widely adopted. For example, in 1984, Walker noted that "the potential of computers for improving education is greater than that of any prior invention including books and writing" (p. 30). Extreme supporters of the positive impact of computers in education claimed that "There won't be any schools in the future … the computer will blow up the school" (Papert, 1984, p. 38). However, the reality did not meet these early expectations, as computers still have not revolutionised education in the way they were expected to do.

The impact of computers on education has been the subject of much research and scholarly debate. In the early 2000s, Rusten (2003) noted that “after many promising experiments, numerous failures and near failures, and a few notable successes, it is clear that the promised revolution has not come” (p. 209). Research is available on the impact of computers on classroom interactions, student learning environments (Schank, 2000), transformation of classroom practice (Brayley, 1999; Higgins, 2003) and how computers assist with critical thinking and cognitive skills (Hokanson & Hopper, 2000). Literature seems to confirm that computers have not influenced teaching and learning in the way or to the extent they were projected to do (Bladergroen et al., 2012; Spangehl & Hoffman, 2012; Schleicher, 2015; Serdyukov, 2017). The Organisation for Economic Co-operation and Development (OECD) reported on a study which sought to answer this question: What is the impact of computers on education? The study found “no appreciable improvement in student achievement in reading, mathematics or science in countries that had invested heavily in ICT for Education” (OECD, 2015, p. 15). In developing countries such as South Africa, the debate has focused on the potential benefits as well as the possible adverse effects of ICT in education. For example, with respect to the latter, the introduction of computers in the classroom can aggravate or widen the existing educational, digital, and rural-urban divide (Lemphane & Prinsloo, 2014; Kady & Vadeboncoeur, 2017).

Educators are under pressure to integrate computers in their practice. The four rationales for the use of computers in education, identified in the early 1990s by Hawkridge (1990), are still relevant today. The *social rationale* (Hawkridge, 1990) refers to the fact that learners need to acquire a certain level of comfort with technology in order to live and work in today’s society where Information and Communication Technologies (ICT) play an important role (Potashnik & Adkins, 1996; Voogt, 2008). Computers have become interwoven in the fabric of people’s work and social lives (Sawyer et al., 2000) and the school needs to contribute to building ICT competent learners. A key principle for those who subscribe to this rationale, such as Hammond (2014), is that there needs to be a greater correspondence between schooling and the rest of the world. Hawkridge's (1990) second rationale is the *vocational rationale.* The school must give learners an opportunity to operate computers in order to prepare them for the labour market. Courses in basic computer literacy, basic programming, use of programmes such as Word, spreadsheets, etc. should be encouraged for learners in schools so that they can be prepared for the different career opportunities requiring ICT skills. The vocational rationale emphasises the importance of preparing learners for future employment in ICT-based economies and businesses (Tarragó, 2009).

Hawkridge's (1990) third rationale is the *catalytic rationale*, which argues that computers can promote educational innovations in teaching and learning within schools. Once computers are introduced in the school, they have the power to change the way teaching or learning is done. Computers can change the role of the teacher in the classroom to that of a facilitator. Children learn differently; not so much by "memorising facts but information handling and problem solving by collaborating rather than competing with other children" (Hawkridge, 1990, p. 2). The *pedagogical rationale* (Hawkridge, 1990; Voogt, 2008) refers to the "potential of computers in helping children learn" (Hawkridge, 1990, p. 3). Hawkridge (1990) further notes that teaching with computers offers some advantages and goes as far as to say that computers may eventually substitute teachers in some activities. While Hawkridge (1990) spoke about computers, these four rationales would apply to the integration of any ICT including laptops, netbooks, tablets and mobile phones.

South Africa is a relatively advanced country in terms of ICT compared to the rest of Africa, yet according to the most recent figures from the Gini Index, South Africa is the most unequal country in the world (Barr, 2017; Alvaredo, Chancel, Piketty, Saez, & Zucman, 2018) with affluence found side by side with abject poverty (Nyapokoto, 2014; Orthofer, 2016; Schotte, Zizzamia, & Leibbrandt, 2018). As a result, there are two different narratives in South Africa regarding ICT in education. On the one hand, experiences in affluent areas match first world ones in many respects. On the other hand, ICT use in marginalised schools covers a wide range of situations comparable to those found in other parts of rural and peri-urban Africa. The Global Information Technology Report for 2015 shows that South Africa is still lagging behind in terms of access to ICT (di Battista, Dutta, Geiger, & Lanvin, 2015). The report notes that:

> The general state of ICT readiness remains very low; the result of the poor quality of ICT-related infrastructure, notably the limited international Internet bandwidth. The cost of ICTs in South Africa is also a drag. Overall, the potential of ICTs has not been fully unlocked. Their social impacts have not yet materialised, and they have not significantly improved access to basic services or facilitated citizens' e-participation (p. 25).

The statement above highlights that the state of ICT use in South Africa is still very low. The present study was conducted in marginalised communities, where the majority of the South African population lives. Marginalised communities are described by the School Home Support (SHS) organisation as communities excluded from activities central to normal social life (SHS, 2015). People in marginalised communities "may not have access to resources and opportunities available to others because of economic, social, cultural or political factors" (SHS, 2015, p. 11). This is reflected in the school context, which is often characterised by lack of infrastructure, poor educational achievement and under-prepared teachers.

1.1.1 Problem statement and gap

There is a discrepancy between policy and practice in the South African context. The implementation of policies, such as the 2004 White Paper on e-Education, has been slow and not rigorous enough to match the policy intentions (Draper, Howie, & Blignaut, 2008). By 30 August 2019, 87.18% (i.e. 3 691) of ordinary schools in the Eastern Cape Province did not have a computer centre (DBE, 2019). The policy goal to ensure that every teacher and learner was ICT capable by 2013 has still not been fully realised (Mnisi, 2014). The issues surrounding ICT in education are many and complex in the developing world, while in developed nations such as Norway, The Netherlands and Japan, ICT in education is ubiquitous (Law, Pelgrum, & Plomp, 2008). However, Ainley, Enger and Searle (2008, p. 8) contend that "there is little understanding of the way in which ICT is used in schools and classrooms around the world". This is even more true in developing countries where the focus over the years has been on access, policy and training and not the actual use of ICT's, be it for administration, communication, research, or teaching and learning (Hokanson et al., 2000). Anderson and Plomp (2009) support this notion, stating that making decisions about whether and how to integrate ICT into teaching and learning is complex, technically demanding and the effects are not always known due to lack of research. There are insufficient studies to provide a clear picture of what is happening in terms of the actual use (or lack thereof) of ICT in South African classrooms. In the present study, I seek to contribute to filling this gap in research by looking at why some teachers in marginalised schools appear not to integrate ICT in their teaching, even in cases where there is apparent motivation and technical/pedagogical support. In addition, although several studies on ICT utilisation have been conducted all over the world (OECD, 2015; Law et al, 2008; Ainely et al, 2008), such studies are not prevalent in the Eastern Cape Province of South Africa particularly in marginalised contexts such as Grahamstown and

Dutywa districts where this study was conducted. The few studies on ICT utilisation in the Eastern Cape Province do not focus on Social Sciences teachers, which this study does.

1.1.2 Situating the study

The present study is situated within the context of teacher professional development. This is one of the priority areas identified in the 2004 White Paper on e-Education (DoE, 2004). The uneasy relationship between technology and the teacher can be attributed in part to the expectation that computers would revolutionise education (Rusten, 2003) and change the role of the teacher in the classroom. This led to some teachers feeling threatened in their positions and authority in the classroom which caused “computer anxiety, apathy and resistance” (Schofield, 1995, pp. 102-105). Karasavvidis (2009) argues that, in order to understand the use of computers in the classroom fully, there is a need to study the crucial mediating factor, namely, the teacher. Understanding the teachers’ background, their sociocultural context, personal motivation, confidence, interests and their perspective regarding ICT has a bearing on knowing whether or not computers will be used in the classroom and how they would be used (Karasavvidis, 2009). The South African Department of Education published guidelines for Teacher Training and Professional Development in ICT in 2007 (DoE, 2007). Cognisant of the importance of proper training, the then Director General stated that the guidelines are meant to “guide the development of the ICT knowledge and skills of teachers … and provide direction in addressing the ICT training needs of teachers” (DoE, 2007, p. i).

1.1.3 Participants

Participants in this study can be divided into three groups. First, the 183 respondents to the teacher questionnaire reported on in chapter 5. Second, the 40 in-service ACE-ICT student teachers reported on in chapter 6 and the three in-service ACE-ICT key participants reported on in chapter 7. Furthermore, 113 learners (38, 39 and 36) from the three classrooms of the three key participants completed a learner questionnaire reported on in chapter 7. Data was also collected from two principals and an IT representative at the three key participants' schools. Third, 74 in-service BEd-ICT student teachers participated in this study by completing two questionnaires. It was from these 74 in-service BEd-ICT student teachers that the three key in-service BEd-ICT participants were drawn. The in-service BEd-ICT data is reported on in chapter 8.

1.2 RESEARCH GOALS AND RESEARCH QUESTIONS

The overarching goal of this study was to examine teachers' perceptions and attitudes towards ICT as well as the experiences and challenges they face while using ICT in the classroom. The unit of analysis for this study was the classroom intervention, involving the use of computers as well as other ICT devices available in the target schools. The main research question for the study was:

How do perceptions, experiences and challenges influence ICT use in marginalised Social Sciences classrooms in South Africa?

Three research questions guided this study. I explain each question and provide a rationale for the question and a tentative answer. I also reflect on how answering the question contributes to achieving the goal of the study.

1. **What are teachers' perceptions of using computers in teaching?**

In answering this question, I intend to find out what teachers' views, opinions, ideas and understanding of what the use of computers in teaching entails. It is my assumption that understanding these perceptions allows one to begin to understand the teachers' disposition towards computers in the classroom. Perceptions help in building attitudes and experiences. Researching such perceptions helps in understanding the decision to use computers in the classroom and to understand how computers are used. Considering the main goal of the study (examining teachers' perceptions and attitudes towards ICT) the questionnaire method was considered the most appropriate data collection tool for the first question. The questionnaire that was design included 18 Likert scale statements to understand respondents' perceptions and attitudes towards ICT. As the main focus of the study was on the teacher, assumptions were made about the influence of the teacher's personal characteristics (that is, gender, age, teaching experience, subject and grade taught) on perceptions based on the ongoing debate on this topic in literature (Hong, 2016; Lufungulo, 2015; Buabeng-Andoh, 2012; Alazam, Bakar, Hamzah & Asmiran, 2012; Yukselturk & Bulut, 2009). In order to determine whether personal characteristics (gender, age, teaching experience, grade and subject taught) had an influence on teachers' perceptions in this study, I ran a chi-square test to examine the relationship between personal characteristics (variable 1) and perceptions (variable 2). The hypotheses tested were as follows:

- Null hypothesis (H_o): Variable 1 (personal characteristics such as gender, age, teaching experience, grade and subject taught) and variable 2 (perceptions such as perceived ease of use and perceived usefulness) are independent or are not associated and therefore there is no relationship.
- Alternative hypothesis (H_1): Variable 1 (personal characteristics) and variable 2 (perceptions) are dependent or are associated and therefore there is a relationship.

A p-value of <0.05 was considered as an indication of a significant correlation/relationship.

2. What are teachers' first experiences using ICT in the classroom?

Understanding experiences of teachers was a central part of this study. Literature shows how often people's perceptions do not align with their lived experience (Tilfarlioglu & Unaldi, 2006). Observing teachers and capturing their experiences as they taught using ICT for the first time was expected to highlight the tension between perception and experience. Activity theory was used to show these tensions or contradictions. Highlighting the way Social Sciences teachers use ICTs in their classrooms could yield insights and practical examples for others teachers to follow or not to follow. These practical uses of ICTs in the classroom will come with the interpretation and teachers' own reflection of whether or not they were successful strategies that other teachers can adopt/adapt.

3. **What challenges do teachers encounter when they use computers in the classroom?**

   I undertook this study aware that teachers might face challenges in the process of integrating and implementing the use of computers in the classroom, particularly at the initial stages. Exploring and understanding these challenges was useful in that it might help other teachers in similar contexts wanting to use computers in their classrooms and may inform professional development.

1.3 RESEARCH DESIGN

This study is situated within the pragmatic paradigm. The study used a mixed method approach, combining quantitative (i.e. questionnaires) and qualitative (i.e. interviews, observations and document analysis) data collection methods embedded as a multiple case study to focus with particular depth on the experiences of six key participants. The teachers taught at schools located in the Eastern Cape Province of South Africa, in a rural area in the Dutywa district and in a peri-urban area (known as a township) in the Grahamstown district. These schools are representative of marginalised schools found in rural or township areas across South Africa.

1.4 KEY CONCEPTS DEFINED

Key concepts are critically discussed and working definitions of these terms as used in this thesis are presented here.

ACE-ICT: The Advanced Certificate in Education specialising in Information and Communication Technology (ACE-ICT) was a professional development course offered at Rhodes University. This was a part time course targeting in-service teachers. The in-service ACE-ICT course was replaced by the in-service Bachelor of Education specialising in ICT, (BEd-ICT) in 2012.

Attitude: is "a relatively enduring organisation of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols" (Hogg & Vaughan, 2005, p. 150). An attitude can also be defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Eagly & Chaiken, 1993, p. 1). McLeod (2018) describes attitudes in terms of three components, the Affective component which involves personal feelings or emotions; the Cognitive component which involves a person's beliefs, knowledge or opinions held consciously and the Behavioural component which involves the way the attitude we have influences how we act or behave.

BEd-ICT: The Bachelor of Education specialising in Information and Communication Technology is a professional development course offered at Rhodes University. This course is designed for in-service teachers.

Cross-curriculum ICT integration: Cross-curriculum is defined as “a conscious effort to apply knowledge, principles, and/or values to more than one academic discipline simultaneously. The disciplines may be related through a central theme, issue, problem, process, topic, or experience” (Jacobs, 1989 as cited in Kelly, 2018, p. 1). In this study, I use the concept of cross-curriculum ICT Integration to refer to the application and use of ICT in all school subjects (i.e. across the curriculum).

Curriculum: Curriculum is defined as product, i.e. when it is seen as a technical exercise in which objectives are set, plans are drawn up and applied, and outcomes (products) are measured; as process, what actually happens in the classroom, i.e. the interactions between teachers, students and knowledge, and as praxis where the focus is on the interests a curriculum serves and when it makes an explicit commitment to emancipation (Smith, 2000). Ellis (2004, pp. 4-5) indicates that:

> The term curriculum can be defined as prescriptive, descriptive or both. The prescriptive curriculum provides us with what ought to happen and they more often than not take the form of a plan, an intended program, or some kind of expert opinion about what needs to take place in the course of the study. The descriptive definitions of a curriculum, go beyond the prescriptive as they force thought the curriculum, not merely in terms of how things ought to be, but how things are in real classroom situations.

Digital divide: Digital divide refers to gaps between those who are able to access ICT and those who are not (Sciadas, 2005; Lediga & Fombad, 2018). At this level, people have or do not have physical access to ICT hardware or software (Compaine, 2001; Norris, 2001). The definition of digital divide has been expanded to include the gap between those who have the skills required to access ICT and those who do not (Hargittai, 2002). Eurostat (2019, p. 1) defines digital divide as “the distinction between those who have Internet access and are able to make use of new services offered on the World Wide Web, and those who are excluded from these services". More recently, a third dimension of the concept of the digital divide has been added which is the difference between those who are able to gain tangible outcomes from being online and those who do not (Van Deursen & Helsper, 2015). Hillier (2018) defines digital divide as gaps that separate segments of society as well as whole nations into those who are able to take advantage of what the new ICT opportunities (e-learning, digital learning, etc.) have to offer and those who are not and therefore remain unconnected. The digital divide can be classified according to criteria that describe the differences in participation according to gender, age, education, income, social groups and geographic location.

Epistemological access to ICT: This refers to the ability to use hardware and software. In this study, I operationalise epistemological access to ICT to include the five dimensions of the expanded meaning of access, i.e. content access, design access, psychological access, production access and institutional access as outlined by Aungamuthu (2010).

Experience: Roth and Jornet (2014, p. 2) define experience as "participation in events or activities and in the process having certain feelings". Roth et al. further explain that experience "is a category of thinking, a minimal unit of analysis that includes people (their intellectual, affective and practical characteristics), their material and social environment, their transactional relations (mutual effects on each other) and affect" (2014, p. 2). Experiences can be grouped into two – "past experiences which refer to knowledge accumulated over time and current experiences related to sensory or senses, i.e. current perceptions or series of perceptions, awareness-cum-feeling and reliable knowledge of a place and time" (Wierzbicka, 2010, p. 31). Mcintosh and Wright contend that the word 'experience' has "a deep cultural presence in the English language which might explain why it is often taken for granted and why it is routinely employed in prominent ways with little explication" (2019, p. 451). They further add that this deep cultural presence can have the effect of giving experience “an authenticity that can be assumed rather than justified” which Scott (1992) warns against. Scott (1992) argues that experience requires explanation and that there is a need to attend to the historical processes that produce experience to fully understand experiences. Erlich (2003) echoes this stating that experience is a process and advises focusing on “how experience is formed rather than what experience tells or communicates” (p. 1125). In this study, both past and current experiences are considered and the processes leading to such experiences are explored to get a deeper understanding of the participants and how they feel and think about integration ICT in their teaching.

ICT: The term ICT has evolved over the years to incorporate and capture the changes in the technology field. At first, the term ‘Information Technology’ (IT) was used to refer to technology used to store and convey information, e.g. floppy disks. The term then changed to ICT which incorporates the storage of data, conveying, access and use of information as well as communication which was enabled mostly by the Internet (Andrews & Haythornwaithe, 2007). The term ‘ICT’ includes many different devices such as tablets, mobile phones, netbooks, laptops, computers, data projectors, etc.

ICT integration: The “appropriate selection, use, mix, fusion and integration of many sets of competencies including, but not exclusively, those in pedagogy and technology” (UNESCO, 2003, p. 18). The guidelines for teacher training and professional development in ICT further state that “These competencies, once achieved and contextualised, create new learning environments in which learners take decisions about their own learning while teachers facilitate the process. ICT integration into curriculum delivery requires understanding from the teacher and requires some changes in classroom practices. It is a multi-dimensional concept that requires a wide base of understanding and an exploration of the many opportunities that ICT offers. It requires creativity and imagination from both teachers and learners, and teachers should believe that learners can also contribute to the learning experience. Inevitably, this will change the way that teaching and learning take place and the way they are organised and managed. It can offer flexible-learning contexts in terms of how, when and where learning takes place. This can have an impact on the way a school is managed and administered" (DoE, 2007, p. 4).

In-service (with reference to the ACE-ICT or BEd-ICT courses)**:** In-service teacher education is broadly defined as "any learning opportunity for practicing teachers. The term *in-service teacher* designates a teacher that has certification or is already teaching in a classroom, in contrast to a *pre-service teacher*, who is in the process of preparing to become a teacher" (Koellner & Greenblatt, 2018, p. 1).

Marginalised area/schools/communities: Marginalisation "is a term used to encompass the disadvantages of individuals, households, social groupings or spatial areas in terms of some social, economic, cultural or political activities or processes" (Ballard, Habib, Valodia & Zuern, 2005, p. 7). It is often linked closely to the lack of material resources and poverty and is often associated with powerlessness and lack of representation and freedom. A marginalised community is a group that is confined to the lower or peripheral edge of the society (Morato, Ruiz-Robles, Sanchez-Cuadrado, & Marzal, 2016). Underlying causes of marginalisation in South Africa can be associated to a large extent with the apartheid political dispensation which used discriminatory laws to segregate people on racial grounds.

Mobile computer lab: A mobile computer lab is a movable or transportable computer lab (The Journal, 2003). In this study, a mobile computer lab populated with 12 netbooks was used with the in-service ACE-ICT student teachers.

Netbook: A netbook is small lightweight laptop computer that can perform all the functions of a laptop or desktop computer. It is often referred to as a mini laptop (Ogg, 2009; King, Kong & Bleil, 2011).

Operation Phakisa: *Phakisa* is a South African word in the local Sesotho language, which means hurry up. Operation Phakisa was launched by the former President, Jacob Zuma in July 2014, deriving the concept from Malaysia's Big Fast Results Methodology (The Presidency, 2015). Operation Phakisa involves setting clear plans and targets, on-going monitoring of progress and making these results public. The focus on ICT is known as Operation Phakisa: ICT in Education.

Perception: Perception refers to "an understanding of the world constructed from information obtained by means of the senses" (Johnson, 1994 p. 476). Sternberg (2003) defines perception as the interpretation of sensory information received from environmental stimuli through our eyes, ears and skin, that is, what we see, hear and feel. There are four aspects fundamental to perception as outlined by Lewis (2001). First, that "there is an experiencing person or perceiver" – in this study these are the teachers and learners. Second, that "something (either an object, person, situation or relationship) is being perceived" – the use of ICT in teaching Social Sciences. Third, that "there is the context of the situation in which objects, events or persons are perceived" - marginalised classrooms. Fourth, that "there is the process nature of perception starting with the experiencing of multiple stimuli by the senses and ending with the formation of precepts [principles or guidelines]" pp. 274-275.

Physical access to ICT: This refers to the availability of hardware and software. In South Africa, the low levels of physical access to computers are due in part to the fact that most marginalised schools have no electricity supply, or such supply is inconsistent or that they do not have decent, secure buildings (Nelson Mandela Foundation, 2005; Farrell & Isaacs, 2007, DBE, 2019).

Rural area: Any area that is not classified urban. According to Statistics South Africa (2001, p. 1) "rural areas are subdivided into tribal areas and commercial farms. For example, villages, which are settlements in a tribal area. A village has delimits (boundaries), which encompass not only populated areas, but also agricultural areas, e.g. grazing land, crop land or forested land. Villages are usually under the jurisdiction of tribal authorities, headed by chiefs, while sub-chiefs are direct principals of villages".

Social Sciences: This is a subject taught in South Africa at the Senior Phase level – that is, Grade 7 to 9. It is "a combination of History and Geography" (DBE, 2011, p. 8).

Technology adoption: It is "the choice to acquire and use a new invention or innovation" (Hall & Khan, 2002). Adoptions of new technology signals a confidence in its potential to alleviate a particular problem or make a job easier or more efficient.

Township: In the South African context, the term 'township' usually refers to "the urban living areas (often underdeveloped) that during the apartheid era were reserved for non-whites i.e.

blacks, coloured and working class Indians" (Bond, 2008, p. 1). Reference is sometimes made to 'Black Township', 'Coloured Township' and 'Indian township', meaning that these settlements were created for these population groups. By contrast, the white population resided in suburbs. Generally, every town/city has one or several townships associated with it.

1.5 OVERVIEW OF THE THESIS

This thesis comprises ten chapters. In this chapter, I introduced the study, I gave an overview of the problem that this thesis sought to address and the background and context within which the study was undertaken. I outlined the goals and research questions as well as the research design.

In *Chapter Two,* I contextualise my study within the South African education system based on a comprehensive review of literature on teachers' perceptions and experiences of using computers in teaching. The review focuses on how computers have been used in education and in classrooms in marginalised communities in South Africa.

In *Chapter Three,* I present a multidisciplinary theoretical framework bringing together two fields - ICTs and education. The tensions and nuances across these two fields enriched the study and gave a deeper understanding of the issues that span these two fields. I look closely at the role of ICT in education and use three theories to trace teachers' progression from acceptance to adoption of ICT.

In *Chapter Four,* I outline the research design of the thesis. I discuss my choice to conduct a mixed method, multiple case study research within the pragmatic paradigm. The research design adopted for this study is also discussed. Issues around the trustworthiness of research, ethics, and my positioning in the study are also included in this chapter.

In *Chapter Five,* I present the findings on the perceptions of 183 teachers towards the use of ICTs in teaching. Perceptions towards ICTs influence whether or not teachers use that technology in their classrooms and their experience of teaching with ICT. A questionnaire was used to collect data from 183 teachers in the two educational districts, Grahamstown and Dutywa. The findings presented in this chapter thus provide a contextual profile for the study.

In *Chapter Six,* I present findings from the in-service ACE-ICT cohorts of 2010 to 2012. The chapter reports on the perceptions of the in-service ACE-ICT student teachers towards ICT in education.

In *Chapter Seven,* I present findings on the classroom interventions of three in-service ACE-ICT key participants' experiences of teaching with ICTs. The CHAT elements of subject, tools, object, rules, community and division of labour are used to unpack, report on and discuss the classroom observations.

In *Chapter Eight*, I present findings from the 2015-2017 in-service BEd-ICT cohort – which replaced the in-service ACE-ICT course. I reflect on the changes implemented for the new cohort which were based on the findings of in-service ACE-ICT student teachers' experiences as presented in chapter 6 and 7. Given the three-year gap between the cohorts, findings presented in this chapter provide a deeper and nuanced understanding of ICT use in marginalised classrooms and confirm findings presented in chapter 6 and 7.

In *Chapter Nine*, a discussion of all the data presented in chapters 5 to 8 is presented. The discussion is guided by the research questions presented in chapter 1 and findings are discussed in relation to the conceptual and theoretical frameworks presented in chapter 2 and 3.

In *Chapter Ten*, I make some concluding remarks. The contribution this thesis makes to knowledge is articulated. Recommendations and suggestions for future research are also presented.

CHAPTER TWO: ICT INTEGRATION IN THE CLASSROOM

In this chapter, I discuss my understanding of the issues surrounding ICTs in the South African education system. I draw on literature that focuses on access, use and perceptions held by teachers towards ICT in education, as well as their experiences and challenges. I start this chapter with a look at projects and policy implementation followed by challenges to ICT integration in the classroom. The final section focuses on the role of the teacher in ICT integration.

2.1 PROJECTS AND POLICY IMPLEMENTATION

In this section, I review the South African national policy around ICT in education and its implementation. I argue that the policy lacks clarity, direction and its implementation has been plagued by many challenges. In the absence of clear policy direction at a national level, interpretation and implementation of the ICT policy differs across provinces. This has led to discrepancies and the widening of the digital divide across regions. A closer look at the local level reveals that private public partnerships for communities and individual schools are the drivers of ICT in education.

2.1.1 National level

Government strategies are driven by the National Integrated ICT Policy (NIIP) White Paper of 2016, which outlines the South African government's plan of action to meet the objectives of the National Development Plan (NDP): 2030 (DTPS, 2016). The NIIP acknowledges that:

- the quality of school education is poor;
- infrastructure is poorly located, inadequate and under-maintained;
- spatial divides hobble inclusive development; and

- South Africa remains a divided society. (DTPS, 2016, pp. 8-9)

The argument presented in the NIIP White Paper is that ICTs can assist in addressing the above-mentioned challenging areas highlighted in the National Development Plan by providing access to information. For example, “e-learning and the innovative use of ICTs in education can assist in addressing inequalities in education in schools across South Africa and ICT can reduce geographical divides and facilitate participative and inclusive development across the country” (DTPS, 2016, p. 8).

Following the government’s curriculum pronouncements for ICT in education in South Africa, a White Paper on e-Education was gazetted in 2004. This White Paper is still a reference document for ICT in education. The White Paper on e-education (DoE, 2004) was meant to “inform decision making on the use of ICT in education” in South Africa (Draper et al., 2008, p. 2). The White paper on e-Education (DoE, 2004) “encourages a learner-centred and activity-based approach to education (p. 22). According to the White Paper, “every school in the country was expected to be equipped with computers by 2013 and all learners and educators were expected to become competent users of ICT in the school context” by that date but that did not happen (DoE, 2004, p. 17). The policy document also promotes the use of ICT to accelerate the achievement of national education goals and supports the RNCS (2002) by including guidelines on learning about ICT, learning with ICT and learning through using ICT. The South African e-Education policy acknowledges “the massive financial investment required for attaining its goals but despite this, there is no national budget for e-Education implementation” (Draper et al., 2008, p. 2). Without a dedicated budget, it is difficult to implement the policy. Results of the PanAf Research Agenda 2008 to 2011 showed that the policy was poorly implemented because the targeted timeframes had passed and little had been achieved (PanAf, 2011). The National Planning Commission's diagnostic report of June 2011 also identified the failure of government to implement policies as the main reason for slow progress in South Africa (NDP, 2011).

Webb (2002) identifies three key policy aspects around ICT and the curriculum: ICT education, ICT for education and ICT in education. These are articulated in the White Paper on e-Education (DoE, 2004) as learning about ICT, learning with ICT and learning through the use of ICT respectively. Learning about ICT refers to "exploring what can be done with ICT. This is an operational dimension that refers to skills that are necessary for the use of ICT" (DoE, 2007, p. 3). Draper (2010) calls this learning ICT as a subject. To this end, ICT was initially introduced in the South African curriculum first for Grade R-9 (that is pre-primary to secondary schools) as part of a subject called Technology through the Revised National Curriculum Statement (RNCS) of 2002 (DoE, 2002). Information Technology (IT) and Computer Applications Technology (CAT) were established for Grade 10-12 in 2003. IT and CAT are examinable subjects which teach basic skills for software use and information gathering (DoE, 2003). IT "involves the integration of theory and practice, as well as structured experiential learning, which affords learners the opportunity to exercise and reinforce the computer skills and knowledge acquired in the school and to provide orientation to further study in the field" (DoE, 2003, p. 11). CAT focuses on learners wanting to gain "knowledge, skills, values and attitudes to create, design and communicate information in different formats" (DoE, 2003, p. 9). Hennessy, Harrison and Wamakote (2010) note that the teaching of ICT as a subject is not an effective way of acquiring basic computer skills. They refer to research which indicates that integrating ICT into subject learning areas is far more effective in teaching learners' basic skills for software use and information gathering rather than when ICT is treated as a discrete, examinable subject.

The present study focuses on what Webb (2002) calls ICT *for* education, or learning with ICT according to the DoE (2007). This refers to "using ICT to supplement normal processes and resources" (p. 3). The Department of Education envisions teachers "stepping into the culture and mindset that supports the practice of using ICT for educational purposes, regardless of one's level of expertise" (p. 3). This should be done with a view to encouraging teachers to use ICT *in* education (Webb, 2002) or learning through the use of ICTs (DoE, 2007), whereby ICTs begin to transform the classroom and teachers use it to support new ways of teaching and learning.

Cognisant of the limitations of the White Paper on e-Education of 2004, the Department of Basic Education tabled a new e-Education strategy 2013-2025 in 2012. This was an implementation plan guided and informed by the White Paper on e-Education (DBE, 2012). Subsequent to this, the Minister of Education stated in the 5-year strategic plan of 2015-2016 to 2019-2020 that ICT in education in South Africa will now be driven by a new initiative called Operation Phakisa: ICT in Education (DBE, 2015). Reports on the project indicate that there is work being done (Odendaal, 2017), but whether or not this will be a successful campaign is yet to be seen.

The discrepancy between policy and its implementation has implications for infrastructural challenges and sustainability of ICT initiatives in marginalised contexts in South Africa. For instance, the government announced and gazetted the Teacher Laptop Initiative (TLI) in 2009, meant to provide physical access to computers for all public school based permanently employed teachers over a two-year period (DoE, 2009). The project targeted 400 000 teachers who were set to receive a subsidy of R130 per month for five years, to purchase a package that included a laptop, Internet connectivity, software and insurance (Gazette 32207, Section 4.2).

A total of “R550 million per year for 5 years was budgeted for this project” (Evoh, 2009, p. 7). However, the project was never implemented as intended. Following a year of delays, the R550 million budgeted in the 2009/2010 financial year for the TLI project was redirected to teacher salaries (Bauer, 2011). Plans to revamp the project were discussed in 2010 (Worst, 2010) and then again in 2012 when the Minister of Basic Education announced that the project was back on track (SANEWS, 2012). However, the project still stalled in 2013 (Tubbs, 2013) and according to Paris (2013) it has not yet been implemented five years after it was announced and gazetted. This initiative provides an example of the haphazard implementation of national policies.

2.1.2 Provincial level

ICT use varies considerably within South Africa and perpetuates what has been termed ‘the urban-rural digital divide’ (Conradie, Morris, & Jacobs, 2003; Rao, 2005) which results in ICT use being geographically biased in favour of urban areas. This reinforces the digital gap between and within provinces. For instance, by 2006, ICT had “only been significantly implemented in education in two out of nine provinces, Gauteng and the Western Cape” (Howie, 2010, p. 511). These two provinces are developed and rich due to their infrastructural advantage throughout South Africa’s history. In the Western Cape, the Khanya Project was started on 1 April 2001 by the Provincial Education Department to service government schools in that province (Khanya Project, 2001). By the time the project ended on 31 March 2012, the Khanya Project was active in 1402 schools, 50 824 computers had been placed in schools, 31 718 teachers had been trained to use computers in teaching and 968 901 learners had been reached (George, 2014).

The Gauteng Provincial Department of Education established the Gauteng Online (GoL) schools programme in 2001. The initiative was meant to address the digital divide by providing all 2200 public schools in the province with a computer laboratory and provide all learners with free Internet access. According to the then MEC for Finance in the Gauteng Province, Mandla Nkomfe, the programme "achieved its objectives as it succeeded in improving computer literacy in public schools and demystify phobias associated with the World Wide Web" (Shologu, 2013, p. 1). The success was not without challenges with deadlines missed and extensions granted on several occasions (Serrao, 2009). In keeping with the developments in technology, in 2014 the GoL programme evolved into a new programme called the e-Learning Solution through which 88 000 tablets were provided to all public schools over two years (The Star, 2013; Shologu, 2013).

The Eastern Cape Province launched the teacher laptop initiative in 2017 which gave teachers laptops and data for teaching purposes (George & Linden, 2017). The initiative targeted the Foundation Phase (Grade R-3) teachers in its first phase. Challenges with lack of training for ICT integration have been reported on the initiative (Macupe, 2017). A comprehensive list of other initiatives at provincial level in South Africa can be found in Blignaut and Howie (2009). Moletsane (2012) questions why marginalised schools continue to be neglected 20 years after the demise of the apartheid regime in South Africa, which is seen generally as the reason for lack of resources and poverty. He recognises that many interventions meant to bring solutions to the plight of the rural marginalised communities ignore the voices of the people they are meant to assist and, as a result, do not make any real difference (Moletsane, 2012). Most projects utilise the top-down approach in their planning, design and implementation with the result that they are imposed on communities. In these cases, such projects or interventions do not succeed. This top-down approach is problematic in rural communities that are characterised by homogeneity, strong relationships, interactions and a sense of communality (Farooq, 2012). However, this was not the case in the two government led top-down projects implemented in the Western Cape and Gauteng provinces as they were both successful.

Public Private Partnerships (PPPs) have been central in the provision of physical access to ICT in marginalised contexts. Kozma (2008) suggests that PPPs are important in ensuring physical and epistemological access to ICTs. The South African White Paper on e-Education of 2004 acknowledges the contribution of PPPs in providing access to ICT, stating that "sources of funding will include the following: private sector donations and support from international development assistance agencies, appropriate public private partnerships to ensure the sustainability of the e-education policy implementation" (DoE, 2004, p. 36). By 2014, the DoE found that of the 162 ICT initiatives implemented in the country, 42% (68) were supported by the private sector while 58% (94) were supported by the public sector (Mnisi, 2014).

2.1.3 Local level

Poverty entails infrastructural challenges that hinder physical access to computers. Many schools in the Eastern Cape Province do not have sufficient access to ICTs. According to the National Education Infrastructure Management System (NEIMS), in 2009 only 10% of ordinary schools (not including private/special schools) had a computer lab in the Eastern Cape (DoE, 2009) where the present study was conducted. The situation has not changed much over the years. In a report to the Portfolio Committee on 20 August 2013, the DBE stated that only 10% of schools in the Eastern Cape Province had computers for teaching and learning (Mweli, 2013). By June 2016 the percentage of schools with computers in the Eastern Cape Province had increased only by 0.82% to 10.82% and by August 2019 the percentage rose by another 1.65% to 12.47% as shown in figure 2.1 below (DBE, 2019).

basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NEIMS
National Education Infrastructure Management System

Computer Centre Summary Report

30/08/19

Site Type: Ordinary Operational Schools

Province Name	Number of Sites(excl micro schools)	With Computer Centre	% With Computer Centre	Without Computer Centre	% Without Computer Centre
Eastern Cape	4 234	528	12.47	3 691	87.18
Free State	852	420	49.3	432	50.7
Gauteng	1 975	1 597	80.86	378	19.14
KwaZulu Natal	5 031	1 837	36.51	3 194	63.49
Limpopo	3 390	549	16.19	2 841	83.81
Mpumalanga	1 518	653	43.02	865	56.98
North West	1 204	589	48.92	615	51.08
Northern Cape	415	255	61.45	160	38.55
Western Cape	1 203	792	65.84	411	34.16
Total	**19 822**	**7 220**	**36.42**	**12 587**	**63.50**

Figure 2.1: Schools with computers per province as at August 2019, NEMIS report (DBE, 2019)

According to Grant (2013), poverty rankings of schools (quintiles) are "determined nationally according to the poverty of the community around the school as well as certain infrastructural factors" (p. 1). Quintile 1 is the poorest while quintile 5 is the richest. In 2016, 71.6% of schools in the Eastern Cape were within the quintile 1-3 ranking (see table 2.1 below). Schools in quintiles 1 to 3 are no-fee paying schools and receive a larger allocation from the National Norms and Standards for school funding than schools in quintiles 4 and 5 (Grant, 2013).

Table 2-1: 2016 National poverty distribution table (Source: DBE, 2016)

National poverty distribution table for 2016					
	National Quintiles				
	1	**2**	**3**	**4**	**5**
EC	**27.3%**	**24.7%**	**19.6%**	**17.0%**	**11.4%**
FC	20.5%	20.9%	22.4%	20.8%	15.4%
GP	14.1%	14.7%	17.9%	21.9%	31.4
KN	22.1%	23.2%	20.2%	18.7%	15.8%
LP	28.2%	24.6%	24.2%	14.9%	8.0%
MP	23.1%	24.1%	21.5%	17.7%	13.5%
NC	21.5%	19.3%	20.7%	21.4%	17.1%
NW	25.6%	22.3%	20.8%	17.6%	13.7%
WC	8.6%	13.3%	18.4%	28.0%	31.7%
SA	20.0%	20.0%	20.0%	20.0%	20.0%

In the Eastern Cape Province, two key projects exist: Siyakhula Living Lab (siyakhulasll.org) and the Cofimvaba Schools Technology Project. Both projects were in response to the challenges of physical and epistemological access to ICT. CSIR Mereka championed ICT for rural education (ICT4RED) initiative in 26 rural schools in Cofimvaba in the Eastern Cape Province between 2012 and 2015 (Herselman, Botha, & Ford, 2014). The project, funded by multiple government departments, focused on providing teachers and learners with tablets and the training of teachers to use these tablets comfortably in their teaching (Herselman et al., 2014). The project aimed to change the way teachers applied technology to their teaching. Throughout this project, researchers learnt that the readiness of all stakeholders - the teachers, the principal, school management teams and the provincial Department of Education - was important in guaranteeing the continued use of ICT in the classroom. Ford (2016) found that the Eastern Cape provincial Education Department was not ready for ICT implementation at the time.

The Siyakhula Living Lab started in 2005 as an initiative of the Telkom Centres of Excellence in Telecommunication at the University of Fort Hare and Rhodes University. Since its inception, the project has provided ICT infrastructure to the Dwesa community (one of the sites for this present study) by setting up computer labs at 17 schools with the support of industry partners and community champions (Gumbo, Terzoli, & Thinyane, 2013). Researchers from both Rhodes and Fort Hare universities, including myself, were involved in computer literacy training for community members similar to the one reported in Ntšekhe, Terzoli, Gumbo and Thinyane (2014). Lessons learnt from this initiative include, but are not limited to, the importance of community involvement and ownership of ICT projects, as well as ensuring sustainability through skills transfer.

2.2 CHALLENGES TO ICT USE IN THE CLASSROOM

A combination of physical and epistemological access to ICT is a precondition for quality use of ICT in education. In this section, I discuss challenges related to access to ICT, epistemological access to ICT as well as professional development for ICT cross-curriculum integration.

2.2.1. Access to ICT

In this section I discuss challenges or obstacles to accessing ICT use in the classroom. These challenges include lack of physical access to ICT hardware and software, limited or no Internet access as well as the lack of skills to utilise ICT equipment.

Physical access to computers or laptops

Physical access refers to the availability of hardware and software. The general lack of ICT infrastructure and devices noted above has partly shaped the kind of research that has been conducted in marginalised schools, which appears to be limited to a few, small-scale studies (Ngololo, 2010). Moreover, there seems to be a tendency to focus on what is easier to investigate, such as barriers to technology use, rather than the actual use of technology in the classroom (Maholwana-Sotashe, 2007); what does not work and why, rather than what works and why (Draper, 2010); or policy intentions by policymakers and project leaders rather than classroom realities (Howie, 2009).

Desktop computers depend on a functioning basic infrastructure such as a stable supply of electricity. In South Africa, the low levels of physical access to computers are due in part to the fact that most marginalised schools have no or inconsistent electricity supply including the deliberate coordinated shutdown of electricity commonly referred to as load shedding (Larson, 2015) or that they do not have decent, secure buildings. For example, there are over 6% (395) mud schools (see Yang, 2015) in the Eastern Cape Province whose buildings are not secure and do not have electricity (Conway-Smith, 2011; DoE, 2013; Skelton, 2013). In addition, ageing or outdated hardware and software are also common in marginalised contexts. Salomon and Ben-Zvi (2006) found that limited use of ICT in schools is due to old, poorly maintained computers, with outdated software. In most instances, this is compounded by the lack of technical support services (to refurbish old computers and carry out maintenance work) and physical security of the computers (Brandt, Terzoli and Hodgkinson-Williams, 2005). Such challenges led to innovative ideas of dealing with the issue of physical access to ICT such as the One Laptop per Child initiative founded in 2005 by Nicholas Negroponte. The initiative provided cheap, durable, low battery laptops to children in developing countries. While commendable and initially taken up by many developing countries, there is no evidence of the success of the project (Cuban, 2001). The project did not achieve its main goal of the founders, of allowing children to engage in their own education, learn, share and create together and there was no real improvement in terms of benchmark tests or other metrics of academic achievement.

In the African context, mobile labs have been used as a way to address some of the challenges associated with desktop computers and traditional computer labs. A mobile lab is constituted by a number of laptops stored and moved from one class or school to another using a trolley or vehicle (Olsen, 1998; Varvel & Harnisch, 2001). It can be used either to complement or make up for ICT infrastructure in schools. Africa provides several examples of the latter case scenario. In Kenya, the *computer lab on wheels* was established in 2009 (ITNews, 2009) followed up by the Craft Silicon Nairobi's solar-powered computer lab on a bus in 2014 (Ruvaga, 2014). A mobile computer lab shared by a group of schools could be a solution to the problem of physical access to and limited budgets for computers in marginalised schools in South Africa (Draper et al., 2008). Some initial positive feedback, such as increased access to ICT, new teaching strategies, as well as increased motivation on the part of learners, were associated with the use of the mobile computer labs (Daly, 2005; Trucano, 2016). As recent as May 2016, the South African Minister of Telecommunications and Postal Services handed over a mobile computer lab, equipped with 21 laptops, through the Telkom connected school's initiative, to a high school in Pretoria (SANews, 2016). In 2016, the Minister of Science and Technology in South Africa gave a similar mobile computer lab in the KwaZulu-Natal Province (DST, 2016). The concept of a mobile lab or computers in general appears to be overshadowed by the impressive uptake of mobile phones in sub-Saharan Africa (BiztechAfrica, 2014).

Internet penetration

As noted by Donner (2008) for most people in marginalised communities, the Internet is mobile-first, mobile-centric and often mobile-only. Although mobile devices provide access to the Internet on an unprecedented scale, it is important to remember that in South Africa mobile Internet poses specific constraints such as high cost of data, low speeds and insufficient connectivity infrastructure or network coverage (O'Hagan, 2013), which greatly affect its potential use for educational purposes. Most smartphone features are not optimised for educational purposes (O'Connell, 2013). South Africa has no policy on mobile learning (Aluko, 2017; O'Hagan, 2013). In most schools in South Africa mobiles for learners remain banned (Ngesi, Landa, Madikiza, Tshotsho, and Cekiso, 2018) mainly because of distraction (Porter et al., 2016) and time wasting in the classrooms (Hawi & Samaha, 2016), cyberbullying (Popovac & Leoschut, 2012), use of sites that are not relevant to school work (Mavhunga, Kibirige, Chigonga, & Ramaboka, 2018) and the possibility of cheating in examinations. In 2015, WhatsApp was used to leak the Life Sciences examination paper to other learners in the Limpopo Province (Themba, 2015). Only recently, the Western Cape Province has provided official guidelines on the use of mobile phones in schools, which schools can adapt if they decide to allow the use of mobile phones in the classroom (Western Cape Government, 2018). In the sites used for the present study, research on mobile phones penetration (Gunzo & Dalvit, 2012) and growth (Dalvit & Gunzo, 2014) have been conducted. Findings from these studies showed that mobile phones were used more frequently than computers. However, mobile phones were mostly used for their multimedia features which are seldom used for educational purposes.

The use of the Internet is still relatively low in South African schools, more so in marginalised ones. Brandt (2006) found that South Africa has an alarmingly low tele-density of sometimes less than 5%. This makes it very difficult to connect schools that have computers to the Internet via fixed lines. Fixed line Internet penetration remained below 10% until 2009, when it climbed to 12.3% in 2010 (ITU, 2010). In 2016, the Internet penetration stood at 52.6% (Internet World

Statistics, 2016). Limited or no access to the Internet is a challenge common in developing contexts. Where access is available, the Internet has challenges embedded in its use. Most schools in a developing context cannot afford the connectivity costs associated with providing fast, reliable Internet connection for all learners. The proliferation of information on the Internet means there is a plurality of sources, with differing views and some with untrustworthy and inappropriate information for children. Nink (2003) found that the majority of teachers (90%, n=24) in a study on the use of the Internet in German classes felt the Internet contained unsafe material for children and exposed children to "uncontrolled, non-scrutinised and even dangerous content" (p. 88). In the present study, the limitations and potential challenges of using the Internet in the classroom were taken into account when shaping interventions and classroom activities.

2.2.2 Epistemological access to ICT

Epistemological access refers to the knowledge and skills needed to use ICT effectively. Rambe and Mawere's (2011) definition of epistemological access to ICT is informed by Morrow's (1993) definition of epistemological access to education. He contend that epistemological access to ICT:

> … gives users of ICT, language and practices of the field, that is, the ability to interpret, analyse, synthesise, manipulate different forms of text (including graphs, pictures and videos) encoded as ICT language to enable students to effectively solve academic problems, questions, issues and debates in their disciplines (p. 7).

Knowledge and skills play a central role in defining access to technology. A user needs to have an understanding of what the technology is and what it does and needs to possess the skills to use it in order to access the technology fully. Computer competence is crucial for the effective use of ICT in the classroom and can be defined as being able to handle a wide range of varying computer applications for various purposes (van Braak, 2004). Teachers need to have the knowledge, ability and skill to use the computer. Peralta and Costa (2007) found that technical competence influenced teachers' use (or lack thereof) of ICT in teaching. If teachers are unable to use relevant software during their teaching, they will not be able to fully utilise the affordances provided by ICT (see Molefe, Lemmer & Smit, 2005).

Teachers who feel they lack computer knowledge and skills that would allow them to make an informed decision often have negative perceptions regarding the use of computers in teaching and most likely decide not to use computers (Al-Oteawi, 2002 as cited in Bordbar, 2010). Jones (2004) notes the direct relationship between teacher computer competence and confidence. Compeau and Higgins (1995 as cited in Gilakjani, 2013, p. 262) define confidence in this case as "the judgement of one's capability to use a computer" and term it 'computer self-efficacy' (see Buabeng-Andoh, 2012, p. 139). Computer self-efficacy has an influence on computer integration in the classroom (Koh & Frick, 2009; Liaw, Haung, & Chen, 2007). Confidence refers to the teacher's perceived likelihood to succeed and how far the teacher perceived the success as being under his/her control (Peralta et al., 2007).

Confidence is an important determinant of whether or not computers will be integrated in teaching. Confidence is built by practice. Most teachers are not ready to integrate technology into their teaching and most of them are not using computers in their classrooms (Draper et al., 2008). In 2009, Blignaut and Howie carried out a study to determine if South African secondary schools were ready to integrate ICTs into the teaching and learning of Mathematics and Science. They discovered that teachers with less confidence in using the computers were unlikely to develop competence in using ICTs for teaching. Sometimes this lack of confidence is due to lack of sufficient training (Acikalin, 2010; Yang, 2008; Bauer & Kenton, 2005) and/or a lack of skills. Lack of skills leads to lack of motivation on the part of the teachers, which hinders the use of computers in their classes (Salomon et al., 2006; Kotrlik & Redmann, 2009; Hennessy et al., 2010; Selwyn, 2011). Confidence is developed through the use of computers over time. Constant access and frequent use of computers is therefore important so that a user is able to practice and in turn become more familiar with and confident using computers.

Besides the skills and knowledge, the users of technology need to attach meaning and relevance to the technology and the information they access through it in order for them to actually use that technology, i.e. content access (Aungamuthu, 2010). Similarly, the design of the technology must be accessible to users, i.e. the ease with which users can operate and interact with the technology is also an important aspect of access to technology (ibid.). Likewise, psychosocial access, which refers to the need to be supported by peers and friends in using technology (ibid.), is crucial. Research has shown the successes of allowing learners, for example, to work with ICT independently and/or with the help of their peers for educational purposes or learning (Dangwal & Kapur, 2009) in projects such as the Hole in the Wall in India (Mitra, 2000) and Digital Doorways in South Africa (Gush, Cambridge, & Smith, 2004). For many speakers of African languages with low English proficiency, ICT is largely inaccessible because there is not enough content in African languages (Maseko, Sam, Dalvit, Nosilela & Terzoli, 2010) and this hinders access.

2.2.3 Professional development for ICT cross-curriculum integration

Availability of and ability to use computers in schools does not translate into their effective use for teaching and learning. While physical and epistemological access to ICT is important, it is not enough. Teachers need to be able to integrate ICT into their teaching for pedagogical purposes. Bates and Poole (2003) state that teachers rarely have formal training on how to use computers in teaching. Teachers also often hold a misconception that basic computer literacy training prepares them for quality ICT pedagogical integration (Ndlovu & Lawrence, 2012). Ndlovu and Lawrence (2012) make reference to a study of ten public schools in South Africa which found that, besides typing lesson plans, activities and tests, the majority of teachers did not use computers for anything else. ICT trainers (e.g. government agencies and private companies) believe that ICT workshops prepare teachers for ICT integration. Gilakjani (2013) notes that traditional workshops are not useful in preparing teachers to integrate computers in their classrooms, yet in South Africa two to seven day workshops on how to integrate computers in teaching are common. According to PanAf (2011) most South African teachers in public schools have attended ICT training sessions which have only given them computer literacy skills and not the requisite skills needed to integrate ICT into their teaching so cross-curriculum integration is limited. Training that is useful for teachers, then, is that which addresses the classroom needs of the teacher. It must be content-focused, collaborative in nature and must pay attention to specific teaching approaches, as well as the computer technology applications teachers can use (Zhao & Frank, 2003; Chen, 2004).

Continuous professional development is critical to achieving valued outcomes in ICT integration (Tondeur, Forkosh-Baruch, Prestrige, Albion and Edirisinghe, 2016). ICT integration is a skill that requires constant practice in order to reach a sufficient level of competence and confidence (Sheingold & Hadley, 1990; Govender, 2012; de Oliveira, Camacho & Gisbert, 2014). In both the in-service ACE-ICT and the in-service BEd-ICT programmes teachers were encouraged to take professional development in ICT as part of their lifelong learning process as advocated by Tondeur et al. (2016). In literature, several ways of conducting effective teacher professional development training that produces successful results have been tested and recorded. For example, Tondeur et al. (2016) found that "constructing professional learning communities around stellar cases carried out by excellent teachers who practice innovative ways of integrating ICT into teaching" is key to diffusing ICT integration. On the other hand, Twining, Raffaghelli, Albion & Knezek, (2003) found that using a model of networked communities of practice that facilitate sharing of experience also helps with teacher professional development in ICT. Teacher design teams are another means through which teacher professional development could be undertaken. Handelzalts (2009) describes a teacher design team as "a group of at least two teachers from the same or related subjects, working together on a regular basis, with the goal to (re)design and enact (a part of) their common curriculum" (p. 7). This teacher design teams concept is the model that was adapted for this study.

In both the in-service ACE-ICT and the in-service BEd-ICT student teachers worked in groups with fellow student teachers who taught in the same grade and the same subject. Research has shown that professional development should be tailored to a subject discipline (Bingimlas, 2009; Hennessy et al., 2010). This allows teachers to deepen their ICT pedagogical skills and share common practices within their discipline. Tondeur et al. (2016) supported the idea that teacher professional learning/development "is driven by the teachers' agency in the process and supported by collegial interactions and inputs from the wider education system" (p. 117). It was anticipated that this group work space would provide an opportunity for teachers to share knowledge, skills, experiences, frustrations and successes from their practice. I also understood that teachers will acquire or enhance ICT integration skills better through learning by doing, collaboration, practical training and discussion (Jimoyiannis, 2010). Collaboration leads to meaningful and effective learning (Putnam & Borko, 2000; Whitcomb, Borko & Liston, 2009). These are the same values that I hoped would lead to the formation of communities of practice within the in-service training programmes. Unlike in Kafyulilo's (2016) study where teachers did not know exactly how to go about collaborating in the design teams, in this study collaboration was closely guided and specified with set deadlines. Student teachers were able to self-organise and set their own deadlines outside the main deadline for the course.

Ndlovu and Lawrence (2012) note that there is a misconception that access to ICT is equivalent to quality use for educational purposes. To many, ICTs must be easily accessible and connected to the Internet and the use of the Internet means taking information as it is for use in the classroom (PanAf, 2011). On the contrary, teachers first need to ensure that they prepare their learners to engage with information in such a way that they can use it constructively to respond to any task they are given, regardless of whether that information is available in book form or through the Internet. Limited use of ICT is disappointing given the multiple possibilities ICT offers for learning (de Oliveira et al., 2014). Ndlovu & Lawrence (2012) concluded in their study that often teachers with limited ICT resources do not maximise the use of the few resources they have at their disposal. They add that teachers' capacity to deal with constraints is what needs to be developed (Ndlovu & Lawrence, 2012). Given that all student teachers in both the in-service ACE-ICT and the in-service BEd-ICT courses were teaching at schools in marginalised contexts, training these teachers on how to utilize/work with few/limited resources was one of the focal areas of the courses. In the in-service ACE-ICT, for example, modelling the use of the mobile computer lab populated with the 12 netbooks was done in order to show students how to group their learners and how to ensure all learners are engaged while working with the few resources.

2.3 THE ROLE OF THE TEACHER

There are several factors that influence teachers' use of ICT in teaching. For the purposes of this study, related factors have been put into three groups, that is factors relating to the personal characteristics of the teacher, the context within which the teacher works and the teachers' perceptions of ICT. Personal characteristics factors include demographic characteristics (Kay, 2006; Wozney, Venkatesh, & Abrami, 2006), teaching experience (Wong & Li, 2008), computer self-efficacy (Koh et al., 2009) and teachers' attitudes and beliefs (Keengwe & Onchwari, 2008). Factors relating to the context include teacher workload (i.e. time constraint) (Abuhmaid, 2011) and technical and leadership support (Tong & Trinidad, 2005; Buabeng-Andoh, 2012). Teachers' perceptions in relation to experience and benefits end this section.

2.3.1 Personal characteristics

In this section I discuss how personal characteristics such as gender, age, teaching experience, subject and grade taught influence teachers' use of ICT in teaching.

Gender

Issues around gender and ICT use have been the object of much attention but results are contradictory. A publication by UNESCO (2013, p. 1) notes that "unequal power relations in our societies contribute to differential access, participation and treatment for males and females vis-à-vis access to, and control of ICTs". Research that explores the differences along gender lines appears inconclusive. Some authors found that female teachers displayed low levels of computer use due to limited access, skills and interest (Volman & van Eck, 2001) and that male teachers used more ICT in their teaching than females (Kay, 2006; Wozney et al., 2006). Others found that female teachers actually applied more ICT in their teaching than male teachers and more female than male teachers used ICT in their teaching (Yukselturk et al., 2009). A third group of researchers found that gender did not influence computer integration in teaching (Norris, Sullivan, Poirit, & Soloway, 2003). Kay (2006) maintains that quality preparation of computer integration has more influence than gender. The South African schooling context is often described as feminised. Crouch (2003) suggests that those employed as teachers in South Africa tend to be females and that the teaching force has 20-25% more females than the rest of the labour force.

Age

Age does not appear to influence ICT integration in the classroom directly. Age differences may be responsible for the differences in ICT skills among teachers. Alazam et al. (2012) found "significant differences of teachers' skills as a function of their age in that younger teachers had higher ICT skills" (p. 74). Similarly, Lau and Sim (2008) report that a teacher's age correlates significantly with ICT skills scores, and that younger teachers have higher levels of ICT skills. In these studies, age was not found to influence ICT integration in the classroom. This is surprising given the correlation between ICT competence, confidence and use noted above in relation to epistemological access. Teachers with less teaching experience – who in most cases can be assumed to be younger – have been found to integrate computers more easily than more experienced teachers (Baek, Jong, & Kim, 2008). Changes to practice may be difficult for a teacher who has been teaching without ICT for a long time and who is new to ICT use in the classroom (Prensky, 2001).

Experience

By contrast, research conducted by Russell, Bebell, O'Dwyer and O'Conner (2003) showed that teachers with comparatively little experience tended to focus more on learning how to teach, becoming familiar with the curriculum and managing the classroom, so they did not have time to integrate computers in their teaching. Depending on the training the teacher receives, teachers spend most of their time in their early years of teaching, learning how to use ICT rather than how to integrate ICT into their teaching (Russell et al., 2003). Experienced teachers "having already mastered aspects such as classroom management and lesson planning are more likely to integrate computers into their teaching" (Buabeng-Andoh, 2012, p. 141). While there is strong evidence that integration of computers in the classroom is linked to teaching experience, in that teachers with more teaching experience are likely to integrate ICT in their classroom, actual use appears to depend on ICT training and skills and not on teaching experience (Hernandez-Ramos, 2005; Giordano, 2007; Russell, O'Dwyer, Bebbell, & Tao, 2007; Wong et al., 2008).

Subject taught

Some subjects are more compatible with ICT than others (Zhao et al., 2003). For example, Science was one of the first subjects in which technology was integrated. Science teachers have benefitted from this long engagement with ICT which is seen in how comfortable science teachers are with ICT (John & Baggott La Velle, 2004). Social Sciences teachers have been reluctant to embrace ICT in their lessons for fear of compromising the humanistic nature of their subject (Zubkovic, Pahljina-Reinic, & Kolic-Vehovec, 2017). A survey of schools on ICT in education conducted by the European Schoolnet in 2014 showed that frequency of ICT use was dependent on subject (European Schoolnet, 2014). The survey showed that Social Sciences teachers used ICT more frequently than teachers of any other subject while Science teachers were more confident in their skills than teachers of any other subject and Social Sciences teachers had the lowest level of ICT efficacy and the least frequent use of ICT in teaching. Although Social Sciences teachers have been slow in adopting ICT (Van Fossen & Waterson, 2008), there is a gradual interest in using ICT in Social Sciences classrooms (Karaseva, Pruulmann-Vengerfeldy, & Siibak, 2013). Hong (2016) found that Social Sciences teachers enjoyed working with computers and recognised the need to use ICT to make Social Sciences appealing to students since Social Sciences is perceived as boring.

As the Internet grew, computers became more commonly used in Social Sciences classrooms (Whitworth & Berson, 2003). The South African government acknowledges this in the curriculum document for Social Sciences, stating:

> "It is important to bring the world into the Social Sciences classroom. Visual resources can make information more accessible to many learners. Teachers should therefore, try to use the Internet wherever possible. Many organisations and projects provide useful information through the Internet. Google Earth, for example, provides extensive aerial photographs. You-tube provides videos of many historical events" (DBE, 2011 p. 9).

The common uses for ICT are information gathering and lesson planning by the teachers rather than for teaching and learning activities in the classroom (Van Fossen, 2001). Computers are commonly used to "support learning through reducing time spent on mechanical tasks such as rewriting, helping find information, helping to organize information, making it easier to share information and ideas with others" (McPherson, 2001, p. 2). Often, multimedia, drill and practice for learning history facts and geographic names (Pye & Sullivan, 2001), web-based activities such as WebQuests, Cyberhunts, online quizzes (Acikalin & Duru, 2005; Friedman, 2014) and digital games and historical simulations (Lee & Probert, 2010) are used in Social Sciences classrooms.

Grade taught

In terms of the grade that the teachers teach, research is available on the attitudes, perceptions and experiences of primary school teachers (Tondeur, Hermans, van Braak, & Valcke, 2008; Lufungulo, 2015) and secondary school teachers (Olofsson, Lindberg, Fransson, & Hauge, 2011; Mukhari, 2016; Ekberg & Gao, 2018). Lufungulo (2015) found that primary school teachers had positive attitudes towards ICT integration and perceived ICT as useful in education. Similarly, Tondeur et al. (2008) found that primary school teachers were receptive to ICT integration. Debates continue on the use of ICT in primary school classrooms. Research has shown both positive and negative impacts of exposing young children to ICT resources

(Aston, 2016). Supporters of ICT in primary classrooms argue that children in primary schools have unlimited access to ICT and the Internet at home and have skills to use these devices. They claim that the use of ICT in primary classrooms will ensure that there is no disconnect between home and school and that school will equip children with the requisite skills needed in this digital area (The Room 241, 2018). Opponents of ICT in primary schools note the potential negative impacts of ICT in the classroom, such as ICT being a distraction, exposure to inappropriate material and cyberbullying (The Room 241, 2018). In some cases, teachers focus on exposing children to ICT but do not integrate it in their classrooms. For example, Pallitt (2009) conducted a study on the use of email at a school in Cape Town with Grade 5 learners. Email was not assessed or considered schoolwork; as such, it was very seldom used, and teachers considered it a marginal activity.

In general, clear and focused goals, well-aligned learning outcomes and activities, collaborative efforts, and shared goals among teachers are reliable predictors of successfully integrating ICT in education (Mercer, Hennessy, & Warwick, 2010). Teachers must constantly ask themselves "how can the computer be used to assist and improve teaching a specific subject?" (Cockcroft, 1982, p. 374). Teachers ought to plan carefully what they are going to use the computers for and at what point of the lesson, and know the expected outcome (Eady & Lockyer, 2013). Whyburn and Way (2012) reinforce the idea that, unless teachers carefully plan their lessons and teaching approaches with technology in lessons, there would be a negative impact on the achievement of deeper understanding of the concepts taught.

Personal commitment is required for successful cross curriculum integration to take place. Teachers gain more experience of using computers in the classroom and change their whole experience of teaching with computers with constant effort and practice. Sheingold et al. (1990)

found that teachers were getting comfortable in using computers by devoting personal time to learning how to use ICT. De Oliveira (2014) talks of effort on the part of the teacher which is necessary for the successful use of ICT in the classroom. Similarly, Thomas, Tyrrel and Bullock (1996) report on a study conducted in New Zealand on the use of computers in the mathematics classroom. They found that putting computers in the classroom was unlikely to result in changes in teaching or learning in the classroom unless the personal philosophy of the classroom practice held by the teacher underwent major transformation.

2.3.2 Context

The South African government sees teachers as “mediators of learning, interpreters and designers of learning programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area/phase specialists” (DoE, 2004, p. 4). This statement highlights one of the challenges in the South African education system, that of an overloaded teacher who has no time to commit to the core of his/her duties – that is teaching. Hayes (2007) found that teachers’ success in integrating ICT was highly dependent on the availability of time to think deeply about pedagogical practices, develop learning programmes, collaborate with colleagues and try new approaches to teaching in a supportive environment, but South African teachers do not seem to have time to plan and implement the use of computers in their teaching. In the district of Ethekwini in KwaZulu-Natal (KZN), Govender (2012) found that the main challenge perceived by teachers was “the mismatch between ICT and class time frames of the existing curricular” (p. 565). Teachers felt they did not have enough time to prepare, plan and practice with technology before they could teach with it. In a study by Abuhmaid (2011), a teacher noted that “teachers are overloaded to learn, prepare and practice what they learn” (p. 12).

Initial experiences in cross-curriculum ICT implementation need to be understood as an investment for student teachers to gain experience and prepare material. Cassim and Obono (2011) stress that teachers perceive computers as reducing time spent on lesson preparation in the long run as lessons are saved for future use. Efforts are being made with the latest Curriculum and Assessment Policy Statement (CAPS) to alleviate the administrative duties on the teacher (DBE, 2013). Govender (2012) argues that policy makers should provide teachers with extra planning time for them to familiarise themselves with technology by reducing their workload.

Teacher workload

Teacher workload influences the teachers' decision to use/not use computers in their classrooms. A heavy workload is often coupled with teacher shortages (SAPA, 2014) and sometimes unequal distribution of teachers in schools. This is particularly evident in rural areas because of the difficulty of attracting and retaining skilled personnel in these areas. In 2014, the Minister of Basic Education was quoted saying she had given a directive to the Eastern Cape Province to fill over 3000 vacant posts by the end of 2014 (SAPA, 2014). In some cases, teachers are required to teach more than one subject sometimes in different grades as well as do multi-grade teaching (Ramatlakana, 2013). Teaching with technology requires more work in learning new skills and a continuous search for sustainable strategies, which then contribute to the increased teacher workload (Samarawickrema & Stacey, 2007).

Support

In marginalised schools, a generally unsupportive environment exacerbates time pressures. Hoadley (2012) suggests that "the issue of time is especially pressing when one considers the implication on learners coming from low income households. Because there is, in general, less learning and less support for learning in these homes, the school, as a site for learning, becomes more crucial, and more time is required for these children to master the curriculum" (p. 193). The introduction of ICT can either compound or alleviate such challenges, depending on how it is done as well as the level of support it enjoys. Teachers depend on the leadership support available at their schools for direction (Buabeng-Andoh, 2012). With leadership that supports the use of ICT in teaching, the vision of the school and resources will be directed towards the infrastructure and maintenance of ICT resources (Yee, 2000). Equally important is technical support. In Dutywa district, there is only one IT technician for the whole district. This technician services 343 schools in the district as well as the district offices [Mbete, 2015, Personal communication]. Most schools are sparsely located and this poses logistical challenges for the one technician in the district. Tong et al. (2005) state that lack of technical support results in frequent breakdowns of equipment which causes frustration for teachers and may lead to reluctance in using computers for fear of equipment failure. When there is no technical support in schools, research has shown that teachers lose time attending to problems with equipment (Korte & Husing, 2007). In some schools, school management decides to prevent teachers from using computers because of lack of technical support (Katulo, 2010). The rationale appears to be that if computers are not used then the equipment will not need maintenance or repairs. Mutual support among learners and between teachers and learners can influence the experience of teaching and learning with computers.

2.3.3 Teachers' perceptions

Positive attitudes may lead to a decision to use ICT in the classroom. In a study of Taiwanese teachers' perspective of the factors that influenced technology integration in their teaching, ChanLin et al. (2006) found that environmental (hardware and software), personal (teachers' personality, experiences and beliefs), social (support) and curricular (curricular objectives) issues shaped the teachers' perceptions about technology use. Teacher attitudes and beliefs influence successful computer integration (Keengwe et al., 2008). Even in contexts where there is limited access to ICT tools, positive attitudes have led to successful integration. For instance, Demirci (2009) found that teachers from schools that lacked hardware and software in Turkey had positive attitudes towards geographic information systems (GIS) and that resulted in the successful integration of GIS into geography classrooms. Cassim et al. (2011) found that ICT awareness, positive attitudes and perceptions contributed to the decision to use ICT for teaching. A teacher who believes that computers play a major role in the learning of children, that they have an impact on their future and that learners must be familiar and able to use computers, is more likely to make an effort to expose learners to ICT.

The relationship between experience and attitudes is controversial. Tondeur et al. (2008) conducted a study that analysed the relationship between the teachers' educational beliefs and the approach to computer use in the classroom and found a strong relationship between the two. While some research supports the notion that experience, among other things, has an effect on the attitudes and perceptions of users towards computers, Tilfarlioglu et al. (2006) found that experience had no considerable correlation with teachers' attitudes towards computers. Once given the chance to use computers, studies have shown changes in attitudes based on the experience. Similarly, Schofield (1995) noted some changes in students' behaviour, especially an increase in motivation once the students had had a chance to use computers. Schofield (1995, pp. 36-58) noted an "increased sense of competition and personal challenge, increased enjoyment, increased ability to express negative effect and decreased fear of embarrassment" as factors leading to increased motivation.

Many teachers "are not convinced of the usefulness of computers in their teaching" (Manoucherhri, 1999, p. 37) and still express the feeling that the benefits are small and exaggerated (Balanskat, Blamire and Kefala, 2006). Thomas (2006) notes that "teachers have a crucial role to play in the use of technology in the classroom and their beliefs and attitudes are major elements in the progress in computer use" (p. 271). He found, however, that teachers felt that technology (including computers) in classrooms was overrated, claims of benefits in education were often overstated, that learners relied on technology too much instead of understanding the content and that learning was not significantly enhanced by the use of technology. When a teacher does not recognise the value computers add to their work and the learning process, it is unlikely that that teacher would use computers in his or her classroom. Thomas (2006) concludes that the teacher's transition to positive views of computer use in the classroom needs to develop from the teacher's experiences of using computers.

Researchers have found little evidence of a relationship between the use of ICT for teaching and learning and academic performance (Leuven, Lundahl, Oosterbeek & Webbink, 2004; Shi & Bichelmeyer, 2007; Gibson, 2001; OECD, 2015). Student and teacher characteristics as well as the education environment are strong determinants of academic performance (Youssef & Dahmani, 2008). Factors such as the purpose for which computers are used, the specific hardware and software chosen to achieve this, the ratio of students to computers and the physical location of the computers (classroom vs. computer lab) all seem likely to influence academic outcomes profoundly (Schofield, 1995). Hartley and Treagust (2006) conducted a study that explored Grade 12 learners' perceptions of the use of computers in a physical science classroom in a rural school in the Western Cape province of South Africa and found that learners thought computers were improving their learning. In the present study I focused on teachers' subjective understanding of success in ICT use rather than its objective impact on academic performance. Perceptions such as this are exacerbated by the lack of empirical evidence of a strong relationship between computers and improved academic performance

(Leuven et al., 2004). Education is a performance-based field and success is based on academic performance measured in various ways.

2.4 TYPOLOGIES OF BARRIERS TO ICT INTEGRATION

In this section, I discuss different typologies for the barriers to ICT integration as they are discussed in literature. Despite the different names used by different researchers, there is consensus on the barriers and the manner in which they influence ICT integration in the classroom. I outline the first and second order typology proposed by Ertmer (1999); the third order barriers suggested by Tsai and Chai (2012); the micro, meso, exo and macro classification put forward by Kirkland and Sutch (2009); the teacher-level and school-level category of barriers by Bingimlas (2005) and the system-level barriers as articulated by Balanskat et al. (2006).

2.4.1 First and second order barriers

Ertmer (1999) uses the typology of first order (external to self/extrinsic) and second order (internal to self) barriers. First order barriers include lack of access to computer hardware and software, insufficient time to plan instruction, inadequate technical and administrative support and well as limited or no training. The majority of early integration efforts focused on these first order barriers (Fisher, Dwyer & Yocam, 1996) with an underlying assumption that once adequate resources were obtained, integration would follow (Ertmer, 1999). An additional assumption was attached to these first order barriers, that is, the implementation process could not begin until all the necessary resources were in place (Kerr, 1996). These barriers are easy to measure and eliminate by providing additional funding, resources and training.

The second order barriers, however, are not easily identifiable or measurable as these are internal/intrinsic to the teacher. These sets of barriers are thought to cause more difficulties for integration than first order barriers (Dede, 1998) probably because “they are less tangible, more personal and more deeply ingrained” (Ertmer, 1999, p. 52). Barriers include beliefs about teaching, beliefs about computers, established classroom practices and unwillingness to change. These barriers can be identified through the reasons teachers give when they voice their frustration with the first order barriers. Second order barriers can reduce or magnify the effects of the first order barriers on technology integration (Ertmer et al., 1999; Miller & Oslon, 1994). Second order barriers can be eliminated by challenging belief systems and institutionalised routines.

Ertmer (1999) asserts that “Brickner (1995) extended the concept of 1st and 2nd order change to categorise obstacles as 1st and 2nd order barriers to change” (p.48). As such, first order changes “adjust” current practice in incremental fashion making it more effective or efficient, while leaving underlying beliefs unchallenged. The second order barriers to change confront fundamental beliefs about current practice thus leading to new goals, structures or roles.

2.4.2 Third order barriers

Tsai et al. (2012) proposed a third order of barriers which they view as having capabilities of tackling the Ertmer’s (1999) 1st and 2nd order barriers of Ertmer. Their 3rd order barriers are known as the lack of design thinking and disposition. A design mindset is not problem-focused; it’s solution-focused and action-oriented and involves both analysis and imagination. Design thinking draws on logic, imagination, intuition and systematic reasoning to explore the possibilities of what could be and to create desired outcomes that benefit the end user (Naiman, 2019). Liedtka (2018) asserts that design thinking unleashes people’s full creative energies, wins their commitment and radically improves processes. Design thinking is the best tool for sense-making, meaning making, simplifying processes and improving experiences – it minimizes risk and reduces costs. According to Tsai et al. (2012), design thinking seeks to change and improve current situations and create what is desired. They contend that design thinking has capabilities of tackling both first and second order barriers as it treats all barriers as problems that need to be tackled and resolved through human creative thinking. For example, with regards to a first order challenge of limited physical access to computers, careful design thinking can solve computer lab clashes and booking procedures. Additionally, insightful design of teacher education programmes can be used to tackle teachers' beliefs about ICT and teaching to produce the necessary shift in pedagogy. Tsai et al. (2012) state that once third order barriers are resolved, teachers will start using ICT at the right time and in the right place.

2.4.3 Layers of influence model

Kirkland et al. (2009) viewed the practice of creating solutions to individual problems on an individual level as an act of innovation. They believed that learning from the individual acts of innovation and wider system level innovation could be supported by encouraging more local level individual innovators. The school can be viewed as a complex set of interrelationships and so barriers/resistance to innovations must be investigated at the range of levels (Thomson, 2007). Kirkland et al. (2009) supported the idea of sorting barriers through the development of overarching themes that bring together related groups of resistance. However, Zhao et al. (2003, p. 810) are of the opinion that this approach helped the research community "to come up with a list of what 'barriers are' but we are short on how [they operate and can be changed". In order to understand how these themes interrelate and interact, Kirkland et al. (2009) took the emerging overarching themes and viewed these atop a range of layers of influence to cover the barriers highlighted instead of grouping them as is common in literature.

Drawing on Bronfenbrenner's Ecological Systems theory (1989) and Groff and Mouza's (2008) identification of critical factors affecting school change, Kirkland et al. (2009, pp. 3-4) identified four core layers and mapped out their influence in the layers of influence model. The four layers are:

- Innovation – these are factors associated with the innovation itself.
- Micro layer – influence directly, relevant to the innovator themselves and related highly to personal relationships, e.g. teachers with their students or colleagues.
- Messo layer – local level influences, e.g. school culture, the school management teams, school infrastructure as well as the wider community and local authorities.
- Macro layer – government led initiatives, national policy and national curricula and wider research.

2.4.4 Teacher-level and school-level barriers

Bingimlas (2005) and Balanskat et al. (2006) categorised barriers to ICT integration into teacher-level and school-level barriers although these differed in meaning. Within the teacher-level barriers, Balanskat et al. (2006) discussed the lack of ICT skills, lack of motivation and confidence in using ICT and inappropriate teacher training, while Bingimlas (2009) included lack of confidence, lack of competence, resistance to change and negative attitudes. The school-level barriers according to Balanskat et al. (2006) include the absence and poor quality of ICT infrastructure which encompasses the absence of technology or the lack of high quality hardware and suitable education software as well as the lack of access to ICT equipment. Balanskat et al. (2006) also added the school's limited project-related experience as a barrier to ICT integration, noting that often the inability of schools to plan, implement and manage development projects and follow up on them leads to non-implementation. In comparison, Bingimlas (2009) referred to lack of time (particularly for teachers to plan for ICT integrated lessons or explore the different websites on the Internet); lack of effective training for teachers, lack of accessibility to ICT resources and the lack of technical support.

2.4.5 System-level barriers

Balanskat et al. (2006) added another level to the teacher-level and school-level barriers, the system-level barriers. System-level barriers refer to barriers related to the wider education context. Balanskat et al. (2006) discuss the rigid structure of the schooling system as a hindrance to ICT integration. They note that the curricula in schools is often restrictive. They also referred to the current assessment methods which are traditional in that they "focus on content and neglect social and other abilities or competencies of learners…even though these are important for the society" (p. 53).

2.5 SUMMARY

In this chapter, I presented some literature related to ICT integration in the classroom. I started with a discussion of the projects and policies in South Africa and looked at the national, provincial and local levels. The policy framework provided a backdrop to how ICT is integrated in teaching in South Africa. Lack and/or limited physical and epistemological access to ICT remain real challenges in marginalised contexts in South Africa, which affects cross-curriculum integration of ICT. I also discussed the role of the teacher, arguing that individual characteristics of the teacher, the context in which they work and their perceptions towards ICT in education influence whether or not ICT is used in the classroom. In the final section of the chapter, I presented five typologies of barriers to ICT integration as outlined in literature.

CHAPTER THREE: UNDERSTANDING THE USE OF COMPUTERS IN THE CLASSROOM

In this chapter, I discuss the theoretical framework of my research. I draw on theories commonly used across various fields, ranging from information systems to education. The chapter covers a discussion of the role of ICT in teaching and learning and theories that focus on ICT acceptance to adoption.

3.1 THE ROLE OF ICT IN TEACHING AND LEARNING

In this section, I discuss the role of ICT in teaching and learning. I start by looking at the various education theories that underpin the integration of ICT in teaching and learning. This is followed by a discussion of ICT as a teaching and learning tool. This section ends with a discussion of ICT and its role in the mediation of teaching and learning.

3.1.1 Teaching/ learning theories and ICT cross-curriculum integration

Cross-curriculum ICT integration can be understood in behaviourist, cognitive or constructivist terms.

Behaviourist learning theory

Behaviourist learning theories focus on "the external events as the cause of changes in observable behaviour" (McInerney & McInerney, 2002, p. 126). Learners are considered passive recipients of information which may lead to rote learning. A focus on behavioural outcomes of learning rather than knowledge is a common challenge when ICT is involved in the learning process. Early work on ICT in education can be summed up by the work of one behaviourist theorist, B. F. Skinner, with the teaching machine constructed in 1958. The machine was a rote-and-drill machine which could be generalised and described as the root of behaviourism (Weegar & Pacis, 2012). A generalised behaviourist assumption amongst teachers that learners can learn from computers prompted Jonassen (2000) to remark that:

> Students do not learn from computers or teachers – this has been a dominant traditional assumption of most schooling - rather, students learn from thinking in meaningful ways, and thinking is engaged by activities, which can be fostered by computers or the teacher (p. 4).

ICTs on their own cannot make learners learn; instead focus should be on strengthening the real ways in which learners learn such as critical thinking and good qualified teachers who can engage learners in the classroom.

Cognitive learning theory

Cognitive learning theories are based on "the activities that take place within an individual's mind – learners' cognitive activity" (Dalgarno, 2001, p. 184). Computers make it easy to incorporate active learning activities in teaching. Sargeant (1997) elaborates on these active learning activities by explaining that it is easier to use ICT in teaching when teachers and students are involved in developing materials. Teachers have the power to ensure that learners use computers meaningfully for learning provided they foster the importance of critical thinking prior to the use of computers in the classroom. The effect of computers on teaching and learning is understood to "depend to a large extent on the social and educational context within which computers are embedded" (Sheingold, Kane, & Enderweit, 1983, p. 431).

Constructivist learning theory

According to the constructivist perspective, learning can take place when ICTs are used as a cognitive tool (Jonassen & Reeves, 1996; Hokanson et al., 2000; Hodgkinson-Williams, 2006). Learners actively construct their own knowledge rather than receive preformed information transmitted by others. In order for this to happen, curriculum emphasis, classroom dynamics and classroom interactions must change in major ways (Schlechty, 1990 as cited in Green & Gredler, 2002). Constructivist learning takes place when learning environments are provided that offer maximum learner control and learning opportunities that are meaningful to the learners, allowing learners to be more active in their construction of mental representations of phenomena (McCombs, 2000). Learning is the result of constructed meaning, what a student brings cognitively to the learning environment is very important as it will determine what and how knowledge is constructed by the learner (Winn, 2003). A basic tenet of constructivism is that any idea developed or discovered by the learner is valid. Learning is a social active process, where the focus shifts from teacher-directed to student-directed learning. Tasks should support critical thinking and flexibility with respect to learning opportunities and individual differences. Becker (1998) found that the longer a teacher uses computers in teaching the more constructivist-oriented changes in pedagogy and perceptions can be seen.

Over the years, the gradual change in the teachers' role towards becoming a facilitator in the classroom can be seen (Schofield, 1995; Rogers, 2017). With the introduction of ICT in the classroom, students work well in groups and by themselves and need little or no guidance from the teacher to complete tasks (Starr, 2000). This leads to a change in the content and context of the help given by the teacher. Students' demands change as they require a different kind of attention and help – the type a teacher does not always give. As the teacher's role shifts to facilitator, so do the strategies of classroom management and it is imperative for the teacher to be aware and prepared for this change. However, the potential shift from teacher to learner-centred learning is largely dependent on how technology is used by both the teachers and learners in the classroom (Lowerison, Slater, Schmid, & Abrami, 2006).

3.1.2 ICT as a teaching and learning tool

The learning theory underpinning a teacher's approach is reflected in a particular use of ICT as a productivity, representational, instructional, information-gathering, cognitive and mediation tool. While the first five uses are briefly discussed, the focus of the present study is on the latter.

ICT as productivity tools

Teachers use ICT as productivity tools, e.g. to create a document for project-based teaching. Word processing can be used to prepare lesson plans and spreadsheet to capture class marks. Computers have the potential of making data retrieval precise, speedy and accurate, sifting relevant data from irrelevant and turning data into information (McPherson, 2001). Teachers often employ ICT as a productivity tool during planning and lesson preparation rather than during teaching in the classroom. Acikalin et al. (2005) found that teachers used ICT for lesson plans, creating worksheets, writing reports and keeping records.

ICT as representational tools

Teachers may use ICT as a representational tool "merely to represent information in another medium – not to generate or construct new information" (Wilson-Strydom, Thomson and Hodgkinson-Williams, 2006). As an example, teachers may use PowerPoint to present their lessons instead of writing on the chalkboard. Ndlovu and Lawrence (2012) found that teachers held the misconception that the representational use of ICT for teaching is equivalent to a quality use of ICT meant to improve learner performance. However, as a representational tool, ICT is not necessarily teacher-centred. Students can also use PowerPoint to present their work.

ICT as instructional tools

ICT can be used as instructional tools to facilitate the delivery of content. Teachers need to ask important questions like, "how best can I reach my goal and with what kind of technology" (Debele & Plevyak, 2012, p. 286) in order to meet the objective of the lesson. Teachers ought to have clear learning outcomes in mind before the start of the lesson – clearly outlined goals help in directing the lesson. For instance, Molefe et al. (2005) conducted a study that aimed to compare the effectiveness of computer-based demonstrations with conventional demonstrations when teaching Kinematics concepts in a Grade 11 class in the rural North West Province in South Africa. In both experiments the motion of a trolley on a runway was represented graphically through manually plotted graphs and through software, Vernier, which displayed graphs on the screen in real time. The report of the study showed how the teacher had to meticulously plan for the lesson and infuse computers with the conventional method of measuring the motion of the trolley. Although the findings highlighted that both methods were equally effective as they recorded the same average gains the ticker timer was more successful in establishing basic concepts and skills while Vernier established higher-level outcomes. The instructional use of ICT leverages the multimedia features and requires higher levels of confidence and ICT proficiency compared to productivity and representational uses.

ICT as information-gathering tools

The use of ICT as an information-gathering tool often implies access to the Internet. The following quote by McPherson (2001, p. 2) explains how the Internet can be used effectively in the classroom:

> When the web is used simply as a source of material/information that can be downloaded and pasted, without thought, then it is of no value. But when the learner searches the web, evaluates the information and is able to sift relevant from irrelevant information, uses that to construct a knowledge base, to develop meaning, then yes, it is a valuable resource.

The use of ICT as an information-gathering tool requires critical understanding and evaluation on the part of the teachers as well as the learners.

ICT as cognitive tools

When used as a cognitive tool (also called mind tools) ICT promotes the development of higher cognitive processes. For Jonassen et al. (1996) cognitive tools refer to the role of ICTs in enhancing the learners' cognitive powers during thinking, problem-solving and learning. McPherson (2001) talks of the true value of computers being seen by teachers not only as a presentation tool (making work attractive), a productivity tool (producing work more quickly) or an information-gathering tool (accessing the Web) but as a cognitive tool, which helps learners think. For example, teachers can design WebQuest or Cyberhunt activities "to support learners thinking at the levels of analysis, synthesis and evaluation" (Starr, 2000, p. 1).

ICT as mediation tools

Tool mediation is a term coined by Lev Vygotsky (1978) who suggested that the primary tool of activities represented in signs and symbols, acted as agents for and subsequently provided definitions for culture and served as intervening links to consciousness. These tools are described as "anything that mediates a person's action upon an object" (Russell, 2002, p. 70). In Engestrom's (1987) activity theory, tools shape the way humans interact with the environment as well as how they learn. The use of ICT as a mediation tool relates to how technology re-organises interactions between human and technological agencies and changes the way that knowledge is produced, shared and tested.

Metaphors for ICT use

As noted by Goos, Galbraith, Renshaw and Geiger (2003), ICT in the classroom can be viewed by teachers in terms of four metaphors. As a servant, it is used as a fast, reliable replacement for mental work, but the tasks of the classroom remain unchanged (Goos et al., 2003). From the teacher's perspective, technology is a servant if it simply supports teaching methods, e.g. if the overhead projection panel is used as an electronic chalkboard, providing a medium for the teacher to demonstrate calculator operations to the class. Several studies have found that computers are often used only as an extension of the chalkboard (Yazon, Mayer-Smith, & Redfield, 2002) or for drill-and-practice (Roblyer, 2003). When technology is treated as master, teachers may become subservient to the technology if their knowledge and usage are limited to a narrow range of operations over which they have technical competence. According to Grasha and Tangarber-Hicks (2000), many teachers use technology simply to try it out and do not consider why they are using technology in their classes. One has to have an 'aim' - not mere ICT use for the sake of using it.

Technology as an extension of self is the most sophisticated mode of functioning. This involves users incorporating technological expertise as a natural part of their pedagogical repertoire. From the teacher's perspective this may involve creating courseware to support an integrated teaching programme. Technology becomes a partner only when computers are used creatively to increase the power students exercise over their learning, e.g. by providing access to new kinds of tasks or new ways of approaching existing tasks, using technology to facilitate understanding or to explore different perspectives. Technology may act as a partner by mediating classroom discussion with learner presenters leading the dialogue. In small group interactions, technology may also promote peer discussion as students cluster together to compare their screens – some students might develop a distinct rapport with technology, e.g.

instead of functioning as a transmitter of teacher input, the overhead projection can become a medium for students to present and examine alternative ideas (Goos et al., 2003).

3.1.3 ICT and the mediation of teaching and learning

Roschelle (1996) defines mediation as something that acts in the middle or between learning. Mediating tools are nodes of participation, thinking, and negation (DeGennaro, 2010), where students begin to try out and interact with ideas. Vygotsky (1978), through his socio-cultural learning theory, views tools as mediating engagement with teaching and learning as well as with each other. The tools that mediate learning become central to how people perceive and experience learning and, as Roschelle (1996) states, tools (physical and symbolic) shape human experience of the world.

I draw on the Activity theory in order to understand the context within which ICT mediates teaching and learning. Activity theory is an approach that aims to understand individual human beings in their natural, daily circumstances through analysing the genesis, structure and process of their activities. It has three generations that have evolved over time. Activity theory is based on the founding principles and ideas of Vygotsky's framework for analysing relationships between human actions and cultural artefacts (1978). The first generation activity theory focuses on Vygotsky's notion of mediation, which shows a direct connection between a stimulus and a response transcended by a complex mediated act (Engeström, 2001). The mediated action is the unit of analysis. Vygotsky (1981) proposed that the relationship between individuals and their environment is mediated by physical tools (e.g. computers), symbolic tools (e.g. language) and cultural means. I consider two forms of mediation identified by Vygotsky (1978), the teacher as a mediator and mediation through dialoguing with the other. Vygotsky (1978) notes the contribution of speaking to others for effective learning to take place. The use of computers in the classroom and the experience of the teacher depends on how the teacher mediates learning using the computer. The views and beliefs of the teacher, and to a lesser extent of the learners, (as they had limited agency in determining the use of the mobile computer lab), mediate the way in which the potential of the mobile computer lab was realised. This study therefore focuses on the mediating nature of tool use to frame the analysis.

Three main contributing elements in the 1st generation activity theory are the tools used, the individual using them and the objective of the activity, which lead to a specific outcome (see figure 3.1 below).

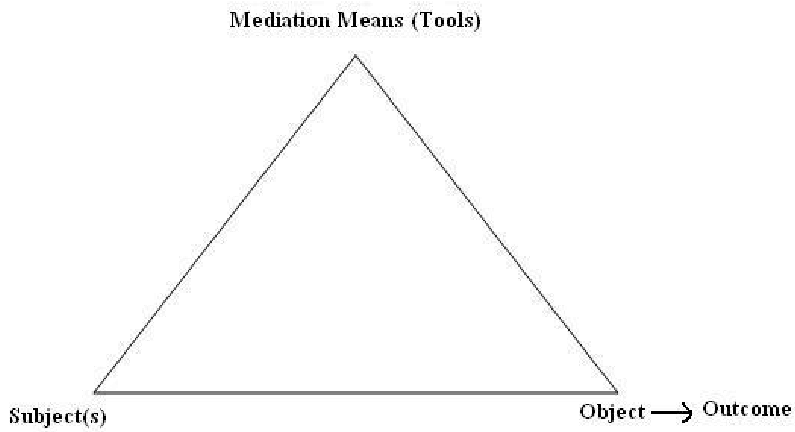

Figure 3-1: Leontiev's Activity model (Engestrom, 1999, p. 30)

Second generation activity theory is based on the work of Leontiev (1978), who developed his theory in reaction to the doctrine that knowledge derives from experience and conceptualises human beings as both passive and reactive (see Kozulin, 1986). Leontiev (1978) meant to address the Cartesian split between the individual and societal structure through a focus on activity by developing further the work of Vygotsky (1978). For Leontiev, goals and motives are the driving force for activity and result in the transforming of an object into an outcome

(Kuutti, 1996). Attwell et al. (2010) view the second generation activity theory as one that contextualises the interaction between humans and computers and brings interrelations between the individual and his/her community into focus. In the present study, the tools used include the netbooks, laptops and data projectors. The teacher is the subject while the objective is teaching a Social Sciences lesson.

Second generation activity theory portrays the interrelationships between the subject, object and mediating tools, set in the social context of rules, community and division of labour, which are socio-historical aspects of mediation omitted by Vygotsky (Engeström, 1999 as cited in Yamagata-Lynch, 2003). Most activities are realised in specific contexts, which determine, largely, conditions surrounding the actions or the activity, for example, the availability of ICT tools. Second generation activity theory focuses on human activity in its relevant environment/context (Jonassen & Rohrer-Murphy, 1999). The 2nd generation activity theory complements the three activity elements identified above, i.e. tools (ICT), subject (teacher), and object (teaching) within collaboration with others - community (teachers and learners). The structure of the activity is constrained by cultural factors including conventions - rules (class/school rules) and social strata - division of labour (among teachers and learners) within the context (classroom) (Ryder, 1998), as shown in Figure 3.2 below:

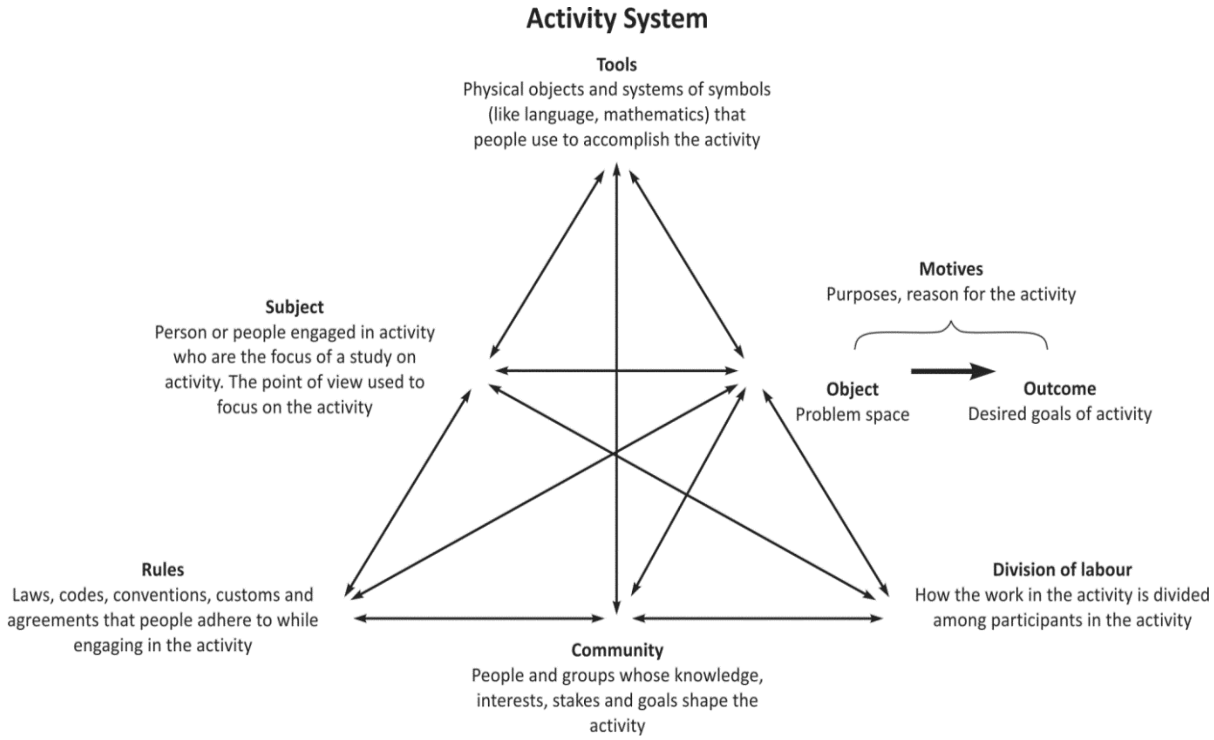

Figure 3-2: A model of Human Activity proposed by Leontiev (Source: Engeström, 2001 p.135)

Engeström (2001) developed a third generation activity theory also referred to in literature as Cultural Historical Activity Theory (CHAT). Its unit of analysis is the interaction between two or more systems of the second generation type. One of the strengths of CHAT is that it offers a broad lens of inquiry that encompasses various aspects of the educational setting such as students' and teachers' backgrounds and perspectives as illustrated by Murphy and Rodriguez-Manzanares (2008). Engeström (2001) outlines five main principles of activity theory that make it possible to analyse various aspects of the educational setting. The first of these principles is that "a collective, artefact-mediated, and object-oriented activity system" should be viewed in the context of other surrounding activity systems, that is, the network of activity systems (Engeström, 2001, p. 136). The assumption here is that interactions of surrounding activities might show contradictions between these activity systems. The second principle is the multivoicedness of activity systems, evident in participants' traditions, interests, opinions, and the diversity of instruments, rules, and histories present in any activity system. The third principle highlights the historicity of activity systems in that they always carry past history and change over time.

The fourth principle is the role of contradictions in activity systems, a concept central to this study. Originally introduced by Leontiev (1981) and further explicated by Ilyenkov (1982), contradictions are understood as potential causes of desirable changes in all activity systems. Kuutti (1996) defines a contradiction as a misfit within elements while Larkin (2010) says contradictions exist "when external influences change elements of activities causing imbalances between them" (p. 57). These contradictions are often "characterized by ambiguity, surprise, interpretation, sense-making, and the potential for change" (Engeström, 2001, p. 134). They become visible through disturbances and innovations at the action level of individual participants of activity systems. As contradictions cannot be observed, Engeström and Sannino (2011) suggest that they must be analysed through their manifestations which Scanlon and Issroff (2005) state are problems, ruptures, breakdowns or clashes as well as dilemmas, conflicts, critical conflicts and double blinds as outlined by Karanasios et al. (2017). Contradictions can occur at an individual level when individuals drive the expansion of an activity system because of their desire to change aspects of their personal world (Jonassen et al., 1999). Activity systems are therefore almost always in a state of change due to these contradictions.

I was cognizant of the fact that contradictions cannot be observed but can be analysed through their manifestations as suggested by Engeström and Sannino (2011). These authors went further to discuss the following four types of manifestations which were used during analysis:

- Dilemmas, i.e. "expressions or exchanges of incompatible evaluations either between people or within the course of a single person. It is commonly expressed in the form of hedges and hesitations, such as “on the one hand [...] on the other hand” and “yes, but”. In ongoing discourse, a dilemma is typically reproduced rather than resolved, often with the help of denial or reformulation” (p. 373);

- Conflicts in the form of “resistance, disagreement, argument and criticism” (p. 374);
- Critical conflicts which are the ‘inner doubts which paralyse them in front of contradictory motives unsolvable by the subject alone (p. 374) and
- Double blinds, i.e. when actors repeatedly face pressing and equally unacceptable alternatives in the activity system with seemingly no way out (Engeström & Sannino, 2011, pp. 373-374).

I am cognisant of the fact that “the burden on educational researchers is not merely to articulate principles, but to provide practitioners with tools to resolve the contradictions that arise in applying them” (Roschelle, 1996, p. 250). As a starting point, I articulate the four types of contradictions - primary, secondary, tertiary and quaternary - as outlined by Engeström (1987). Primary contradictions arise within each element of the activity system, i.e. contradictions within the subject, tool, object, community, rules and division of labour elements. Karanasios, Riisla and Simeonova (2017) refer to this as the double nature of the element. Secondary contradictions occur between the nodes of an activity system, e.g. community and division of labour. Tertiary and quaternary contradictions occur between different activity systems. Madyarov and Taef (2012) further explain the difference between tertiary and quaternary contractions saying “tertiary contradictions arise when a culturally more advanced activity within the central activity of interest introduces a more advanced object or motive while quaternary contradictions exist between the central activity system and the outside activity systems” (p. 82). In this study the concept of contradiction was utilised to reflect upon the impact of the mobile computer lab in the classrooms observed and in turn how that influenced the experience of teaching with computers. The concept of contradictions is a useful analytical tool enabling the identification and classification of particular instances of change and development in an activity system (Waycott, Jones and Scanlon, 2005). A visual presentation of the contradictions considered for this study is shown in the adapted generic CHAT triangle below (Figure 3.3). This generic CHAT triangle was used as the basis for the analysis of each of the six classroom interventions.

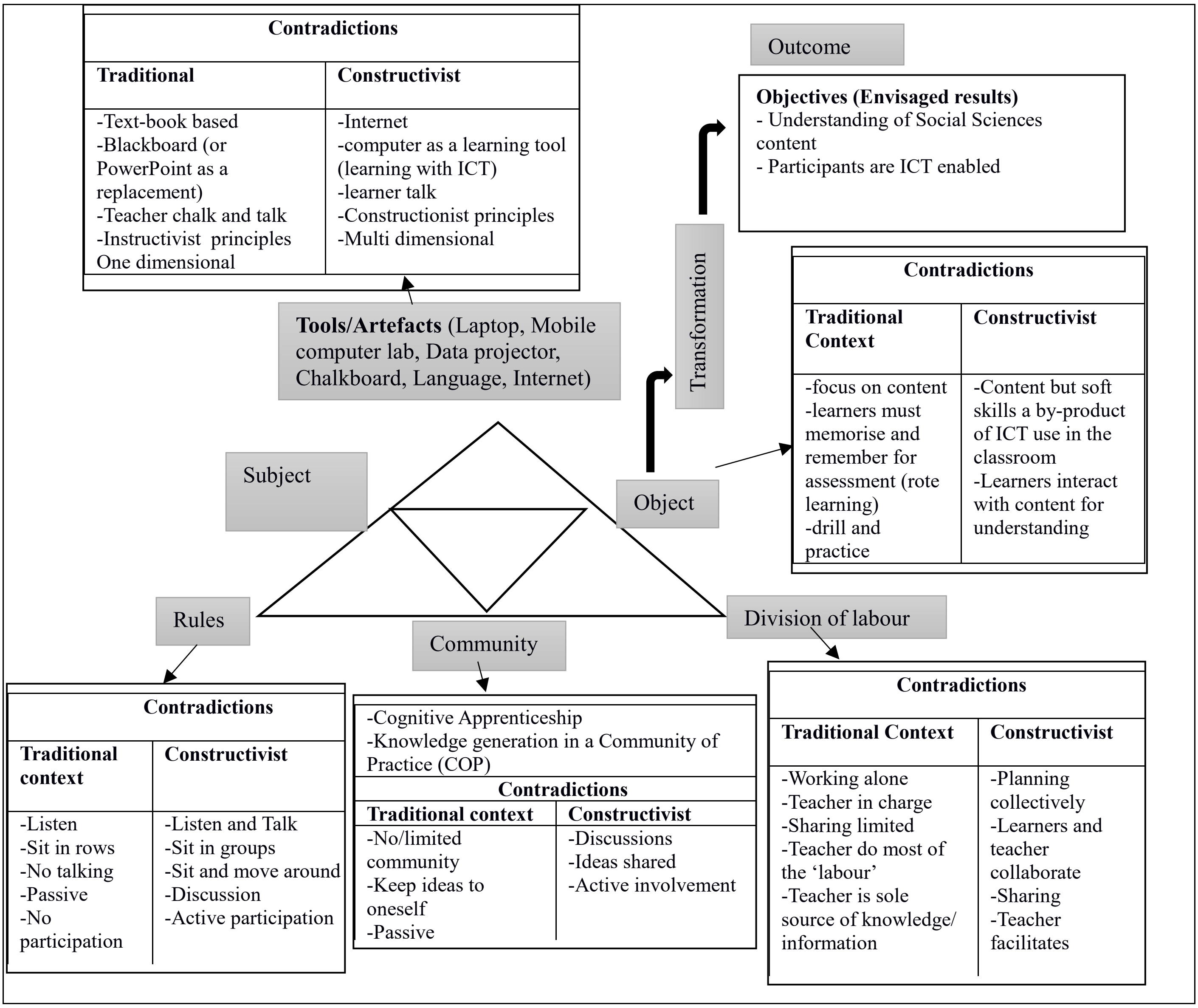

Figure 3-3: Adapted CHAT generic triangle for data analysis (Source: Engeström, 2001)

When contradictions are resolved an activity system undergoes a transformation or sometimes enters a new expansive cycle of growth, the last of the five principles of activity theory proposed by Engeström (2001). In this study each of the classrooms are considered as similar, but separate activity systems. I am also aware that "boundaries between activity systems are hard to demarcate, but methodologically they could be defined by their objects" (Madyarov et al., 2012, p. 89). It is thus possible that the key participants in this study might have multiple activity systems.

3.2 FROM ICT ACCEPTANCE TO ADOPTION

In this section, I discuss how teachers move from acceptance to adoption of ICT. I outline the Technology Acceptance Model (TAM), teacher cognition and adoption of innovation, articulating their relevance in the present study.

3.2.1 The Technology Acceptance Model (TAM)

What teachers know, believe and think about ICT influences their acceptance of such technology and ultimately its use. According to Yates (2007), 70% to 80% of all ICT related projects fail not because of technical issues, but due to lack of user acceptance. Similarly, Davis (1989) notes that user acceptance is pivotal in determining the success or failure of any technology. These two authors (Yates, 2007 & Davis, 1989) highlight that it is therefore important to look at issues of user acceptance of technology before looking at ICT use. Various technology acceptance theories have been tested and refined over the years. These include, but are not limited to, the Theory of Diffusion of Innovations (DIT) (Rogers, 1995), Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1991) and Decomposed Theory of Planned Behaviour, (Taylor & Todd, 1995).

One of the most authoritative is the Technology Acceptance Model (TAM), which focuses on the perceptions that influence technology use.

Fred Davis developed the Technology Acceptance Model in 1986. TAM was his adaptation of Fishbein and Ajezen's (1975) Theory of Reasoned Action (TRA). TAM describes technology adoption behaviour, that is, how users accept and use technology based on the theoretical beliefs-attitude-intention behaviour causal relationship initially established by TRA. Davies, Carbonaro, Kendal and Beauchamp (2003) note that TAM is based on the premise that when users are presented with new technology a number of factors influence their decision of whether, how and when they use it. Over a 100 researchers (see Abdullah & Ward, 2016, p. 8 for a comprehensive list) have suggested several external variables to understand "the impact of outside factors on users' two main perceptions, perceived ease of use (PEOU) and perceived usefulness (PU)" (Abdullah et al., 2016. p3). PEOU directly influences PU. These perceptions affect users' positive or negative attitudes towards using the technology. Attitude towards using the technology influences behavioural intention to use the technology. PU also directly influences behavioural intention to use. Behavioural intention to use technology then determines actual use (see figure 3.4 below).

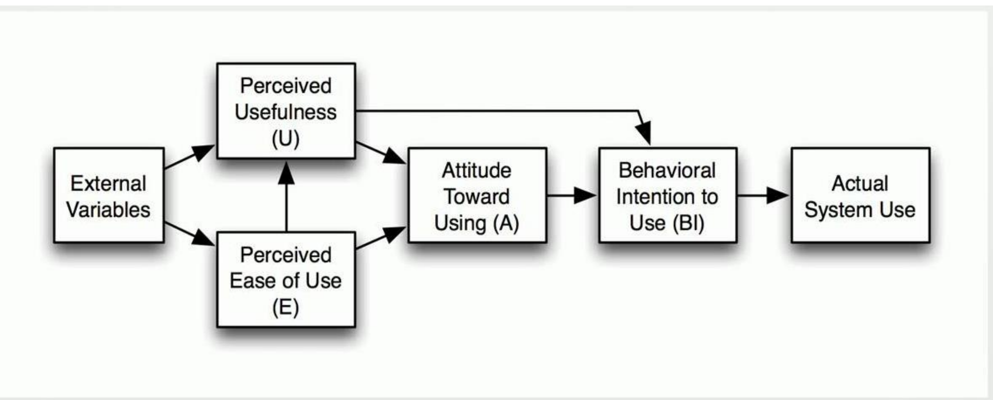

Figure 3-4: Technology Acceptance Model (Davis, 1989)

TAM views the users' attitudes and perceptions towards technology as an important determinant of the kind of experience a user will have while using that technology (Elwood, Changchit & Cutshall, 2006). This model maintains that external variables influence technology adoption and traces the impact of external variables on internal beliefs, attitudes, and intentions (Davis, 1989).

Perceptions around the usefulness of ICT and their ease of use led the discussion in this study as these two are the main determinants of whether a teacher decides to use ICT or not and to what extent. The perceived ease of use and perceived usefulness of technology (Elwood et al., 2006; Stols, 2008) are the two main components of TAM. Perceived ease of use is the degree to which technology is regarded as easy to use/understand and operate. The perceived ease of use is a direct determinant of attitude and perceived usefulness. Perceived usefulness refers to the degree to which a person believes a technology will enhance their performance. Perceived usefulness is an especially strong determinant of technology use and it is impacted upon by various factors including "social influence and cognitive instrumental processes" (Venkatesh & Davis, 2000, p. 186). Various dimensions of TAM provide *explanatory tools* of why a participant perceives technology as easy to use or useful. I relied on TAM dimensions such as fit between task and technology (Dishaw & Strong, 1999), technology characteristics (Lederer, Maupi, Sena and Zhuang, 2000), computer anxiety and computer playfulness (Venkatesh, 2000), prior experience (Agarwal & Prasad, 1999) and self-efficacy (Agarwal, Sambamurthy and Stair, 2000) to explain teachers' behaviour change *(or no change)* and what influences that change.

Figure 3.5 which follows shows the relationships between these dimensions in the present study. The internal variables influence perceive ease of use and perceived usefulness of ICTs and form part of the data gathered and analysed. Only selected external variables relevant to this study were incorporated and used in the data generation and analysis stage.

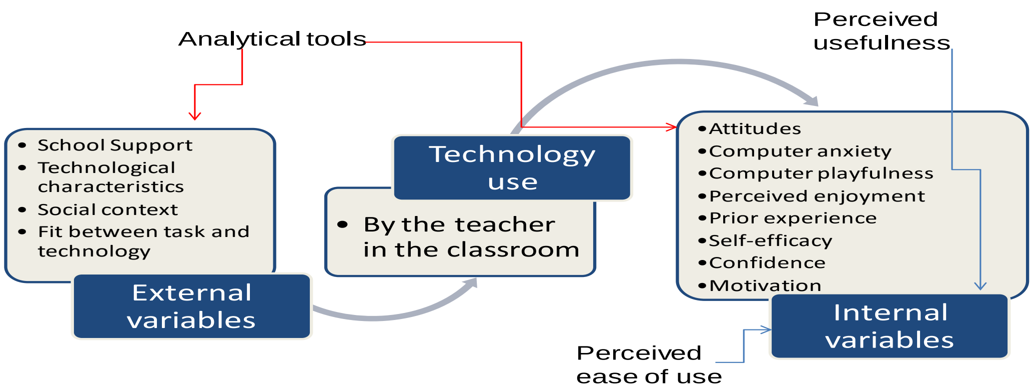

Figure 3-5: Technology Acceptance Model (Adapted from Venkatesh & Davis, 2000, p. 186)

I used the adapted TAM model above as an analytical tool in the present study. Similar to Borg's theory of teacher cognition, discussed below in the next section, both external and internal variables were explored to get a fuller understanding of the teacher and his or her perceptions. Bagozzi (2007) acknowledges TAM as a useful model that has informed how a number of studies have been conducted; however, he found it "unreasonable to expect that one simple model could explain decisions and behaviours across a wide range of technologies, adoption situations and differences in decision making" (p. 244). He goes further to claim that TAM "seduces researchers into overlooking the fallacy of its simplicity – that is, by using TAM researchers have overlooked the omission of essential determinants of decision making and turned a blind eye to the inherent limitations of TAM" (Bagozzi, 2007, p. 244). TAM does not help to understand what happens in the classroom when ICT is used and/or why it happens as noted by critics of the model. Critics of TAM note that analysis of empirical research using the model shows that results are not consistent or clear (Legris, Ingham, & Collerette, 2003). Legris et al. (2003) also conclude that "significant factors such as organisational and social factors are not included in TAM and that though it is a useful model, it has to be integrated into a broader one which would include variables related to both human and social change processes" (p. 191). TAM is a framework for explaining individual decision-making, but "this framework has not considered group, cultural and social aspects of decision making and usage" (Bagozzi, 2007, p. 247). In the present study, cultural and historical aspects are accounted for through the integration of CHAT.

TAM has been extended to TAM 2 in an attempt to account for social and cognitive determinants and to understand how these factors can change in different circumstances when user experience increases (Bagozzi, 2007*,* pp. 187-188). TAM 2 predicts that the importance of social influences will decrease as experience increases, as one's own considerations and experiences take precedence over the thoughts/ideas of others. External influence is particularly relevant for teachers such as the ones considered in the present study, whose experience with ICT is relatively limited. However, cognitive functions such as job relevance (which is whether or not the system will support one in executing tasks necessary to the fulfilment of one's job), output quality (which is the degree to which the system is able to complete the task), result demonstrability (which is whether or not one will be able to identify how the system is benefiting her/him) and perceived ease of use (the less effort it is to use a system, the more likely people will use it) also play an important role in the acceptance of technology, but do not decrease in importance as experience increases.

3.2.2 Teacher cognition

Cross-curriculum ICT integration into education is not a simple process. It involves many aspects, such as training, support, accessibility of resources, time management and so on. Borg (2003, p. 81) maintains that “teachers are active, thinking decision-makers who make instructional choices by drawing on complex, practically-oriented, personalized and context-sensitive networks of knowledge, thoughts and beliefs”. The theory of cognition is useful for understanding how the teacher arrives at the decision to use ICT in the classroom. Teacher cognitions influence what teachers do and “in order to fully understand what teachers do, one needs to understand what they believe, what they know, their attitudes and their feelings” (Birello, 2012, p. 88). The concept of cognition helps to understand why teachers choose to teach with ICT and in what way. Baron (2010) examines the factors that affect technology acceptance in teaching English. She found that once external factors of access to working computers and training were addressed, teachers’ cognitions played a central role in whether or not the teacher used technology in their classroom and the methods used. I expand on Baron’s (2010) work to include classroom practice, cognisant that practice can change with the actual experience of teaching with ICT.

Teachers’ decisions to use/not use ICT in the classroom are not made randomly, nor are they always conscious. Lam (2000) found that “the main reasons for the teachers’ decisions regarding technology seemed to depend on whether the teacher was personally convinced of the benefits of using technology” (p. 410). A teacher’s own schooling experience, initial training, personal beliefs, assumptions, teaching experience and knowledge (etc.) all affect the “teacher’s cognitions, which in turn shapes decisions made with regard to the teacher’s actual practice” (Freeman & Johnson, 1998, p. 401). Teacher training “does not always result in teachers implementing what they have learnt, nor does it necessarily result in a change of attitudes or beliefs" (Borg, 2003, p. 89).

Kagan (1990) offers three critiques of the concept of teacher cognition. Firstly, teacher cognitions generally cannot be assessed directly. Borg (2003, p. 81) calls them "unobservable cognitive dimensions". There are a number of reasons why this is so. Teacher cognitions are held unconsciously. Sometimes teachers do not have the language to describe them, struggle to put their thoughts into words, or teachers may be reluctant to share unpopular beliefs (Birello, 2012). In order to access teacher beliefs, the researcher must ask the teacher to say what their beliefs are or to produce work in which their beliefs are implied (Birello, 2012). Interviews, stimulated recall interviews (Haertel, 1990) or document analysis can be used to elicit teacher beliefs and researchers must interpret underlying beliefs from data generated using these methods.

Secondly, often people hold conflicting beliefs about the same issue. Inconsistency is inherent in the nature of beliefs, so sometimes people do not do what they say they believe they should do (Birello, 2012). Beliefs are also usually highly contextualised (Leinhardt, 1990). Borg (2003) gives the following example: if a teacher is asked his/her beliefs about pair work, he/she is most likely to give an abstract theoretical answer such as *I believe pair work is valuable and think it is something all teachers should do*. He notes that if the same teacher is observed teaching and then asked the same question in relation to their own practice then the response may be different such as *In my context it is not feasible*. In the present study, I account for contextual factors by including both CHAT and TAM in my analytical framework. Self-reported beliefs coupled with observations were used to identify and analyse inconsistencies in the beliefs reported by participants. The Theory of Reasoned Action (TRA), which, as previously mentioned, led to the development of TAM and later TAM 2, belongs in the realm of social psychology, which focuses on the social context and group relationships (Borg, 2003, p. 118). Thirdly, the term ‘teacher cognitions’ is too vague or ambiguous because researchers use the term to refer to various issues related to teaching such as teachers’ thoughts during instruction, thoughts during lesson planning, beliefs about students, the classroom, etc. He further notes that even when the focus is on one aspect of teacher cognitions, often that aspect can be interpreted in different ways. In this study, a definition of teacher cognition has been adopted and was used as the frame of reference of this study.

3.2.3 Diffusion of innovation

For this thesis, it is not the process of diffusion that I was interested in but the description of adopters of innovations that was useful and relevant for this study. Diffusion is “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1983, p. 5). Four key components emerge from the definition of diffusion of innovation; these are innovation, communication, time and social system. An innovation is “an idea, practice, or object perceived as new by an individual or other unit of adoption” (Rogers, 1983, p. 12). Even if an innovation may be developed and exist for a long time, if it is new to individuals then it is considered an innovation. For example, the use of ICT in the classroom is no longer an innovation for certain sections of the society – however, in marginalised contexts and at schools where this is not the case yet, ICT integration is an innovation.

Communication is “a process in which participants create and share information with one another in order to reach a mutual understanding” (Rogers, 1983, p. 5). In order for diffusion to take place, an interpersonal communication needs to take place in which an innovation is communicated through a particular channel. This aspect of communication was not relevant for this study. The time aspect is present in the diffusion process and the adopter categorisation which takes place over a certain period of time – again, this was not relevant for this study. Rogers (2003) defined the social system as “a set of interrelated units engaged in joint problem solving to accomplish a common goal” (p. 23). He further claimed that the nature of the social system affects individuals’ innovativeness, which is the main criterion for categorizing adopters. This was particularly interesting for this study as the context within which the teachers worked was expected to have an influence on ICT integration.

Rogers (2003) defined the *rate of adoption* as “the relative speed with which an innovation is adopted by members of a social system” (p. 221). He suggest that for an innovation to be adopted:

- “it must be perceived to be better than the idea it supersedes” – i.e. relative advantage, p. 229;
- “it must be “compatible with the values, past experiences, and needs of potential adopters – i.e. compatibility, p. 15;
- “it must be perceived relatively simple and easy to understand and use – i.e. complexity, p. 15;
- “it must able to be experimented with on a limited basis prior to commitment –i.e. trialability, p. 16; and
- “the results of the innovation can be viewed by others, i.e. observability, p. 16.

In summary, Rogers (2003) argued that innovations offering more relative advantage, compatibility, simplicity, trialability, and observability will be adopted faster than other innovations.

The diffusion of innovation provides useful terminology by which to characterize the participants in this study. Rogers (1983) described adopters according to specific categories based on level of innovativeness. Prior to the descriptors suggested by Rogers (1983) a number of other researchers had been using adjectives to describe adopters. These included “Progressists, Hightriers, Experimentals, Lighthouses, Advance Scouts, Ultra adopters, Drones, Parochials, and Diehards” (Rogers, 1983, p. 242). The following five categories of adopters as suggested by Rogers (1983) were adopted for this study:

- Innovators: these are described as venturesome. These individuals are willing to try new experiences and ideas. Although they may not be the most respected within the social system, they play a major role in the diffusion process.
- Early Adopters: these are considered respectable in that they are more integrated into the social system than innovators. These individuals have a greater degree of opinion leadership in that potential adopters will look to these persons for advice and information. They serve as “role models for many others of a social system” (p. 249).
- Early Majority: these will adopt new ideas before the average member of the social system and are deliberate in their efforts. These individuals usually do not hold leadership positions, but interact frequently with their peers. "They follow with deliberate willingness in adopting innovations, but seldom lead" (p. 249).
- Late Majority are seen as sceptical and adopt new ideas after the average member of the social system. Their acceptance may be based more on economic necessity as well as increasing pressures from peers.
- Laggards: these are traditional in their mindset and are the last to adopt an innovation. They are not opinion leaders and they use the past as their point of reference. They are

extremely suspicious of innovators and change agents. This term, laggard, has been criticized as being especially negative.

In addition to these five categories of adopters, Rogers (2003) further described his five categories of adopters in two main groups: earlier adopters and later adopters. Earlier adopters consist of innovators, early adopters, and early majority, while late majority and laggards comprise later adopters. These two main groups are used to describe the teachers in this study.

3.2.4 Adoption of Innovation

The Adoption of Innovation theory explains how the extent of adoption of an innovation is the culmination of the decision-making processes of users regarding its implementation (Toledo, 2005). Gladhart's (2001) Adoption of Innovation theory has its roots in the work of Rogers' concept of Diffusion of Innovation, first proposed in the 1960s and tested in several studies (Robinson, 2009). The Diffusion of Innovation theory seeks to explain how populations take up innovations. While the Diffusion of Innovation theory focuses on the communication of an innovation to potential adopters, as discussed above, Adoption of Innovation looks at levels of innovation adoption. The South African Department of Basic Education draws on Gladhart's (2001) Adoption of Innovation theory in the White Paper on e-Education (DoE, 2004) as well as in the Guidelines for Teacher Training and Professional Development in ICT (DoE, 2007). Gladhart (2001) acknowledges five levels of technology adoption, which are: entry, adoption, adaptation, appropriation and invention depending on the behaviour of teachers. The levels of adoption are not static and can only be read and understood in the context of a particular lesson. A teacher can move to the next level with a single change to his/her teaching and the higher the level the more ICT use responds to learner educational needs.

At the *entry level*, teachers have little or no experience with technology and demonstrate little interest in changing their instruction (Dwyer, Ringstaff and Sandholtz, 1992). At this level, teachers have little interaction with colleagues about their successes and failures with technology. The South African Guidelines for Teacher Training and Professional Development in ICT (DoE, 2007) state that at this level “the teacher is computer literate and is able to use computers, however, frustrations and insecurities are common” (p. 6) which could be a result of what Toledo (2005) terms ‘individualism’, that is, the potential feelings of people using technology, the lack of communication with other people about the innovation and generally an attitude of observation rather than activity. Ndlovu & Lawrence (2012, p. 5) suggest that at the “entry level the quality use of ICTs is compromised as teachers do not possess the attributes that enable them to achieve educational goals”. Teachers’ negative attitudes, lack of expertise, lack of autonomy and lack of knowledge to evaluate the use and role of ICT in teaching are some of the main factors hindering teachers’ readiness and confidence to use ICTs in their teaching (Hennessy et al., 2010). According to the guidelines for teacher training and professional development “at this level, the teacher is likely to lack confidence” (DoE, 2007, p. 6). Ndlovu and Lawrence (2012) assert that schools that have recently acquired computers can be expected to “be in the lower phase of integrating ICTs and probably not using them at a level where they can help learners develop higher thinking skills” (p. 19). This is similar to the views of Balanskat et al. (2006) who also concluded that “most schools in most countries, are in the early phase of ICT adoption, characterised by patchy uncoordinated provision and use, some enhancement of the learning process, some development of e-learning, but no profound improvements in learning and teaching” (p. 2).

A teacher reaches the *adoption level* when concerns shift from learning how to use ICT to learning how to use ICT to support teaching (Dwyer et al., 1992). At this level, the teacher is "able to use various ICT, including computers to support traditional management, administration, teaching and learning and is able to teach learners how to use ICT" (DoE, 2007, p. 6). Teachers provide technical assistance to their colleagues and share knowledge about how to manage the equipment and use the software. In schools where resources are available computers can be found in the classroom or in a computer lab where teachers and students have regular access – appropriate relevant software is also available that can be used for teaching and learning. Teachers start to apply their newly acquired technology skills to their teaching (Gladhart, 2001; Toledo, 2005). Ndlovu and Lawrence (2012) state that teachers are at the entry and adoption levels when they do not possess the requisite ICT skills needed in order to design learning activities that will promote higher order cognitive thinking in the learners. In some instances, the teacher simply does not have the know-how to integrate ICTs into their teaching. At the two lowest levels of the Adoption of Innovation theory, entry and adoption, teachers' abilities are restricted to using ICTs for limited generation or interaction with knowledge only (Ndlovu & Lawrence, 2012).

At the *adaptation level*, teachers begin to share instructional ideas instead of technical assistance (Dwyer et al., 1992). At this stage, teachers are able to develop the curriculum for their teaching and share with others. South African teachers are expected to "use ICT to support everyday classroom activities" (DoE, 2007, p. 6). Evidence of work done by South African teachers at the adaptation level can be seen on platforms such as Thutong[1], where teachers share their work (lesson plans, worksheet, experiments etc.). These platforms give teachers a chance to collaborate on instructional topics and experiment with new technologies and software. Toledo (2005) argues that the increase in skills levels allows the teacher to apply the

[1]Thutong Portal is an online resource that provides information about education in South Africa including the curriculum. For more information, visit their website (http://www.thutong.doe.gov.za).

use of new technology in their teaching. At the adaptation level, teachers start incorporating higher-level, problem solving activities and the quality of the students' work improves as well. The adaptation level has benefits for both the teacher and learner.

At the *appropriation level*, team-teaching, interdisciplinary project-based instruction, and individually paced instruction become more common (Dwyer et al., 1992). Teachers begin to question old patterns and they speculate about the causes behind changes they are seeing in their students. At this level, a teacher has "a holistic understanding of the ways in which ICT contributes to teaching and learning" (DoE, 2007, p. 6). Teachers incorporate more digital technologies, multimedia software and networked activities (for file sharing and collaboration) in their teaching. Most teachers make use of individualised instruction, collaborative group work, simulation, self-paced and multimodal learning at the appropriation (Carr, 2006). In Gladhart's (2001) study, teachers were seen changing their instruction methods after they started using technology from a teacher-centred approach to a more learner-centred approach. At this level teachers have "the experience and confidence to reflect on how ICT can influence teaching and learning strategies and to use new strategies" (DoE, 2007, p. 6).

Finally, at the *invention level*, teachers are ready to implement fundamental changes in their teaching approaches and use ICT also in new innovative ways (Dwyer et al., 1992). They are more disposed to view teaching as an active, creative, and socially interactive process (Dwyer et al., 1992). Knowledge is viewed as something children construct and less as something to be transferred (Gladhart, 2001). At this level, the South African teacher is expected to be able to:

> Develop entirely new learning environments that use ICT as a flexible tool, so that learning becomes collaborative and interactive and ICT is expected to be integrated as a flexible

> tool for whole-school development through redefining classroom environments and creating learning experiences that leverage the power of technology (DoE, 2007, p. 6).

Such teachers have strong pedagogical and content knowledge and are able to transform the classroom environment into an exciting and rich knowledge generation for learners (DoE, 2007). It is not so much the tools they use, but their ability to structure content using suitable teaching methods that can stimulate the advancement of learner thinking processes and draw the best out of learners. In other words, through the use of ICTs, they equip learners with what it takes to develop their thinking skills to such an extent that they are able to independently search, analyse and synthesise information to help them solve authentic problems using available technology.

While the Adoption of Innovation theory is useful in knowing where to place a user of technology, in reality it is not always clear-cut or easy (Lyytinen & Damsgaard, 2001). Knowing that a teacher is using ICT in a lesson at the adoption level, for instance, does not tell us how he or she got there, or how he or she intends to move to the next level; neither does it help in explaining the teacher's use of computers in teaching. The present study sought to explore the passage from one level to the next by shaping and implementing an intervention with teachers teaching with computers in their classrooms. Understanding the moment of transition and exploring factors that hinder or enable the transition will generate knowledge that will be useful for other teachers in the process of integrating ICT in their teaching.

3.3 ALL-ENCOMPASSING CONCEPTUAL AND THEORETICAL FRAMEWORK FOR THIS STUDY

In this section, I present the all-encompassing conceptual and theoretical framework presented in chapters 2 and 3 above. I drew on learning theories: CHAT, TAM, Teacher Cognitions; Adoption of Innovation and Diffusion of Innovation and the various types of ICT tools/use in the classroom to help me explain how and why teachers integrate ICT the way they do in their classrooms. The all-encompassing framework is presented in pictorial form in Figure 3.6 below. Using this all-encompassing framework as my analytical framework I show how these various components influence the decisions a teachers makes regarding ICT use in the classroom. I was cognisant of the fact that within and between these components of this framework are various barriers to ICT integration, and contradictions/tensions stemming from a number of things including the discrepancy between policy and practice.

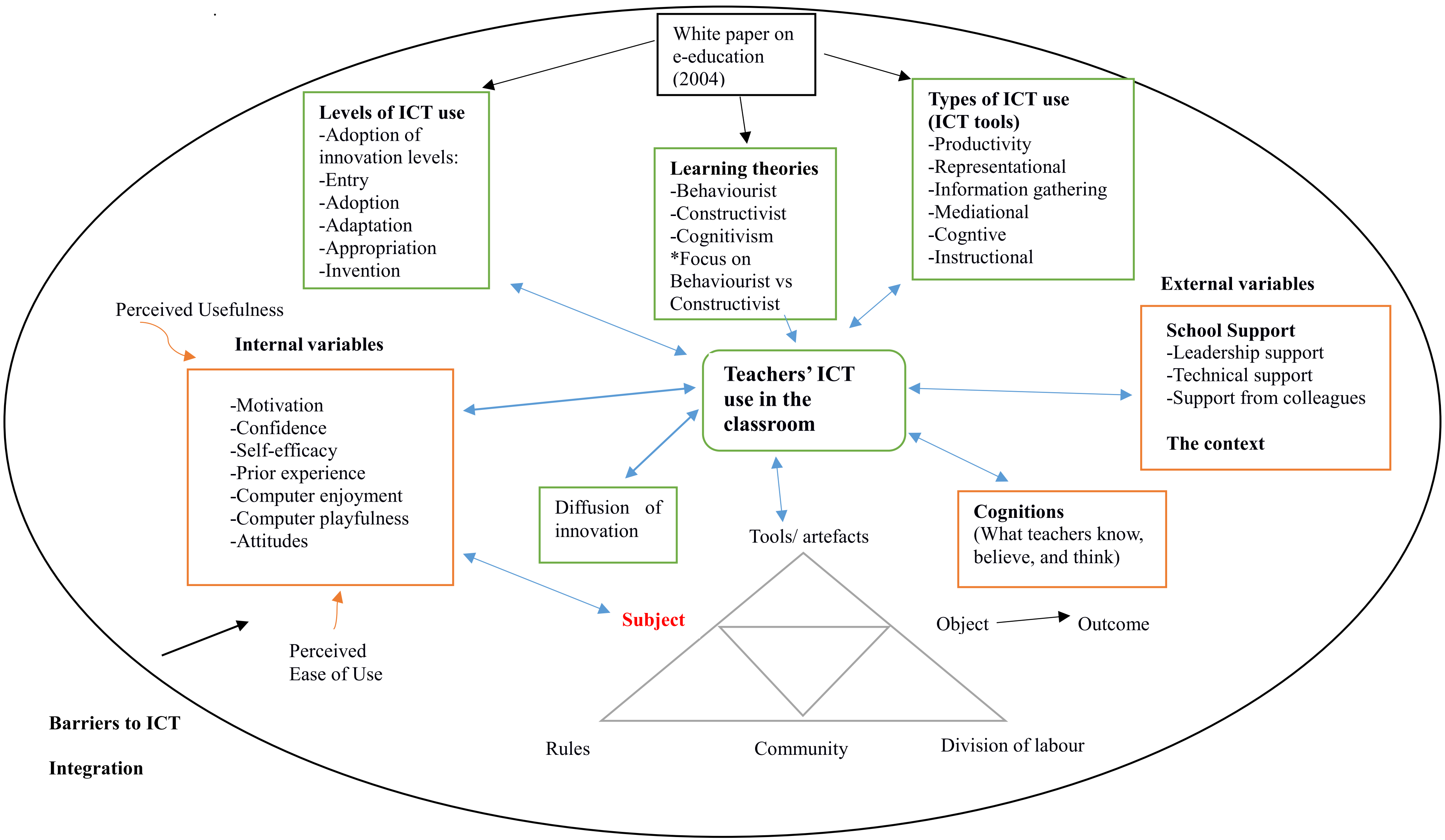

Figure 3-6: All-encompassing conceptual and theoretical framework

3.4 SUMMARY

A multidisciplinary theoretical framework was discussed in this chapter. The chapter started with a discussion of the role of ICT in teaching and learning, starting from learning theories, ICT as a tool in teaching and mediation. The second generation of CHAT provides analytical tools to analyse in context how the teacher uses computers in teaching and a language to explain the relationship between various components of the classroom activity system. I then discussed how ICT is accepted and adopted for use through the Technology Acceptance Model, Teacher Cognition and the Adoption of Innovation theory, which is concerned with the different levels of technology adoption. Describing the level the teacher is at is a crucial first indicator of technology acceptance, adoption and use in teaching but does not help in understanding the teacher's perception and experiences using computers. I combine the Teacher Cognition theory and the Technology Acceptance Model to understand what influences the teacher's decision to use/not use computers in his/her teaching.

CHAPTER FOUR: RESEARCH METHODOLOGY

In this chapter, I provide justification for the choice of the research paradigm in which I located my study and explain how the paradigm shaped the overall research design. I articulate the research process, outlining the research approach taken, the process of choosing the research sites and the participants. I discuss the data collection methods, data handling and analysis and conclude the chapter with ethical considerations, including a discussion of my role as the researcher and how I ensured trustworthiness of data.

4.1 METHODOLOGICAL ORIENTATION

In this section I discuss the methodological orientation I chose to work in and the research design I adopted in order to achieve my research goal and answer my research questions. In the present study, I examined teachers' perceptions and experiences using ICT in the classroom. In order to achieve this goal, four research questions needed to be answered:

1. What are teachers' perceptions of using computers in teaching?
2. What are teachers' first experiences using ICT in the classroom?
3. What challenges do teachers encounter when they use computers in the classroom?

4.1.1 Research paradigm

A paradigm is "a broad view or perspective of something" (Taylor, Kermode & Roberts, 2007, p. 5). Rossman and Rallis (2003, p. 45) define a paradigm as a "shared understanding of reality" and note that "each paradigm carries a set of assumptions about the nature of Social Science and about the nature of society". There are four elements/components to a paradigm (epistemology, ontology, axiology and methodology) through which the basic assumptions, beliefs, norms and values of each paradigm are expressed (Lincoln & Guba, 1985). The choice of a paradigm depends on one's view of the world and the assumptions/beliefs about what constitutes truth and knowledge (Schwandt, 2000) or as Cooksey and McDonald (2000) say, counts as knowledge within the world, i.e. epistemology. Additionally, it is what we believe about the nature of reality, i.e. ontology and what we believe is true, i.e. axiology (Patton, 2002). Simply put, Mackenzie and Knipe (2006) describe a paradigm as the researcher's worldview, which is "the perspective, thinking or shared set of beliefs that informs the meaning or interpretation of research data" (Kivunja & Kuyini, 2017, p. 26). A paradigm therefore "leads one to ask certain questions and use appropriate approaches to systematic inquiry," i.e. methodology or how we should study the world. There are a number of paradigms discussed in literature; however, Candy (1989) suggests that all can be grouped into three main categories: positivist, interpretivist and critical. A fourth paradigm which borrows from these three called the pragmatic paradigm has been proposed by Tashakkori and Teddlie (2003).

Within the positivist paradigm, knowledge is believed to be objective, i.e. objects around us have existence and meaning, independent of our consciousness of them (Crotty, 1998). Science is believed to be the only foundation for true knowledge (Kawulich, 2012). The positivist paradigm reflects a strict empirical approach in which claims about knowledge are based directly on experience and it emphasises facts and the causes of behaviour (Bogdan & Biklen, 2003). Other characteristics of research located within this paradigm include the assumption that "context is not important; results of an inquiry can be quantified; theory can be used to predict and to control outcomes; generalisations can be made across contexts; research rests on formulation; and testing of hypotheses" (Kivunja & Kuyini, 2017, p. 31). After years of grappling with this paradigm, researchers accepted that the social world is not value free, that it cannot be studied in the same way as the natural world and that it is not possible to provide explanations of a causal nature. Questioning and modification of the characteristics mentioned above led to the formulation of the post-positivist paradigm which accepts that "reality can never be fully understood, only approximated, that reality is imperfect and that truth is not absolute but probable" (Kivunja & Kuyini, 2017, p. 32).

The interpretive paradigm places emphasis on understanding the subjective world of human experience (Guba & Lincoln, 1989). This means researchers "make meaning of the data through their own thinking and cognitive processing of data informed by their interactions with participants" (Kivunja & Kuyini, 2017). The goal is to understand and interpret what the subject is thinking or the meaning s/he is making of the context. Therefore, studies that fall within the interpretive paradigm tend to generate subjective data because the paradigm focuses on individuals and their interpretations of the world as they see it (Reeves & Hedberg, 2003). Babbie and Mouton (2008) believe that all humans are attempting to make sense of their worlds and in so doing "they continuously interpret; create; give meaning; define and rationalise daily actions" (p. 28). Characteristics of research conducted within the interpretive paradigm include a belief that the context is vital for knowledge and knowing, that knowledge is created by findings, can be value laden and values need to be made explicit and that contextual factors need to be taken into consideration in any systematic pursuit of understanding (Lincoln et al., 1985; Morgan, 2007; Kivunja & Kuyini, 2017).

The critical paradigm has its focus on "social justice issues and seeks to address the political, social and economic issues which lead to social oppression, conflict, struggle and power structures at whatever levels these might occur" (Kivunja & Kuyini, 2017, p. 35). This paradigm is sometimes called the transformative paradigm because it seeks to change or confront politics and, through that, improve social justice. It is also sometimes called an emancipatory paradigm since it aims to emancipate participants or communities through group action (Mertens, 2009). Dominant theories within this paradigm include Marxism, critical theory, feminist theories and Freirean theory. Characteristics of research located within this paradigm include concern with power relationships set up within social structures, the respect of cultural norms, and deliberate efforts of the research to promote human rights and increase social justice and reciprocity.

I situated my work within the pragmatic paradigm. The origins of this paradigm can be found in the writings of Pierce (1878, 1905), James (1907) and Dewey (1917, 1920, 1922, 1938) and this has been refined by, for example, Rorty (1999, 2000) and Rescher (2000). Johnson and Gray (2010) point out that these authors advocate for various forms of pragmatism. I adopt the pragmatic paradigm, which was developed by philosophers who wanted to end the opposed views of the positivists (and post-positivists) and the interpretivist researchers and end what was referred to as paradigm wars (Gage, 1989; Kivunja & Kuyini, 2017). These philosophers (Tashakkori et al., 2003; Alise & Teddlie, 2010; Biesta, 2010) argued for "a worldview which would provide methods of research seen to be most appropriate for studying the phenomenon at hand" (Kivunja & Kuyini, 2017, p. 35). The pragmatic paradigm is associated with action, intervention and constructive knowledge (Goldkuhl, 2012). Theorists considered approaches to research that could be more practical and pluralistic, allowing for a combination of methods that, when used together, could provide understanding of actual behaviour of participants, the beliefs behind those behaviours and the consequences likely to follow (Tashakkori et al., 2003; Alise & Teddlie, 2010; Biesta, 2010). Kivunja and Kuyini (2017) summarise it as follows:

> The pragmatic paradigm advocates for relational epistemology (i.e. relationships in research are best determined by what the researcher deems appropriate to that particular study), a non-singular reality ontology (that there is no single reality and all individuals have their own and unique interpretations of reality), a mixed methods methodology (a combination of quantitative and qualitative research methods) and a value-laden axiology (conducting research that benefits people) (p. 35).

The paradigm advocates for the use of mixed methods as a pragmatic way to understand human behaviour.

Some of the characteristics of the pragmatic paradigm include the rejection of the need to locate one's study in either a positivist (or post-positivist) or an interpretivist paradigm. Instead it advocates for the adoption of a worldview that allows for a research design and methodologies that are best suited to the purpose of the study. There is emphasis on workability in research, i.e. the use of what works so as to allow the researcher to address the questions being investigated without worrying as to whether the questions are wholly quantitative or qualitative in nature.

4.1.2 Research approach

A mixed methods research approach was chosen for this study meaning that both qualitative and quantitative research methods were used. In a video, Dyce and Williams (2014) explain that qualitative research describes behaviours or experiences of participants while quantitative research examines differences between quantifiable variables. The combination of qualitative and quantitative research methods is not unusual, in fact, it is a growing phenomenon in social science research (Schwandt, 2000; Mason, 2006; Johnson, Onwuegbuzie and Turner, 2007; Creswell, 2014). I used what Johnson et al. (2007) call "qualitative dominant mixed methods, which involves including quantitative data and approaches into an otherwise qualitative research" (p. 124). Like Mason (2006) I gave qualitative research a primary goal in what he calls a "qualitative-driven mixed methods research". In this study, quantitative research played a supportive role in providing a rich description of the context within which the study was conducted (Creswell, Shope, Plano Clark & Green, 2006).

There are different types of mixed methods research recorded in literature. In the final chapter of the Handbook of Mixed Methods in Social and Behavioural Research, Tashakkori et al. (2003b) indicated that they had found nearly 40 different types of mixed method designs. However, there four major types according to Creswell and Plano Clark (2011). These are embedded design; explanatory design; exploratory design and triangulation design. In the embedded design, one data set provides a supportive secondary role in a study based primarily on the other data type (Creswell et al., 2011). The explanatory design is a two phase design in which qualitative data helps explain or build upon initial quantitative results. Results of the first method (qualitative) can help develop or inform the second method (quantitative) in the exploratory design. For this study, the triangulation design was selected. This design allows "for the collection of different but complementary data on the same topic" (Morse, 1991, p. 122). For example, perceptions were collected through closed-ended Likert scale statements as well as in interviews and written narratives. This was useful as noted by Patton (1990) in that I was able to bring together strengths and no overlapping weaknesses of the quantitative data (e.g. reaching a large sample size) with those of qualitative data (e.g. going in in-depth).

Based on three main components of the decision tree for mixed methods design criteria, i.e. timing of data collection and analysis; weighting of the data and how the methods will be mixed, the concurrent triangulation mixed method design was chosen for this study (Creswell, Plano Clark, Gutmann and Hanson, 2003). In this study, quantitative and qualitative data were collected, analysed and interpreted concurrently in a single phase. In phases 2, 3 and 4 of the study, both quantitative and qualitative data were collected and analysed at approximately the same time (see table 4.3 below). The weighting of the data was unequal, as there was more emphasis on qualitative data than quantitative data. Data to answer the first question on perception was collected mainly through questionnaires; data for use, experiences and challenges was collected using observations, interviews and documents. This decision was deliberate as I have more experience with qualitative than quantitative data. Data in this study was merged during the analysis and interpretation phase as shown in the discussion chapter.

Aliaga and Gunderson (2002) define quantitative research as "explaining phenomena by collecting numerical data that are analysed using mathematically based methods, in particular statistics" (p. 1). Similarly, Babbie (2010) emphasises that quantitative research focuses on gathering numerical data and generalising it across groups of people or to explain a particular phenomenon. Both these definitions highlight numerical data which reflects a relatively narrow understanding of quantitative research. Quantitative research can be used when dealing with data that is not naturally in a quantifiable format (e.g. attitudes and beliefs) by designing an instrument that converts that data into numerical form and analyses it statistically, e.g. using Likert scales (Muijs, 2011). Quantitative research is described as being realist and often falls within the positivist paradigm. Positivist researchers take the view that their job is to uncover an existing truth that is already out there. In order to do so effectively, these researchers utilise reliable, objective research methods and remain detached from the research so that they can present valid, unbiased findings (Muijs, 2011). Positivists believe the world works according to fixed laws of cause and effect and so quantitative research typically attempts to build on or test theories about these laws and either rejects or accepts them. Probability sampling is often used with the goal of making generalisations from the sample being studied to a wider population (Brians, Willnat, Manheim & Rich, 2016).

Questionnaires, surveys, structured interviews and structured observations and laboratory-based methods are common data collection methods used to generate quantitative data. Quantitative research allows for a broader study, involving greater numbers of subjects and employing prescribed procedures to ensure validity, reliability and replicability (Babbie, 2010; Brians et al., 2016). Although quantitative research allows for breadth, it may appear shallow when one wants to explore a problem in depth (Babbie, 2010). In such instances, qualitative techniques are more useful (Babbie, 2010). It is also difficult to use quantitative research when studying the meaning of particular events or circumstances. It is therefore advisable to mix quantitative and qualitative research if one wants both breadth and depth as well as causality and meaning.

The main goal of this research, focusing on attitudes and experiences, was qualitative in nature. My research questions are questions which Bricki and Green (2007) suggest are "best answered by qualitative methods" (pp. 3-4). Qualitative research enabled me to understand human behaviours and interpret the meanings and actions of the participants. The nature of the study I undertook sought to understand and interpret an aspect of social life, so the use of qualitative methods was appropriate for this purpose. I used the qualitative research approach to "study human action from the insider's perspective" with the aim of "describing and understanding, rather than explaining and predicting human behaviour" (Babbie, Mouton Vorster and Prozesky, 2010, p. 270). The qualitative approach allows researchers to "discover the meanings that participants attach to their behaviour, how they interpret situations, and what their perspectives are on particular issues" (Woods, 2006, p. 1).

The qualitative approach foregrounds the context within which the present study was undertaken. I focused on the process of the research rather than the outcome, with the primary aim of "making in-depth thick descriptions, understanding actions, events and social action in terms of its specific context rather than attempting to generalise to some theoretical population" (Babbie, 2010, p. 270). This is in line with the theoretical and conceptual framework I have discussed in chapters 2 and 3 above, which emphasised the importance of context in technology related research. Criticisms levelled against qualitative research include that the subjective data generated is prone to the researcher and participants' bias. Additionally, it is difficult to say how much of the researcher's bias influences the results (Bricki et al., 2007).

Of the three main qualitative research designs - ethnography, case study and life histories - the case study design appeared to fit the present study best. A case study approach was used for an in-depth exploration of the context – the marginalised classrooms in which this research was undertaken – as well as understanding and interpreting a situation – teaching with computers (Berg, 2001; Merriam, 2009; Leedy & Ormrod, 2010). I used the multi-case studies approach involving teachers in different schools in the research process in order to gather data from different perspectives and be able to compare findings from different settings (Bogdan et al., 1998; Yin, 2003; Merriam, 2009). Berg (2001) maintains that a case study approach involves "gathering enough information about a particular person or group to allow the researcher to effectively understand how it operates or functions" (p. 225). Through the case study approach, I was able to collect in-depth data on classroom activities and experiences of teaching with ICT. Extremely rich, detailed, and in-depth data characterises the type of information gathered in a case study.

The case study approach seeks to focus on a particular issue, context or person (s) where data is typically generated using qualitative methods as explained above. Babbie et al. (2010) state that "to understand and interpret case studies, researchers describe the context in detail" (p. 282). This is in line with the theoretical framework presented in the previous chapter that showed the focus and emphasis on understanding the context in which the teachers operate as a basis for understanding their experiences and better interpreting their perceptions. The focus of this research was on the perspectives of the individual teachers. A case study approach seemed appropriate as it seeks to "illicit what is important to individuals as well as their interpretations of the environment in which they work through in-depth investigations of individuals and their milieu" (Bryman, 1989, pp. 24-25). Seeing through the eyes of the participant means the researcher is committed to "viewing events, actions, norms, values etc. from the perspective of the people being studied" (Bryman, 1989, p. 61).

The main criticism levelled against the case study approach is that findings that come out of a case study cannot be generalised to other contexts (Yin, 2003). The purpose of this study was not to generalise but to present findings that might be interpreted and adapted by other researchers and/or teachers (in similar contexts) at the initial stages of using computers in the classrooms.

4.1.3 Research sites and participants

The sites of the present study were three marginalised schools in the Eastern Cape Province of South Africa. School A and school B are located in Dwesa/Cwebe, a rural area on the Wild Coast, in the former homeland of Transkei. The area is located in the Dutywa district. There are approximately 200 households in the village within the schools' vicinity. People in the area survive on subsistence farming and government social grants. The community is traditional and it is still ruled by a king and village headmen. The village lacks basic infrastructure such as roads, electricity or a clinic. Consistent with the low socio-economic status of the village, schools A and B were categorised as quintile 1 schools. As noted by Mitra, Dangwal and Thandani (2008) quality education declines with remoteness and disadvantage, making ICT integration more and more challenging. It can be assumed that these schools have needs that take priority over ICT and its integration in teaching. Dwesa is the home of the Siyakhula

Living Lab (SLL) a project that provides computer infrastructure to schools in the area and basic computer training (see Dalvit, Sieboerger, & Thinyane, 2011).

The third site is a school in a peri-urban area, known in South Africa as a township. School C is located in Grahamstown, a city of about 70 000 people. According to the last census (Statistics South Africa, 2011), 73%[2] of the inhabitants were black, 14% coloured, 11% white, 1% Indian or Asian and 1% were categorised as other. School C is approximately three kilometres away from the centre of Grahamstown. The school is in an area populated mostly by coloured[3] people. The township is characterised by high levels of poverty and unemployment due to limited economic activities in the area (Kelly & Ntlabati, 2007). Being in an urban area, the school has basic infrastructure – electricity, running water, flushing toilets, and security – a fence surrounds the school and there is an alarm system installed. The school received a computer laboratory from the Shuttleworth Foundation with 20 computers and benefits from technical support and internet connectivity from Rhodes University. School C was ranked quintile 3 – which means it is a no fee-paying school (Grant, 2013; Mtshali, 2014).

The questionnaire respondents in this research were 183 teachers working in the education districts of Grahamstown and Dutywa, which are representative of a wide spectrum of marginalised areas and schools in the Eastern Cape. In addition to the 183 teachers, 40 in-service ACE-ICT and 74 in-service BEd-ICT student teachers at Rhodes University were also participants in this study. The in-service BEd-ICT replaced the in-service ACE-ICT in 2012. Both qualifications targeted in-service teachers who undertook a professional development course aimed at the cross-curriculum integration of ICT and the effective use of technology in

[2]https://census2011.adrianfrith.com/place/264004
[3]In South Africa, coloured people refer to a heterogeneous ethnic group who possess ancestry from Europe

the classroom. I taught on both courses and interacted with the participants in that capacity. Findings from the 183 teachers allowed for the contextualisation of the research sites while the in-service ACE-ICT and in-service BEd-ICT students provided the context of the professional development courses within which this study is located.

The six key participants in this study were chosen through non-probability sampling methods, convenience and purposive sampling. In convenience sampling participants who meet certain criteria, for example, easy accessibility, geographical proximity, availability or willingness to participate, are chosen from the target population (Dornyei, 2007; Etikan, Musa, & Alkassim, 2016). It was convenient to focus on teachers trained at Rhodes University through the in-service ACE-ICT or in-service BEd-ICT because this is where I worked. These were teachers I was already familiar with and had established some form of a relationship over the period I taught on the courses. The purposive sampling method "is a deliberate choice of a participant due to the qualities the participant possesses" (Etikan et al., 2016, p. 2). Guided by the research questions, the researcher decides what needs to be known and purposefully looks for people who can and are willing to participate in the study. In this study, participants had to be teachers who, having acquired computers – either personally or at the school where they work – only recently, had little or no experience of cross-curriculum ICT integration. Secondly, the teachers had to be teaching Social Sciences because there is limited research on ICT for teaching and learning in the humanities classrooms (see Lee, 2000; Hafeez, Khattak, & Gujjar, 2011). Thirdly, key participants had to teach Grade 9 or 10. As noted by Gunzo et al. (2012) learners in these grades could be expected to have had some experience with technology, especially cellphones, which might provide them with some relevant skills when using computers. Also Grade 9 was a good year as learners are not busy preparing for state exams in that year and can spare some time to participate in research. All key participants voluntarily agreed to take part in this study. Pseudonyms were used for all six key participants. Principals and learners of some of the key participants provided additional information on the school and classroom context respectively. For example, I used the interaction with the principals to understand the schools and their functioning, the ICT available at the schools and its use, as well as the measures put in place to support the teachers in their quest to use computers in their teaching.

4.2 DATA COLLECTION METHODS

In this section I outline the four methods I used to gather data, i.e. questionnaires, interviews, observations and document analysis. Before embarking on the data collection for the main study, I conducted a pilot study. Polit, Beck and Hungler (2001, p. 467) define a pilot study as "a trial run done in preparation for the complete study". De Vos (2002) postulates that a pilot study takes place in a setting convenient for the researcher and that resembles the one used for the main study. A school in the category of marginalised schools as I defined them in chapter 1 was used. I asked for a volunteer from one of the in-service ACE-ICT student teachers who taught at a township school in Grahamstown – where I lived – for convenience.

4.2.1 Questionnaires

Questionnaires were used in this study as a way of collecting data quickly from large numbers of teachers in Grahamstown and Dutywa. Babbie (2010) states that questionnaires "are the best way of collecting original data for describing a population too large to observe directly" and are ideal for "measuring attitudes and perceptions in a large population" (p. 232). Paper questionnaires were chosen ahead of online or telephone questionnaires to maximise the number of respondents, as the Internet is not readily available to the people in the context targeted. Considering the topic, an online survey would have introduced an unnecessary bias in favour of participants familiar with digital technology. Two questionnaires were designed and piloted, one for teachers and another for learners.

The teacher questionnaire data provided a broad understanding of the perceptions and experiences of teachers in the two educational districts. Administering the questionnaire in Grahamstown was simpler than in Dutywa, where schools were remote and difficult to reach. The Dutywa district office helped distributing the questionnaire to teachers when they visited the office. I was aware that not all teachers visit the district office, but those who do are representative of the schools in the district. The district office often runs different courses for teachers' continuous professional development in the form of workshops, seminars and discussion groups. Understanding learners' social context, perceptions and experiences with computers and cellphones appeared important to interpret the perceptions and experiences teachers had towards the use of computers in the classroom.

I initially considered and piloted a focus group discussion with the learners before opting for a questionnaire. Firstly, it was difficult to get the learners to participate in the discussion as most of them left for home immediately after the lesson with pre-arranged transport. Although the pilot took place in the afternoon, morning sessions would present similar problems with timetable clashes. Secondly, learners' body language suggested that some were giving false information in order to impress their peers. Thirdly, what Fontana and Frey (2008) call groupthink may have been at play, as evidenced by answers such as "*Yes me too, I agree with him, I did the same*". A questionnaire seemed a better alternative, less time consuming for the learners and quicker to analyse. As suggested by Peat, Mellis, Williams and Xuan (2002) soon after they completed the questionnaire, I asked learners what they thought each question meant, what they did not understand and what was unclear. I noticed that learners asked their teacher to translate some of the questions for them. I reworded two questions and removed two questions, which the learners indicated were vague. During the pilot, I took note of the time that learners took to complete the questionnaire (Peat et al., 2002), and factored in between 15 to 20 minutes for the main study.

Both questionnaires required responses on a Likert scale, a standard practice in attitudes research (Bertram, 2012). Likert scales are simple to construct, easy to read and complete for participants and they are likely to produce a highly reliable scale (Bertram, 2012). However, Likert scales present challenges as outlined by Bertram (2012) which I needed to deal with. Often in Likert scales participants may avoid extreme response categories, known as central tendency bias. I used negative statements and started from strongly disagree to strongly agree because people tend to agree when faced with a Likert scale (McLeod, 2019). It is also common for participants to agree with statements as presented in order to please the researcher. This was particularly true with the learner questionnaire where the learners wanted to please their teacher who had their lecturer visiting their class. From the pilot I learnt that learners seemed to be more concerned with portraying themselves in a socially favourable light rather than with being honest. In order to deal with this, all questionnaires were anonymous, and both handed out and collected by myself since I did not know the learners personally. I used the standard five-point scale for the teacher questionnaire but included a sixth option – 'I don't know' – on the Likert scale for learners (see Appendix I). This was after most learners indicated that they did not know answers to some of the statements and had ended up selecting neutral. For example, learners who had never used a computer did not know how to respond to the statement, "*the computer is easy to use*" or "*I use the computer to learn things*".

Both questionnaires had four sections, demographic data, prior experience with computers, experience with mobile phones and perceptions towards the use of computers in the classroom. Closed-ended questions and open-ended question were included in the questionnaires. Four of the questions in the *teacher* questionnaire (see Appendix D) related to perceived ease of use of computers – that is, the extent to which the teachers thought that computers were easy to use, understand or operate as outlined by Davis (1989) in the TAM. Another major determinant of the use of ICT is how useful teachers perceive them to be, that is, the degree to which teachers believe technology will enhance their performance (Davis, 1989). As such four statements related to the perceived usefulness of computers were included in the questionnaire. As discussed in section 3.3.2 above, TAM recognises attitudes as an important determinant of the experience a user has of technology (Elwood et al., 2006). Attitudes make up the internal variables that teachers (or any users of technology) draw on to make decisions on whether or not to use ICT. As such, in the questionnaire I included four statements on attitudes and six statements that captured challenges or barriers to ICT use.

Table 4-1: Likert scale statements included in the teacher questionnaire (see Appendix D)

Likert scale statements
Perceived ease of use PEU1: I find the computer is easy to use PEU2: It takes up much time for me to find things on the computer PEU3: I find the computer difficult to use PEU4: I find it easy to get the computer to do what I want to do *Perceived usefulness* PU1: Overall, I find the computer useful in my job as a teacher PU2: Using the computer for teaching saves me time PU3: ICT is not considered to be useful in my school PU4: Using the computer makes it easier to do my job as a teacher *Affect/attitudes* A1: I enjoy using the computer A2: It is fun to use the computer A3: I get anxious when I have to use a computer A4: Using the computer will complicate my life as a teacher

Barriers to ICT integration B1: I do not have sufficient confidence to try teaching with computers alone B2: My learners do not have access to the required ICT tools outside of the school premises B3: There is too much work involved in using computers in teaching B4: I do not have the time to develop and implement ICT related activities B5: My learners do not possess the required ICT skills B6: My school does not have the required ICT infrastructure

The table (4.1) above shows the Likert scale statements and their categories.

4.2.2 Interviews

Interviews are a data collection tool that can be used to find out things that cannot be seen or heard such as interviewees' inner state and reasoning behind their actions and feelings. Interviews are "active interactions between two or more people leading to negotiated, contextually based results" (Fontana et al., 2008, p. 119). Interviews can be conducted in three ways. A focus group interview involves a small group of respondents whose discussion about a particular topic is guided by the interviewer. Focus groups are often used when it is envisaged that the group dynamic might lead to interaction. As discussed above, the pilot study suggested the limitations of focus groups for this study. Secondly, interviews can be conducted on the telephone or online. Although this type of interview is considered impersonal and body language is lost, I used it minimally when I conducted follow up interviews with participants. Instead of travelling to the schools where these teachers worked, telephone calls and WhatsApp text messages were a convenient, fast and cost-effective way of getting information from the teachers. This interview type was limited only to follow up and not any other interviews, as I was dealing with attitudes of people from a culture different to mine and understood that reading clues from body language was extremely important. Options such as the use of Skype for interviews (Hanna, 2012) was not possible in this study due to connectivity issues and costs.

The final way of conducting interviews is the face to face method which I used extensively in this research.

There are three types of interviews, structured, unstructured and semi-structured (Bryman, 2012). The structured interview is restrictive and often too formal (Edwards & Holland, 2013). Questions are set, and the interviewer cannot deviate from them either by probing or following up on the interviewee response. Given the topic of discussion and being aware from literature that it is difficult to articulate cognitions, attitudes and perceptions, the structured interview was seen as inappropriate for this study. I anticipated that I would need to probe and direct my participants to verbalise aspects with which they might struggle. Unstructured interviews require a high level of skills on the part of the interviewer in order for them to be a useful exercise (Edwards et al., 2013). I was sceptical of undertaking an unstructured interview as I was weary of losing control of the interview, of wasting time and of failing to gather useful data.

I conducted semi-structured interviews. I prepared a set of all important questions that I wanted all my participants to respond to but was open to adapting or altering the rest of the questions as the interview progressed. This type of interview allowed for probing and following up on what a participant said but at the same time gave my interviewees enough space to speak freely (Edwards et al., 2013). I interviewed the school principals for school A and school B as well as an IT representative at school B (see Appendix F) to understand the state of ICT at the schools. The questions focused on the "vision of the school, ICT infrastructure and support available for teachers which research has found to be key determinants for the use of ICTs in schools" (Howie, 2010, p. 509). I also interviewed the three key participants (see Appendix F) about their background, prior experience with technology, perceptions and beliefs on the use of computers in teaching and learning. Interview questions were generated from the dimensions of the Technology Acceptance Model (TAM), perceived ease of use and perceived usefulness of computers as well as the Teacher Cognition theory.

Stimulated recall interviews (see Appendix F) were conducted with each teacher after classroom interventions to capture what the teacher "thought (about the lesson) and what they experienced" (Van der Mescht, 2008, np). In stimulated recall interviews, the interviewer uses data generated through observations or document analysis to kick start a conversation around an issue. Stimulated recall interviews can be used to trigger a memory, draw the attention of the interviewee to something specific or to confirm or verify information. I used video footage of the teaching in class to ask teachers to explain what was going through their minds as they were teaching in class. The recordings were helpful in getting the teachers to verbalise their experiences of teaching with ICT in the classroom.

4.2.3 Observations

Observation involves "a prolonged immersion to gain first-hand knowledge of the context, primarily through observation of individuals as they go about their normal work activities" (Gillham, 2000, p. 46). It also involves listening to what people say to each other, engaging in conversations and using some people as informants. Observation emphasises meaning and interpretation (Gillham, 2000). Observations start with descriptive observations of context, the people, activities, and apparent feelings to develop a general picture of what is happening on the surface (Gillham, 2000) in the classroom. I conducted a variation of observation in that my observations were not prolonged and were not conducted as participants went about their normal activities. Instead, observations in this study were restricted to two visits to a school and one classroom observation and the teachers were teaching for the first time with computers in their classrooms. Observation allowed me to vividly describe and explain the classroom context and what was happening as computers were being used. The observation method was "the most direct way of getting data – not what people have written on a topic, or what they have said but what they actually do" (Gillham, 2000, p. 46). I used my observations during the stimulated interviews as a way of probing teachers to say more on what happened as they were teaching.

During the pilot study, I observed two lessons. The teacher taught Social Sciences and the lessons observed were on History. The observations were useful in that they assisted me to clarify what to look for during the observations in the main study. I also used the pilot to take note of the time needed to set up the ICT tools in the classroom. For the in-service ACE-ICT interventions, I was taking to the classrooms the mobile computer lab and data projector for the teachers. During the pilot study, I tried out the whole process of transporting the mobile computer lab, checked to see the time needed to set up the netbooks before the teacher could use them, as well as connecting the data projector and starting up the PowerPoint presentation. This information was important for the key participants as I shared it with them during their planning and preparation of their classroom interventions.

Prior to the start of this study, Rhodes University acquired a mobile computer lab populated with 12 netbooks. I developed a model that allowed student teachers to use the mobile computer lab in the in-service ACE-ICT class. This was critical and served several purposes. Since the student teachers had no prior experience of using computers in their teaching this model provided an opportunity for student teachers to become familiar and comfortable using computers before the classroom interventions. I intended to use this Rhodes University mobile computer lab populated with 12 netbooks to address the challenge of physical access in these student teachers' schools. I believed a successful model could be replicated in marginalised contexts in South Africa. I used the limitation of the 12 netbooks for a class of 20 to model the use of limited ICT resources effectively in the classroom. For example, as the student teachers had to share the netbooks, this sometimes meant that some of them could not finish the work they had to do. I addressed this by identifying student teachers who were reasonably comfortable with the netbooks and so worked faster and asked them to use the netbooks first. I also allocated more time for work done on the netbooks by carefully planning all activities of my lectures. I expected that this experience of working with limited resources would encourage student teachers to think deeply and creatively about their own classrooms and influence the planning of their classroom activities. I anticipated that using the same, well supported and fully functional mobile computer lab would make the experience of teaching with computers more rewarding for student teachers and support meaningful sharing and reflection of the experience within a community of practice.

An observation guide assisted me to keep focused during the lessons. The observation guide (see Appendix G) was prepared using the Cultural Historical Activity theory concepts as well as Mwanza's (2002, p. 86) eight-step model (see table 4.2 below).

Table 4-2: Eight-step model (Source: Mwanza, 2002, p. 86)

Activity System component	**Question to ask**
Activity	What sort of activity am I interested in?
Objective	Why is this activity taking place?
Subjects	Who is involved in carrying out this activity?
Tools	By what means are the subjects carrying out this activity?
Rules and regulations	Any cultural norms, rules and regulations governing the performance of this activity?

Division of labour	Who is responsible for what, when carrying out this activity and how are the roles organised?
Community	What is the environment in which the activity is carried out?
Outcome	What is the desired outcome from this activity?

The observation method is time consuming (Gillham, 2000) but preparing and using the observation guide in the classroom made it much easier and manageable. The guide was also very helpful at the analysis stage of the observation data. One lesson was observed for each of the three in-service ACE-ICT key participants. Field notes were kept to record details of classroom tasks, teacher actions, and student actions involving technology use (see sample Appendix H).

4.2.4 Document analysis

Document analysis is a "systematic procedure for reviewing or evaluating both printed and electronic material" (Bowen, 2009, p. 27). The initial data was gathered through a learning management system at Rhodes University, which was used for both the in-service ACE-ICT and in-service BEd-ICT courses. The data collected from the learning management system included student teachers' expectations for the course and a self-report of the resources available at their schools. One of the uses of document analysis as outlined by Bowen (2009, pp. 29-30) is the "provision of data on the context within which a study is conducted". Given the context where these teachers worked and based on literature, I anticipated that a tension would emerge between course expectations (i.e. teaching with ICT in the classroom) and the context in which these student teachers worked, which often did not provide physical access to computers. At schools where computers were available, these were often old, poorly maintained and few. This meant that the only real experience most of the student teachers had with functional computers was during contact sessions at Rhodes University. Relatively few student teachers could be expected to own personal computers. Document analysis at this stage of the research suggested questions that I needed to ask and situations that I needed to observe and manage (Bowen, 2009).

Both the in-service ACE-ICT and in-service BEd-ICT student teachers wrote a narrative entitled "How I became computer literate" to cover systematically a wide range of issues from their earliest memories and experiences using computers or any other technology to attitudes and perceptions towards the use of computers. I used this story to ascertain the teachers' motivation for ICT use, and to probe the teachers' understanding of the computer as a teaching tool. Both the in-service ACE-ICT and in-service BEd-ICT key participants prepared lesson plans which were analysed. In addition, the in-service BEd-ICT key participants also wrote reflections on the classroom activity and these were also analysed. As a researcher, I kept a journal to reflect on the lessons I observed. Below is a table (4.3) that shows the data collection methods discussed above and where or how they were used in this study.

Table 4-3: Data gathering matrix

Phase	**Description of phase**	**Participants involved**	**Date spectrum**	**Data gathering tool**	**Location of data gathering tool in appendices**
Phase 1 in Chapter 5	Snapshot overview of the perceptions related to ICT of teachers	183 teachers	February to June 2013	Teacher Questionnaire	Appendix D
Phase 2 in Chapter 6	In-service ACE-ICT students' perceptions	40 in-service ACE-ICT students	2010 and 2011	1.In-service application form page 3 2.How I became computer literate written narrative brief 3.Proposal for the use of the Mobile computer lab 4. Mobile computer lab [online questionnaire]	Appendix E1 Appendix E2 Appendix E3 Appendix E4

Phase 3 in Chapter 7	Zooming into experiences and perceptions of in-service ACE-ICT students that teach Social Sciences	3 in-service ACE-ICT Students	April to October 2013	Interview questions 1.School A: a. Principal interview b. How I became computer literate narrative c. Mr Asiya interview d. Stimulated recall interview 2. School B: a. How I became computer literate narrative b. Mrs Banda Interview c. Stimulated recall interview 3.School C: a. Principal interview b. How I became computer literate narrative c. Mrs Chamu interview d. Stimulated recall interview e. IT representative interview	Appendix F
				4.Observations a. Observation guide b. Field notes -sample	 Appendix G Appendix H
	Learners perceptions of ICT use in education	113 learners	April to May 2013	Learner questionnaire	Appendix I
Phase 4 in Chapter 8	Zooming into experiences of B.Ed. ICT students that teach Social Sciences	1.74 B.Ed. ICT student teachers 2.3 B.Ed. ICT students	1.January 2015 2.2017	1. Selection questionnaire 2. Lesson plan template 4. Lesson plan and reflection online questionnaire	1.Appendix J 2. Appendix K 3. Appendix L
				2.Mr Dali; Mrs Efi and Mrs Fani a. Selection form b. How I became computer literate narrative c. Application form page 3 d. Lesson plan e. Reflection on the lesson	

4.3 DATA HANDLING

In this section, I discuss how data was analysed. I also discuss ethical issues and how I handled the data to ensure that the trustworthiness of my findings was not compromised.

4.3.1 Data analysis

The analysis of both quantitative and qualitative data began as soon as data collection started. The questionnaire data was captured using Ms Excel and analysed using descriptive statistics. Teachers' personal characteristics were captured by binary oppositions, e.g. between males and females, experienced and inexperienced, as well as young and old. Teachers 35 years old and younger were referred to as young teachers while teachers over 35 years old were referred to as older teachers. In South Africa, people between the ages of 14 and 35 are considered youth as stated in the National Youth Commission Act of 1996 (Sekwati & Hirschowitz, 2001; Van der Byl; 2014; The Presidency, 2015). Teachers with less than ten years of experience were referred to as having less experience while those with over ten years of experience were referred to as experienced.

In addition to descriptive statistics, for the teachers' questionnaire (see Appendix D), I analysed each Likert scale statement separately as ordinal data. I accounted for the possibility that different respondents may have subjective understandings of the difference between, for instance, strongly agreeing and agreeing, avoiding the mistake most researchers make when they analyse Likert scales responses as interval data (Bertram, 2012). The next level of analysis of the quantitative data was across variables to check for relationships. A chi-square test was run using statistical package R. To do this, I reduced the Likert scales to nominal levels of agree and disagree. As stated in chapter 1, the following hypotheses were examined:

- Null hypothesis (H_o): Variable 1 (personal characteristics) and variable 2 (perceptions) are independent or are not associated therefore there is no relationship.
- Alternative hypothesis (H_1): Variable 1 (personal characteristics) and variable 2 (perceptions) are dependent or are associated and therefore there is a relationship.

Variable 1 were the personal characteristics of gender, age, teaching experience, subject taught and grade taught. Variable 2 were the four categories of the Likert scale statements, perceived ease of use, perceived usefulness, attitudes and barriers to ICT integration (see table 4.1 above). The chi-square test was not done for the learner questionnaire as only five items were included as Likert scale statements (see Appendix I).

All field notes taken during and soon after observations were typed (see Appendix H for a sample). All interviews and classroom observations that were recorded were transcribed. Transcripts are available as appendices. Interpretational data analysis was used for data from field notes and interviews. Interpretational data analysis is a process whereby all the data is closely examined to find constructs, themes and patterns (Winegardner, 2000). Time was spent reading the transcripts, i.e. the raw data, over and over again as I began the process of understanding the data. As I analysed my data, I was aware that a novel tool such as a computer in the classroom can cause conflict within the context into which it is introduced (Hardman, 2005).

It was useful reading and re-reading my transcripts – finding new meanings to information and a new understanding of my participants each time I read them. Categorising strategies of coding and thematic analysis were used (Maxwell, 2008). Connecting strategies were also used as a way of understanding the data in context and identifying the relationships among the different elements of the text (Maxwell, 2008). As I analysed data, I learnt that there was no single way of analysing textual data. To quote Patton (2002):

> Qualitative analysis transforms data into findings. No formula exists for that transformation. Guidance, yes, but, no recipe. Direction can and will be offered, but the final destination remains unique for each inquirer, known only when—and if—arrived at. (p. 432)

CHAT elements (subject, tools, community, object, division of labour and rules) were used to analyse the classroom activity. In addition, the CHAT concept of contradictions/tensions was used to delve deeper into the findings and highlight the differences between the traditional and the constructivist teaching method. As discussed in chapter 3 above, contradictions cannot be observed but can be identified through their manifestations (Engeström & Sannino, 2011; Scanlon et al., 2005). Activity theory triangles were presented for each case to show my understanding of how ICT was used in the six classrooms based on my observations and/or interpretations of the documents received relevant to the lessons taught.

As a multi-case study approach was used for this study, each of the six cases was comprehensively and independently analysed. Once the within-case analysis was complete, cross-case analysis was conducted. In the cross-case analysis "general explanations were made that fit each of the individual cases, even though the cases varied in their details" (Yin, 2003, p. 121). After the contextual variables and data findings for each single case were individually discussed, cross-case analysis was done to find patterns and build abstractions that applied across all the cases (Merriam, 1998). As patterns emerged in the data, the analysis became more focused and selective. This led to the gradual refinement of the categories used to interpret the data. Field notes and videotapes were regularly reviewed to create initial categories for teacher-student-technology interactions. Categories were progressively tested and refined against further observations, interviews and questionnaire responses (Goos et al., 2003). What all these strategies used for data analysis had in common is that they looked for relationships that connected statements within a particular context into a coherent whole.

4.3.2 Ethical considerations

As I embarked on this study, I was aware of a number of formal requirements I had to satisfy. First, permission to conduct the study was obtained in the form of approval of my proposal by the Rhodes University Education higher degrees committee. After this, a letter seeking permission to conduct the study was submitted to the Department of Basic Education district offices in Idutywa and Grahamstown districts (see Appendix A). I also submitted formal letters to the three principals (see Appendix B). Although my sample was selected purposively, participation was voluntary, and all teachers signed an informed consent form (see Appendix C). Teachers were informed of their right to withdraw at any time and the option for their class activities not to be considered as part of the study. Questionnaires were anonymous so that the confidentiality and anonymity of the participants could be upheld. All video recordings were taken from the back of the classroom to maintain the anonymity of the learners.

The advantage of having an existing relationship with the student teachers was that I gained access into the schools and classrooms easily. I did not face challenges of access to the schools. The teachers communicated to their principals on my behalf. My first visit to the three schools was not to negotiate access but to introduce myself, continue the conversation about my research with the principals and deliver formal permission letters. Building and maintaining good relationships throughout this study was valuable but involved particular ethical implications in asking the student teachers to participate in my study while they were still my students. When I made the initial announcement calling for participants in my research, there was a lot of confusion, with some teachers thinking that they would be treated differently if they did not want to participate in the study. There were fears that assessments would be compromised once I became closer to the teachers participating in my study. Another fear among the teachers was that they did not want to be observed by their lecturer. Although they knew that the study was not in any way directly related to the work covered in the course, teachers felt that I was going to judge them once I went to observe them for my study. Teachers felt pressurised to volunteer so that they could remain in my good books. As a result of these issues, I postponed data collection until the teachers completed the in-service ACE-ICT course. While this meant a delay in the study, it was a risk I felt was necessary and useful because it strengthened my study.

4.3.3 Ensuring trustworthiness of the data

Trustworthiness refers to the degree of trust or confidence readers have in the results (Jordan, Gust and Scheman, 2011; Schmidt & Brown, 2015). Trustworthiness of a research is based on the concepts of reliability and validity (Seale, 1999).

Reliability and validity of the questionnaire

Reliability is the ability of an instrument (questionnaire) to measure consistently (Hearle and Twycross, 2015; Tavakol, Mohagheghi and Dennick, 2008). The Cronbach's alpha is "the most widely used objective measure of reliability" (Tavakol and Dennick, 2011, p. 53). It is a coefficient of reliability test or a consistency test. The Cronbach's alpha was developed by Lee Cronbach in 1951 to provide a measure of the internal consistency of a test or scale and is expressed as a number between 0 and 1 (Cronbach, 1951). Internal consistency refers to what extent all items in a test or scale measure the same concept/construct hence it is connected to the interrelatedness of the items within a test (Tavakol et al., 2011). Put simply, it is how closely related a set of questions are as a group.

A high value of alpha implies a high degree of internal consistency – however this is not always true as alpha is also strongly affected by the length of the scale (Streiner, 2003, p. 101). If a test or scale too short, the value of alpha is reduced (Streiner, 2003; Nunnally and Bernstein, 1994). Alpha was calculated for each of categories in the questionnaire rather than for the entire scale (Cohen and Swerdlik, 2010; Nunnally et al., 1994). There are different reports on the Cronbach's alpha value. Most researchers consider values of alpha ranging from 0.70 to 0.95 as good (Arbaugh, Bangert and Cleveland-Innes, 2010; George & Mallery, 2003; DeVellis, 2003; Nunnally et al., 1994; Bland and Altman, 1997). However, there are researchers who support the notion that even with Cronbach's alpha values lower than 0.70 a scale can still be useful (Schmitt, 1996). Cronbach himself stated that the key should be for one to be able to interpret a scale adding that this can be achieved even for a scale with low alpha values (Cronbach, 1951).

I measured the reliability of the teacher questionnaire (see Appendix D) by calculating the Cronbach's alpha for each of the four categories of the Likert scale items that were included in the questionnaire. The reliability coefficients shown in table 4.4 below reveal that the Likert scale items in the teacher questionnaire demonstrated sufficient levels of alpha 0.70 or greater for three of the four categories.

Table 4-4: Extract of reliability coefficients for four categories included in the Likert scale

Category	**Cronbach's Alpha**	**Cronbach's Alpha based on standardized items**	**Number of items per category**
Perceived ease of use	.775	.775	4
Perceived usefulness	.711	.720	4
Attitudes	.559	.567	4
Barriers to ICT integration	.774	.792	6

There were four questions in the perceived ease of use (PEU) category which had a high reliability coefficient of α=0.775. Similarly, the perceived usefulness (PU) category consisted of four questions and had a high reliability coefficient of α=0.711. There were six questions in the barriers to ICT integration (B) category and had a high reliability coefficient of α=0.774. These three categories (PEU, PU and B) demonstrated sufficient levels of internal consistency reliability as they had alpha greater than 0.70 (Tavakol et al., 2011; Arbaugh et al., 2010; George et al., 2003). The attitudes category had a sufficient reliability coefficient of α= 0.559 probably because the four questions in this category are not interrelated (Tavakol et al., 2011). The list of the statements for the attitudes category (see table 4.1) show that each question asked for a different attitude. This was purposely done as I intended to measure different attitudes towards computers. Taber (2018) offers another explanation for low Cronbach's alpha values for attitudes stating:

> In educational research, it may be quite difficult to test the reliability of an instrument such as an attitude scale because human beings are constantly changing due to experiences *between* instrument administrations, and also because they may undergo changes due to the experience of the measurement process itself (p. 1274).

Given the alpha values reported above and the explanation given for the attitudes category, I concluded that the questionnaire was an acceptable and reliable data collection tool. There were only five Likert scale items included in the learner questionnaire and therefore the Cronbach's alpha could not be done due to the small number of items (Tavakol et al., 2011).

Validity is defined as "the extent to which a concept is accurately measured" (Hearle et al., 2015, p. 66). Validity was ensured through the piloting of the questionnaires as reported in section 4.3.1 above. The process led to rephrasing and removing of items from the questionnaire. To determine the factorial validity of the questionnaire, an exploratory factor analysis (EFA) was conducted for each of the four categories using SPSS. EFA is "a statistical method used to examine the construct validity of an instrument/questionnaire" (Yu and

Richardson, 2015, p. 135). EFA was used to identify dimensionality of constructs/concepts/attributes by examining the existence of relationships between items and factors (Yu et al., 2015; Netemeyer, Bearden and Sharma, 2003. Unidimensionality is the quality of measuring a single construct, trait, or other attribute. Testing for unidimensionality of the items provides general information regarding factorial validity of the test score. The idea of unidimensionality is often tested thoroughly using a diverse set of analytical tools, for example, exploratory or confirmatory factor analysis or item response theory. Hattie (1985) makes reference to researchers who have used the eigenvalue to determine unidimensionality such as Carmines and Zeller, 1979; Hutten, 1979; Hambleton and Traub, 1973. Hattie (1985 explains further stating that:

> Since the first principal component explains the maximum variance, then this variance, usually expressed as the percentage of total variance, has been used as an index of unidimensionality. The implication is that the larger the amount of variance explained by the first component, the closer the set of items is to being unidimensional (p. 146).

The total variance percentage was used to determine unidimensionality of the four categories as reported below.

Table 4.5 shows that 77% of common variance is explained by the first two eigenvalues (60% by the first eigenvalue).

Table 4-5: Statistical evidence of validity with EFA - Perceived Ease of Use category

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
PEU1	2.396	59.898	59.898	2.396	59.898	59.898
PEU2	.677	16.930	76.828			

PEU3	.485	12.137	88.965			
PEU4	.441	11.035	100.000			
Extraction Method: Principal Component Analysis.						

This means that the perceived usefulness category was unidimensional (Grau, 2007).

Table 4.6 shows that 75% of common variance is explained by the first two eigenvalues (55% by the first eigenvalue).

Table 4-6: Statistical evidence of validity with EFA - Perceived Usefulness category

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
PU1	2.197	54.919	54.919	2.197	54.919	54.919
PU2	.823	20.571	75.490			
PU3	.522	13.054	88.544			
PU4	.458	11.456	100.000			
Extraction Method: Principal Component Analysis.						

This mean that the perceived usefulness category was unidimensional (Grau, 2007).

Table 4.7 shows that 66% of common variance is explained by the first two eigenvalues (44% by the first eigenvalue).

Table 4-7: Statistical evidence of validity with EFA - Attitudes category

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
A1	1.751	43.771	43.771	1.751	43.771	43.771
A2	.888	22.190	65.961			
A3	.793	19.818	85.778			
A4	.569	14.222	100.000			
Extraction Method: Principal Component Analysis.						

This mean that the attitudes category was unidimensional even though this category scored a low Cronbach's Alpha of .559. This supports the notion that even when the Cronbach's alpha is low, the category can still be unidimensional (Grau, 2007).

Table 4.8 shows that 69% of common variance is explained by the first two eigenvalues (44% by the first eigenvalue).

Table 4-8: Statistical evidence of validity with EFA - Barriers category

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
B1	2.995	49.923	49.923	2.995	49.923	49.923
B2	1.153	19.218	69.141	1.153	19.218	69.141
B3	.892	14.864	84.005			
B4	.586	9.771	93.776			
B5	.373	6.224	100.000			
B6	7.893E-17	1.315E-15	100.000			
Extraction Method: Principal Component Analysis.						

This mean that the barriers to ICT integration category was unidimensional (Grau, 2007).

The Likert scale was considered a reliable and valid data scale following the Cronbach's alpha and the exploratory factor analysis reported above.

Reliability and validity of the qualitative data

To ensure trustworthiness of my qualitative findings, I strengthened the process of data collection. For example, all field notes were written down soon after each school visit/observation while details were still fresh in my mind (see Appendix H). Electronic devices such as a video-recording device were used to record all the classroom observations, which made it possible to make thick descriptions of the contexts and my observations. Transcripts were taken back to participants after transcribing for verification of facts, a process known as member checking (Wolcott, 1990). Member checking provided participants with an opportunity to correct errors of fact immediately and to give additional information (Lincoln et al., 1985). Only the final transcript, proofread by the participants, was used as data for the study. All transcripts are available only to the researcher for confidentiality and anonymity of participants. Wolcott (1990) advises starting to write early, reporting fully, writing field notes accurately, being candid and being aware of one's subjectivity at all times as ways of ensuring quality in research. I kept a reflexive journal in which I recorded my reflections each time I visited schools. Each reflection included a description of what I did, details of what happened, how I thought the day went and my feelings towards what happened. I always ended this entry with ideas for improvement allowing me to use each experience to influence the next one.

While there are no claims of a bias-free research (Moen, 2006), I endeavoured to minimise personal bias in my study as I was fully aware of the threat it might have on the results of a qualitative study (Cypress, 2017). Of importance for me was to identify the sources of bias (for example, sampling bias, interpretation bias, researchers' characteristics, etc. (Cypress, 2017; Kriukow, 2018) and formulate ways of reducing the bias and the threat to the validity of my work. Interaction with critical friends and colleagues assisted in spotting blind spots in my sampling method, the interpretation of my data, or the influence of my personal characteristics in my research (Rajendran, 2001). After working with the teachers as their lecturer for two years I had my own biased opinions about their strengths and weaknesses with technology. I could have chosen to work only with strong students but instead I designed a sampling method that helped me select teachers based on the important criteria for this study (i.e. subject taught and willingness to participate) and not based on their performance in class. Bias is also typically expressed in the way data is interpreted. I was careful to distinguish my interpretation from that of the participants. To minimise the influence of my personal bias on the interpretation of data, I relied on the theoretical framework which provided the language of explanations and description of the data. Findings emerged from the data and not my own predispositions (Lincoln et al., 1985).

I triangulated three data collection tools, the interviews, questionnaires, and observations. I included behavioural observation data to confirm the self-reported data from questionnaires and interviews and raise their credibility, reducing the danger of misinterpretation of findings and helping detect possible biases in subject reports (Schaumburg, 2001). Fielding and Fielding (1986, p. 31) suggest that "the important feature of triangulation is not the simple combination of different kinds of data, but the attempt to relate them so as to counteract the threats to validity identified in each". As such, field notes of the observations I conducted were very thorough (see Appendix G and Appendix H).

Peer debriefing was another way I used to ensure the trustworthiness of my study (Robson, 2002). The Department of Education at Rhodes University has a programme that sees all PhD scholars (full-time and part-time) coming together three times a year to attend what are known as PhD weeks. The sessions take the form of seminars, presentations, group work and work-in-progress presentations. These PhD weeks provided an opportunity to discuss my work and get feedback from my peers. As a full-time student, I joined a group of seven other scholars who were also studying full-time in a Friday morning meeting. In these Friday meetings we each had an opportunity to present our work and get feedback from the group. It was in these groups that my "biases were probed, meanings were explored, and bases of interpretation were clarified" (Lincoln et al., 1985, p. 295). I also had critical friends who read my work and often listened to me clarify my thoughts. They helped me to remain honest to myself in the way I interpreted my data. Throughout my research, these opportunities to interact with my peers gave me a space to "clear my mind of emotions, and ideas that would otherwise cloud good judgement" (Lincoln et al., 1985, p. 295).

Responsible engagement is the commitment to listen to and learn from a diverse group of individuals and communities who have a stake in the research product (Jordan et al., 2011). Trustworthiness of data is strengthened by "high response rate, lower attrition, and increased compliance, improved accuracy of reported information and fewer cultural and language barriers" (Jordan et al., 2011, p. 181). As mentioned above I had learnt enough of the local IsiXhosa language to communicate with teachers in their own language and minimise language or cultural barriers. I sought to involve teachers in my study as often and as meaningfully as I could (Jordan et al., 2011). In their study of a community project in America, Jordan and his colleagues (2011) found that there was a challenge with trust between the community and researchers because the community felt that "the researchers were doing research for their personal gain" (p. 175). I explained as often as I could that the research was meant to benefit the teachers and empower them in their use of computers for teaching and also give them the opportunity to try out in a real context all they had learnt in the in-service ACE-ICT course.

4.4 SUMMARY

In this chapter, I presented the methodological choices I made in this study. I discussed my orientation and described the research process. I also articulated how data was collected and analysed as well as how I ensured the validity of my findings. I ended the chapter by outlining some ethical issues I considered for the study. In the following chapters, I present the findings of my research.

CHAPTER FIVE: TEACHERS PERCEPTIONS TOWARDS COMPUTERS: FINDINGS FROM THE QUESTIONNAIRE

This chapter explores "what teachers know, believe and think" (Borg, 2003, p. 81) about computers in teaching and examine their acceptance of a computer as a tool for teaching (Davis, 1989). I used the questionnaire method to collect data from teachers in the Grahamstown and Dutywa educational districts, where the intervention discussed in the following chapters took place.

5.1 FACTORS AFFECTING CROSS-CURRICULUM ICT INTEGRATION

In this section, I discuss personal characteristics and the context within which teachers work.

5.1.1 Personal characteristics

Various demographic and personal characteristics influence the perceptions teachers hold towards computers and their use in teaching. In this study, five characteristics: gender, age, teaching experience, subject taught, and grade taught were analysed. Out of the 183 teachers who filled in the questionnaire, 117 (64%) were female (see figure 5.1 below).

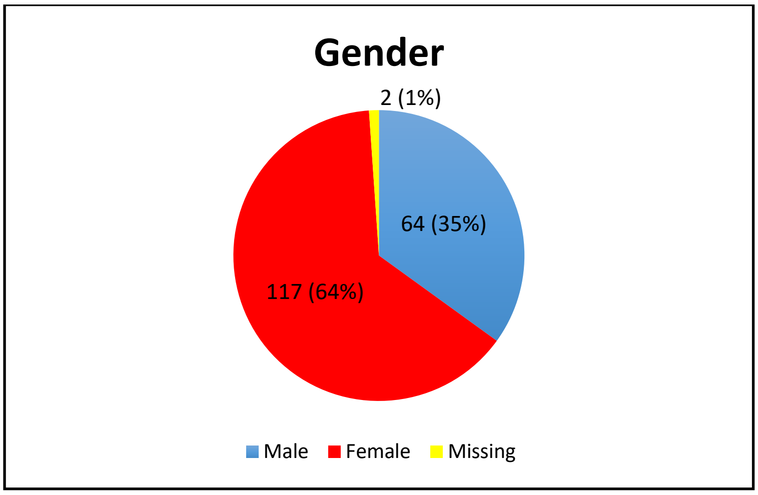

Figure 5-1: Gender (n=183)

According to the DBE (2015) the corresponding figures for the Dutywa and Grahamstown districts are just slightly higher, 71% and 70% respectively. These figures are consistent with literature describing the South African teaching profession as feminised (Crouch, 2003). The influence of gender on ICT integration is inconclusive. Depending on the context, researchers have found that females integrate ICT less when compared to males due to limited access, skills and interest, while in some instances females appear to integrate ICT more readily than males (Volman et al., 2001; Norris et al., 2003; Yukselturk et al., 2009).

The vast majority of the questionnaire respondents (154 or 84%) were teachers over 35 years of age (see figure 5.2 below).

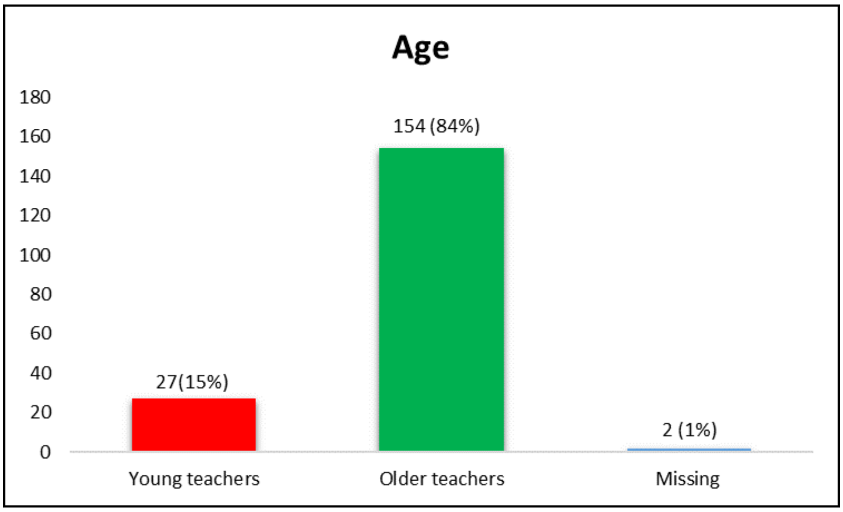

Figure 5-2: Age (n=183)

The increasing average age of teachers has been a topic of discussion in the recent past. South African teachers are ageing (Arends, 2007, p. 14; DHET, 2015, p. 68) and this has implications for the profession. Age differences are responsible for differences in ICT skills in teachers, but do not have a direct influence on whether or not ICT integration takes place in the classroom.

Teaching experience is closely related to age. The majority of the questionnaire respondents (118 or 64%) had over ten years' teaching experience (see figure 5.3 below).

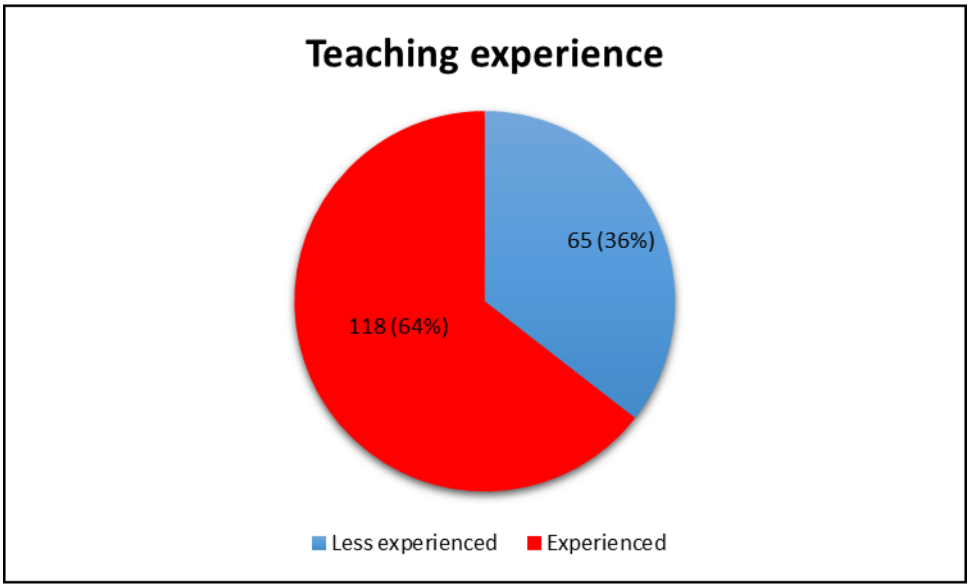

Figure 5-3: Experience (n=183)

Given this finding, one would assume these teachers are likely to integrate ICT in their teaching. Previous studies have found that teachers with more teaching experience are more likely to integrate ICT in their teaching than those with little experience (Russell et al., 2003; Buabeng-Andoh, 2012).

A higher percentage of the questionnaire respondents (66 or 36%) taught both Science and Social Sciences subjects while 64 (35%) taught Science, 41 (22%) taught Social Sciences subjects and 12 (7%) of the questionnaire respondents did not answer the question on subject taught (see figure 5.4 below).

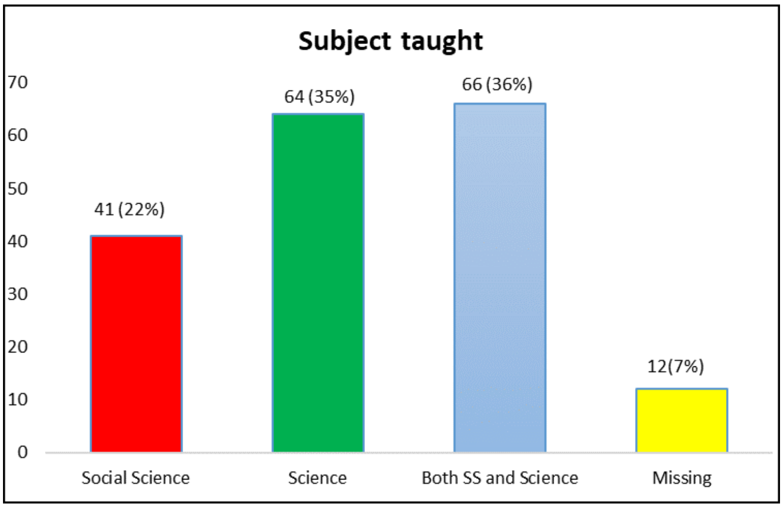

Figure 5-4: Subject taught (n=183)

The vast majority of the teachers (150 or 82%) taught more than one grade and the majority of the teachers (111 or 61%) taught more than one subject (see figure 5.5 below).

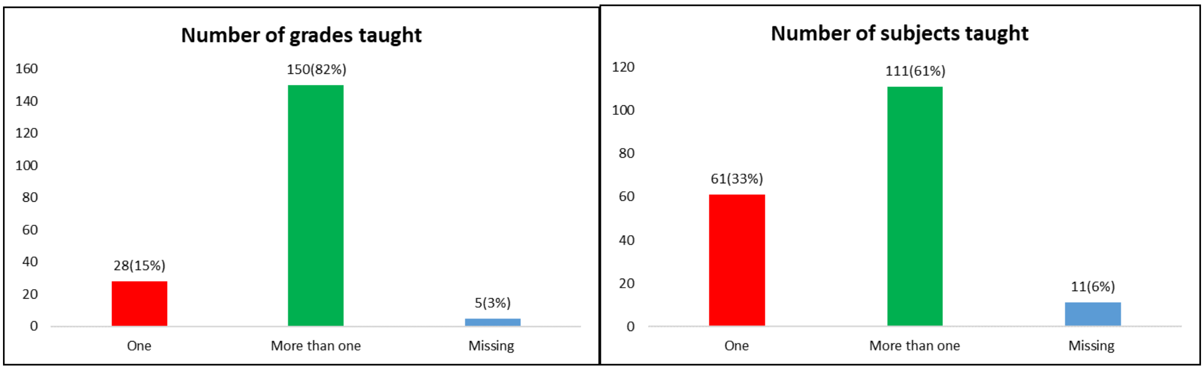

Figure 5-5: Number of grades taught and subjects taught

The grades teachers taught were divided as primary, secondary and those who taught in both primary and secondary school. The majority (105 or 57%) of the teachers were secondary school teachers as shown in figure 5.6 below.

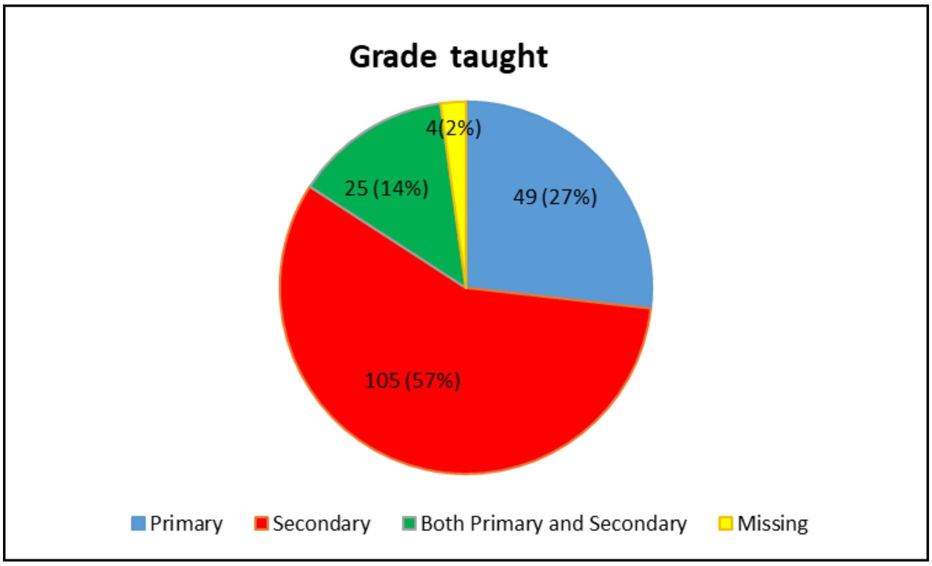

Figure 5-6: Grade taught

Regardless of the class size, these teachers would spend a lot of time preparing lessons for the different grades and different subjects. Heavy workloads might make it difficult for teachers to find time to integrate ICT into their teaching (Abuhmaid, 2011; Samarawickrema & Stacey, 2007).

5.1.2 Context

The context within which teachers operate can influence their perception of computers and the use of computers in teaching. All questionnaire respondents were working and living in marginalised contexts. In such contexts, the teachers are likely to face issues in terms of availability of computers, access to computers and support in using computers, which might influence perceptions towards computers. The majority of the questionnaire respondents (125 or 68%) owned a laptop or desktop computer (see figure 5.7 below).

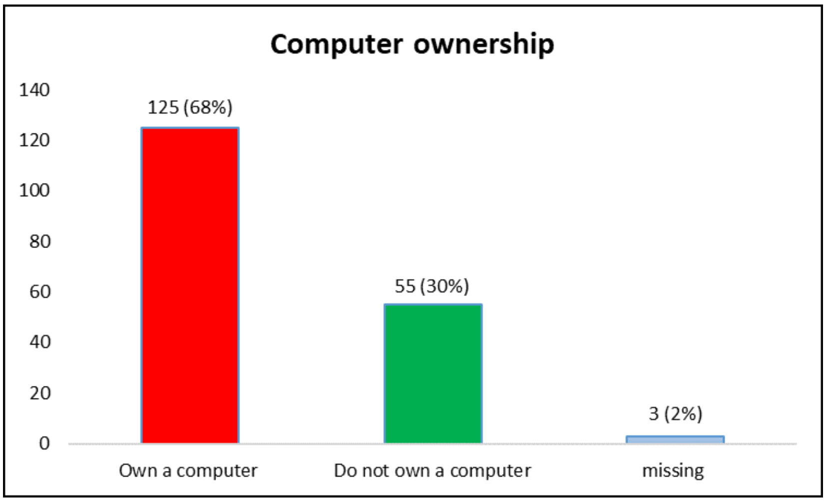

Figure 5-7: Computer ownership (n=183)

Confidence is an important determinant of whether or not computers are used in the classroom. Literature has shown a relationship between computer competence and confidence in the use of computers (Jones, 2004). Less than half of the questionnaire respondents (84 or 46%) claimed that their computer skills were very good to good (see figure 5.8).

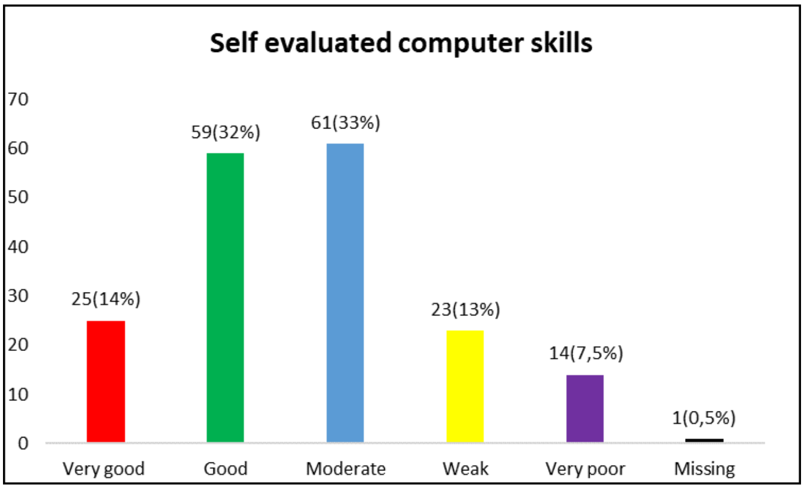

Figure 5-8:Self-evaluation of computer skills (n=183)

The majority of the questionnaire respondents (128 or 70%) claimed to use computers daily to a few times a week (see figure 5.9 below).

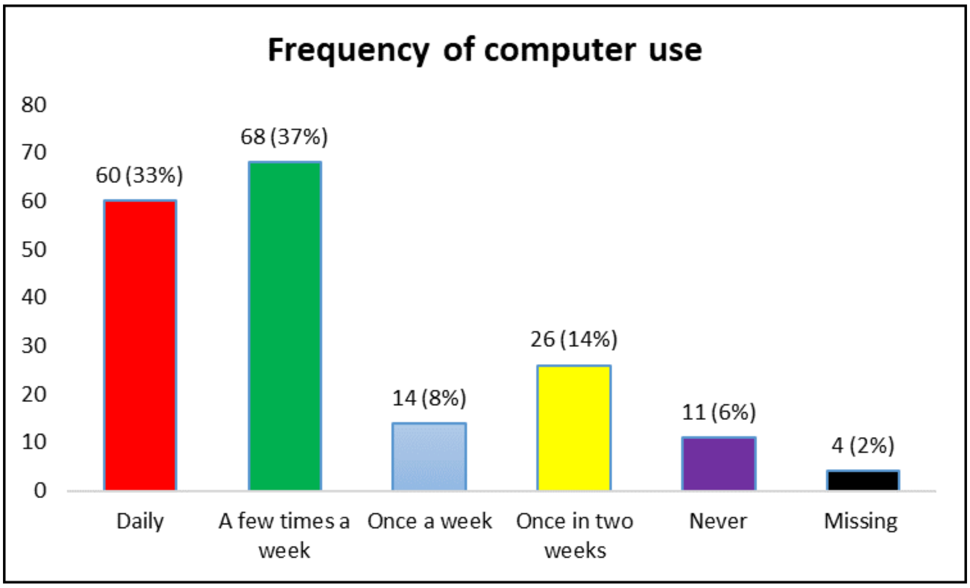

Figure 5-9: Frequency of computer use (n=183)

This finding was important because frequency in using computers increases computer competence and builds confidence (see Jones, 2004) which in turn influences perceptions. More than half of the questionnaire respondents (101 or 55%) said their schools had computers for teaching and learning (see figure 5.10 below).

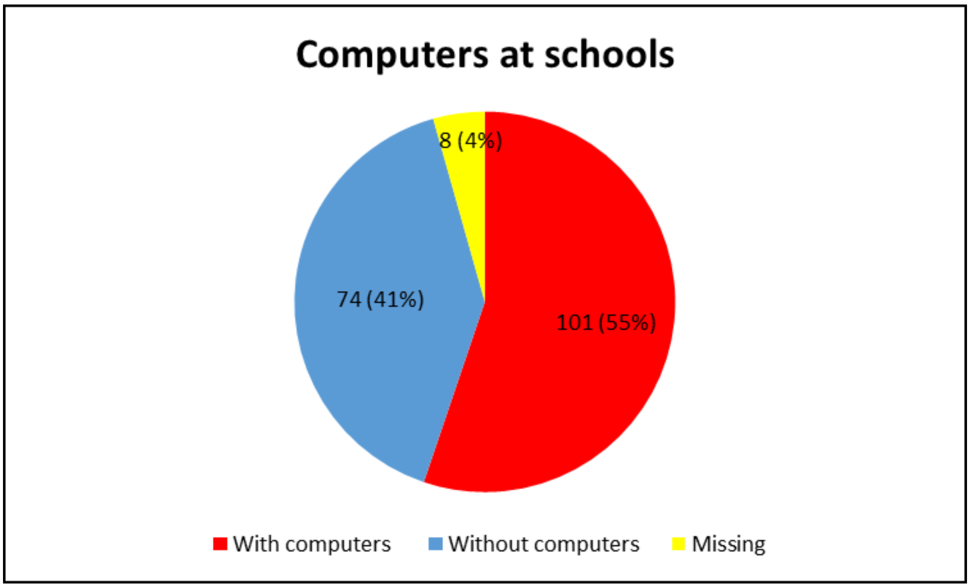

Figure 5-10: Computers at schools (n=183)

Availability of computers at the schools did not equate to actual use. The teachers selected the software application they normally used from the word processor, presentation or spreadsheet application options given. To avoid restricting the teacher's choice, the option 'other' was included. As shown in the figure below, word processing was the most commonly used software application (150 or 82%). Spreadsheets were more common (66 or 36%) than PowerPoint (53 or 29%) (see figure 5.11 below).

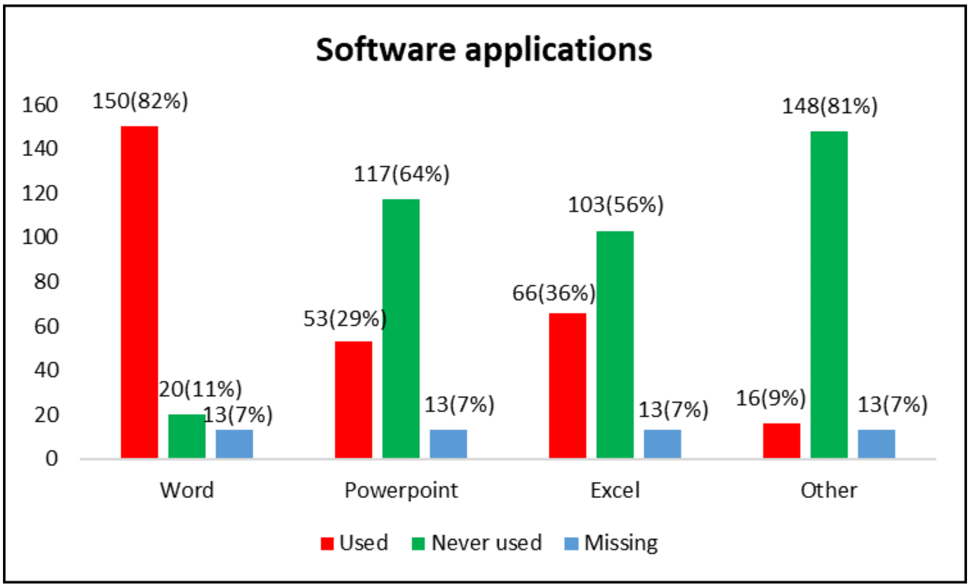

Figure 5-11: Software applications (n=183)

The majority of the 16 questionnaire respondents who said 'other' did not specify what software they used. Only three questionnaire respondents indicated that they used the Internet (questionnaire respondent number 17); Geogebra (questionnaire respondent number 21); and the CAPS document (questionnaire respondent number 159).

Questionnaire respondent number 69 confirmed using the computer mainly as a productivity tool when she said, "*I never teach using my laptop in the class, I just use it for schedules, tasks, tests and memos*". Teachers appeared to use computers mainly as a productivity tool for planning and preparation rather than for actual teaching or for instructional purposes (see Gladhart, 2001).

Besides computers, teachers had other ICT devices at their disposal, e.g. cell phones. The vast majority of the questionnaire respondents (170 or 93%) owned a cell phone. Slightly more teachers accessed the Internet through their cell phones (141 or 77%) than on the computer (134 or 73%). Furthermore, the vast majority (146 or 80%) of the teachers played games, music and videos on their cell phones (see figure 5.12 below). Compared to the expectations based on the literature reviewed, teachers appeared to live and work in relatively ICT-rich

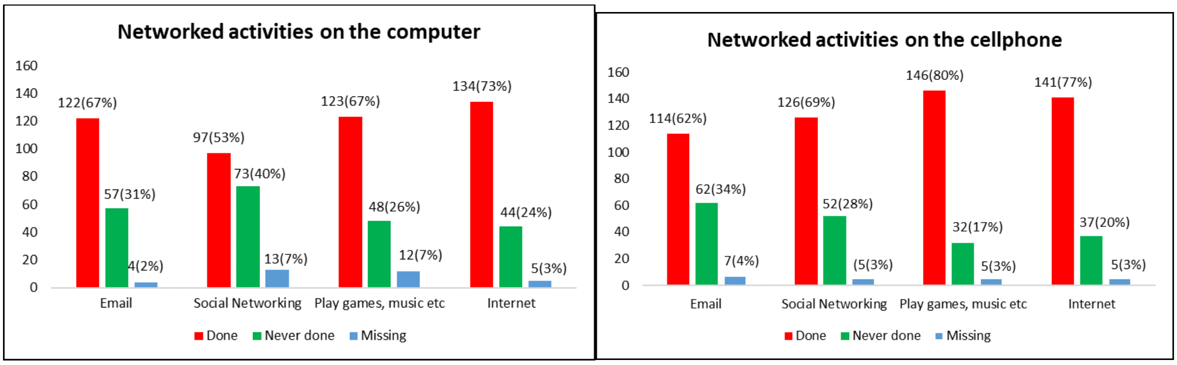

Figure 5-12: Networked activities on the computer and cell phone (n=183)

environments.

Technical support was available either internally or externally in most schools (see figure 5.13 below).

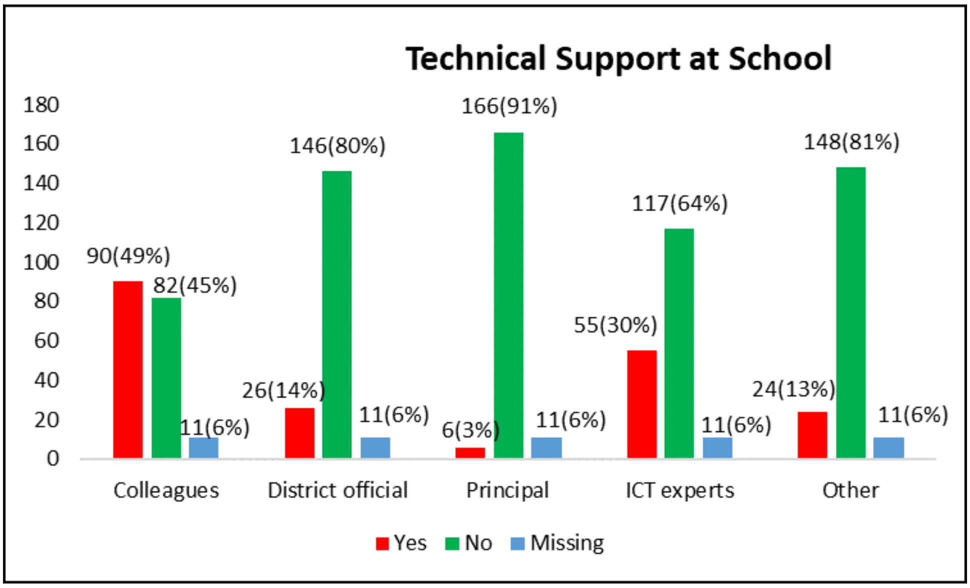

Figure 5-13: Technical Support (n=183)

The results showed that 90 (49%) of the teachers relied on their colleagues for help when they faced technical problems while using computers. Almost a third of the teachers (55 or 30%) relied on researchers from the SLL project. Student teacher 39 from Dwesa said, *"For support we rely on the* [research] *students from Fort Hare and Rhodes to help us."* Only 26 (14%) of the teachers said their source of support was the Education Department district IT official. Most schools in the Dutywa district are sparsely located and this poses logistical challenges for the one technician for the whole district (Personal Communication, Mbete, 2015). One teacher from the Dutywa district said, "*There is a lab technician at the district office; he never comes here, I have never seen him, not even once."* This teacher believed that the district official only visited schools that offered CAT (Computer Applications Technology) as a subject, especially closer to exams so that their labs were in good working condition for the examinations. A few teachers (6 or 3%) said they asked their principals for technical support with ICT. Tong et al. (2005) state that the lack of technical support might frustrate teachers, stir up negative perceptions and might lead to reluctance to use computers for fear of breakdowns. The 24 (13%) questionnaire respondents who selected 'other' on this question did not specify who the others were. Only 46 (25%) of questionnaire respondents felt that ICT was not considered useful at their school. The majority of questionnaire respondents (106 or 58%) said that their students did not possess the required ICT skills for them to use ICT in their teaching.

5.2 TEACHERS' PERCEPTIONS

In this section I report on the perceptions of teachers using the two determinants of TAM, perceived ease of use and perceived usefulness.

5.2.1 Perceived ease of use of ICTs in education

Four Likert scale statements were included in the questionnaire. The statements are in table 5.1 below. As indicated in section 4.3.1 the five point Likert scale was reduced to two, agree and disagree, for analysis purposes.

Table 5-1: Descriptive statistics - Perceived ease of use (n=183)

Statements	**Agree**	**Disagree**	**Not sure**	**Missing**	**Mean**
I find the computer easy to use	141 (77%)	24 (13%)	14 (8%)	4 (2%)	1.73
It takes up too much time for me to find things on the computer	57 (31%)	102 (56%)	19 (10%)	5 (3%)	2.17
I find the computer difficult to use	23 (12%)	132 (73%)	14 (8%)	14 (8%)	2.01
I find it easy to get the computer to do what I want to do	143 (78%)	19 (10%)	16 (9%)	5 (3%)	2.17

The findings reveal that the questionnaire respondents perceived computers as easy to use. The vast majority of the questionnaire respondents (141 or 77%) agreed with the statement *"I find the computer easy to use"*. Teachers were given an opposite statement – *"I find the computer difficult to use."* which was meant to counter the above statement, *"I find the computer easy to* *use"*. Only 23 (12%) of the questionnaire respondents agreed with the statement, confirming an earlier finding that the vast majority of the questionnaire respondents find computers easy to use. Closely linked to the question above, teachers were asked to respond to the statement *'I find it easy to get the computer to do what I want to do'* and the vast majority (143 or 78%) of the teachers agreed. The converse of this question *"It takes up too much time for me to find things on the computer"* had 57 (31%) of the questionnaire respondents agreeing with the statement. Lack of training was mentioned as the reason it took questionnaire respondents too much time to use the computer. For example, questionnaire respondent number 31 said, *"…it takes me more time to use computer as I'm not trained on it"*. Respondent number 36 said, *"…my computer skills are not that much so it cost me time using a computer"*.

5.2.2 Perceived usefulness of ICTs in education

In this section, I discuss the teachers' perceived usefulness of computers. Four Likert scale statements were included in this category (see table 5.2 below).

Table 5-2: Descriptive statistics - Perceived usefulness (n=183)

Statement	**Agree**	**Disagree**	**Not sure**	**Missing**	**Mean**
Overall, I think the computer will be useful in my job as a teacher	163 (89%)	7 (4%)	8 (4%)	5 (3%)	2.49
Using the computer for teaching will save time	135 (74%)	10 (6%)	30 (16%	8 (4%)	1.84
ICT is not considered to be useful in my school	46 (25%)	106 (58%)	27 (15%)	4 (2%)	1.72
Using the computer makes it easier to do my job as a teacher	149 (82%)	11 (6%)	15 (8%)	8 (4%)	2.33

The vast majority of the questionnaire respondents (163 or 89%) agreed with the statement: "*Overall, I think the computer will be useful in my job as a teacher.*" The majority of the questionnaire respondents (135 or 74%) said that computers save them time. A quarter (46 or 25%) of the questionnaire respondents agreed with the statement *"ICT is not considered to be useful in my school."* Consistent with results reported above, teachers perceived ICTs to be useful in making it easy for them to do their job. The vast majority of the questionnaire respondents (149 or 82%) agreed with the statement: "*Using the computer will make it easier to do my job as a teacher.*"

Questionnaire respondents were asked if, given the opportunity and resources, they would use computers for teaching. The vast majority (161 or 88%) questionnaire respondents said they would (see figure 5.14).

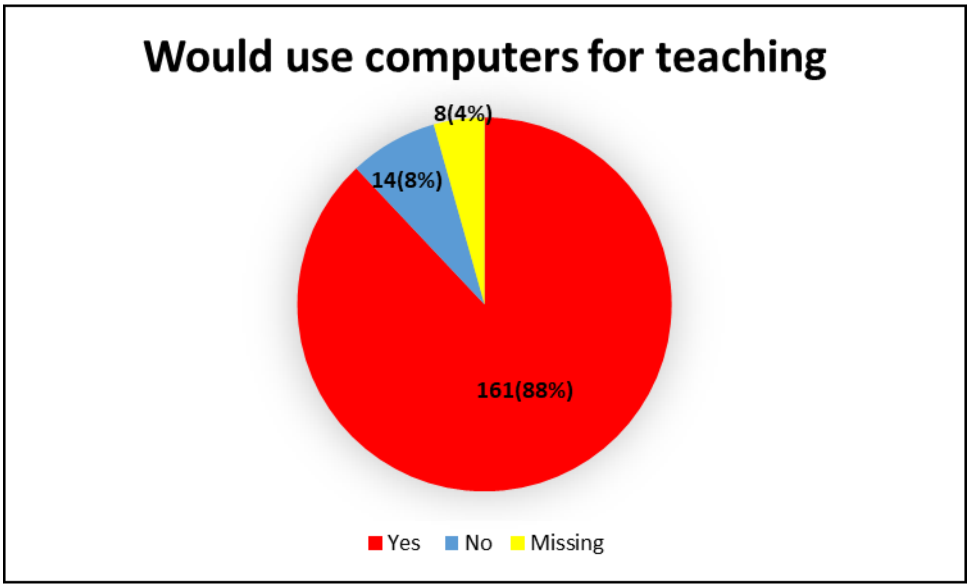

Figure 5-14: Teachers who would use computers in their teaching n=183

Questionnaire respondents were asked if they thought it was worth the effort, time and money to use computers for teaching. The vast majority of the questionnaire respondents (141 or 77%) said it is worth the effort, time and money to use computers for teaching (see figure 5.15).

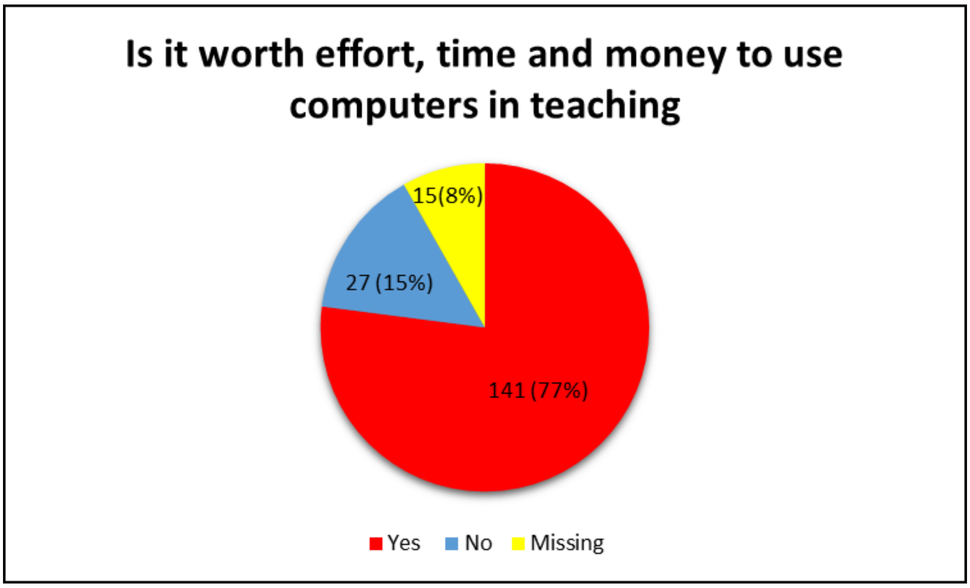

Figure 5-15: Questionnaire responses to question 12 n=183

Following this question of whether questionnaire respondents felt it was worth the effort, time and money to use computers in teaching or not, respondents were asked to give reasons for their answers in the only open ended question in the questionnaire. Of the 183 questionnaire respondents almost a third (56 or 31%) did not give reasons to support their answers to question 12. Of the 127 questionnaire respondents who responded to question 13, there were a total of 185 reasons given by questionnaire respondents which were grouped into two main categories, the positive reasons (these reasons supported using computers in teaching) and negative reason which were against the use of computers in education. The vast majority of the responses (159 or 86%) were positive. As this was an open ended question, questionnaire respondents were free to give more than one reason to justify their answer. Below are the reasons in support of the use of computers in teaching.

a) Easier for teachers to do their job

A total of 33 (18%) of the reasons given by the questionnaire respondents were related to their jobs as teachers. Questionnaire respondents felt that the use of computers would make it easier for them to do their jobs. This is in line with a different question presented above in which the vast majority (149 or 82%) of questionnaire respondents also agreed with the statement *"Using computers will make it easier to do my job as a teacher"*. The following excerpts from three questionnaire respondents show the type of statements questionnaire respondents gave:

"*…it makes work easier for me as a teacher"* (respondent number 169)

"…computers make life easy because you can prepare before the lesson and have notes ready and diagrams ready" (respondent number 133)

"…helping me to do my work, makes life easier" (respondent number 136)

Questionnaire respondents also referred to how using the computer as a productivity tool makes it easier for them to do their jobs. A total of 21 (11%) of the reasons referred to the usefulness of a computer as a productivity tool. Comments such as those below were made by questionnaire respondents:

"*…it gives you an opportunity to keep your work forever, easy to effect changes, will always stay there for a long time"* (respondent number 181)

"…as I am teaching large number of learners with marking very big, my computer is my second in command and assists in my teaching" (respondent number 163)

"Presentations, administration work such as schedules, reports can be done through them" (respondent number 112).

b) Rationales for using ICTs in education

Respondents referred to four rationales as the reasons it is worth investing in the use of ICT in teaching. Teachers noted the *"potential of computers in helping children learn"* though improving understanding of content knowledge as argued by Hawkridge's pedagogic rationale (1990, p. 3). A total of 24 (13%) of the reasons given were pedagogical reasons. For example, questionnaire respondent 27 said: *"learners can understand better because computers help* *them to visualise the concept."* Questionnaire respondent 18 was of the view that: *"access to computers can improve the insight of learners to certain topics which they might have difficulties with."* Questionnaire respondents noted the advantages of technology for learners such as that "…you *stimulate more than one sense of learning e.g. sight, hearing"* (questionnaire respondent 116) and *"…learners remember the work for a long time because they have seen the work"* (questionnaire respondent 118). In terms of classroom management, questionnaire respondents noted that computers could help in monitoring homework. Questionnaire respondent 179 said:

> There will be no excuse like I left my notebook or textbook at home. Learners will have no choice but to do their homework and classwork. If they are also given a computer or laptop, there will be enough time for revision after terms' work has been covered.

A total of 17 (9%) of the reasons given by questionnaire respondents were for the social rationale reason. Questionnaire respondents indicated the importance to prepare learners for the times we now live in. Questionnaire respondents noted: *"children need to be computer literate"* (questionnaire respondent 68) because *"the world of today is technology based, learners need to learn to use computers for academic and social purposes"* (questionnaire respondent 40). Questionnaire respondent 71 put it succinctly saying: *"the world has changed in terms of technology, kids need this."* Computer awareness is therefore not an option, but a necessity given the technological world we live in. There was also acknowledgement of the pervasive presence of computers in our social lives and a need to bring computers into the classrooms: *"our learners are so exposed to these digital devices it is worthwhile to use them for education"* (questionnaire respondent 16).

Teachers explained that teaching and learning needs to change to captivate the interest of the learners. This is consistent with the catalytic rationale which states that ICTs have the power to change the way teaching and learning is done, promote educational innovations, as well as change the role of the teacher in the classroom (Hawkridge, 1990). Only 4 (2%) of the reasons given were for this rationale. Questionnaire respondent 16 said: "*learning needs to be interesting"*. Questionnaire respondents showed that they understood the possibility of change in their roles as teachers in the classroom. Questionnaire respondent 110 said, "*Your kids [learners] can open the computer and work on their own. As a teacher you can just give your learners feedback on their work."* Questionnaire respondents noted the importance of using computers in schools to prepare children for after-school activities such as further/tertiary education or work, what Hawkridge (1990) calls the vocational rationale. Only 2 (1%) of the reasons given were within this rationale. Questionnaire respondent 42 said, "*Learners get exposed to computers before they get to tertiary institutions where they are forced to use them"* while questionnaire respondent 40 said, "*the world of today is technology based. Learners need to learn to use computers for academic and social purposes and in preparation for the world of work."* While this finding suggested the vocational rationale of the use of computers in education, the statements of the teachers were not clear on whether they supported the teaching of ICT subjects that learners could build a career on or cross-curriculum integration of computers.

c) Saving time

A total of 31 (17%) of the reasons given were related to computers saving time. This seemed an important characteristic for teachers. While most of the comments were simply "*saves time*" other questionnaire respondents explained further how computers saved time as such *"no need to write on the chalkboard and waste time"* (questionnaire respondent 166) or questionnaire respondent number 105 who explained *"teaching using a computer saves time because its unlike using a chalkboard where you'll have to write and rub very often health wise it saves* *money because the dust is not good for one's health."* Similar to Cassim et al. (2011), I found that other questionnaire respondents perceived computers as reducing time spent on lesson preparation in the long run as lesson are saved for future use. For example questionnaire respondent 68 said, "*one can plan and prepare work at home using the computer"* while questionnaire respondent 181 said, *"it saves time and it gives you an opportunity to keep your work forever, easy to effect changes, will always stay there for a long time."* Put differently, questionnaire respondent number 101 said, *"what is taught is stored and can be retrieved anytime in future that saves time for preparations. You develop your teaching material easily."*

d) Improving access to information and educational content

A total of 27 (15%) of the reasons given by questionnaire respondents were related to the usefulness of computers as an information gathering tool. There was a view that computers gave access to information immediately, for example questionnaire respondent 23 said, *"I get answers instantly rather than reading or buying books, computers make life easy"*. The Internet also has the advantage of providing access to a variety of information. Questionnaire respondent 138 noted this saying, "… [there is a] w*ide variety of content"* or respondent number 42 who said, *"Teachers are exposed to a variety of information".* Questionnaire respondents also referred to the opportunity to access relevant, recent, up to date information on the Internet as said by respondent number 175: "*it helps you find relevant information".* Questionnaire respondent 8 said, *"Computers offer a lot of knowledge and skills like creativity and innovation because when you are using the Internet you gain a lot of information and as an educator there are so many classroom activities you can get"*. Though this was vague, it was possible this respondent was referring to the South African Department of Education portals such as Thutong and Encarta, which offer teachers access/links to preselected, free educational content/resources. Questionnaire respondent 62 made specific mention of "*educational programs like Encarta.*" Teachers need to be aware that the process of retrieving information on the computer requires skills, such as being able to distinguish authentic sources of information, and the ability to sift through websites for relevant and reliable information.

Results showed that 26 (14%) of the reasons given were against the use of ICT in education. Three main categories for these negative reasons were using computers is time consuming especially for those who had limited skills, there are high costs associated with the use ICT in education and schools had no ICT infrastructure. A total of 14 (8%) of the reasons given were related to the high costs associated with computers. Questionnaire respondents noted the high costs for installation of ICT resources, like respondent 83 who said, *"Yes because for one to have a computer you must have money to buy it. Also to get access to the Internet money plays an important role".* Other questionnaire respondents noted the costs due to consumables that are needed to use the computer, for example respondent number 36 who said, "*It cost me cartridge or money to print".* A total of 10 (5%) of the reason given were that computers are time consuming. Questionnaire respondent 81 said, "You *need to put more time to work with a computer, and for you to understand it you need to put effort".* Some of the comments regarding the time consuming nature of computers were due to the limited skills questionnaire respondents possessed. For example, respondent 36 said, *"my computer skills are not that much so it cost me time using a computer".* Only two (1%) of the reasons given were related to the unavailability of ICT resources. Questionnaire respondent 1 said, *"There is no technological equipment at my school".*

5.3 ATTITUDES TOWARDS COMPUTER USE

Results on the questionnaire respondents' attitudes towards computers are reported in this section. Four questions were included in the teacher questionnaire (see table 5.3 below). In general questionnaire respondents had positive attitudes towards computers.

Table 5-3: Descriptive statistics - attitudes towards computers (n=183)

Statements	Agree	Disagree	Not sure	Missing	Mean
I enjoy using the computer	170 (93%)	3 (2%)	8 (4%)	2 (1%)	2.15
It is fun using the computer	160 (87%)	10 (5%)	9 (5%)	4 (2%)	1.73
I get anxious when I have to use a computer	50 (28%)	109 (59%)	18 (10%)	6 (3%)	1.36
Using the computer will complicate my life	18 (10%)	156 (85%)	4 (2%)	5 (3%)	2.10

The vast majority (170 or 93%) of the questionnaire respondents agreed with the statement *"I enjoy using the computer."* The vast majority (160 or 87%) of the questionnaire respondents agreed with the statement "*It is fun using the computer"*. Fifty (28%) of the questionnaire respondents agreed with the statement "*I get anxious when I have to use a computer."* A few teachers (18 or 10%) agreed with the statement that "*Using the computer will complicate my life"*.

5.4 BARRIERS TO ICT INTEGRATION

Questions were posed to the questionnaire respondents to indicate their views towards ICT integration barriers. Six statements were posed in this section whereby three statements were barriers teachers identified about themselves and three other statements where perceived barriers as it cannot be verified how teachers knew what they said.

Three Likert scale statements were posed asking respondent if they had the barrier or challenge indicated. The three statements focused on lack of confidence, lack of time and perceived heavy workload (see table 5.4 below).

Table 5-4: Descriptive statistics - Barriers towards ICT integration (n=183)

Statement	**Agree**	**Disagree**	**Not sure**	**Missing**	**Mean**
I do not have sufficient confidence to try teaching with computers alone	67 (37%)	85 (46%)	27 (15%)	4 (2%)	1.89
My learners do not have access to the required ICT tools outside of the school premises	105 (57%)	50 (27%)	24 (13%)	4 (2%)	1.74
There will be too much work involved in using computers in teaching	37 (20%)	111 (61%)	30 (16%)	5 (3%)	1.85
I do not have the time to develop and implement ICT related activities	55 (30%)	96 (53%)	26 (14%)	6 (3%)	1.85
My learners do not possess the required ICT skills	106 (58%)	44 (24%)	28 (15%)	5 (3%)	2.10
My school does not have the required ICT infrastructure	89 (49%)	75 (41%)	12 (6%)	7 (4%)	1.92

Computer use requires time commitment. Over a third of the questionnaire respondents (67 or 37%) said they did not have sufficient confidence to try teaching with computers on their own. Only 37 (20%) of the questionnaire respondents felt that *"there would be too much work involved in using computers in teaching"*. Thirty percent of the questionnaire respondents said they did not have time to develop and implement ICT related activities. The majority (106 or 58%) of the questionnaire respondents said their learners did not possess the required ICT skills while 105 (57%) said the learners did not have access to ICT resources outside the school.

Almost half (89 or 49%) of the questionnaire respondents said their school did not have the required ICT infrastructure. This is slightly lower than what is presented in figure 5.10 above where 101 (55%) of the questionnaire respondents said their school had computers for teaching and learning.

5.5 CORRELATIONS BETWEEN PERSONAL CHARACTERISTICS AND LIKERT SCALE ITEMS

In this section I present and discuss the correlations between the five personal characteristics which are represented as variable 1 (gender, age, teaching experience, subject taught and grade taught) and 4 categories (PEU, PU, Attitudes and Barriers) represented in the 23 questionnaire items as variable 2. The correlations were calculated using R and the chi-square test. The test was conducted on each personal characteristic against each of the 23 items in the Likert scale. This gave a more nuanced understanding of the influence of personal characteristics on the 23 items included in this study. The general hypotheses tested (cognisant of the explanations given above) were as follows:

- H_o: Variable 1 and variable 2 are independent or are not associated and therefore there is no relationship.
- H_1: Variable 1 and variable 2 are dependent or are associated and therefore there is a relationship.

A p-value of <0.05 was considered as an indication of a significant relationship/correlation. For easy identification, results from R are presented according to the personal characteristics. Within each category, those questions with a significant relationship are highlighted in green.

Gender correlations

Five questions/statements yielded a dependent result for gender as seen in table 5.5 below. The hypothesis tested for this category were as follows:

- H 1 – gender will not have a significant correlation with statements in the PEU category
- H 2 – gender will not have a significant correlation with statements in the PU category
- H 3 – gender will not have a significant correlation with statements in the attitudes category
- H4 – gender will not have a significant correlation with statements in the barriers category

There was a correlation between computer enjoyment and gender (p – value 0.02263). A higher percentage of females (93%) said they enjoyed using computers compared to males (92%). There was a correlation between confidence to try teaching with computers and gender (p – value 0.005641). A higher percentage of males (62%) said they had sufficient confidence to try teaching with computers compared to 38% of females.

Table 5-5: Gender correlations

Gender versus the questions/statements listed below					
Number	**Statement**	**x-squared**	**Df**	**p-value**	**Decision**
	Attitudes				
1	Enjoy	7.5767	2	0.02263	Dependent
2	Fun	0.091785	2	0.9551	Independent
3	Anxious	0.70183	2	0.704	Independent
4	Complicate	3.0259	2	0.2203	Independent
	PEU				
5	Easy	2.5771	2	0.2757	Independent
6	Take time	1.5272	2	0.466	Independent
7	Difficult	1.0551	2	0.5901	Independent
8	What I want	0.91738	2	0.6321	Independent
	PU				

9	Useful	0.046613	2	0.977	Independent
10	Saves time	0.89357	2	0.6397	Independent
11	Not useful	5.5599	2	0.06204	Slightly dependent
12	Easier to do job	2.9625	2	0.2273	Independent
	Barriers				
13	Confidence	10.355	2	0.005641	Dependent
14	Student no access	8.1537	2	0.01696	Dependent
15	Much work	1.1828	2	0.5535	Independent
16	No time	2.0839	2	0.3528	Independent
17	Student no skill	6.5378	2	0.03805	Dependent
18	No computers	1.2574	2	0.5333	Independent

There was a correlation between the perceived student access to ICT tools outside the school and gender. A higher percentage of females (71%) agreed with the statement that their students do not have access to required ICT tools outside the school compared to 51% of males. There was a correlation between perceived student skills and gender (p – value 0.03805). A higher percentage of female questionnaire respondents (59%) said their students did not possess the required ICT skills compared to 53% of males.

Based on the chi-square test results reported in table 5.5, hypotheses 1 and 2 were accepted because no significant correlation was found between gender and statements in the PEU and PU categories. Hypotheses 3 and 4 were rejected as there was evidence of significant correlation between gender and statements in the attitudes and barriers category.

Age correlations

Only one statement was dependent for age as seen in table 5.6 below. The hypotheses tested for this category were as follows:

- H5 – age will not have a significant correlation with statements in the PEU category
- H6 – age will not have a significant correlation with statements in the PU category

- H7 – age will not have a significant correlation with statements in the attitudes category
- H8 – age will not have a significant correlation with statements in the barriers category

There was no correlation between age and statements in the PEU, PU, attitudes and the barriers categories as shown in table 5.6 below.

Table 5-6: Age correlations

Age versus the questions/statements listed below					
Number	**Statement**	**x-squared**	**Df**	**p-value**	**Decision**
	Attitudes				
1	Enjoy	0.35046	2	0.8393	Independent
2	Fun	2.0364	2	0.3612	Independent
3	Anxious	0.11491	2	0.9442	Independent
4	Complicate	5.126	2	0.07707	Slightly dependent
	PEU				
5	Easy	0.18631	2	0.9111	Independent
6	Take time	0.42956	2	0.8067	Independent
7	Difficult	2.0287	2	0.3626	Independent
8	What I want	1.5108	2	0.4698	Independent
	PU				
9	Useful	0.13407	2	0.9352	Independent
10	Saves time	1.097	2	0.5778	Independent
11	Not useful	0.24545	2	0.8845	Independent
12	Easier to do job	1.1828	2	0.5536	Independent
	Barriers				
13	Confidence	2.0421	2	0.3602	Independent
14	Student no access	0.49572	2	0.7805	Independent
15	Much work	0.65386	2	0.7211	Independent
16	No time	0.84772	2	0.6545	Independent
17	Student no skill	5.5027	2	0.06384	Slightly dependent
18	No computers	1.7961	2	0.4074	Independent

Based on the chi-square results reported in table 5.6 above, all hypotheses for this category were accepted as the results show that age was not significantly correlated to statements in all four categories, PEU, PU, attitudes and barriers.

Teaching experience correlations

No statements yielded a dependent result for teaching experience as shown in table 5.7 below. The hypotheses tested for this category were as follows:

- H9 – teaching experience will not have a significant correlation with statements in the PEU category
- H10 – teaching experience will not have a significant correlation with statements in the PU category
- H11 – teaching experience will not have a significant correlation with statements in the attitudes category
- H12 – teaching experience will not have a significant correlation with statements in the barriers category

There was no correlation between teaching experience and statements in the PEU, PU, attitudes and the barriers categories as shown in table 5.7 below.

Table 5-7: Teaching experience correlations

Teaching experience versus the questions/statements listed below					
Number	**Statement**	**x-squared**	**Df**	**p-value**	**Decision**
	Attitudes				
1	Enjoy	0.36599	2	0.8328	Independent
2	Fun	0.41399	2	0.813	Independent
3	Anxious	2.4372	2	0.2956	Independent
4	Complicate	2.735	2	0.2547	Independent
	PEU				
5	Easy	0.35263	2	0.8384	Independent
6	Take time	0.91763	2	0.632	Independent

7	Difficult	2.6346	2	0.2679	Independent
8	What I want	1.602	2	0.4489	Independent
	PU				
9	Useful	0.48563	2	0.7844	Independent
10	Saves time	3.7469	2	0.1536	Independent
11	Not useful	5.1656	2	0.07556	Slightly dependent
12	Easier to do job	2.4118	2	0.2994	Independent
	Barriers				
13	Confidence	0.34391	2	0.842	Independent
14	Student no access	1.2778	2	0.5279	Independent
15	Much work	0.54746	2	0.7605	Independent
16	No time	1.0954	2	0.5783	Independent
17	Student no skill	0.57725	2	0.7493	Independent
18	No computers	0.98442	2	0.6113	Independent

Based on the chi-square results reported in table 5.7 above, all hypotheses for this category were accepted as the results show there was no significant correlation between teaching experience and statements in the PEU, PU, attitudes and barriers categories.

Subject taught correlations

Two statements were dependant on the subject taught as shown in table 5.8 below. The hypotheses tested for this category were as follows:

- H13– subject taught will not have a significant correlation with statements in the PEU category
- H14– subject taught will not have a significant correlation with statements in the PU category
- H15– subject taught will not have a significant correlation with statements in the attitudes category

- H16– subject taught will not have a significant correlation with statements in the barriers category

There was a correlation between perceived ease of use of computers and subject taught (p – value 0.00755). A higher percentage of teachers teaching Social Sciences (88%) or Science (84%) perceived computers as easy to use when compared to 64% of teachers teaching both Science and Social Sciences. This finding confirms the difference between teachers who teach within one discipline and those who teach across disciplines noted above.

Table 5-8: Subject taught correlations

Subject taught versus the questions/statements listed below					
Number	**Statement**	**x-squared**	**Df**	**p-value**	**Decision**
	Attitudes				
1	Enjoy	3.569	4	0.4675	Independent
2	Fun	4.2241	4	0.3765	Independent
3	Anxious	2.7459	4	0.6012	Independent
4	Complicate	2.7206	4	0.6056	Independent
	PEU				
5	Easy	13.921	4	0.00755	Dependent
6	Take time	5.8581	4	0.21	Independent
7	Difficult	6.6094	4	0.158	Independent
8	What I want	4.6475	4	0.3254	Independent
	PU				
9	Useful	2.8575	4	0.582	Independent
10	Saves time	3.5106	4	0.4763	Independent
11	Not useful	1.2703	4	0.8664	Independent
12	Easier to do job	2.1878	4	0.7013	Independent
	Barriers				
13	Confidence	5.9792	4	0.2007	Independent

14	Student no access	2.2226	4	0.6949	Independent
15	Much work	4.3243	4	0.3639	Independent
16	No time	1.133	4	0.889	Independent
17	Student no skill	8.4917	4	0.07514	Slightly dependent
18	No computers	3.4655	4	0.4831	Independent

Based on the chi-square test results hypothesis 13 was rejected as there was a significant correction between subject taught and statements in the PEU category as reported above. Hypotheses 14, 15 and 16 were accepted as there was no significant correlation between subject taught and statements in the PU, attitudes and the barriers categories.

Grade taught correlations

There were three statements dependent on the grade taught as shown in table 5.9 below. The hypotheses tested for this category were as follows:

- H17 – grade taught will not have a significant correlation with statements in the PEU category
- H18 – grade taught will not have a significant correlation with statements in the PU category
- H19 – grade taught will not have a significant correlation with statements in the attitudes category
- H20 – grade taught will not have a significant correlation with statements in the barriers category

There was a correlation between perceived difficulty in using computers and the grade taught (p – value 0.02973). A higher percentage (17%) of secondary school teachers agreed that they find it difficult to use the computer compared to 8% of primary school teachers and 4% of teachers who teach in both primary and secondary schools. There was a correlation between teachers' perception that computers save them time and the grade taught (p – value 0.0363). A higher percentage (76%) of teachers teaching both primary and secondary school grades believed that computers saved them time when compared to 72% of teachers teaching in secondary school grades only and 69% of teachers teaching in primary school grades only.

Table 5-9: Grade taught correlations

Grade taught versus the questions/statements listed below					
Number	**Statement**	**x-squared**	**Df**	**p-value**	**Decision**
	Attitudes				
1	Enjoy	4.0363	4	0.4011	Independent
2	Fun	2.4299	4	0.6572	Independent
3	Anxious	3.2033	4	0.5244	Independent
4	Complicate	2.9558	4	0.5653	Independent
	PEU				
5	Easy	3.7297	4	0.4438	Independent
6	Take time	5.1184	4	0.2754	Independent
7	Difficult	10.733	4	0.02973	Dependent
8	What I want	0.37305	4	0.9846	Independent
	PU				
9	Useful	1.7317	4	0.7849	Independent
10	Saves time	10.258	4	0.0363	Dependent
11	Not useful	5.1655	4	0.2707	Independent
12	Easier to do job	2.7459	4	0.6012	Independent
	Barriers				
13	Confidence	4.1827	4	0.3818	Independent
14	Student no access	1.6377	4	0.802	Independent
15	Much work	5.3502	4	0.2532	Independent
16	No time	1.6787	4	0.7946	Independent
17	Student no skill	9.1881	4	0.05657	Slightly dependent
18	No computers	3.0379	4	0.5515	Independent

Based on the chi-square test results presented in table 5.9 above, hypotheses 17 and 18 were rejected as there was a significant correlation between grade taught and statements in the PEU and PU as reported above. Hypotheses 19 and 20 were accepted as there was no significant correlation found between grade taught and statements in the attitudes and barriers categories.

In summary, the following table shows the conclusions made based on the hypotheses tested and reported on in this section.

Table 5-10: Conclusions based on the hypotheses tested

Personal characteristic	Likert scale statement	Conclusions based on hypotheses tested
Gender	It is fun to use the computer	Females enjoy using computers more than males.
	I do not have sufficient confidence to try teaching with computers alone	Males have more confidence to try teaching with computers alone than females.
Age	All Likert scale statements	Age does not correlate with statements in the PEU, PU, Attitudes or Barriers categories.
Teaching experience	All Likert scale statements	Teaching experience does not correlate with statements in the PEU, PU, Attitudes or Barriers.
Subject taught	I find the computer is easy to use	Teachers who teach single discipline find it easy to use computers when compared to those who teach multiple disciplines.
Grade taught	Using the computer for teaching saves me time	Teachers teaching across phases find computers time saving when compared to those who teach within a single phase.
	I find the computer difficult to use	Secondary school teachers find computers difficult to use when compared to primary school teachers or those who teach both primary and secondary schools.

5.6 SUMMARY

Teachers who responded to the questionnaire perceived computers as useful in teaching. Evidence presented above showed that teachers considered computers more useful for various functions or activities of teaching, other than teaching itself. Excerpts from the only open ended question in the questionnaire showed that teachers considered computers useful as a productivity, information gathering and representational tools. Teachers perceived computers as important and felt that being aware of computers and knowing how to use them was essential. Most of the teachers had access to a computer at school or at home. They also had extensive personal use of a computer. Teachers perceived computers as easy to use and had high self-evaluated computer skills. Data presented above suggested that female teachers supported and are in favour of the use of computers in teaching even though they lack the skills and confidence and find it hard to use computers when compared to males. Despite facing more challenges with ICT integration than males, female questionnaire respondents perceived computers as useful in teaching. Males, on the other hand, seemed to find computers easy to use, fun, and time saving, yet they seemed least likely to use them in their teaching. There were no significant differences in perceptions between Science and Social Sciences teachers. Instead, findings showed that there were differences between teachers who taught within one discipline and those who taught across disciplines.

CHAPTER SIX: STUDENT TEACHERS' PERCEPTIONS TOWARDS ICT INTEGRATION: FINDINGS FROM THE IN-SERVICE ACE-ICT

This chapter discusses the school context, course expectations and planning of classroom interventions by 40 in-service Advanced Certificate in Education (ICT) students, henceforth referred to as in-service ACE-ICT student teachers. Findings highlight student teachers' perceptions towards the use of computers in teaching and the challenges student teachers face.

6.1 FACTORS AFFECTING CROSS-CURRICULUM ICT INTEGRATION

In this section I discuss the personal characteristics and the context in which the in-service ACE-ICT student teachers worked.

6.1.1 Personal characteristics

Data presented here was gathered from the application forms of the in-service ACE-ICT student teachers (see Appendix E1), the Mobile Computer Lab (MCL) online questionnaire (see Appendix E4) that students completed on RUConnected – a learning management system at Rhodes University, the how I became computer literate narrative (see appendix E2) student teachers wrote and a proposal assignment (see Appendix E3) on how to use the mobile computer lab in their schools which they wrote in their 2nd year of study. The findings on the personal characteristics of the 40 in-service ACE-ICT student teachers are comparable to those presented in chapter 5 above.

The vast majority (34 or 85%) of the 40 in-service ACE-ICT student teachers were female (see figure 6.1 below). At Rhodes University the percentage of female students in professional development courses focusing on ICT seems to match that in other disciplines and is consistent with the overall proportion of females in the profession nationally (Crouch, 2003). Such consistency also appears to be stable over the years. In my own experience being involved in these courses and with the Siyakhula Living Lab training community members, female teachers tend to be at the forefront and often act as ICT champions in their schools and communities.

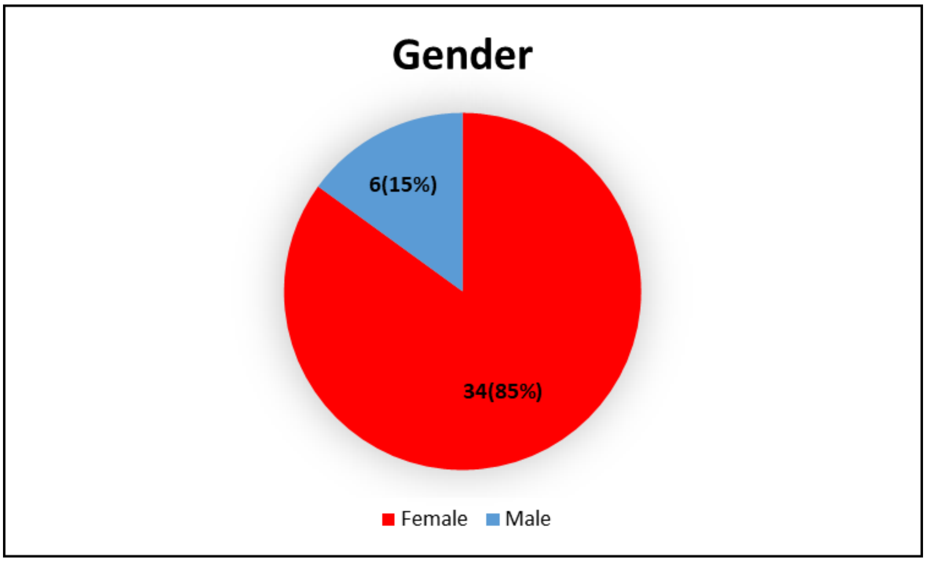

Figure 6-1: Gender n=40

In terms of age, the vast majority (37 or 93%) of the student teachers were over 36 years old (see figure 6.2 below).

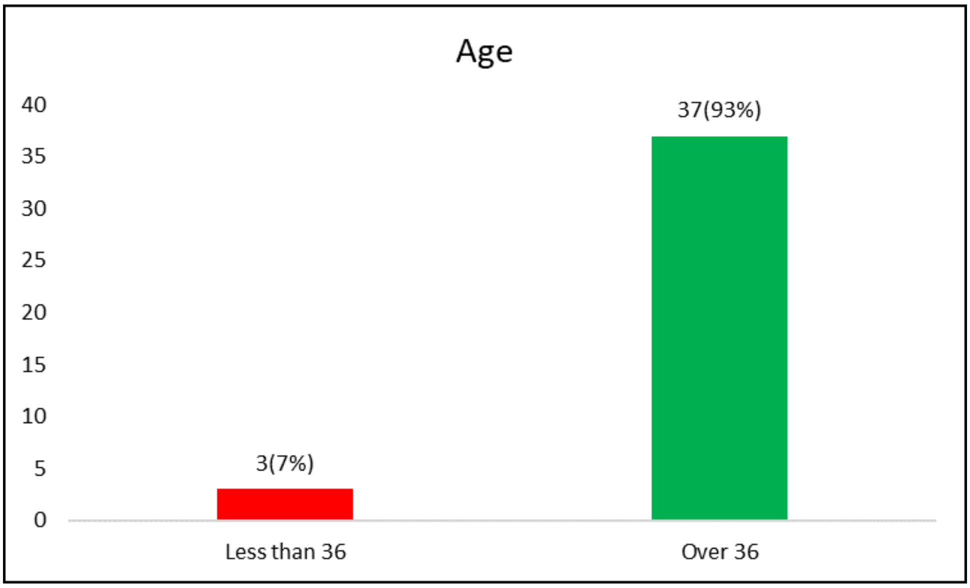

Figure 6-2: Age n=40

Closely related to age, the vast majority (35 or 88%) of the student teachers had over ten years' teaching experience (see figure 6.3 below).

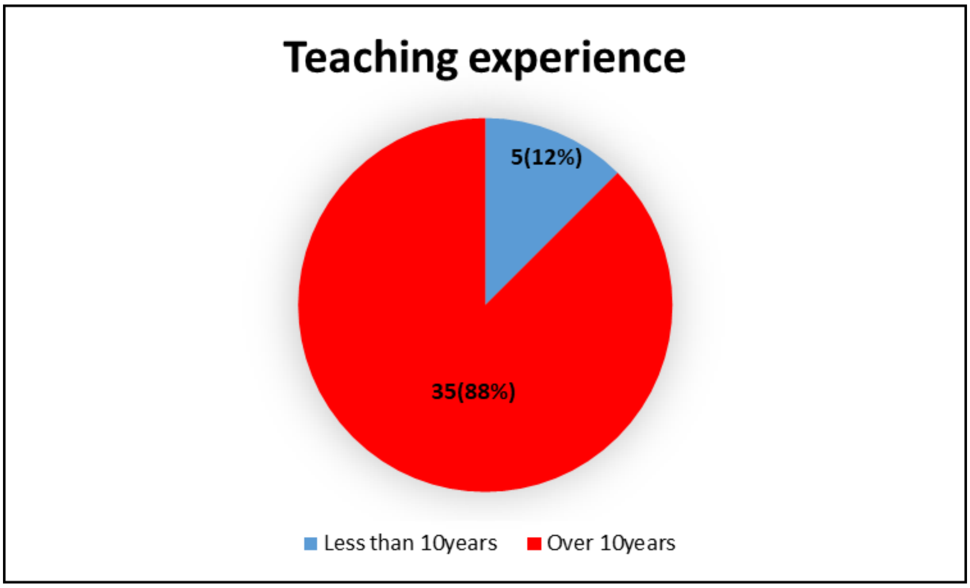

Figure 6-3: Teaching experience n=40

6.1.2 The context

Of the 40 in-service ACE-ICT student teachers, three were e-learning subject advisors with the Department of Education. Their job mainly involved training teachers on ICT integration and helping with school implementation, but they also taught in schools. The 40 in-service ACE-ICT student teachers were from marginalised schools located in townships, farms and rural areas (see table 6.1 below).

Table 6-1: Location of schools

Type of school	**Number of student-teachers**	**Percentage**
Township school	12	30%
Rural School	26	65%
Farm School	2	5%
Total	**40**	**100%**

The majority (26 or 65%) of the student teachers taught in rural areas while 12 (30%) taught in township schools. Only 2 or 5% taught at farm schools. All schools were either quintile 1 or 2 schools which means they were located in poor marginalised communities (see Grant, 2013). Schools in rural areas appear to suffer from low enrolments due to rapid urbanisation (Ramatlakana, 2013). Student teacher 27 described this phenomenon in her community saying: *"schools in rural areas have a problem of having small numbers of learners enrolled. Their young mothers take them* [learners] *away to other provinces where they work, especially the Western Cape"* [Student teacher 27, MCL proposal – July 2012]. *S*chools with very small enrolment numbers were particularly common in Dwesa. For example, there were less than 50 learners at student teacher 34's school: "*the enrolment at my school has drastically dropped down to below 50 learners"* [Student teacher 34, MCL proposal – July 2012] and 55 learners at student teacher 3's school: *"there are 55 learners, 6 post-level 1 educators and it [the school]* *started from grade 8 to 12"* [Student teacher 3, MCL proposal – September 2010]. The majority (23 or 58%) of the student teachers taught Social Sciences subjects. The vast majority (31 or 78%) taught at least two subjects.

Most of the schools where student teachers worked had computers and basic infrastructure. The vast majority (17 or 85%) of the 20 teachers from Dwesa were at a school that had just received at least one computer through the SLL project. Of the three schools that did not have computers, two did not have electricity and one was a mud school. Student teacher 36 was from the mud school and described her school saying: *"my school has poor infrastructure. It has four classrooms made of mud … learners sit on cement blocks or mud rocks and others sit on the floor"* [Student teacher 36, MCL proposal – July 2012]. These three schools could not host desktop computers. The majority (27 or 68%) of the 40 student teachers were at a school that had a computer lab. However, computer labs often do not have enough computers for all learners. Student teacher 38 highlighted this in his comment saying: *"large class sizes at our school make it impossible for each and every learner to be admitted to an ICT course* [computer skills training]*"* [Student teacher 38, MCL proposal – September 2010]. Student teacher 2 noted that computers available at her school were too few for the large number of learners. She said, *"We have 16 computers in my school, if we use computers, we have to group learners; that takes a long time to finish work"* [Student teacher 2, MCL questionnaire – September 2010]. Student teacher 2 described the challenge of not having a data projector so that his learners could follow from the board. He said, *"We have no projector that means I have to move from one computer to another computer. The enrolment for my grade 3s is 70"* [Student teacher 2, MCL proposal – September 2010]. Lack of resources, limited access to resources and lack of support might influence teachers negatively and lead to the non/under-utilisation of the few resources available to them as suggested by Lundall and Howell (2000).

6.2 PERCEIVED USEFULNESS OF ICTS IN EDUCATION

Student teachers enrolled for the course for their learners, for themselves, or for their colleagues and school. In this section I organise the presentation of findings accordingly.

6.2.1 Social and vocational rationales for learners

Student teachers wanted to prepare their learners for the information society, in line with Hawkridge's (1990) social and vocational rationales. Student teachers perceived the lack of access to computers as inhibiting learners from enjoying the benefits of the digital world and expected an opportunity to introduce their learners to computers. Student teachers were unanimous in their belief that learners needed to get to a comfortable level with technology in order to live and work in today's society where ICT plays an important role. Student teachers acknowledged that their learners lagged behind in terms of ICT competence and suggested a basic computer literacy course for all grades depending on the context of the school. For example, a teacher from a rural school, which did not have a computer, stated that learners had never used computers within the school context and an introduction to computers for all grades was therefore appropriate. Student teacher 3 said, *"Learners are computer illiterate and yet nowadays computers are widely used"* [Student teacher 3, MCL proposal – September 2010]. Student teacher 13 recognised learners as *"future leaders"* and saw the *"need to empower them as much as possible"* [Student teacher 13, MCL questionnaire – September 2010].

Student teachers wanted to prepare learners for employment and for tertiary education. Student teacher 6 captured it succinctly saying: *"without computer skills it will be impossible for our kids to make it in colleges and in universities, and later in the work force"* [Student teacher 6, MCL proposal – September 2010]. Student teachers acknowledged that learners in marginalised schools had the potential to learn computer skills and use them in their work life provided they had physical and epistemological access to computers. Some student teachers explicitly linked the need for computer skills by Grade 12 and the possible demands put on their learners at university. Many student teachers shared a concern that limited computer literacy might negatively affect the transition to university. Student teacher 5 said, *"It is sad when you meet a former learner telling you they are doing a computer literacy course at university level*" [Student teacher 5, MCL proposal – September 2010], implying that this should have happened at school. Student teacher 19 noted the importance of computer skills for Grade 12 learners saying:

> I am mentioning Grade 12 because they are going to tertiary institutions next year and most, except for CAT [Computer and Applications Technology] learners, know nothing about computers. It will be very difficult for them to cope at tertiary level if they don't know how to open a computer [Student teacher 19, MCL proposal – September 2010].

These concerns must be understood within a context where most black students do not meet the requirements to access university (Chetty, 2014). In 2011, only 11% of black youth and 7% of coloured youth in the 18-24-year age bracket were in university (Higher Education South Africa, 2011).

6.2.2 Personal and professional development as an enabler

Some student teachers viewed the in-service ACE-ICT course as an opportunity for personal as well as professional development. Student teacher 34 said, *"The qualification will enhance my ability in work situations and in public service"* [Student teacher 34, Application – December 2010]. Student teacher 6 who said, *"By the end of the course I would like to be the best computer teacher at my school though we don't have computers presently*" [Student teacher 6, Application – December 2008] echoed this. Student teacher 1 hoped that she would be able to transform her practice. She said, *"I would like to change my traditional way of* *teaching whereby I use the chalkboard and chalk as a teaching aid"* [Student teacher 1, MCL proposal – September 2010]. Student teacher 9 expressed her excitement saying: *"it's been quite some time since I felt so excited like today, I'm so glad to have got such a chance in my life*" [Student teacher 9, Application – December 2008]. Similarly, student teacher 17 said she was *"confident that the ACE-ICT course will empower me so that I can use computers in teaching"* [Student teacher 17, Application – December 2008]. Some student teachers took the in-service ACE-ICT so that they could be the first teacher at their school trained to integrate ICT in their teaching. Having more trained teachers would mitigate the problem of under-utilisation of ICT resources at schools. Student teacher 5 said, *"The school received a donation from SAPS. These worked for a short while. Only one educator could teach learners computer literacy – she left in 2001, then the lab became a white elephant"* [Student teacher 5, MCL proposal – September 2010]. Research has articulated this problem of under-utilisation of ICT resources, describing the ripple effect that stems from lack of proper training (see Salomon et al., 2006; Kotrlik et al., 2009; Hennessy et al., 2010; Selwyn, 2011).

For some student teachers, the course was about obtaining computer skills, like student teacher 40 who said, *"I want to improve my computer skills with Rhodes University"* [Student teacher 40, Application – December 2010]. Some student teachers showed they wanted to be able learn troubleshooting skills like student teacher 5 who said, *"I am studying to try and further my knowledge of computers. Hopefully when I finish the course I would have learned more even how I can present lessons using technology"* [Student teacher 5, How I became computer literate narrative – November 2010]. There were also student teachers who were motivated by the prospect of getting a better or different job once they graduated with the ACE-ICT.

6.2.3 Enabling colleagues and uplifting schools

Student teachers stated how their colleagues motivated them to study. Student teachers said they wanted to develop or enable peers. Some of the student teachers indicated that there were teachers at their schools who were computer literate but were demotivated to integrate ICT into their teaching. Student teacher 3 said, *"Most teachers at my school are already computer literate, computers will assist them in doing work easier, faster and effectively"* [Student teacher 3, MCL proposal – September 2010]. Student teacher 4 believed that this was because most teachers did not know how to integrate ICT into their teaching and said, *"Teachers do not have an understanding of how exactly to integrate ICT into the curriculum"* [Student teacher 4, MCL proposal – September 2010]. This was something the in-service ACE-ICT student teachers wanted to do once they were confident in ICT integration themselves. Student teachers were aware that without teacher training there would be little or no use for ICT in the classroom. Student teachers acknowledged that some teachers held negative attitudes towards computers and their use in teaching, mostly because they did not understand how ICT integration worked. Student teachers elaborated by giving reasons why teachers develop negative attitudes. For example, student teacher 7 explained, *"teachers who are computer illiterate will be threatened"* [Student teacher 7, MCL questionnaire – September 2010]. Student teacher 24 said, *"Many teachers are computer illiterate and are not interested* [in teaching with ICT] *because government is not giving us any support and is not promising anything"* [Student teacher 24, MCL proposal – July 2012]. This finding confirms the challenge South Africa faces concerning ICT training for teachers. The finding is significant when the relationship between ICT training and confidence is considered. If teachers in marginalised contexts remain untrained this could have serious consequences for the use of computers in teaching. Perhaps what is encouraging from this finding is the fact that teachers were aware of the need for training.

Student teacher 31 noted that the Eastern Cape needed to increase the use of computers in the classroom as it was lagging behind when compared to other provinces. She said, *"Our province is far behind in the implementation of e-Learning compared to other provinces like Gauteng and the Western Cape, it is very much important to speed up recovery programme so as to be on par with other provinces"* [Student teacher 31, MCL proposal – July 2012]. It was understandable therefore that all three subject advisors said computers were useful for teachers. Following from the finding presented above on the need for ICT training, these subject advisors also highlighted this in their proposals. Student teacher 4 narrated her experiences during a visit to a rural school to assess whether or not a school was ready to implement ICT integration. She found that, while the school met all the requirements to receive government assistance to get a computer laboratory, the school did not receive it because all the teachers at the school were not trained in ICT integration.

Student teachers wanted to build the status of schools and their recognition in the community. The perception among student teachers was that a school that offers access to computers for learners earns recognition in their context. Student teacher 24 said, *"it makes us to be recognised by other schools"* [Student teacher 24, MCL proposal – July 2012]. As the communities surrounding these schools were characterised by poverty, having computers set a school apart in these communities. For example, student teacher 1 said, *"my wish is to boost the standard of my school"* [Student teacher 1, MCL proposal – September 2010]. It also attracts more learners to the school as parents associate computers with better quality education. In chapter 2, I discussed the relationship between access, both physical and epistemological, to computers and quality education. I argued that children learn from thinking in meaningful ways and that computers can enable this to happen (Jonassen, 2000). Some student teachers had unrealistic expectations from the course. I noted these with concern, as the expectations were the motivating factors why the student teachers were undertaking the course. I was aware that with expectations not met the desire to continue with ICT integration might diminish with time. Some of these unrealistic expectations were similar to those voiced by student teacher 14 who said, *"We hope that the university will really assist our schools and bring these laptops to improve and develop personnel for the benefit of our schools and the education system as a whole"* [Student teacher 14, MCL proposal – September 2010]. Student teachers still made such comments even though they knew that the mobile computer lab was and would remain the property of the university and that the student teachers were not to expect that the university would give them a similar mobile computer lab.

6.3 PLANNING FOR CLASSROOM INTERVENTIONS

The in-service ACE-ICT student teachers had to plan a lesson involving the use of computers in education as part of the cross-curriculum integration and implementation module. The students were aware that they had access to the Rhodes University mobile computer lab populated with 12 netbooks. Student teachers had the autonomy to decide who (teachers, learners, administration staff) and what to focus on. There were no restrictions on when the activity could be done or the length of the activity.

6.3.1 Target groups

Only three student teachers suggested using the mobile computer lab for administration. These student teachers mentioned that, due to limited computer facilities, e.g. computer labs, their clerk did everything they needed on the computer. There were also suggestions of training colleagues to use the South Africa School Administration and Management System (SA-SAMS). SA-SAMS is an Electronics School Management System implemented by the South

African Education Department (Edross & Klokow, 2018). Student teacher 14 stated that the school management team (SMT) is a priority in the school as far as ICT integration training is concerned since they are responsible for the administration of the school. The teacher argued that the mobile lab could assist the SMT to access and practice using SA-SAMS. The student teacher said *"management should be given, priority reason being that management is the team that is responsible for managing the institution, its task is to do the administration of the school"* [Student teacher 14, MCL questionnaire – September 2010]. Student teacher 18 added administrative staff saying:

> The school clerk is the one who is doing a lot of writing and filing can use SA-SAMS to make the administration work easier, for example, writing letters, saving all the important information about the parents, children, educators and government information and quarterly returns [Student teacher 18, MCL questionnaire – September 2010].

Despite the assignment being meant for ICT integration in teaching and learning, these few student teachers suggested giving access to administration staff and not teachers or learners as was expected. Administration work would have been acceptable if it was done by the teacher and related to classroom teaching but, as presented above, the administration work suggested here was for the school clerks. These three proposals were not included in the selection of the key participants.

The vast majority of student teachers chose learners as initial users of the mobile computer lab at their school. Student teachers noted that learners, unlike teachers and administrative staff, were likely to learn computers fast and therefore the planned classroom interventions could yield results in a short period. Teacher 13 said, *"Learners are faster than us as parents and educators"* [Student teacher 13, MCL questionnaire – September 2010]. She went further to explain why learners are likely to learn computers fast by linking computer use to the use of mobile phones. She said, *"They* [learners] *are used in this kind of technology through their advanced cell phones"* [Student teacher 13, MCL questionnaire – September 2010]. Student teachers attributed learners' mobile phone competence to their inquisitiveness and eagerness to learn. Teacher 13 said, *"They* [learners] *are always eager to learn new things"* [Student teacher 13, MCL questionnaire – September 2010]. Research has confirmed the ability of children to learn computers quickly through inquiry or exploration. Findings from the Hole in the Wall project in India (Mitra, 2000) and from the Digital Doorways in South Africa (Gush et al., 2004) supported this notion. Student teacher 21 said he wanted to *"transfer my* [computer] *knowledge to the learners"* [Student teacher 21, Application – December 2010] and student teacher 7 who taught in the Foundation Phase (Grades R to 3) said she was doing the in-service ACE-ICT course so that she could *"teach learners so that they can be computer literate at an early stage"* [Student teacher 7, Application – December 2008].

6.3.2 ICT uses

Student teachers noted the usefulness of the PowerPoint application as a representation tool. Student teacher 32 explained that the computer in the classroom allows her learners to see what she will be teaching. She said:

> I am a grade six educator teaching Technology, my lesson will be on structures. This computer lab will help me when I am preparing my work. When I am presenting my lesson on structures my learners will see the structures, the types and the functions of structures [Student teacher 32, MCL proposal – July 2012].

This ability to show learners content using the data projector might sound obvious, but is central to why computers are useful in a marginalised context. None of the 40 in-service ACE-ICT student teachers planned to use ICTs as a cognitive tool, confirming relatively low levels of adoption of innovation. Student teachers also planned for the use of ICT in teaching as a productivity tool. In-service ACE-ICT student teacher 16 said, *"This year I am doing the in-service ACE-ICT and I bought my own computer and can use it for preparation and printing. I also do schedules, report forms and class lists"* [Student teacher 16, How I became computer literate narrative – November 2010].

All 40 in-service ACE-ICT student teachers noted that access to the Internet would be most useful in teaching, particularly as an information gathering tool while preparing their lessons. They suggested using the mobile computer lab to access online resources for their learners. They suggested working with online educational databases in South Africa such as Encarta as a way of restricting the information learners access. Student teacher 5 believed that Encarta will *"help the learners to do research about different topics given by educators of various learning areas"* adding that *"learners do not like to research information using the thick encyclopaedia but would rather look up research material in the computer"* [Student teacher 5, MCL proposal – September 2010]. Student teacher 26 echoed the same sentiments saying: *"I will also educate them on how to use education programmes like Encarta as I often use them as reference for my notes"* [Student teacher 26, MCL proposal – July 2012]. These educational programmes are safe environments on the Internet as experts of the various learning areas carefully select all information on them. Student teachers showed that they were aware of the challenges associated with Internet use in teaching, such as the availability of too much information that is not always relevant or reliable, ability to distract learners and the lack of infrastructure for connectivity.

Student teachers had the perception that computers can make teaching easier and lighter. For these student teachers, using computers in teaching had the potential to reduce their workload. Student teacher 7 said, *"Teachers will have less work as timetable, worksheets, administration* *and teaching and learning will be done using the computer"* [Student teacher 7, MCL questionnaire – September 2010]. More specifically, several student teachers emphasised that using a computer was easier than writing on the chalkboard. Student teacher 5 said:

> In my class, it would make life easier for both myself and learners. It will make teaching much easier, in that I will stop using the chalkboard to make summaries because everything will be on PowerPoint slides. The learners would have the slides that they can refer to when studying" [Student teacher 5, MCL questionnaire – September 2010].

Student teacher 9 raised an issue of saving time when comparing using PowerPoint and chalkboards. They key dimension emerging from the data was the use of ICT to avoid duplication of effort. Student teacher 9 explained why she thought that the use of computers and specifically PowerPoint was time saving saying:

> In my school, we still make use of the chalkboard for teaching. I have five Grade nine Natural Sciences groups [classes]. When they come to class, I have to write on the board repeatedly. By the time group 3 comes, I am exhausted and doing a disservice to them sometimes by leaving out some important stuff which I have already mentioned to others. In this instance [using a computer], I will have one well prepared presentation for all the groups and they will have it too [Student teacher 9, MCL questionnaire – September 2010].

Student teachers also noted the risk of teachers making mistakes on the board in front of the learners and passing on wrong information. For example, student teacher 10 said:

> It [computer] certainly will be [good to use]. It will replace the use of the chalkboard that has its disadvantages, for example, teachers are humans, which means they can make spelling mistakes when writing on chalkboard, resulting in passing the wrong message [information] to learners if not identified. A computer will automatically bring the mistake to the teachers' attention in the process of planning [Student teacher 10, MCL questionnaire – September 2010].

Student teachers 10 felt that using the computer would reduce such mistakes. She put this succinctly saying:

> It [computer] is also going to provide me with opportunities to correct my spelling mistakes in time during the process of preparation unlike the chalkboard that would have made the early correction impossible resulting in learners getting the wrong message [Student teacher 10, MCL questionnaire – September 2010].

The computer therefore allows teachers to avoid misinformation while also protecting their self-esteem.

Student teachers noted that computers are useful for boosting confidence. Student teachers were of the view that the use of computers in teaching assists both teachers and learners develop what student teacher 9 called *"the 'I too can do it' attitude"* [Student teacher 9, MCL questionnaire – September 2010]. Closely related to comments on confidence were student teachers' views on the ability of computers to boost learner's self-esteem particularly of those in rural areas. Student teacher 37 said, *"the use of ICT in my school will take away the stigma that they* [learners] *are different from the learners who are studying in urban areas"* [Student teacher 37, MCL proposal – July 2012]. Student teacher 27 who was based at a rural school echoed this saying: *"they* [learners] *will not be looked down upon because of their background"* [Student teacher 27, MCL proposal – July 2012]. Student teacher 9 on the other hand shared how the computers helped her grow self-confidence, as she doubted this at times. She said:

> In areas that are isolated and disadvantaged as ours, there is a tendency to feel too inferior for access to some facilities, that is, we always think, 'it is not for us, it is for the model C4 schools or those schools nearer to the cities. This will therefore help us realise that these appliances can be used by us too as long as we are guided/trained on their use [Student teacher 9, MCL questionnaire – September 2010].

[4]School previously for whites only in South Africa.

The hands-on approach of the in-service ACE-ICT course enabled the teachers to gain confidence in their use of computers. For these student teachers the use of computers in their marginalised contexts in South Africa was expected to elevate their status as a people and, most importantly, if they could use computers it would prove to themselves that they were equal to the rest of the teachers and learners from well-off schools and communities. In the South African context, this is significant. Computers and their use for teachers in marginalised contexts carry an added potential, that of levelling society and bringing learners, regardless of their backgrounds, onto the same footing. Student teacher 35 put this succinctly saying that the use of the mobile computer lab was going to *"offer teachers and learner's access to a variety of learning and teaching support material that promotes the appreciation of diversity, a collective identity across the institutions and begins to connect them to the broader societal goals"* [Student teacher 35, MCL proposal – July 2012]. For these student teachers having access to a resource that would make them feel that they belong to South Africa and that, regardless of their geographical location, having access to the same knowledge and opportunities in life was very important.

6.3.3 Potential challenges

Student teachers identified the number of learners versus the available netbooks as a potential challenge. Referring to the 12 netbooks, student teacher 20 said the number of netbooks was *"insufficient when compared to the number (of) learners"* [Student teacher 20, MCL proposal – July 2012] she had in her class. The number of netbooks was a concern for student teachers as most of them had large classes. Due to the large classes, student teachers felt that their teaching strategies were limited. Student teacher 38 said, *"Large class sizes at our school make it impossible for one teacher to employ interactive teaching strategies or gain insight of different problems encountered by the learners"* [Student teacher 38, MCL proposal –

September 2010]. Student teachers saw the use of computers in the classroom might assist with this challenge. However, student teachers suggested group work as a strategy to overcome this challenge. For example, student teacher 20 said:

> As the number of laptops may be fewer than the number of learners, grouping them requires a deliberate selection according to the aims of the activity. I would like to group them to their intellectual ability because the more brilliant ones will finish their activity faster and this will help in the assistance of the slow ones. Assisting the ones with the slower pace may also increase the confidence of other learners due to the constructivism view, i.e. learners can learn better in the assistance of others. There may be no noise which is usually caused by the fast learners as they will now be engaged with others" [Student teacher 20, MCL proposal – July 2012].

Adding to the problem of the limited number of netbooks was the size of the netbook. However, they were cognizant of the fact that the small size of the netbook might result in learners having difficulties to see and follow the work in groups. Student teachers suggested using additional ICT tools such a data projector so that learners could follow from the board and allowing learners to take turns to use the netbook.

The student teachers were eager to start using the netbooks even though they struggled at first with their small size. Student teacher 13 captured a common concern and noted, *"The key pads are so close"* [Student teacher 13, MCL questionnaire – September 2010]. The issue with size did not last long and soon the student teachers were comfortable with the keyboards. Student teachers were still learning how to integrate computers in their teaching. In their comments, student teachers expressed the need to familiarise themselves with the netbook first. For example, student teacher 13 said:

> My first impression was, what are these? And what are they used for? I thought it is something else, I did not think they are computers. I was curious because they looked nice, I wanted to start using them … I wanted to know about their features [Student teacher 13, MCL questionnaire – September 2010].

At the planning stage, student teachers already predicted the need to change their classroom management strategies. This is in line with findings from Schofield's (1995) study, which found that learners require a different type of attention and help in a classroom where computers are used. Student teachers were aware of the influence of excitement of seeing computers (for most of the learners, for the first time) on classroom management. Student teacher 36 said:

> I teach in the senior phase and this will be the first time that my learners will see a computer. I anticipate that there will be a lot of noise in my class, when the computers are switched on and when I tell the learners that they will be using them during lessons [Student teacher 36, MCL proposal – July 2012].

Similarly, student teacher 32 said, *"I expect the excitement and curiosity of the learners wanting to touch and see how it works"* [Student teacher 32, MCL proposal – July 2012]. Student teachers had thought about the impact this excitement would have on how they managed their classrooms. Teacher 39 made the connection between excitement, noise and classroom management saying:

> I am picturing the noise that would be on that day because of excitement. It would not be easy to control them because everyone would like to touch [the netbook] even before you say a word, but some would be shy to talk. Fast learners are so problematic, they need too much attention. I will have to group them according to their levels and give the fast learners more work to do to keep them busy so that I have time for slow learners as they need help [Student teacher 39, MCL proposal – July 2012].

In anticipation of the possible disruptive behaviour of learners, student teachers were already thinking of ways to change their classroom management style. For example, student teacher 10 said:

> I know that it is children's' nature to get excited when they see visitors and new things in the classroom. So, to reinforce good behaviour I will reward the best behaved group with a merit [Student teacher 10, MCL proposal – September 2010].

These examples show the resourcefulness and innovativeness of the teachers in trying to make the intervention successful.

6.4 SUMMARY

In this chapter I have discussed the perceptions held by the in-service ACE-ICT student teachers. The findings showed that teachers held positive perceptions towards ICT. The student teachers expected the in-service ACE-ICT course to prepare them for ICT integration. In terms of planning, most of the student teachers chose their learners as the beneficiary of the classroom intervention they were planning. Reasons for selecting learners included that learners needed ICT skills for social and vocational purposes as well as for education.

CHAPTER SEVEN: ACE-ICT IN-SERVICE SOCIAL SCIENCES STUDENT TEACHERS' EXPERIENCES OF USING ICT IN THE CLASSROOM

In this chapter, I discuss three classroom interventions done by in-service ACE-ICT Social Sciences student teachers focussing on their experiences. The six CHAT elements (subject, tools, community, object-outcome, division of labour and rules) were used to analyse the classroom activities. In addition, the CHAT concept of contradictions/tensions was used to delve deeper into the findings and highlight the differences between the traditional and the constructivist teaching method. A visual presentation of the contradictions considered for this study is shown in the generic CHAT triangle above (Figure 4.1). This generic CHAT triangle was used as the basis for the analysis of each of the six classroom interventions. In section 7.1 I discuss case 1, Mr Asiya at school A. In section 7.2 case 2, Mrs Banda is discussed and the 3rd case, Mrs Chamu, is discussed in section 7.3. A cross-case analysis is presented in section 7.4. The chapter ends with a summary in section 7.5.

7.1 CASE 1 – Mr ASIYA AT SCHOOL A

In this section, I present and discuss the first case focusing on the teacher's personal characteristics, the context, the teachers' perceptions and his experiences of teaching the Nazi Germany lesson to Grade 9 learners.

7.1.1 Personal characteristics

Mr Asiya was a 34 year old man. He was born and bred in the same village where he went to the same school he was now teaching at. His mother was also a teacher at the school. Based on the teacher questionnaire he completed, Mr Asiya had been teaching for 11 years. On top of his principal duties, he taught Grades 7, 8 and 9, IsiXhosa, Social Sciences and Technology. Being the principal and a teacher was demanding on Mr Asiya who had to manage these two roles. Mr Asiya had a sense of belonging and interest in developing the school and learners. Mr Asiya had prior experience with ICTs. He said in an interview, *"I started using the computer in the year 2000 at Fort Cox College. The skills I learnt there were basic computer skills"* [Mr Asiya, teacher interview – February, 2013]. However, soon after completing his training, he was deployed to school and stopped using ICTs. He later joined the computer skills training programme, which was offered by the Siyakhula Living Lab in 2009 and enrolled for the in-service ACE-ICT course in 2010. Mr Asiya wanted to re-skill and advance himself in the use of computers so that he would become more confident in using computers in the classroom. Mr Asiya owned a laptop and a modem for Internet connection. In the questionnaire, Mr Asiya claimed to use his laptop daily. He also self-assessed his computer skills as good and stated that he normally used Word processing, presentations and spreadsheets. In addition, Mr Asiya said he had used the computer to search for information on the Internet as well as play games, music and videos on both his computer and his cell phone. He had sent and received emails on his computer but not on his cell phone and had never used social networking on a computer but had done so on his cell phone.

He said that he went through the ICT training so that his community could benefit from his skills saying:

> As time goes on I anticipate the community or at least just this school will have computers, so that I can provide some help to the people in this community. I am willing to plough the information that I have in computers to the people of my community. [Mr Asiya, teacher interview – February, 2013]

Furthermore, he hoped that his participation in the study would help him advance his personal goals for his school. For example, he hoped that I would be able to help him bring electricity to his school. He said:

> I would like technology to be available here at this school. That is why I volunteered to participate in your research and I invited you to come here. Even though we do not have basic resources like electricity, I am hoping that your coming here can help us to direct electricity to this school. The electricity poles are only 200 metres from this school. So, I think you might be able to assist us in that regard. [Mr Asiya, teacher interview, February, 2013]

I explained that I was there to observe his class and assist with ICT integration only. I considered removing Mr Asiya as a participant, but after the discussion we had, in which he indicated that he understood the parameters of my research, I decided to keep him in the study. However, throughout the analysis of the findings from his classroom intervention, I was aware of this bias and was careful to minimise its threat to the findings presented in his case.

7.1.2 Context

The context in which Mr Asiya taught influenced his decision on the classroom activity and his overall experience on the use of computers in his teaching. Firstly, the lack of basic infrastructure at the school and within the community, posed challenges and limited what the teacher could do in his classroom. The South African government through the White Paper on e-education of 2004 sought to provide ICT infrastructure to all schools by 2013. However, school A did not have electricity at the time of the visit as confirmed by the principal who said, "*There is no electricity in this village including at this school*" [Mr Asiya, principal interview, February, 2013]. The school had lost solar power equipment to thieves. The principal said, *"We had put solar here at school but in 2011, our solar system was vandalised so now, we use the generator*" [Mr Asiya, principal interview, February, 2013]. Theft is common in the context of marginalised schools, which usually do not have security. There was no proper gate to the school and the fence was down in some parts. The diesel generator activating a photocopier was used sparingly for copying tests and worksheets due to the high cost of fuel. Other than the photocopier, the school did not have any working ICT device at the time of the study such as computers or a data projector.

The lack of such resources discouraged Mr Asiya from starting to integrate computers in his classroom. He said, "Even *though I have a personal laptop that I could use in my classes I have not been able to, because we do not have a data projector*" [Mr Asiya, teacher interview, February, 2013]. The school had received three computers as a donation a few years prior to this study, which were now old and not working. A television allocated to the school by the Department of Basic Education was also not working. The school had no telephone, fax or a printer. Consequently, the teachers and learners at school A had no access to computers at school or at home. Even though Mr Asiya's school did not have ICT devices, he believed it is worth the effort, time and money to use computers for teaching.

Mr Asiya worked with unsupportive colleagues in terms of his drive for ICT integration at the school. None of the teachers at school A, except Mr Asiya, owned a personal computer. Mr Asiya referred to the Teacher Laptop Initiative (another government initiative) saying he had encouraged his colleagues to apply, but none had applied or were interested in applying. He said:

> …when I talk to them [colleagues] they do show a lot of interest, but they don't do anything. For example these computers that the government said they would help us [teachers] buy, they just took the application forms and none of the teachers completed or submitted the forms…they said they did not want the laptops [Mr Asiya, teacher interview, February, 2013].

The teacher laptop initiative did not take off in 2013 (Paris, 2013; Tubbs, 2013). None of the ten teachers at school A were computer literate or trained on ICT integration in teaching except for Mr Asiya. Mr Asiya said, "*they* [teachers] *are not computer literate so they are not interested in buying* [a laptop]… *they do not like typing, that's why"* [Mr Asiya, teacher interview, February, 2013]. Only one other teacher at school A could type, but Mr Asiya was quick to say that "*she trained to use a typewriter a long time ago and some things have changed, and she hasn't been practicing so she has a clue, but she is not good"* [Mr Asiya, teacher interview, February, 2013]. Mr Asiya said the teachers brought *"their handwritten work and then photocopy that"* [Mr Asiya, teacher interview, February, 2013] as the school did not have a computer or printer. This means that Mr Asiya faced challenges of trying to convince his colleagues of the importance of ICT or the necessity to integrate it in the classroom.

School had to buy fuel to run the generator since the school did not have electricity. The cost implication of this meant there was limited use of the generator which would have a direct influence on ICT integration. The consequence of being in this kind of context was that it was difficult for Mr Asiya because no one shared his enthusiasm for computers and their use in teaching. The lack of both technical and moral support from colleagues hindered Mr Asiya from effectively using computers in the classroom. The school did not receive technical support from the district, as it did not have ICT resources. As a result, Mr Asiya said that he relied on experts from outside his school for support and assistance. I argue that this lack of access influenced Mr Asiya's classroom activity and experience with computers.

School A had 156 learners in Grades R to 9. According to Mr Asiya, the only technology that learners were exposed to at school were their cell phones. This was consistent with findings of studies that indicated that learners in that rural community were exposed to cell phones more than computers (see Gunzo et al., 2012). School A had a strict mobile phone policy, which did not allow learners to bring their cell phones to school. Mr Asiya stated that *"learners are not allowed to use their cell phones at all around the school premises"* [Mr Asiya, principal interview, February, 2013]. He added that if they are caught using a cell phone, it would be confiscated for the day or sometimes "*until after the end of the term"* [Mr Asiya, principal interview, February, 2013]. Mr Asiya acknowledged that given the context his learners were in, the cell phone was the only device they could draw on in their learning.

Mr Asiya worked with a Grade 9 class of 38 learners. The majority (21 or 55%) of the learners were male. The class was made up of learners with ages between 13 and 19 years old.

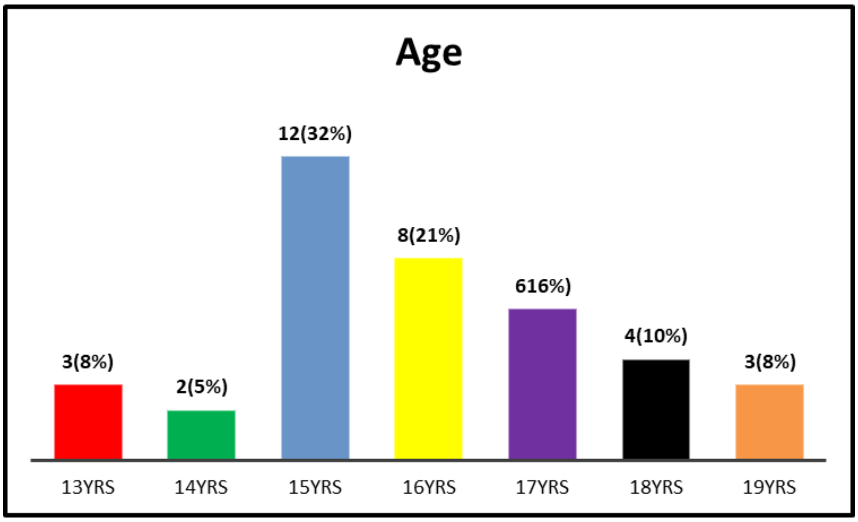

Figure 7-1: Age (n=38)

The vast majority of learners in Mr Asiya's classroom did not have physical access to either a computers (36 or 95%) or a television (32 or 84%) at home. The vast majority (34 or 89%) had access to a radio and a cell phone 35 or 92%). Only 4 (11%) of the learners came from homes that had electric power in the form of solar or a generator as the community did not have electricity.

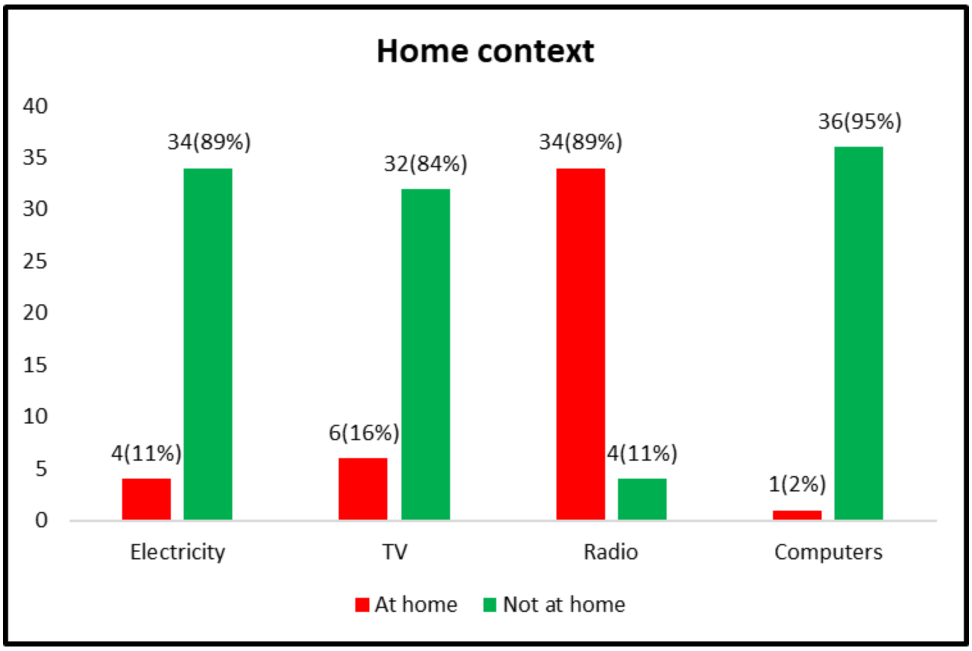

Figure 7-2: Home context (n=38)

Ten (26%) of the learners in Mr Asiya's classroom had never seen a computer prior to the intervention. Only one (3%) learner had used a computer before and indicated that he/she had used the computer at someone's house. The one student also said a teacher had taught them how to use a computer.

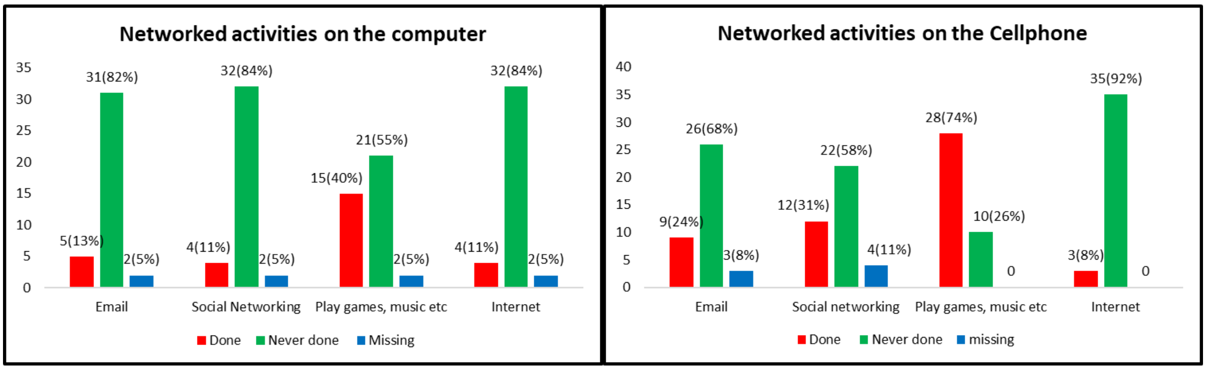

Figure 7-3: Networked activities on the computer and on the cell phone (n=38)

Contrary to the results above that indicated that only one learner had used a computer before, a number of learners indicated various networked activities they had done on a computer. Results in figure 7.3 show that five (13%) of learners could email; four (11%) had used social networking; 15 (40%) had played games or music and four (11%) had used the Internet on the computer before. The figures are slightly higher for cell phones.

Table 7-1: Descriptive statistics: Mr Asiya's learners

Statement	**Agree**	**Disagree**	**Unsure**	**I don't know**
I am scared to use the computer	7 (18%)	30 (79%)	0	1 (3%)
I use the computer to learn things	20 (52%)	12 (31%)	3 (8%)	3(8%)
The computer is easy to use	0	1 (3%)	23(60%)	14(37%)
It is necessary and important for me to know how to use computers?	28 (74%)	10 (26%)	0	0
I look forward to using the computer	31 (82%)	7 (18%)	0	0

Only seven (18%) of the learners said that they were scared to use the computer. Even though these learners had no access to computers at home or at school, the majority (20 or 52%) of the learners said they used a computer to learn. None of the learners thought that it was easy to use a computer; instead, 23 (60%) of the learners said they were unsure if a computer is easy to use or not and 14 (37%) said they did not know if computers are easy to use or not. This is because these learners had no access to computers at school or at home as reported above and over a quarter (10 or 26%) of the learners had never seen a computer while only one (3%) had used a computer before. Despite these findings, Mr Asiya's learners perceived a computer as an important tool for learning. The majority (28 or 74%) of the learners agreed that it was important to know how to use a computer. The vast majority (31 or 82%) of the learners said they were looking forward to using computers.

7.1.3 Teacher perceptions

Mr Asiya perceived ICTs as useful in teaching, particularly lesson preparation. He used solar energy at his home and said that he used his laptop almost daily, mainly for lesson preparation, word processing and Excel. He said:

> …my lesson preparation I now do it on the computer. I get information I need off the Internet, I have a laptop and I buy data bundles and use my modem, and get on the Internet, and search for information, then type it up on the computer [Mr Asiya, teacher interview, February, 2013]

He added that though he was not using these to help him in his teaching due to the unavailability of a data projector at his school, he still prepared lessons on his laptop. He said, *"…even though I have a personal laptop that I could use in my classes I have not been able to because we do not have a data projector for me to use the laptop in my class"* [Mr Asiya, teacher interview, February, 2013]. He thought using ICTs would make his work as a teacher easier, neater and more effective. Mr Asiya had the perception that teaching with ICTs would be easy, but that there was too much work involved in using computers in teaching. He expressed his belief that his learners would benefit from the use of the computers in teaching saying:

> If the learners for instance have access to the Internet, they would be able to search for more information on Google for example and also to compare information from various sources before they take something to be what it is [Mr Asiya, teacher interview, February, 2013].

Mr Asiya was aware that due to costs associated with using the Internet, the Internet was not an option for his classroom intervention. He spoke about how learning with ICTs would enhance learner inquisitiveness, which in turn helps develop an independent learner. He said:

> …the learner relies on what the teacher tells them. They [learners] have no opportunity or chance to learn on their own or to question what the teacher is saying, because they do not know. If you do not use computers they are not jagged up, like they are not open minded, but now technology makes one curious to learn more and to find out more about what the teacher said in the class [Mr Asiya, teacher interview, February, 2013].

He was convinced his learners would be happy if he used computers in the classroom.

7.1.4 Lesson on Nazi Germany

In this section I discuss Mr Asiya's lesson on Nazi Germany using the six CHAT elements. I focus on the contradictions identified.

Mr Asiya's activity systems

The boundaries between activity systems are hard to demarcate, but methodologically they could be defined by their objects (Madyarov et al., 2012). Mr Asiya was engaged in two activity systems that corresponded to two objects or motives: teaching history and exposing learners to ICT.

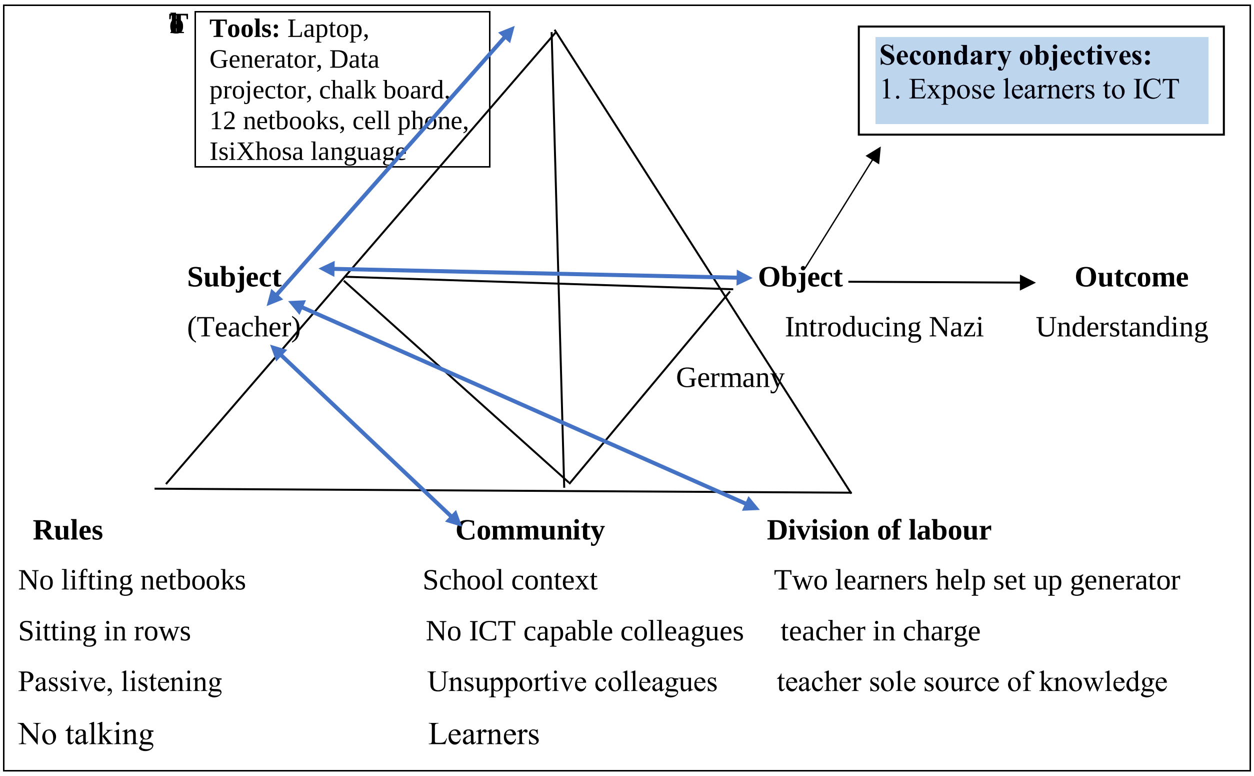

Figure 7-4: Mr Asiya's activity triangle

The secondary objective is representative of the other activity systems which would have the same CHAT elements. In Mr Asiya's case, the blue double sided arrows show the contradictions between elements (see figure 7.4 above).

Mr Asiya's first objective of the classroom intervention was to teach history, in particular, to introduce Nazi Germany. However, in all interviews with Mr Asiya he never mentioned the teaching of history as his goal or motive for participating in the study. Instead, he stated that he was motivated to teach with ICT in his classroom so that he could expose his learners to the world of ICT and opportunities in life. He said:

> I do all this for my learners, so that they can be exposed, and when I do all this I show them that this is what we are talking about when we speak of computers so that they too can develop an interest in computers. [Mr Asiya teacher interview, February, 2013].

Despite this, Mr Asiya did not allow his learners to use computers meaningfully during his class. Instead, he allowed the learners to turn the netbooks on and spent some time explaining how they work by likening a netbook to a mobile phone.

Mr Asiya was concerned about delays due to the lack of ICT skills amongst his learners which was in contradiction with his need to expose his learners to ICT which he voiced prior to the classroom intervention. This confirms Borg's (2003) assertion that often people hold conflicting beliefs about the same issues. It would seem the decision not to use the mobile computer lab in the classroom was in part due to time constraints. Mr Asiya said that he decided not to use ICTs with the learners because it was going to take up too much time. He said, "*I realised that they are going to need a lot of time to practice to be able to use the computers effectively"* [Mr Asiya SR interview, April, 2013]. For instance, he said the reason he had decided not to use the mobile computer lab was that the learners were not yet skilled, and he did not want the learners to "*delay the process since you* [the researcher] *are here for a short time"* [Mr Asiya SR interview, April, 2013]. The issue of time is crucial in the use of ICT in the classroom. Literature supports the notion that teachers must have enough time to plan and to use computers in the classroom and reflect on the experience with the view of improving the next lesson (Hayes, 2007; Govender, 2012). Mr Asiya did not have the time necessary to develop and implement the use of computers in his classes.

Within the community element, which includes the school context and Mr Asiya's colleagues, contradictions were identified. Time was wasted and the lack of support from colleagues impacted Mr Asiya negatively and had an influence on his use of ICT in the classroom. Since the school did not have electricity, time was wasted bringing the generator to his class and starting it up. Additionally, he took approximately five minutes to set up the computer and the data projector, then start up the PowerPoint before the actual teaching began. All lessons at school A were 45 minutes long, and there was a five-minute gap on the timetable to allow for learners to move from one class to the next. Mr Asiya went over time during the classroom intervention. On the other hand, Mr Asiya made little time to engage his colleagues on issues of ICT integration. He said, *"We don't really get the chance to sit down and talk about it"* [Mr Asiya teacher interview, February, 2013]. When probed further and asked why they did not meet at lunch time for example, he answered, *"during lunchtime no one really wants to do anything work-related"* [Mr Asiya teacher interview, February, 2013]. There was no opportunity for sharing or for working within a community of practice.

Within the tools element Mr Asiya used mainly a laptop and data projector as a representational tool. He used a PowerPoint presentation to deliver his lesson. The PowerPoint presentation he used was only in text format (notes) – no pictures or videos were incorporated to enhance learning of the content. The PowerPoint became a mere replacement of the chalkboard. The objective was to teach the formation of Nazi Germany. Mr Asiya set out the desired outcome of the lesson as understanding the background and key people in Nazi Germany. He took the first five minutes of the lesson to show the learners the features of the netbook comparing it to a cell phone, (e.g. the power on/off button, the screen, the keyboard) familiar to learners. However, with a mobile computer lab with 12 netbooks at his disposal, Mr Asiya chose not to use them beyond this. Mr Asiya also used language as a tool to mediate learning in his classroom. He code switched extensively during the class between the local language, IsiXhosa, and English. The teacher explained that even though the official language of teaching and learning in Grade 9 was English, the English proficiency of his learners was so low that he had to explain himself in IsiXhosa, otherwise the learners would not understand the content.

Despite having known in advance that he could not use the Internet, Mr Asiya said in the stimulated recall (SR) interview that the reason he did not use the mobile computer lab with learners was because he *"could not use the Internet"* and therefore he *"could not let the learners search for information I like wanted to"* [Mr Asiya SR interview, April, 2013]. However, when probed further on the suggestion of using websites offline discussed during the in-service ACE-ICT course, he said he had connectivity problems and had run out of data before he could finish selecting the websites. He said, "*I struggled because the connection here is bad and also my data was finished before I could finalise the ones to use. That's why I prepared the PowerPoint"* [Mr Asiya SR interview, April, 2013]. Another reason Mr Asiya decided not to use the mobile computer lab was that his learners lacked access to computers. He assumed that access to computers would improve ICT skills as is shown in what he said below:

> If you remember in that first interview when you came here, I told you that these learners have no access to computers here at school and at home…I was hoping that they would have gained some skill. [Mr Asiya SR interview, April, 2013]

This view, that learners must have computer access first before exposure to computers in the classroom, is a misconception noted in literature (McPherson, 2001). Such misconceptions can delay the use of computers in the classroom. While the reasons given by Mr Asiya are understandable, particularly in his context where there are cellular network problems, he did not accept assistance or support during the planning of his lesson which could have made the difference.

Mr Asiya used a traditional teacher-centred, lecture-dominated teaching method to deliver his lesson. As a result, within the division of labour element, Mr Asiya was responsible for the majority of the 'work' in the classroom. He was the sole source of knowledge in a class where learners were passively listening. Throughout the lesson, the learners were just sitting and not taking down notes. The teacher later explained during the SR interview that he set aside a day in the week for learners to copy notes. The learners did not ask questions, and no one raised their hands to answer the few questions the teacher asked, so he resorted to randomly picking learners to answer his questions. There are several possible explanation for this – it could have been the novelty effect or it is also possible that in an attempt to ensure that the lesson went on smoothly, that he gave strict ‘rules’ for learners to behave themselves. The more plausible reason is that these learners were used to the teacher doing all the talking in the classroom – this is highly possible since the teacher confirmed that this was common practice in his classroom for the learners to sit passively and do nothing and only take notes once a week.

A number of factors influenced Mr Asiya’s overall experience of teaching with ICT in the classroom. For example, a contradiction within the subject element was that Mr Asiya was conflicted because of the student-lecturer relationship we had. Although the classroom visit was a few months after the in-service ACE-ICT student teachers had completed their studies, I realised that Mr Asiya behaved as if I was there to evaluate him. He addressed me directly during the lesson and explained what happened or what he meant to do during his presentation. He turned the whole experience of the intervention to be about me and not the learners or his own experience. Instead of making the lesson about his learners learning about Nazi Germany, the lesson became about impressing his former lecturer. There was no room for authentic learning as he was worried about getting everything right while I was there. He had indicated this before the classroom intervention, saying: *“I want it to be a good one… I am nervous because I don’t want to let you down”* [Mr Asiya teacher interview, February, 2013]. This student-lecturer relationship was still evident with the other cases during the preparations of the intervention, but not in the classroom as with Mr Asiya. He still viewed me as his lecturer and this affected the flow of his lesson and diverted his attention from the lesson.

Mr Asiya exhibited 2nd order (Ertmer, 1999) barriers to ICT integration as shown by his beliefs about teaching and learning. He believed that learners take too much time if allowed to construct their own learning in class and that allowing such constructivist activities in the classroom wastes time.

Although I made several attempts to get Mr Asiya to plan his lesson and share it for feedback and support, he was not forthcoming with details of his lesson. When asked during an interview prior to the classroom intervention, he said, *"I have already prepared the lesson, but it needs to be fixed a bit, it will be ready by the time you come"* [Mr Asiya teacher interview, February, 2013]. When asked if he anticipated any challenges, he said, *"I don't think I will face any challenges because I am just going to save my lesson on the memory stick and then just bring it and use it in the class"* [Mr Asiya teacher interview, February, 2013]. Mr Asiya claims that his preparation for the classroom intervention was affected by the challenges he had with Internet connectivity, although he did not explain further what he would have wanted to find on the Internet and how he would have used it in his class.

Mr Asiya encountered challenges while using his laptop during the lesson highlighting contradictions between the subject and the tool. He asked for assistance from the researcher on two occasions, stopping his lesson to resolve these technical problems. Firstly, he asked help to enlarge the font on his slides because it was very small, and he and the learners were struggling to read the slides. Mr Asiya noticed this when he walked to the back of the class. Secondly, he asked for assistance to remove a pop-up HP assistant as it was blocking his presentation and he did not know how to remove it.

7.2 CASE 2 – MRS BANDA AT SCHOOL B

In this section, I discuss the second case focusing on the teacher, Mrs Banda, her school context and the Anglo-Zulu war lesson she prepared and taught.

7.2.1 Personal characteristics

Mrs Banda was a 55 year old woman born and married in the same village she taught in. She had a sense of belonging in this community. Mrs Banda had been teaching for 29 years, 25 of which were at school B. Mrs Banda taught Grades 8 and 9 Social Sciences. She started using computers in 2007 when the SLL project was started at her school. She said, *"I started using computers in 2007 when Rhodes and Fort Hare Universities* [through the SLL project] *arrived at my school to start training teachers to use computers"* [Mrs Banda teacher interview, February, 2013]. Mrs Banda was part of the school management team and she was the IT representative of the school. Having been involved with the SLL project from its inception, she was a champion of the Siyakhula Living Lab ICT programme at her school. Upon arrival at the school, the SLL team had identified her as a potential champion of the project and had given her computer literacy training including troubleshooting to prepare for the position. She said, *"I was the first learner, and now I am the champion"* [Mrs Banda teacher interview, February, 2013]. At the time of the interview, she was running classes between two pm and five pm for community members. She said:

> I wanted to share what I learnt in the training with others. So now I train others in the community. I hold training sessions for the community at this school in the afternoons from 2-4 or 5 depending on their time [Mrs Banda teacher interview, February, 2013].

She considered helping others with computer skills training as part of her job as the project champion. She had moved on to complete a two-year programme, which prepared her to undertake the ACE-ICT. At the time of the interview, she was enrolled for a Bachelor of Education Honours degree in ICT in Education with a South African university. She said that she had done all these courses "*to gain more knowledge in using computers especially in teaching*" [Mrs Banda teacher interview, February, 2013]. She also spoke about the changes in her personal life due to the computer skills she had acquired. For instance, she saved a lot of time and money that she used in the past to travel to town for banking – instead now she used Internet banking.

In the questionnaire, Mrs Banda stated that her computer skills were very good and that she used a computer a few times a week mostly for word processing, presentations and spreadsheets. She said in the interview:

> I am very comfortable in using computers now. This morning, I was even saying to myself that I have to buy a personal laptop, so that I can use the computer all the time, because now I'm using the school's laptop [Mrs Banda teacher interview, February, 2013].

Mrs Banda enjoyed using computers and thought it was fun using them. Mrs Banda searched for information on the Internet, sent and received emails, and did social networking and played games, music and videos on both the computer and the cell phone which confirms her experience with technology.

7.2.2 Context

School B is located in a rural area on the Wild Coast of South Africa. It is in quintile 1, i.e. it is a no fee-paying school. It had 12 teachers, three of which had completed the in-service ACE-ICT course with Rhodes University. The school was the first point of contact for the Siyakhula

Living Lab in the Dwesa/Cwebe area. When the project started, the school already had electricity. Additionally, its geographical location made it possible for the WiMAX technology to link with other schools in the area (see Seiborger & Terzoli, 2006). The school could be considered well equipped compared to other schools in the area, for example school A.

At the time of the study, the school had five working computers and two laptops - one that the school purchased and another donated - and Internet connectivity. Mrs Banda used the one school laptop as she did not own a laptop. The five computers were located in the staff room. The staff room was small, and the limited space resulted in the computers being stationed on desks associated with particular teachers, who in time came to regard them as their own. This made it impossible for other teachers or learners to use these computers. However, these computers were said to be for teaching and learning although in reality because of where they were located, they were not used for teaching and learning. The main challenge the school had was space. Mrs Banda said:

> At the moment we do not have enough space, we are using the staffroom as a computer lab and it is difficult to take the children to the staffroom when the teachers are there because the space is too small but since now we are preparing the lab and we are waiting for the technician to come in and then now we can use that for teaching [Mrs Banda teacher interview, February, 2013].

The school did not have enough buildings and so did not have a dedicated computer lab. However, plans were underway to convert one of the classrooms into a computer lab.

Mrs Banda received moral support and encouragement from her principal who allowed her to take charge of all ICT related matters at the school. Mrs Banda said:

> My principal is new, he was not here when the [SLL] project started. When he arrived, he always said you can do whatever you want with the computers just report that now you want to do so and so. He allows us to try this and that with the computers [Mrs Banda teacher interview, February, 2013].

At the time I visited school B, the principal had been there for just over a year. He directed me to Mrs Banda for any questions related to ICT use at the school. Though the school did not receive technical support from the education district office, it received a lot of support from the two universities that were working on the SLL project. Two other teachers at school B had completed professional development training focusing on ICT at Rhodes University and could resolve minor troubleshooting which boosted their confidence in the use of ICT. Mrs Banda hoped that working with the two colleagues they could motivate the rest of teachers at school B to embrace ICT use in teaching. She said:

> Some of them [teachers, her colleagues] they are willing to use the computers, and some are not interested…we are three who have done the in-service ACE-ICT so if we show them how to use [computers] then they will now be interested in them [Mrs Banda teacher interview, February, 2013].

On the question of who Mrs Banda consulted for advice and guidance regarding ICT related issues at school, Mrs Banda indicated she consulted colleagues, staff from other schools and experts from outside the school but not her principal.

Mrs Banda worked with a Grade 10 class of 39 learners. The majority of the learners were male 23 or 59%). In terms of age, the class had learners between 12 and 17 years old. Most of the learners were 15 years old (10 or 26%).

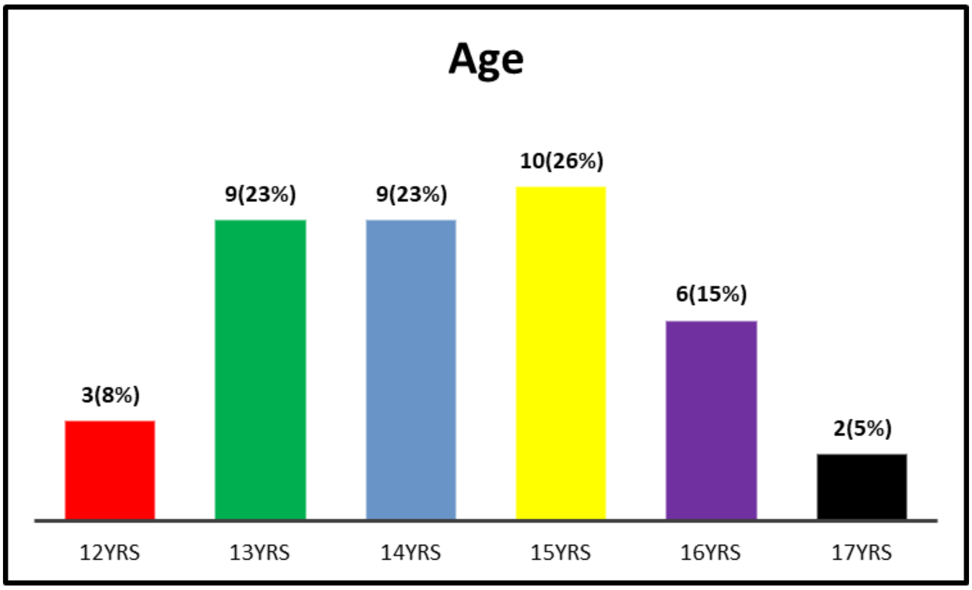

Figure 7-5: Age (n=39)

While the vast majority of learners in Mrs Banda classroom came from homes with electricity (36 or 92%), a television set (32 or 82%) and radio (33 or 85%), the vast majority (36 or 92%) of the learners said they did not have a computer at home.

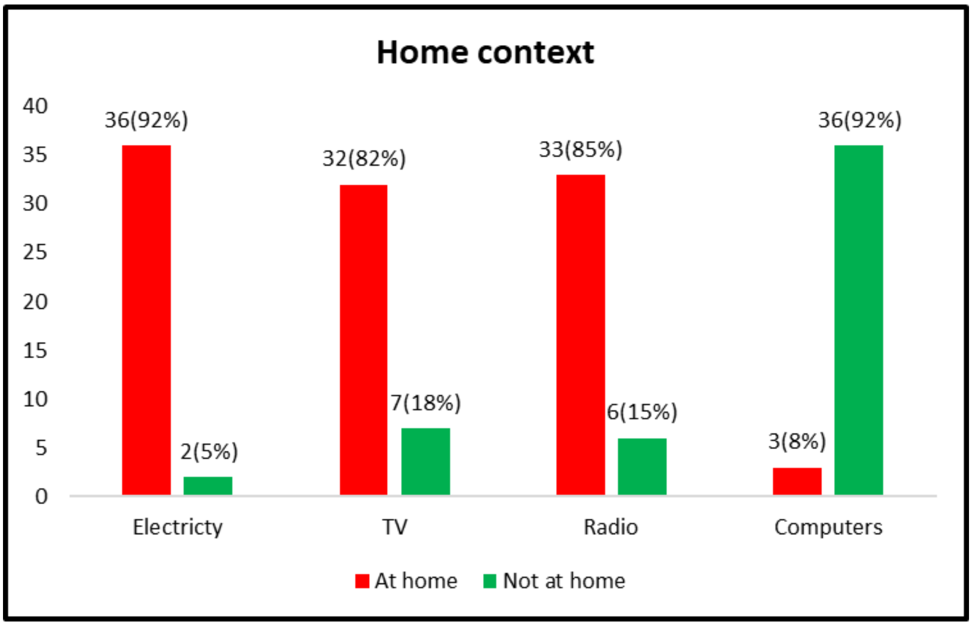

Figure 7-6: Home context (n=39)

The majority (30 or 77%) of the learners could search the Internet on the computer. Only one (3%) of the learners could send and receive emails, five (13%) could do social networking and 32 (82%) could play games, music and videos on the computer.

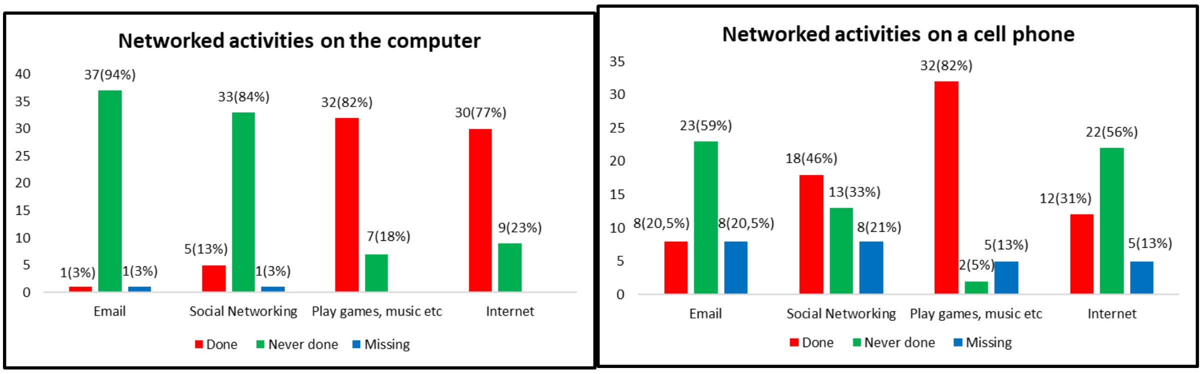

Figure 7-7: Networked activities on the computer and on the cell phone (n=39)

The vast majority (38 or 97%) of the learners had seen a computer before while 32 (82%) had used a computer before. Computers were present at school but not in the homes. The vast majority (31 or 79%) of the learners used computers at school while only three (8%) used computers at home. The majority (30 or 77%) of learners indicated that they had been taught how to use a computer by a teacher while only 2 (5%) had been taught by a parent.

Table 7-2: Descriptive statistics: Mrs Banda's learners

Statement	**Agree**	**Disagree**	**Unsure**	**I don't know**	**Missing**
I am scared to use the computer	10(21%)	21(54%)	4(10%)	1(3%)	3(8%)
I use the computer to learn things	26(66%)	10(25%)	0	0	3(8%)
The computer is easy to use	17 (44%)	8(21%)	7 (18%)	3(8%)	4(10%)
It is necessary and important for me to know how to use computers?	34(87%)	2(6%)	0	0	3(8%)
I look forward to using the computer	33(84%)	1(3%)	2(5%)	0	3(8%)

Findings showed that Mrs Banda's learners had been exposed to ICT before and were relatively computer literate. Only 10 (21%) of the learners said they were scared of using the computer. The majority (26 or 66%) said they used the computer to learn. However, a few learners (17 or 44%) agreed that computers were easy to use. The vast majority (34 or 87%) of the learners believed computers were important and 33 (84%) were looking forward to using computers.

7.2.3 Teacher perceptions

Mrs Banda perceived computers as easy to use. Particularly, she found it easy to operate the computer due to her experience of using computers reported above. She believed that using computers made it easier for her to do her job as a teacher. She thought that computers were considered useful at her school and that they were useful for her as she was now using a computer for *"planning, register and timetabling"* [Mrs Banda teacher interview, February, 2013]. She perceived computers as useful for learners noting that the information society we now live in required learners to be aware of and familiar with technology.

7.2.4 Lesson on the Anglo-Zulu war

Mrs Banda was engaged in a single activity system that corresponded to the object or motive of her lesson, i.e. to teach history (see figure 7.8 below).

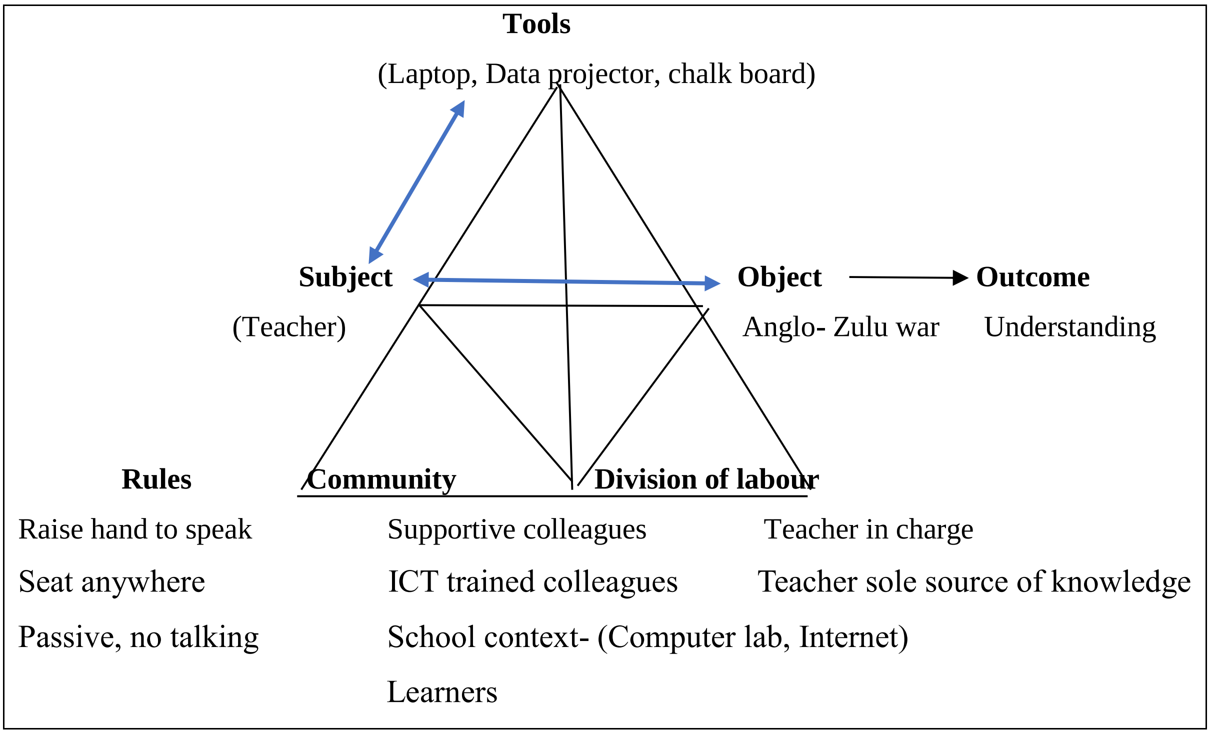

Figure 7-8: Mrs Banda's activity triangle

Mrs Banda presented a lesson on the Anglo-Zulu war using a PowerPoint presentation. She wanted the learners to understand when it happened, what caused it and for the learners to be able to identify the people at the centre of the war.

There was a contradiction between the subject and the object. Mrs Banda spent a lot of time preparing for her lesson and explained why she thought this was necessary saying:

> Preparation time is very important … the computer is time consuming but it [using the computer] makes you prepare your lesson properly because you have to spend a lot of time planning and looking for what you're going to teach [Mrs Banda teacher interview, February, 2013].

Despite all the planning, Mrs Banda did not let the learners use the mobile computer lab.

There was a contradiction between the tools and subject elements. I observed that Mrs Banda stood in front [often giving her back to the class] during the entire lesson and read her slides to the class. The PowerPoint replaced the blackboard in her classroom which was still very traditional and teacher-centred. In the SR interview she noticed this too and reflected on this saying:

> I stood in front the whole time and the learners were not engaging with me. I think it would have been important to walk around in the class, even though they were not using the computers, but I think walking around might have made it better [Mrs Banda SR interview, April, 2013].

She added she stayed in front so that she could move her slides manually on the laptop, as she did not have a pointer.

Within the division of labour element, the teacher took the leading role of giving information while the learners sat passively receiving the information. The teacher agreed that her learners were passive. She attributed this to the learners' unfamiliarity with the content given the time lapse. She explained that learners are more actively involved when the topic was something they had heard about and if it was current. She said, "*I think when teaching recent South African history then the learners can at least know what you are talking about, for example when you talk about the people they know Tat'uMandela* [Nelson Mandela]" [Mrs Banda SR interview, April, 2013]. Mrs Banda went on to explain that the nature of history as a subject is such that it is foreign and sometimes that is boring to learners. She referred to the content which is centuries old and spoke about how her learners struggled to understand the time frames and even the importance of the content to their lives. She said, *"you can see sometimes that they are also confused about the centuries, 18th century, they ask, what is that 18 cause now its 2013"* [Mrs Banda SR interview, April, 2013]. The references to events that have taken place, and to people that they had no idea who they were, contributed to their confusion. She said in her class when she taught about the Dutch people who came to South Africa in 1652, her learners asked her *"where are they* [the Dutch people] *now and who they are"* [Mrs Banda SR interview, April, 2013].

Mrs Banda faced challenges preparing for her lesson – she did not have enough content knowledge for history to teach it comfortably. She said:

> "there were some problems finding content since I was not trained to teach history, I took a while to find references so that I could know the information before I teach it in class" [Mrs Banda SR interview, April, 2013].

Another challenge she faced was the Internet. The school experienced problems with Internet connection, which affected the lesson she presented. Mrs Banda said, "*There was no Internet at that time, so the pictures I wanted to put I couldn't find*" [Mrs Banda SR interview, April, 2013]. During the SRI, Mrs Banda indicated that she wanted to include pictures to enhance the content she was teaching.

In summary, Mrs Banda's experiences were marred by the 1st order barriers to ICT integration as articulated by Ertmer (1999). She could not integrate ICT to her teaching due to the various challenges she encountered prior to the classroom intervention. For example, she had challenges with Internet connectivity which led to her abandoning her idea of including pictures in her PowerPoint presentation. She also indicated that the school had a sport activity and she had to cut short her lesson as the learners were needed for preparation. The challenges Mrs Banda faced, her motivation for doing the classroom intervention, her perceptions, the context and her learners, all influenced her experience of teaching with ICT.

7.3 CASE 3 - MRS CHAMU AT SCHOOL C

In this section I discuss the third case focusing on the teacher, Mrs Chamu, the context and the Introduction to Nationalism lesson she taught.

7.3.1 Personal characteristics

Mrs Chamu was a 52 year old woman who had been teaching for 19 years at the same school since qualifying as a teacher with a Diploma in Education from the University of the Western Cape in 1994. She was the IT representative at her school and was responsible for running the AwareNet programme. AwareNet is a learning platform and social medial tool where learners communicate and collaborate online (AwareNet, n.d.). At the time of the study, Mrs Chamu was enrolled for a Master of Education degree programme specialising in ICT in Education at Rhodes University. Mrs Chamu was comfortable with History as a subject, which she had taught for 19 years. She was aware of the changes in the curriculum and had made it a priority to keep up to date with them.

Mrs Chamu had sinus, which motivated her to move away from chalk. She said *"I wish I can be able to teach using the data projector and do away with chalk because I am suffering from sinus which is aggravated by the use of chalk"* [Mrs Chamu, How I became computer literate narrative – November 2010]. Mrs Chamu believed that using computers in her teaching would motivate her learners to aim higher in life and would enable her to teach history in the way her learners would understand, as they were failing the subject. Mrs Chamu felt computers were useful for preparing and planning lessons. She said, *"Using the computer helps me to prepare before time*" [Mrs Chamu, How I became computer literate narrative – November 2010]. She found the computer saved her a lot of time as she used the same presentation in the three classes per grade that she taught. She did not have to rewrite the notes on the board each time. She said, *"I am now presenting to my classes and have more time to explain what I am teaching, and I have the same notes for all the grades"* [Mrs Chamu, teacher interview – July 2013]. She believed computers would lessen her work because she had six classes to teach, three in each grade. She said, "*I don't have to keep writing the things on the board over and over again*" [Mrs Chamu, teacher interview – July 2013]. She spoke at length about the repetition that went into her job and how this was de-motivating her from doing the best she could as a teacher.

Mrs Chamu had vast experience of using computers for personal purposes. She started learning how to use computers at an older age because she was not exposed to computers during her university years. To an extent, Mrs Chamu was self-taught as she spent a lot of her time practising what she had learnt on the various short courses she took. She had access to a personal laptop and computers at school reserved for teachers. She used her laptop mainly for preparing lessons and communication. In the questionnaire, Mrs Chamu self-evaluated her computer skills as good, stating that she used her laptop daily and that she normally used Word processing and presentation software. She also indicated that she had searched for information on the Internet, used email, social networking, played games, watched videos and listened to music on both her cell phone and computer. Mrs Chamu enjoyed using the computer and thought it was fun.

7.3.2 Context

School C is a quintile 3 high school with Grade 8 to 12 learners. It is located in a township area. The school had a computer lab with 13 working computers for learners and four working computers for teachers all connected to the Internet. However, the computer lab was not fully utilised. The former IT representative said:

> Except for AwareNet which happens at regular intervals, the use of the lab is mainly incidental. In the case of learners, they are allowed to access the facility through prior arrangement and under the supervision of a teacher. Teachers have free access to the facility at any time through liaison with the coordinator or janitor [IT representative interview – July 2013].

The IT representative said that learners did not use the computer lab because there was no teacher available to supervise them all the time. He also spoke about the failed attempt to conduct formal computer literacy training for the learners saying:

> It was also a bit of a problem to get their [the teachers] assistance regarding running computer literacy classes for learners after school. For a number of years now we have been plagued by staff shortages and it is difficult to get teachers to do more than what they are doing already because the teaching load has to be shared among the existing staff [IT representative interview – July 2013].

In addition to the computer lab, the principal said the school had "*one laptop* [for teachers], *we have two data projectors, an overhead projector and a portable screen which is not working at the moment because something is broken, then some smaller items like speakers that go with these technologies*" [IT representative interview – July 2013]. The school also had a landline telephone, a fax, a copier and a website. This school is well resourced when compared to other township or rural schools, for example school A.

School C had 1087 learners. The school was a mixed-race school – with black IsiXhosa speaking learners and coloured Afrikaans speaking learners. English and Afrikaans were both languages of teaching and learning and learners were free to choose the language they wanted to be taught in. School C had 35 teachers, 33 permanent, one volunteer, and one substitute teacher. Of the 35 teachers at the school, four had completed a professional development qualification in ICT in Education with Rhodes University. These teachers provided each other with the necessary support on technical matters and general troubleshooting. Three of those teachers were using technology in their classrooms for teaching and were encouraging others to do the same. Mrs Chamu stated that she relied on those colleagues for support: "*When I have a problem, when I'm using my ICT equipment, I always call a colleague that I think might be able to help. If that one is unable, I approach another one*" [Mrs Chamu teacher interview – July 2013]. However, the rest of the staff could not offer much support to her. The former IT representative said, "*in general they are not averse to ICT. They have been supportive in the sense that new ideas have been welcomed. This, however, does not suggest that one could rely on their physical [technical] support*" [IT representative interview – July 2013]. The principal supported the use of computers in teaching and gave the teachers the freedom to do what they needed in terms of ICT integration. However, she admitted that the school was not doing much to support teachers in the use of computers in their teaching. The school was located within a 10-kilometre radius from the education district office and received regular technical support from there.

Despite the availability of equipment at school C, Mrs Chamu spoke of the challenges with access. She said that the process of booking equipment was difficult and frustrating as there were too many people wanting the same equipment. For example, she mentioned that it was difficult to get a data projector, because the school had one for all five teachers who regularly used computers in their teaching. She also spoke of the fear of breaking school property which was something the principal of the school emphasised each time she tried to borrow equipment. The principal confirmed that the school's equipment is used on a "*first come first serve basis"* [School C principal interview – July 2013]. This is what led Mrs Chamu to buy her own equipment to use in her classroom. She bought a laptop, data projector and portable screen. She also had curtains made for her classroom to help learners see well [her class was the only one at the school with curtains]. The class had history related charts, pictures and maps on the wall.

Mrs Chamu chose to work with a Grade 10 class, which had 36 learners. The majority of learners in Mrs Chamu's class were male 22 (61%).

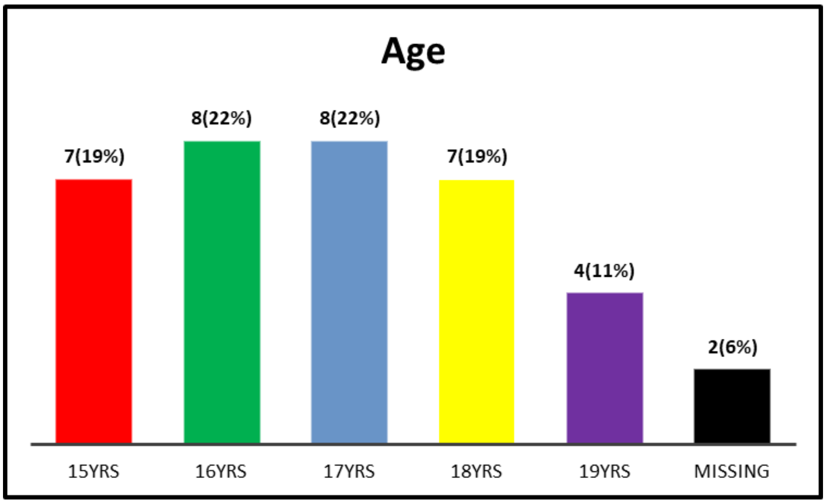

Figure 7-9: Age (n=36)

The class had learners between the ages of 15 and 19 years old. Most of the learners were between 16 and 17 years old.

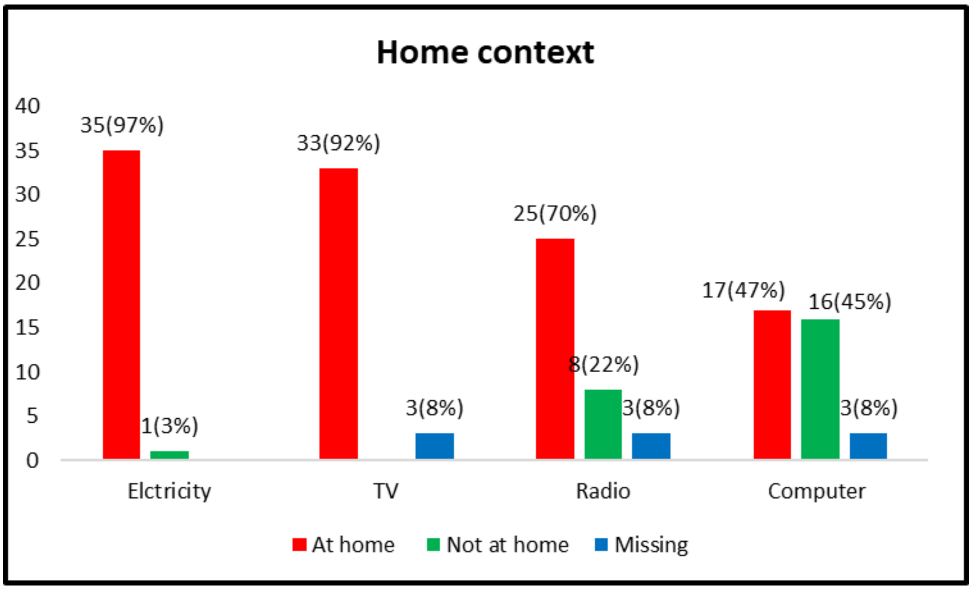

Figure 7-10: Home context (n=36)

The vast majority of learners had electricity at home (35 or 97%) and a television set (33 or 92%). The majority also had a radio (25 or 70%). Almost half of the learners had a computer at home (17 or 47%). These findings are not surprising given that the school was located in a town.

The vast majority (29 or 81%) of the learners had used a computer before. The majority of learners (18 or 50%) said they used a computer at home compared to 3 (8%) who said they used a computer at school. A third (12 or 33%) of the learners said they had been taught how to use computers by their parents compared to 5 (14%) who had been taught by a teacher.

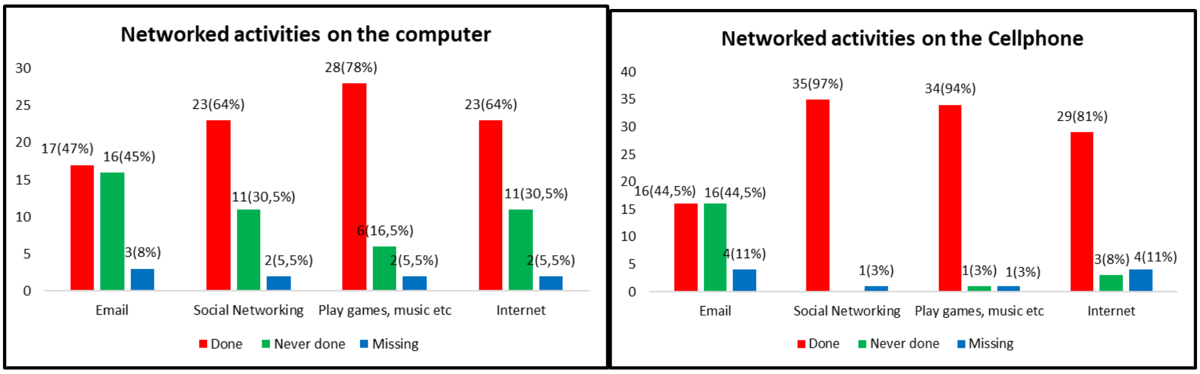

Figure 7-11: Networked activities on the computer and on the cell phone (n=36)

The majority of the learners (28/78%) used computers to play games, listen to music or watch videos. The number of learners who used the Internet on either the computer or the cell phone was almost the same, 17 (47%) and 16 (45%) respectively. The vast majority (35 or 97%) used their cell phones for social networking.

Table 7-3: Descriptive statistics: Mrs Chamu's learners

Statement	**Agree**	**Disagree**	**Unsure**	**I don't know**	**Missing**
I am scared to use the computer	7 (20%)	23 (63%)	5 (14%)	0	1 (3%)
I use the computer to learn things	33 (91%)	0	1 (3%)	0	2 (6%)
The computer is easy to use	16 (44%)	6 (17%)	9 (25%)	2(6%)	3 (8%)
It is necessary and important for me to know how to use computers?	31 (86%)	1 (3%)	2 (5.5%)	0	2 (5.5%)
I look forward to using the computer	31 (86%)	0	0	1 (3%)	4 (11%)

Results of the Likert scale items confirm that Mrs Chamu's learners were comfortable with computers. Only 7 (20%) of the learners said they were scared to use a computer. However, less than half (16 or 44%) thought that it was easy to use a computer. The vast majority of learners said that they used a computer to learn things (33 or 91%) and that it is necessary and important for them to know how to use a computer (31 or 86%). The same number (31 or 86%) said they look forward to using a computer.

7.3.3 Teacher perceptions

She found it easy to use computers, saved her time and made it easier for her to do her job as a teacher. Interestingly, Mrs Chamu said in the questionnaire that she was unsure of whether or not her learners possessed ICT skills or whether or not they had access to ICT tools outside the school. This uncertainty was not a determining factor when she decided on using the mobile computer lab in her classroom.

7.3.4 Lesson on Nationalism

Mrs Chamu had a single activity systems operating as she did the classroom activity, that is, teach History (Figure 7.12 below).

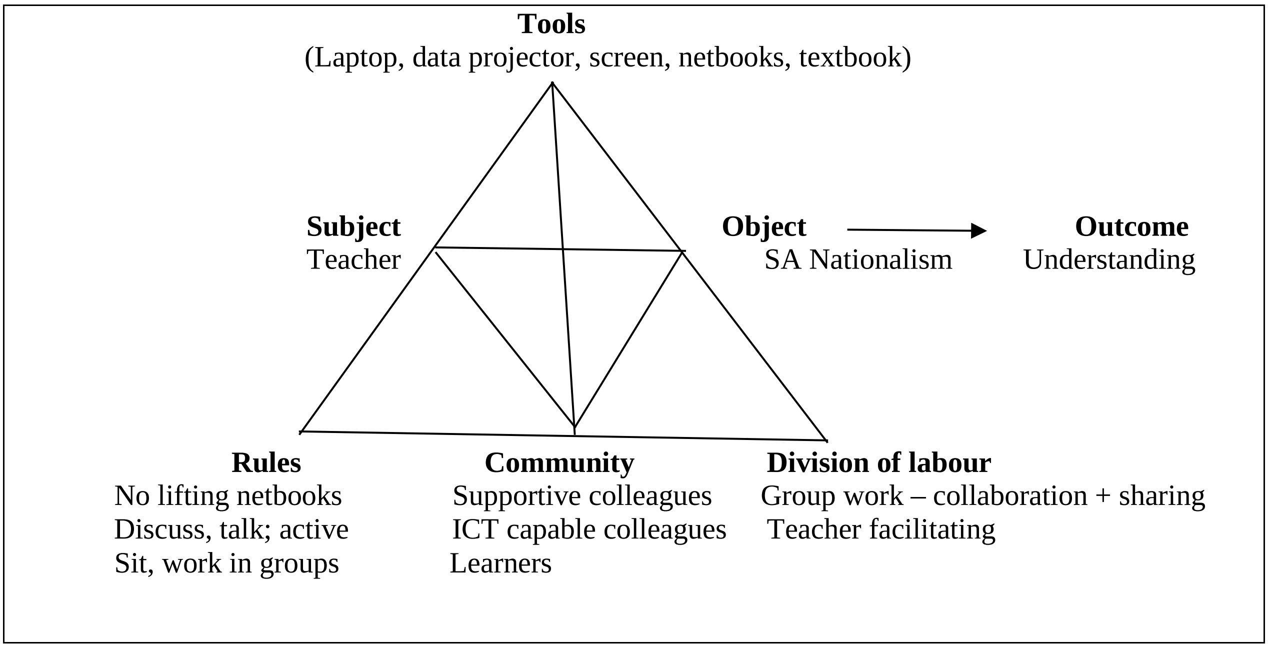

Figure 7-12: Mrs Chamu's activity triangle

Mrs Chamu's lesson was on the introduction to nationalism. The expected outcome was that the learners would get a preview of South African nationalism. The lesson was an introduction to a three-week series on South African nationalism. The teacher had planned to use the flipped classroom technique with her learners. She gave learners sections of this topic to research on and present as a way of introduction to the section. She would then teach each section again over three weeks. She found some websites with information on nationalism, downloaded these websites and saved them in the offline mode on the netbooks.

In terms of the division of labour, I observed Mrs Chamu instruct her learners to work in groups, to access the offline websites and to read the articles and their textbooks for relevant information on nationalism. Her intention was to *"encourage learners to investigate, discover* *and create answers for themselves, rather than wait for the teachers to give the answers"* [Mrs Chamu, teacher interview – July 2013]. This is in line with one of the skills outlined in the CAPS document that is "understanding the range of sources of information available for studying the past" (DoE, 2011, p. 9), as well as learners who must be able to "find a variety of information about the past and selecting relevant information" (DoE, 2011, p. 10). I also observed Mrs Chamu giving guiding questions to help learners with their reading and note taking. She walked in the classroom during the lesson, listening and observing how learners worked in groups and, when needed, guided them. She explained in the interview that she put the groups together in such a way that those who could and could not use the computer were in one group so that they could help each other. She said, *"...I will mix those that are able to use computers with those that cannot use computers, so that if there is a problem the learners can help each other even though I will also be there to help them"* [Mrs Chamu interview - July 2013]. The learners discussed among themselves the important information and decided as a group whether it should be included in the presentation or not.

While learning was the focus, computer skills were a by-product of this process. Learners were able to click and scroll down with the mouse and those who had never used the computer before, took time learning how to scroll up and down and how to click using the mouse. The teacher facilitated and assisted learners with technical problems. Within the groups, learners told each other the parts of the computer and their uses. On a very small scale, this finding confirmed the findings in the Hole in the Wall and the Digital Doorways projects (Mitra and Rana, 2001; Dangwal & Kapur, 2008) that children can learn computer skills from exploring and help from peers. Mrs Chamu used strategies in her teaching that promoted learner interaction – using either small group work on the netbooks, class discussions guided by her questioning and group presentations. The learners did the work that was set for them, that is, reading, group discussion, making notes and preparing a PowerPoint presentation. The teacher instructed the groups to agree among themselves and assign each other roles, the group leader, note taker and presenter. All these strategies encouraged collaborative learning and active participations from all learners.

Lesson at school C were 45 minutes long and learners had to move from one class to another for their lessons. This added some pressure on the teacher as she tried to integrate the mobile computer lab in her lessons. Time was lost as students left and a new group came in. More time was lost starting the netbooks and with learners finding their way to the sites they needed to read. Mrs Chamu used a double period for the lesson. The teacher brought in special rules for the intervention, such as learners could not lift netbooks, they were also asked to do their work and not spend time on other things on the netbooks.

Mrs Chamu spent a lot of time thinking, planning and preparing for the classroom intervention. In total, she requested to meet on four occasions. In each meeting, she would refine her ideas and even try them out so that she could see if they were going to work. At first, she said, *"maybe, researching the information? In other words, I am not going to teach them basic skills like how to open the browser but to search for information"* [Mrs Chamu interview - July, 2013] then she had another idea: *"I think they can get information and extract some cartoons related to history so as to answer a question. We call that source-based questions"* [Mrs Chamu interview - July 2013]. She also thought of how to arrange her learners for the intervention since some learners had never used computers before. She said:

> For some learners who are not used to using computers there will be a challenge. I think it will be important to mix them, I will mix those that are able to use computers with those that cannot use computers so that if there is a problem the learners can help each other even though I will also be there to help them [Mrs Chamu interview - July, 2013].

The thinking that went into the intervention was evident in the intervention I observed

The only issue Mrs Chamu noted as a challenge, was classroom management. Her learners were excited and noisy. She had this to say about the noise levels: *"it was because they were using those computers for the first time in class. Therefore, they were a little bit excited also, so that made them to be loud"* [Mrs Chamu SR interview - August 2013]. This novelty effect on the first class was expected and had been explained to the teachers during the in-service ACE-ICT that this was a normal reaction. Mrs Chamu also acknowledged that even though her learners were a bit noisy, their participation and discussion levels were much higher than in a normal class where she taught without the computers. Mrs Chamu attributed the difficulty in classroom management to the behaviour of the learners. She said, *"our learners are difficult at home first then they bring that behaviour to school and there is nothing you can do"* [Mrs Chamu SR interview - August 2013]. Mrs Chamu's link of the social background and upbringing of the learners with their behaviour in the classroom highlights the reality of the South African marginalised school context.

Overall Mrs Chamu had the only classroom interventions that were learner-centred. In my view it was a combination of personal reasons or commitment to ICT use and the rich details in lesson preparation and planning that Mrs Chamu put into her teaching that separated her intervention from those of the other two key participants. Despite knowing that some of learners had no ICT skills or access to ICT outside the school, she still took the opportunity to expose those learners to ICT in the classroom. While she encountered some time challenges, with more experience she will likely be able to manage her time better.

7.4 CROSS CASE ANALYSIS – IN-SERVICE ACE-ICT KEY PARTICIPANTS

In the cross-case analysis, the three cases were compared to identify some patterns and building abstractions that applied or differed across all the cases (Merriam, 1998; Yin, 2003). I focus on commonalities and differences between them and use that to explain why the three comparable teachers who had access to the same ICT equipment and taught similar lessons had different experiences with ICT in the classroom.

Subjects

In this section, I discuss the differences and similarities of the three teachers. What seemed to have influenced these three teachers' classroom experiences with ICT was the difference in the internal variables of motivation, prior experience and training. Motivation has been identified as an important factor that determines one's attitude and perception as well as decision whether or not to use computers in teaching. Hennessy et al. (2010) noted that the lack of motivation hinders the use of computers in the classroom. It would seem the more personal the reasons, the more teachers are invested in making ICT use in the classroom a success. For example, due to Mrs Chamu's health problems, she invested financially (buying curtains and a white board) to make the use of computers in her classroom a reality. Mrs Chamu's motivation stemmed from two personal reason (sinus and reducing workload) and two reasons were related to her learners in that she wanted to be able to teach in a manner that made it easier for her learners to understand the subject better. For Mr Asiya it was to expose learners to ICT and developing the community which was similar to Mrs Banda who also wanted to train the community.

There was also a marked difference in the key participants' prior experience with ICT which influenced their experiences in their classrooms. Mrs Chamu had a wealth of experience with

ICT and personal drive to learn and explore ICT gadgets. Similarly, Mrs Banda was constantly learning more and sharing her expertise while training community members which was a source of her experience. She had troubleshooting experience which she put in practice daily at her school. These two teachers, Mrs Banda and Mrs Chamu, had been exposed to computers for roughly ten years and were leaders in this field in their schools. In contrast, Mr Asiya had sporadic experiences with ICT in his past and, although he said he used his laptop daily for planning, evidence shows that he was the only one to encounter technical challenges during his lesson. This suggests that prior experience with ICT for personal and professional use is crucial for ICT integration.

Despite these differences in prior experiences with ICT, all three key participants had positive attitudes and beliefs towards ICT and its use in teaching. They all perceived ICT as easy to use and useful in teaching. All three teachers were confident in their ability to use the computers. They were comfortable with the use of computers for planning and preparation; that is, conducting research for the lesson, preparing PowerPoint presentations or typing out notes in Word. All three teachers had indicated in the questionnaire that they had sufficient confidence to try teaching with computers on their own.

Community

The three teachers had different school environments. Although all three key participants held leaderships positions (Mrs Banda – ICT champion, Mrs Chamu – IT representative and Mr Asiya – school principal) it was the difference in the support the teachers received in these positions that separated them. For Mrs Banda, as an ICT champion, she received extensive continuous technical support and training from the UFH and RU researchers. She also had the moral support of her colleagues who completed the in-service ACE-ICT course with her. Similarly, Mrs Chamu received technical support from the education district office and her colleagues who had completed similar ICT integration courses either with Rhodes University or elsewhere. In contrast, Mr Asiya did not have a source of technical assistance either from experts from outside the school as his school was not involved in any ICT related project or the education district office as the school did not have electricity or ICT resources. As Mr Asiya was school A's principal, he also did not have the school management support that Mrs Banda and Mrs Chamu enjoyed. None of his colleagues were computer literate or had completed an ICT integration course, except for one who had typewriting skills. The difference in in the external variable of support accounts for the differences in the three cases presented above.

As alluded to earlier, the three schools represented variations of marginalised schools found in South Africa. Two rural schools and one township school were included in this study. Although all three schools can be described as marginalised, the findings showed that there were differences in the infrastructure available at the schools and in their communities; for example, school A did not have electricity and struggled with an expensive generator as the only source of energy. Mrs Banda's school had an unstable electricity supply due to unscheduled power cuts or the school running out of electricity units. Mrs Chamu's school on the other hand was located in a peri-urban area, the school had no challenges with electricity and provided a different experience for the teachers and learners compared to schools A and B. These finding show that infrastructure problems still plague marginalised schools in South Africa and influence ICT integration.

Besides the challenge with basic infrastructure, all three teachers indicated that there were resource shortages at their schools which explain the differences in how ICT was used. Two of the schools (A and B) did not have a data projector and while it was available at school C there was a booking system that hindered teachers from using it. In two of the school, B and C, teachers indicated that though resources were available they did not have full access to them. Those in positions of authority at schools B and C acted as ‘gatekeepers’ of technology and hindered ICT use in the classrooms. At school C, for instance, the computer lab was open to teachers, but was locked all the time, and those who needed to access it had to ask the IT representative to open for them. This was a barrier for teachers who could not access the computers if the IT rep was busy or away. In both schools B and C, access to the Internet was closely monitored and limited as the schools had an Internet cap per month and systems were put in place so that the school did not ‘run out’ of data for the month. The limited access to or lack of additional resources such as data projectors at schools impede ICT integration.

Learners formed part of the community in this study. Findings from the learner questionnaire show that the vast majority of learners from schools A and B (see sections 7.12 and 7.2.2) did not have access to computers at home when compared to learners at school C which was in a township (see section 7.3.2). In rural areas computers are considered a luxury given the lack of basic necessities such as decent secure buildings, electricity, etc. (Farrell et al., 2007). Hayes (2007) states that without out-of-school access to technology for practice, mastering computer skills will be greatly affected. Findings from the three in-service ACE-ICT key participants highlight the difference on the basis of availability of computers at school not geographical location. The vast majority of learners at schools B and C had used a computer before, mostly to play games, watch videos, etc. These two schools had computer labs (see sections 7.2.2 and 7.3.2). Regardless of geographic location or access to ICT, learners at schools A, B and C were looking forward to using ICT and thought it was important and necessary for them to know how to use computers.

Tools

The three teachers used ICTs as a different tool in the three classrooms. In two of the classrooms (Mr Asiya and Mrs Banda), the computer was used as a servant as the tasks of the classroom remain unchanged and the computer simply supported the old teaching method as found by Goos et al. (2003). Mr Asiya and Mrs Banda's classrooms remained teacher-centred when the computer was introduced. Mrs. Chamu's classroom was changed from teacher-centred to learner-centred and used the computer according to what Goos et al. (2003) call a partner in the learning process. Mrs Chamu did this by encouraging collaborative learning in groups. She put together academically weak students together with academically strong students. This was done so that they could help each other and work together. The learners were discussing among themselves the important information and deciding as a group whether or not it could be included in the presentation. So, while learning was the focus, computer skills were a secondary bi-product of this process. Within the groups learners showed each other parts of the computer and explained the purposes of the parts. This confirms that children can learn computers from each other, through inquisitive inquiry without an adult (Dangwal et al., 2009).

Evidence shows that the use of a computer as a presentational tool was most common in the three classrooms. PowerPoint presentations for all three teachers meant that it would reduce their work of rewriting notes on the chalk board as they had multiple classes per grade (see table 7.4 below).

Table 7-4: Grade teachers taught

Teacher	No. grades taught	No. classes per grade	Average no. learners per class
Mr Asiya – School A	2 (grade 8, 9)	3	38
Mrs Banda – School B	2 (grade 8,9)	2	39
Mrs Chamu– School C	3 (grade 10,11, 12)	4	36

ICT was used as a representational tool in Mr Asiya and Mrs Banda's classrooms and as an information gathering tool as well as productivity tool in Mrs Chamu's classroom. These findings confirmed those of Yazon et al.'s (2002) study, which found that, for the most part, teachers use computers as an extension of the chalkboard (Yazon et al., 2002).

The findings also indicate that all three teachers were at different levels of ICT adoption (Gladhart, 2001). Mr Asiya and Mrs Banda were at the second level of the adoption of innovation theory, that is, the adoption level (Dwyer, et al., 1992). They were comfortable to use computers but not experienced enough to achieve educational goals (Ndlovu & Lawrence, 2012) like Mrs Chamu was. The use of the computer for presentation purposes is in line with this level of adoption in which the teachers' ability is limited to generation or interaction with knowledge only. This finding is in line with that of most teachers in marginalised areas in South Africa who are either at the first level or at the second level of adoption (Ndlovu & Lawrence, 2012). This was to be expected for teachers in a context where the use of computers was just at its inception and teachers are not yet in a position to help learners use computers for higher thinking skills.

Object

Clear objectives and expected outcomes were set by all the three teachers. While teachers believed that the objectives were met and outcomes achieved, in SR interviews the teachers indicated that this could have been done better or differently as seen by the suggestions for improvements made. For example, Mrs Banda suggested the inclusion of multimedia in the form of pictures.

Division of labour

Labour was divided in the classrooms depending on the teaching approach used, for example Mrs Chamu's group work method when computers were used by learners and she facilitated learning. She took the role of guiding and helping learners as they worked in groups and constructed their own learning. Labour was divided further among learners themselves in this class and they started learning together with their fellow learners, researching and consulting each other. As Farrell (1996) notes, classroom interactions change when computers are introduced in the classroom. Mr Asiya and Mrs Banda maintained a leading role in the classrooms when computers were used for representational purposes. In these two classrooms, the traditional teaching method whereby the teacher speaks while learners sit and listen was used when the representation method was used.

Rules

In the three classes the rules teachers employed were in line with the teaching method they used. For example, in Mr Asiya and Mrs Banda's classroom where a traditional teaching method was used, the learners sat in columns or randomly when compared to Mrs Chamu class where learners were in groups working together on a given task.

Overall experience teaching with ICT

All three teachers indicated that they did not anticipate how much time they took when they used ICT in their classrooms. Although the use of ICT in the three classrooms was very different, all teachers were unable to finish the lesson in the time originally allocated to it. For example, Mrs Chamu (in whose classroom learners used the mobile computer lab) used three hours to finish the lesson she had planned to do in one hour 30 minutes. All three teachers agreed that teaching with computers required a lot of planning and preparation time and that this planning and preparation were important. All the three key participants held the perception that it was easy to use ICTs in teaching prior to the classroom interventions. In SR interviews, all three teachers described their experience as "*time-consuming*", "*a lot of work*", and "*very difficult*". After the interventions teachers realised that there is a difference between using computers in teaching and for personal use, and that ICTs are not as easy to integrate in the classroom as they had originally thought.

7.5 SUMMARY

In this chapter, I presented evidence that the three teachers perceived computers as easy to use and useful in their teaching. Two of the teachers (Mr Asiya and Mrs Banda) did not utilise the mobile computer lab, opting to use PowerPoint as a replacement of the blackboard, rather than for deep learning and understanding. I argued that the difference in the manner these teachers used computers in their teaching was due to the differences in motivation, the context, support and their personal characteristics. Observations of Mr Asiya and Mrs Banda's lessons also revealed teacher centred approaches with limited strategies to promote student interaction and higher order thinking. During the SRIs, teachers began to think of how they could help their learners remember, understand and enjoy the content. Several strategies were suggested, such as the inclusion of pictures, short videos, and use of offline web pages that learners could read to extract information. Issues of access, prior knowledge for the teachers and learners and the school and classroom factors also had to be considered.

CHAPTER EIGHT: BED-ICT IN-SERVICE SOCIAL SCIENCES STUDENT TEACHERS' EXPERIENCES OF USING ICT IN THE CLASSROOM

In this chapter, I discuss the in-service BEd-ICT Social Sciences student teachers' experiences with ICT in the classroom. The in-service BEd-ICT replaced the in-service ACE-ICT at Rhodes University from 2012. After a three year period of reflection, the cohort referred to in this chapter comprises students registered between 2015 and 2017. The chapter begins with a reflection on the in-service ACE-ICT experiences (section 8.1). I then present findings on the in-service BEd-ICT cohort in section 8.2. The classroom interventions of the three key participants are reported in section 8.3. The chapter ends with a cross case analysis in section 8.4.

8.1 REFLECTIONS ON THE IN-SERVICE ACE-ICT EXPERIENCE AND REDESIGN OF THE ACTIVITY

In this section, I discuss the follow up with the three in-service ACE-ICT key participants in section 8.1.1. I outline the general lessons learnt from the in-service ACE-ICT experience in section 8.1.2. I then explain how these lessons were used to redesign the classroom interventions that the in-service BEd-ICT students implemented in section 8.1.3.

8.1.1 Follow up with the three in-service ACE-ICT Social Sciences key participants

A follow up in 2018 on the three in-service ACE-ICT Social Sciences key participants whose lessons were observed and reported on in chapter seven showed that nothing much had changed in those classes and schools five years after my first visit. The three teachers were asked three short questions which sought to establish what was happening in their classrooms in terms of

ICT integration since my visit. They were asked if they were using ICT in their teaching, to give examples of what they were doing if they were and, if not, to explain what was hindering them from ICT integration. Two of the three key participants were still working at the same school teaching the same grades and subjects as they did in 2013. One had retired. Telephonic interviews were conducted with each of the teachers. Conversations were started with a phone call to explain the follow up and to receive their consent and then questions were posed via the WhatsApp platform. Below is a brief summary of what the interviews revealed:

- Mr Asiya was still the principal of school A. The school received a modular library and electricity in 2017, but still lacked physical access to ICT. There is still no computer lab for learners. All teachers had received laptops under the provincial government laptop initiative. Mr Asiya indicated that this had not changed anything in terms of ICT use in teaching or in classrooms at the school, because the school does not have a data projector, which he requested the school management body to buy in 2019. His colleagues still did not use their laptops for teaching. He said they were *"scared of ICT"* and attributed this to poor training. He said, "*their training was very poor, only one day for a bulk of educators"* [Mr Asiya follow up Interview – November 2018].

- Mrs Banda had retired in 2016, three years after I visited school B. The school had received a computer lab with 20 computers from the Siyakhula Living Lab a year after my visit. Until she left, she said she did not use ICT in her teaching because she could never get the time to properly plan for it. Before she retired, she had started encouraging other teachers to start using computers for their teaching. She indicated that she had trained/groomed and handed over to another female teacher to champion ICT matters at the school. In the year after I had visited the school, the Siyakhula Living Lab project which provided much technical support to the school had ended. This means the school now had no source of technical support except well-wishers.

- Mrs Chamu's school C received 20 small laptops for learner use in 2017. She indicated that *"these are still locked away and have never been used"* [Mrs Chamu follow up Interview – December 2018]. She never used ICT with the learners in her class again since my visit, which is understandable since the school did not have netbooks or any ICT that she could use in her classroom. She continued to use her laptop and data projector for PowerPoint presentations. She had stopped running AwareNet for learners in the afternoons. The former IT rep, who was a source of support for Mrs Chamu, retired in 2017 as well as two other teachers (from the five) that had trained to integrate ICT in their classrooms. Little support from colleagues was now available after these retirements.

8.1.2 General lessons learnt from the in-service ACE-ICT interventions

From the three in-service ACE-ICT key participants it was evident that lesson planning and preparation separated the three cases. In order to support teachers with ICT integration, lesson planning had to be emphasised. Student teachers noted that the curriculum statement provides a day to day outline of what the teachers ought to do in their classrooms and therefore felt there was no need to plan as the planning had been done for them. This was, however, a misconception as the curriculum statement's outline is meant to be used as a guideline and teachers are encouraged to add or modify the outline for each day. Some in-service ACE-ICT student teachers opted to re-teach a lesson that they knew had gone well or that was not even part of the curriculum at the time, adding to their workload. There was a need to consider lesson planning in these professional development courses and ensure that teachers were supported in this area in order for them to be able to successfully plan and implement ICT integration.

Support was a key concern in the in-service ACE-ICT experience. The in-service ACE-ICT student teachers had indicated that, as pioneers at their schools, they often did not receive support from the school management, from their colleagues or from IT experts. They also felt like they were in competition with each other for marks, which added to their anxiety and put pressure on me as their lecturer to try and provide individual assistance. Time and costs implications meant that I could not visit each of the student's classrooms for observations as this was how the ICT integration activity was designed. This needed to be reconsidered and a more practical way of supporting students and assessing ICT integration found without the expenses or time requirements.

A major concern for the in-service ACE-ICT was how the classroom observation which I required for my research would form part of their assessment. This was a valid reason and led to the delay in the classroom observations which I then conducted after the students had completed the course. As such, I had to think of a new way of collecting this data for the in-service BEd-ICT in such a way that students did not feel pressured. Closely related to this issue of the timing was the request from the in-service ACE-ICT student teachers to teach in their class on their own first before being observed. Student teacher 10 said, *"I would love to be given the opportunity to practice on my own without the panic of someone observing me".* Given the experience in Mr Asiya's classroom, I had to consider carefully how to avoid the manifestations of the student-lecturer relationship in the classroom while at the same time giving teachers the opportunity to get comfortable with teaching with ICT before being observed and given feedback.

While the provision of ICT resources was improving in marginalised communities since the in-service ACE-ICT, I was cognisant that at some schools resource limitations (either availability or access) remain. During the in-service ACE-ICT the mobile computer lab was available, but this could no longer be offered to the in-service BEd-ICT students. As such, a more innovative way of using resources available at schools had to be established and encouraged for the in-service BEd-ICT cohort.

8.1.3 Redesign of the classroom intervention activity

The experience with the in-service ACE-ICT suggested the need for support in lesson planning. In order to do this, I designed an online questionnaire on lesson planning that was completed by 56 (76%) of the 74 in-service BEd-ICT student teachers (see Appendix L). The questionnaire was also drawn up to get their perceptions towards lesson planning and to understanding the views of these student teachers on the topic. The in-service BEd-ICT student teachers also noted that they relied on the CAPS document or the textbook and so they did not see the need to plan. The majority of the student teachers (34 or 61%) said it was enough for them to refer to the teacher guide textbook or the CAPS document just before the lesson. There were several reasons given why teachers do not plan their lessons, such as lack of time to plan and to finish lessons. For example,

> most of the time we do not have time to do so [plan] due to the fact that we normally do not teach one subject and when we come back from work we are so tired and we are also involved in a number of school activities not teaching part only [Student teacher 18, Lesson plan online questionnaire – July 2017].

Other reasons given were due to experience in teaching. For example, student teacher 8 said, *"some educators have been in the education system for a long time and they know the syllabus, they do not see the need to prepare or make a lesson plan for every topic they have to teach*" [Lesson plan online questionnaire – July 2017].

On the other hand, some student teachers indicated that lack of lesson planning was due to lack of training. For example, student teacher 7 said, "*some teachers do not understand how to do the lesson plan and claim they were not taught in their training institutions*" [Lesson plan online questionnaire – July 2017] while student teacher 24 thought it was because of the curriculum policy document that gives a daily guide on what must taught. The student teacher said, *"They think it [lesson plan] is already there on the CAPS document"* [Lesson plan online questionnaire – July 2017]. The majority of the student teachers (41 or 73%) said they had not been taught how to plan a lesson. This was a huge number and warranted the inclusion of a focus on lesson planning in the cross curriculum integration and implementation module.

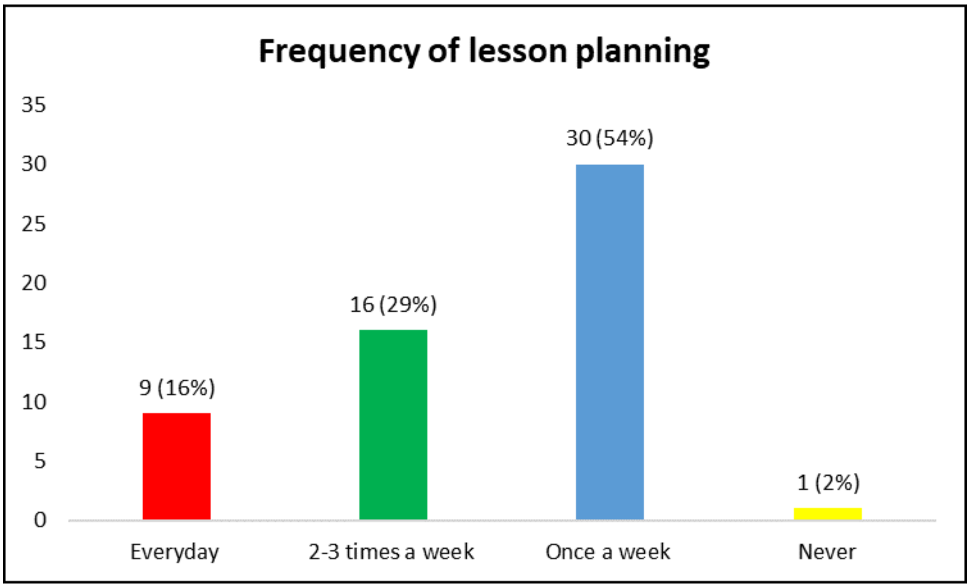

Figure 8-1: Frequency of lesson planning (n=56)

The majority of student teachers (30 or 54%) said they planned once a week with only 9 (16%) saying they planned every day (see figure 8.1). Again, this is despite the fact that the vast majority (49 or 88%) of the student teachers said it was important to prepare a lesson plan every day. Given these findings from this questionnaire, a decision to use a lesson plan template originally designed for pre-service student teachers at Rhodes University was adopted (see Appendix K). After going through the template as a class, all in-service BEd-ICT student teachers had to use that template for all lesson plans. The lesson plan template, which had a set of questions guiding them through various steps, appeared to help with planning, despite some challenges in determining what to include.

Cognisant of the need for support, both moral and technical, as raised by the in-service ACE-ICT student teachers, for the in-service BEd-ICT two ways of ensuring student teachers felt supported were implemented. Formal structured communities of practice (CoP) were embedded into the course to provide student teachers with support and safe spaces to interact with their fellow students and ask for assistance from the beginning of the course. As the course is in-service and therefore part time, contact sessions were used to provide spaces for student teachers to interact and learn together face-to-face. Group work activities were also implemented from the first session which allowed for student teachers to work together based on the subject and grade they taught. The first lesson plan was prepared as a group – this was done to encourage the class to share ideas and to ease them into the activity. As a group, they had to agree on a topic to teach and draw up a lesson plan and each teacher then went and taught that lesson in their own classroom. Between contact sessions, student teachers were encouraged to utilise the online and mobile CoPs such as the forum and discussion board on the university's learning management system and social networking with their group members. These CoPs evolved naturally as the students got familiar with one another. The student teachers often self-organised outside the original CoPs as part of the course. They had an opportunity as a group to discuss how the lessons went during the contact session and to share ideas on how to deal with emerging challenges. This group work prepared them for individual classroom interventions.

One of the main challenges with the in-service ACE-ICT classroom interventions was the timing and the concerns from student teachers that they did not get an opportunity to get comfortable with teaching with computers on their own first before being observed. For the in-service BEd-ICT, the classroom observation was replaced with student teacher reflection on the lesson. Similar to the lesson planning issue, I used an online questionnaire to find out what student understood about reflection (see Appendix L) as a basis for the teaching around this topic and preparing student teachers to reflect on their classroom intervention. Fifty six out of the seventy four student teachers responded to the questionnaire. All student teachers said it was necessary to reflect on their teaching.

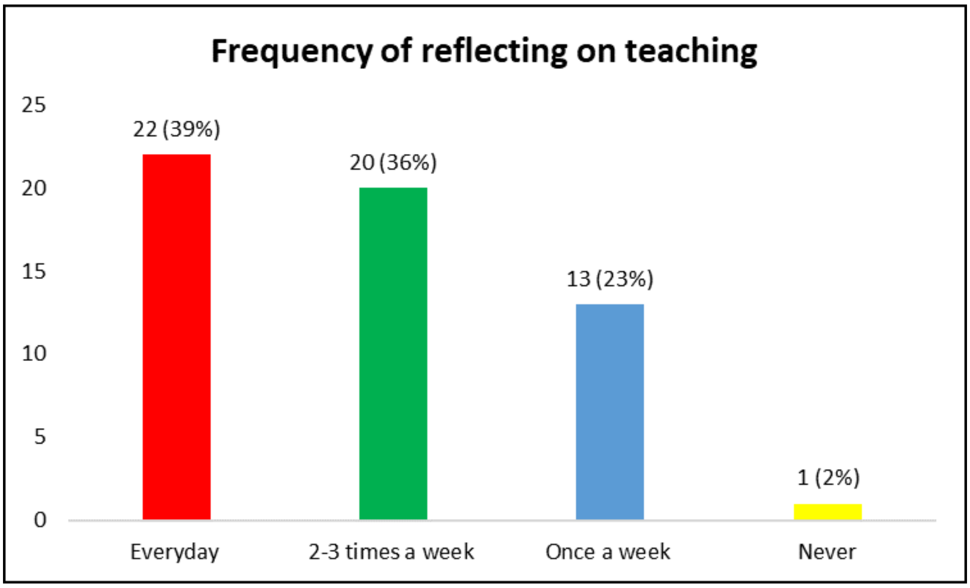

Figure 8-2: Frequency of reflecting on teaching (n=56)

The vast majority (42 or 75%) of the student teachers indicated that they reflected on their teaching every day to 2 or 3 times a week. Only 22 (39%) of the student teachers said they reflected on their lessons every day while 20 (36%) said they reflected on their teaching two – three times a week. Less than half (23 or 41%) thought reflection was time consuming.

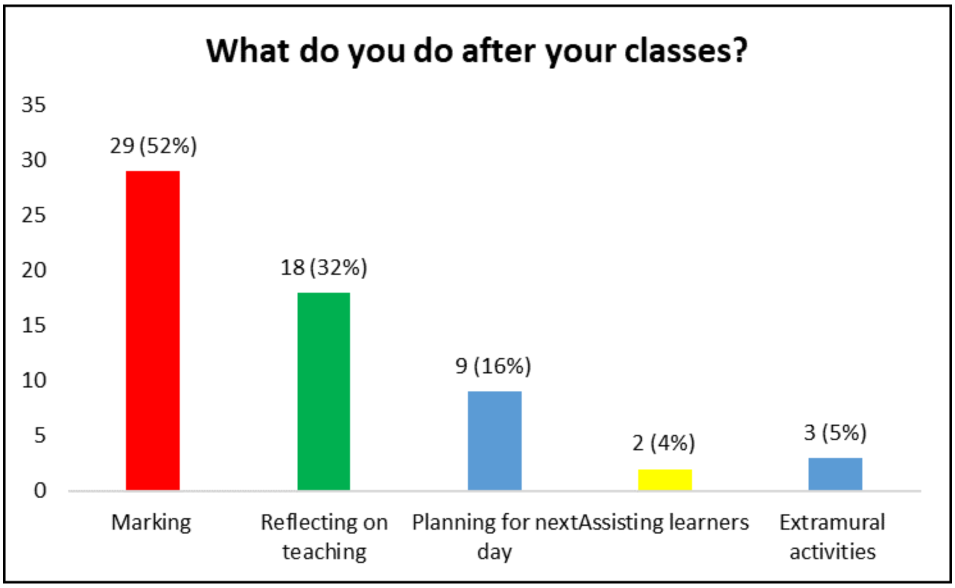

Figure 8-3: What teachers do after classes (n=56)

When asked what they normally did after a lesson, 29 (52%) of the student teachers said they spend that time marking, 18 (32%) said they reflect on the lesson, 9 (16%) plan for the next lesson, 2 (4%) spend the time offering remedial lessons to slow learners and 3 (5%) engage in extra mural activities (see figure 8.3). These results show that few student teachers planned for their lesson or took time to reflect on their teaching and supported my focus on these two areas in the redesigned activity. Students were encouraged to reflect on various smaller tasks during the contact sessions as a way of practising and planning for lessons in groups or as individuals.

Similar to in-service ACE-ICT, the autonomy over what to teach remained open to the in-service BEd-ICT student teachers, but the planned intervention was restricted to a two-week period in a school term. For the in-service BEd-ICT student teachers the activity on their course was aligned to their day-to-day teaching and they were expected to work within the bounds of the curriculum statement. All the in-service BEd-ICT student teachers had to implement a lesson integrating ICT and subsequently reflect on a lesson they taught, using any available digital technology. Such implementation took place at their school in-between contact sessions for the course. In-service BEd-ICT student teachers had the opportunity to try out using ICT for the first time without being observed, a major difference from the in-service ACE-ICT course. One of the in-service BEd-ICT students articulated this difference in the two courses saying:

> "It [the in-service BEd-ICT] is a very interesting course that brings technologies into the classroom and teaches us how to use ICT tools in the classroom, minimising 'talk and chalk' approach. Now I can confidently use as many ICT tools as possible when I am teaching learners" [Mr Dali, How I became computer literate narrative, January 2015]

8.2 THE IN-SERVICE BED-ICT STUDENT TEACHERS

The Bachelor of Education in ICT is an in-service part time degree offered at Rhodes University. Similar to the in-service ACE-ICT, the focus of the degree is on cross curriculum integration and implementation of ICT in education. In this section I discuss the personal characteristics of the student teachers and the context within which they worked before I report on the classroom interventions in the next section.

8.2.1 Personal characteristics

In this section, I present the personal characteristics of the in-service BEd-ICT student teachers. Data used in this section is from the 74 student teachers who were in their 3rd year in 2017 and was collected from the selection questionnaire (see Appendix J) as well as the application form (see Appendix E1). The majority of the in-service BEd-ICT student teachers (54 or 73%) were female as seen in figure 8.4 below, which is consistent with the fact that the majority of teachers in South Africa are female.

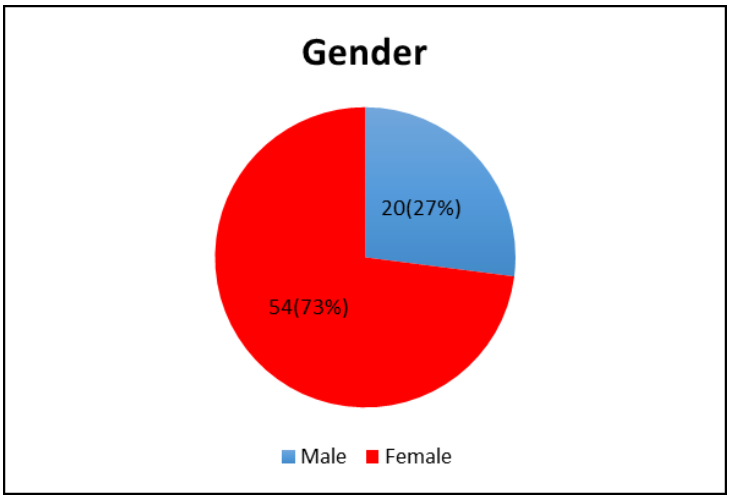

Figure 8-4: Gender (n=74)

The vast majority of the in-service BEd-ICT student teachers were older than 35 years of age (63 or 85%).

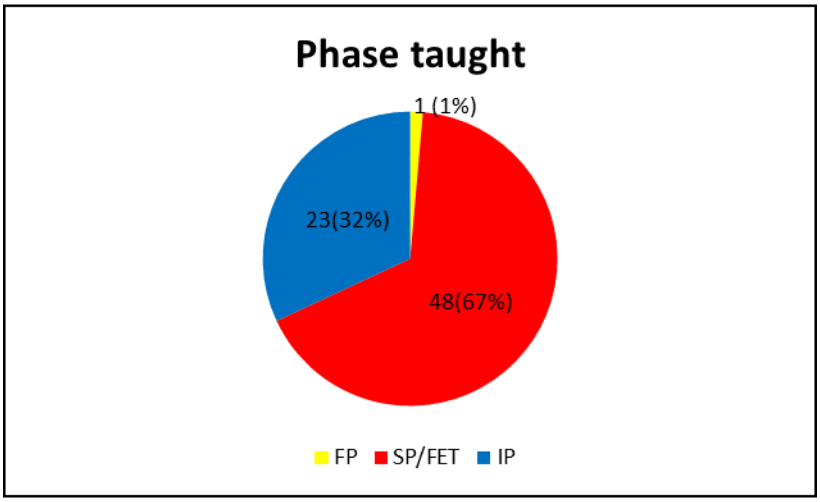

Figure 8-5: Phase taught (n=74)

As seen in Figure 8.5 above, the majority of these in-service BEd-ICT student teachers (48 or 67%) taught in the Senior Phase or FET while 23 (32%) taught in the Intermediate Phase.

In terms of access to ICT, the vast majority of these in-service BEd-ICT student teachers (59 or 80%) owned a laptop which they received through the Eastern Cape provincial laptop initiative under the auspices of Operation Phakisa. Less than half of the student teachers (32 or 43%) had access to the Internet at school while 36 (49%) had access to the Internet at home.

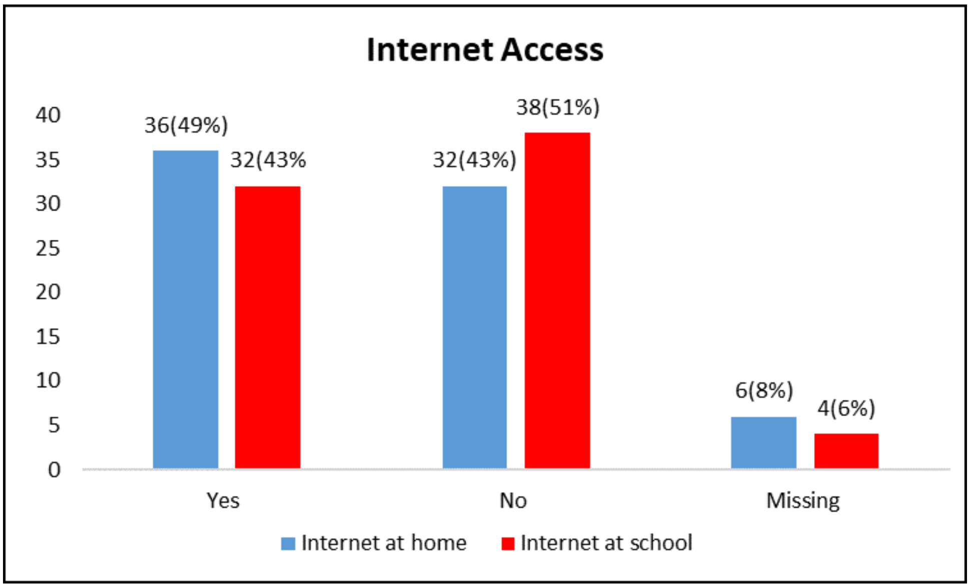

Figure 8-6: Internet access (n=74)

Student teachers were all computer literate.

8.2.2 Context

The schools where the student teachers worked were all in quintile 1 to 3 – that is, they were all no fee-paying schools (see Grant, 2013). However, these schools had good basic infrastructure.

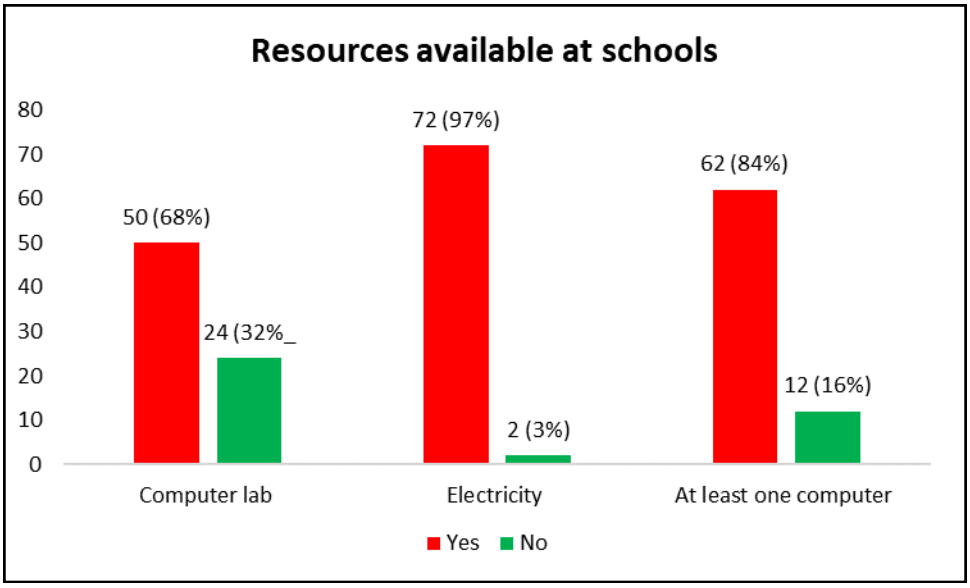

Figure 8-7: Resources available at schools

Findings from the selection questionnaire (see Appendix J) revealed that the vast majority of the in-service BEd-ICT student teachers (72 or 97%) worked at schools that had electricity. The majority of the schools (50 or 68%) had a computer laboratory. The number of schools with physical access to computers increased as the vast majority of the schools (62 or 84%) had at least one computer. When there is only one computer in a school, it is often for administration and therefore teachers and learners do not have access to that computer. When this finding was viewed together with the fact that 59 (80%) of the student teachers owned a laptop, one could assume that the likelihood of ICT integration in these schools was high, because computers and laptops are readily available.

8.3 BED-ICT IN-SERVICE STUDENT TEACHERS' EXPERIENCES OF USING ICT IN THE CLASSROOM

In this section, I discussion the three key in-service BEd-ICT participants' classroom interventions. These interventions are different when compared to those of the three key in-service ACE-ICT key participants presented in chapter 7 above. This is because of the difference in the design of the interventions and the data collected for this group. No interviews or classroom observations were conducted with the three in-service BEd-ICT key participants. For each case, the personal characteristics of the teacher were reported followed by the context and the teachers' perceptions. Data presented here was gathered from documents – the in-service BEd-ICT application forms (see Appendix E1), the 'How I became computer literate' narrative (see Appendix E2), lesson plans and reflections (see Appendix M) that the key participants wrote.

8.3.1 Case 1 - Mr Dali at school D

Mr Dali was a 49 year old man who had been teaching for 18 years at the time of his application in 2015. He taught Social Sciences (History), IsiXhosa and English in Grades 10 to 12. In his application to join the course, Mr Dali articulated his expectations for the in-service BEd-ICT course saying:

> …this is the course that I have been looking for, for some time. The course…is so useful for us as educators teaching the African child and for educational purposes. This will provide me with ICT skills and knowledge in education [Mr Dali, Application Form – December 2014].

He felt that the course was useful for him as an educator since he wanted to "*use ICT for educational purposes*" [Mr Dali, Application Form – December 2014]. Mr Dali identified himself as a computer literate person with substantial prior experience with ICT. He completed a typing course in 1998, an introductory and intermediate computer course in 1999 and later another computer course through the Khula project in 2009. Mr Dali's self-evaluation of his ICT integration capability was very high. He stated in his 'How I became computer literate' narrative how he could "*confidently use as many ICT tools as possible when teaching learners*" [Mr Dali, How I became computer literate narrative – January 2015].

Mr Dali perceived ICT as useful, adding that it made his life as a teacher much easier. In terms of physical access to ICT, Mr Dali owned a personal laptop but did not have access to the Internet at home.

Mr Dali worked at a quintile 2 school located in the Grahamstown Township. The school had access to basic infrastructure such as electricity, running water and decent, secure buildings. The school had a computer lab which both teachers and learners could use. The computer lab was connected to the Internet. In terms of support, Mr Dali was enrolled for the course together with a colleague of his from his school. Mr Dali also mentioned that all teachers at his school owned a personal laptop and a number of the teaching staff were computer literate. This provided a conducive environment for the use of ICT in teaching as all teachers were on board with ICTs and their use in teaching. He stated that all teachers used the laptops as a productivity tool and for administration purposes saying, *"…we are doing school work, schedules, keeping all learners' work, tests, assignments and learner records*" [Mr Dali, How I became computer literate narrative – January 2015].

Lesson on Afrikaner Nationalism

Mr Dali prepared a History lesson on Afrikaner nationalism for Grade 11 learners (see figure 8.8 for Mr Dali's CHAT triangle).

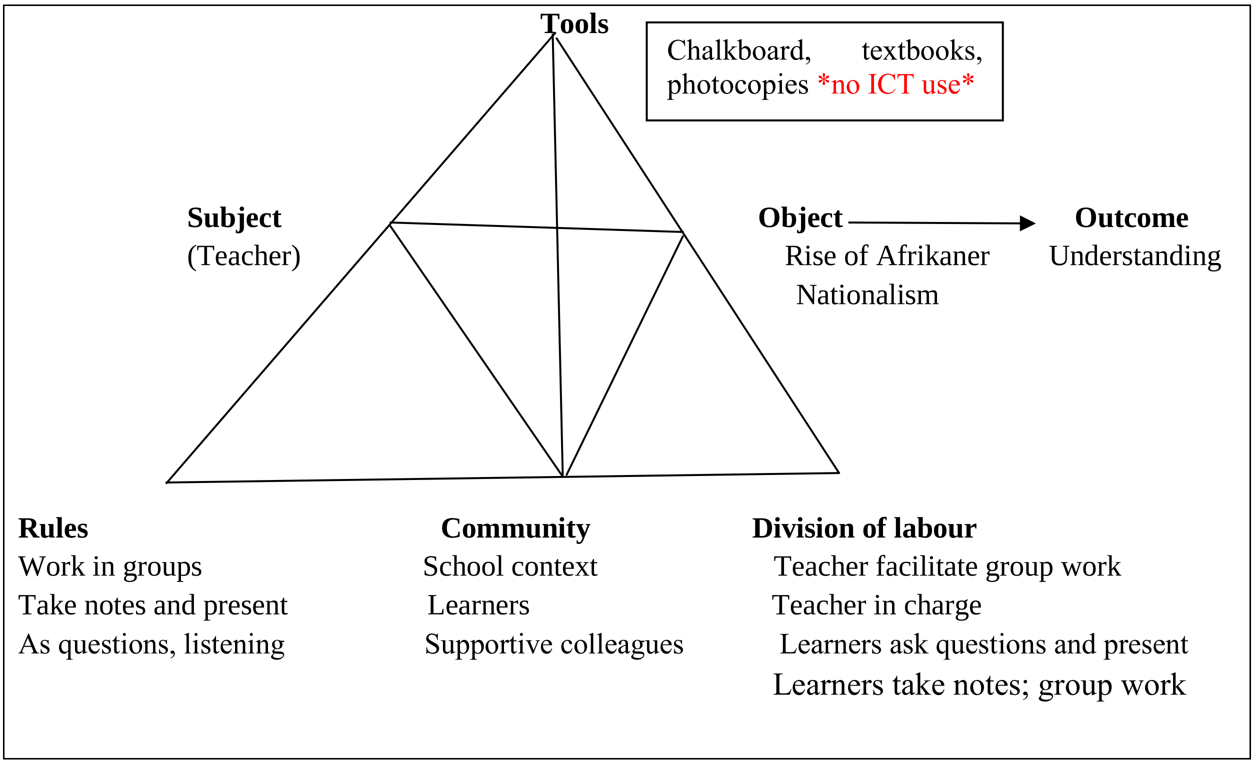

Figure 8-8: Mr Dali activity triangle

The lesson plan clearly outlined learners' prior knowledge, aim of the lesson, forms of assessment and teaching resources required for the lesson. He planned to use ICT as a representation tool to show his learners the "*definition of terms and notes*" [Mr Dali, Lesson Plan – August 2017]. This means Mr Dali intended to use ICT as a replacement for the chalkboard. He also wanted to combine the use of ICT and traditional methods which is highly recommended. He intended to have learners use textbooks in groups of nine because of textbook shortages. Following the teacher's ten minutes of introduction and presentation of the lesson, the learners would then work in groups to answer questions posed by the teacher drawing information from the teacher's presentation and the textbook for 20 minutes. The lesson would end with group presentations of their answers to the questions.

Mr Dali did not integrate ICT into his Afrikaner nationalism lesson as he had planned. He reported, however, that his learners had found the lesson interesting and that he felt it was a success. Mr Dali reported that due to *"disturbances"* he was forced to move his class from the computer lab to a normal classroom where he could not use a data projector which was mounted in the computer lab [Mr Dali, Reflection – August 2017]. He reverted to using the chalkboard and no ICT was used in this lesson. Although Mr Dali did not elaborate on the disturbances, it would seem he had not booked for the computer lab and had to make way for someone who had a booking.

In his reflection, Mr Dali noted time as a challenge for the lesson. Time was lost because learners took long to settle down before the lesson could start. As the teacher could no longer project his notes, he took time writing them out on the chalkboard. The group presentations also took more time than had been set aside. Mr Dali acknowledged time as a weakness in his lesson plan stating:

> The lesson plan was not very much accurate when it comes to the allocation of time to a particular activity, for example, the 20 minutes allocated to group presentations was not enough, bearing in mind that this is a class of 45 learners, 5 groups [Mr Dali, Reflection – August 2017].

Mr Dali made suggestions for improving time management in the future which included ensuring that enough time is allocated to activities and that, if necessary, the lesson can be completed over two lessons instead of trying to finish in haste. Mr Dali said he felt confident in his teaching, knowing what to do next: "*it* [the lesson plan] *made me feel confident when teaching because I knew exactly what to do*" [Mr Dali, Reflection – August 2017]. Lesson planning is crucial and an important step in ICT integration (Whyburn et al., 2012) and having students acknowledge how a good lesson plan positively influences their teaching is evidence of the critical role of lesson planning.

8.3.2 Case 2 - Mrs Efi at school E

Mrs Efi was a 48 year old woman who had been teaching for 20 years. She taught Social Sciences, Creative Arts and Life Skills to Grades 5 to 9. According to her 'How I became computer literate' narrative, Mrs Efi had enrolled for the in-service BEd-ICT course because she wanted to learn more about computers so she could use it in her teaching. She said, *"I decided to enrol for BEd-ICT so that I can learn more about computers….I decided to go further with computer knowledge that I have because I felt that it is not enough"* [Mrs Efi, How I became computer literate narrative – January 2015]. She added that she wanted to *"teach my learners computer skills"*. Mrs Efi was motivated to learn more about computers so she could avoid incidents such as the one she narrated in her 'How I became computer literate' story, how the school did not have anyone who could use the software programme SAAMS. She said:

> …in our school there is a challenge of punching and loading of marks using a programme called SASAAMS. In our school, there was no teacher that was trained and we struggled in so much that we had to do our schedules by hand and report forms [Mrs Efi, How I became computer literate narrative – January 2015].

Mrs Efi also had expectations to start an ICT business in her community whereby she would offer printing, laminating and typing services. She was also looking forward to starting free evening computer classes *"for those who don't have money to go to university"* in her community [Mrs Efi, How I became computer literate narrative – January 2015]. She also hoped that advanced computer skills would offer her opportunities for a career change.

Mrs Efi was a computer literate teacher who had a long history with computers starting in 1990 when she was first introduced to computers during her first year studying a Diploma in Education. She narrated how they had to work in the computer lab for some of the mathematics classes so that they could complete some exercises on the computers. Since this initial use of computers, Mrs Efi said she *"developed the love of computers from that year"* [Mrs Efi, How I became computer literate narrative – January 2015]. She later encountered computers again in 2006 when she registered for an Advanced Certificate in Education specializing in Technology at Rhodes University. She bought her first computer during this time as she needed to practice as suggested by her lecturers and all assignments had to be typed. In 2008 she completed a one year computer literacy course at Rhodes University and in 2013 she was selected by the Department of Education to do an in-service computer skills training for six weeks, which she completed. However, by the time she enrolled for the in-service BEd-ICT she did not own a laptop or a computer or have Internet access.

Mrs Efi taught at a quintile 2 township school in a town surrounding Grahamstown. The school had access to basic infrastructure such as electricity. The school had a computer lab but did not have Internet connectivity. In terms of support, Mrs Efi indicated that there were teachers at her school who were computer literate and supportive of her integration of ICT into the classroom. In her reflection, she referred to the advice that she received from a colleague on the lesson she gave as part of the in-service BEd-ICT course.

Lesson on weather and climate

Mrs Efi planned a Social Sciences Geography lesson on climate for Grade 5 learners (see figure 8.9 for Mrs Efi's CHAT triangle).

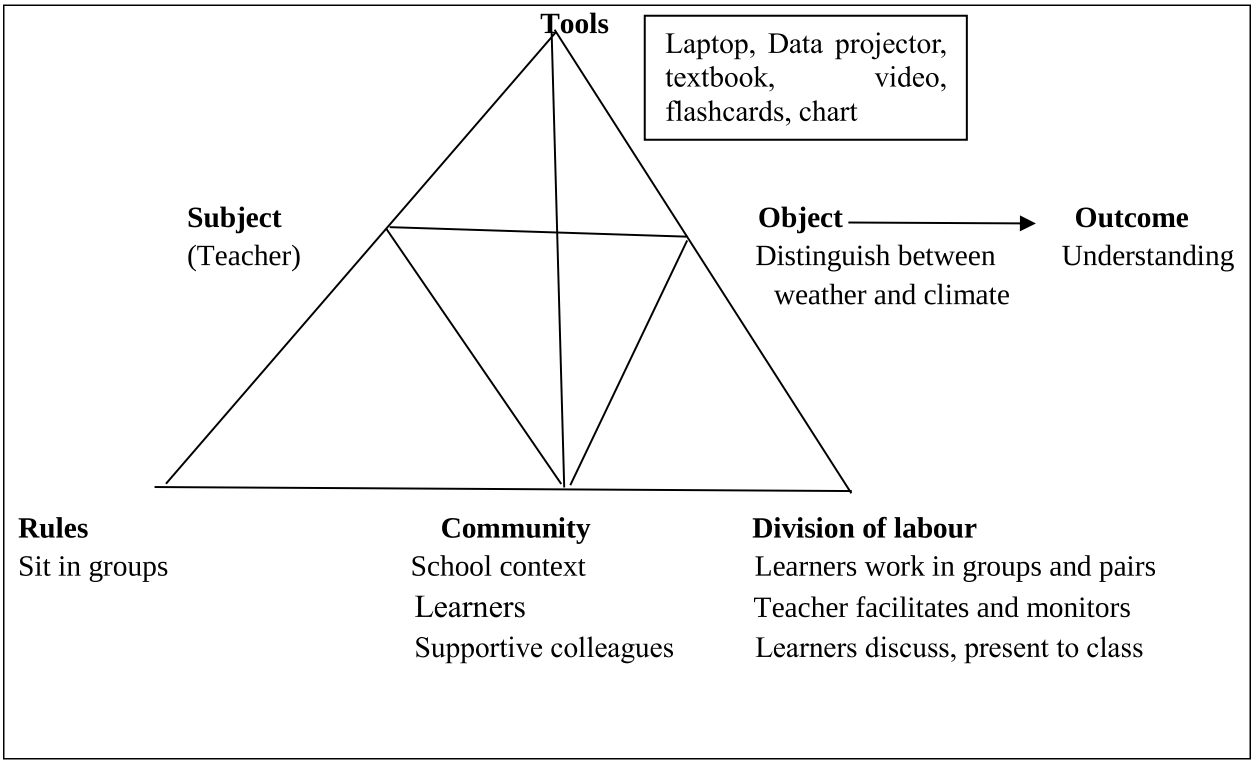

Figure 8-9: Mrs Efi's activity triangle

She prepared a lesson plan that clearly outlined the steps of the lesson. She intended to use ICT as a presentation and information gathering tool in her lesson. She combined both traditional and modern/online methods of teaching her class. Mrs Efi showed learners a video about the weather and climate, projected her notes using her laptop, had the learners working in groups to search for new weather and climate concepts on the Internet and then the learners had to complete a task in the prescribed textbook. However, in her reflection, Mrs Efi indicated she had not been able to follow through the lesson plan, step by step. She had a number of areas for improvement that she noted such as:

> …reading should have been the first activity to familiarize them with the terminology…I must fully involve learners in the activities by telling them and letting them do them on their own…video must be shown at least twice to avoid forgetfulness [Mrs Efi, Reflection – August 2017].

Mrs Efi indicated that she struggled with time management, indicating that "*the lesson was too long"* [Mrs Efi, Reflection – August 2017].

Despite these areas of improvement, Mrs Efi stated that her lesson aims and objectives were met. She said, "*…learner's response in answering [questions] orally proved that they did understand the concept"* [Mrs Efi, Reflection – August 2017]. This was also confirmed by the classwork activity they had to do which, when she marked them, showed that *"half of the class managed to get correct answers"* [Mrs Efi, Reflection – August 2017]. She also indicated that she had noted positives of using technology and group work saying, *"…I used technologies in the lesson that involved learners…learners enjoyed working together and each contributed in groups, group work went well because everyone has given an input"* [Mrs Efi, Reflection – August 2017]. This indicated that there was collaborative learning taking place in Mrs Efi's class and that working together gave an opportunity to all learners to say something during the lesson.

8.3.3 Case 3 - Mrs Fani at school F

Mrs Fani was a 55 year old woman who had been teaching for 26 years. She was the principal at her school and taught Grades 5 to 9 Social Sciences (both History and Geography). Mrs Fani expected the course to assist her in her position as the principal, as well as in her teaching. She said, "*what I want is to be able to present a lesson using a computer, as an administrator I want all my work to be stored in one place where I can find it more easily*" [Mrs Fani, How I became computer literate narrative – June 2015]. Mrs Fani perceived ICT as useful stating that it can make work easier to do. She also found computers useful for information gathering and thought that computers were fun. Mrs Fani owned a laptop, but did not have access to the Internet at home.

She had her first encounter with computers in 1983 when she trained to work in administration. However, she did not have access to a computer and with time forgot the skills she had learnt. She noted, "*In 1996 I just looked as HB learners were using computers. I had forgotten all about computers. I have learnt that the use of computers should be done continuously in order to gain more skills and not to forget*" [Mrs Fani, How I became computer literate narrative – June 2015]. Her next encounter with a computer was ten years later. Mrs Fani viewed her computer skills as excellent as she could use computers as a productivity tool. She said, *"I am able to prepare my learners' tasks using the computer, my lesson plans are no longer written with a pen"* [Mrs Fani, How I became computer literate narrative – June 2015]. She could also use computers as an information gathering tool: *"I am able to research using the Internet. The tutors from Rhodes and Fort Hare taught us how to use google to search for information"* [Mrs Fani, How I became computer literate narrative – June 2015]. She indicated that her learners enjoyed her teaching and that using ICT in the classroom enhanced learning.

Mrs Fani's school was the original site of the Siyakhula Living Lab when it started in the area. Although the school was a quintile 1 school, it had access to basic infrastructure thanks to the public private partnerships that existed at the school. The school has had electricity since 1996, first through solar energy which was paid for by the school's trust. A computer lab was first set up in 2006 when her school bought 20 old computers with the intention of introducing computer studies for learners. Teachers took advantage of them and spent afternoons in the computer room learning from the new computer studies teacher. New computers were installed as part of the SLL project in 2008. The new computer lab had Internet connectivity. As the node for the SLL project, all the teachers at the school were computer literate, as they benefited from the community ICT training projects that were conducted at their school. Mrs Fani described how computer literacy was taken up at the school: "*we were so interested to use computers in* *so much that we spent all the afternoons fiddling with them ... to train our fingers on clicking, double clicking and dragging we played cards each and every afternoon*" [Mrs Fani, How I became computer literate narrative – June 2015].

Lesson on climate and vegetation

Mrs Fani prepared for a Social Sciences Geography lesson on weather, climate and vegetation of South Africa for Grade 5 learners (see Figure 8.10 for Mrs Fani's CHAT triangle). Mrs Fani planned to use ICT as an presentational tool, as she intended to show sources of weather information such as bar graphs, maps and photographs which learners had to interpret. Her lesson combined ICT and textbooks which the learners had to use to do a class activity.

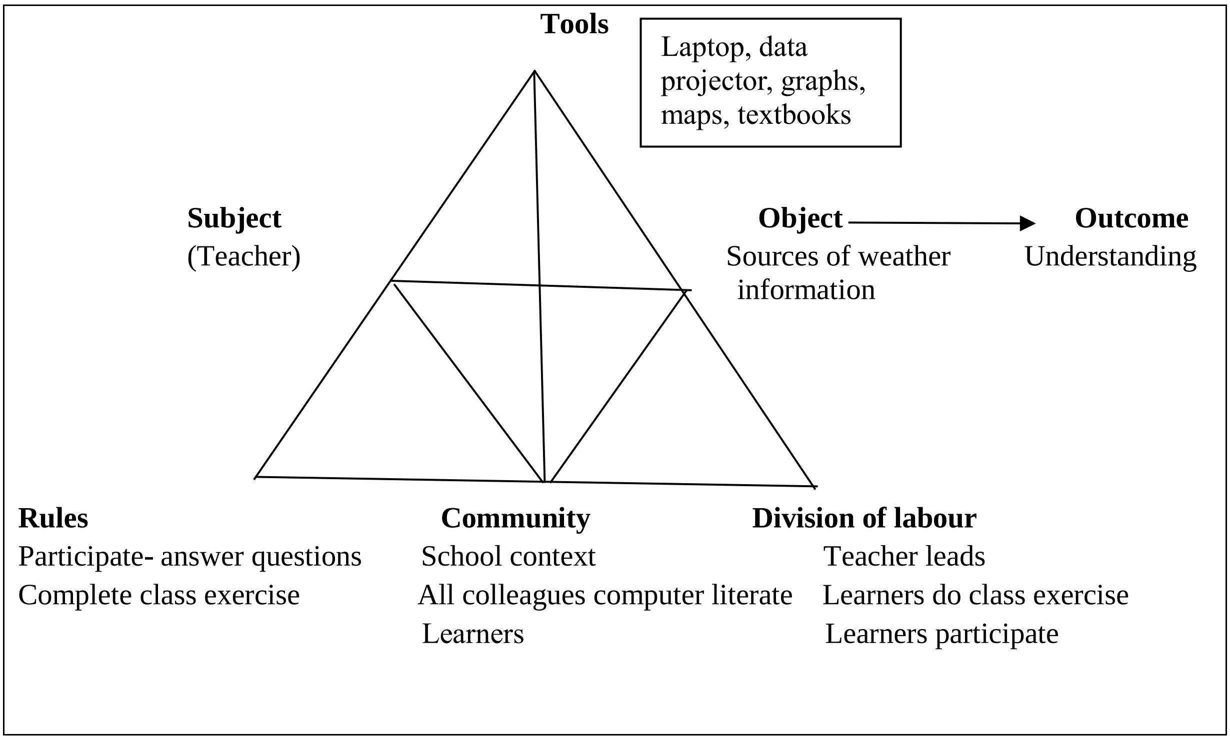

Figure 8-10: Mrs Fani's activity triangle

Mrs Fani mentioned that learners had a positive experience with ICT during her lesson saying: *"the use of the projector during my lesson presentation helped a lot in arousing learner's interest and improving their concentration"* [Mrs Fani, Reflection – August 2017]. She added that learners understood the lesson but added no further reflection or suggestion for improvement.

8.4 CROSS CASE ANALYSIS – IN-SERVICE BED-ICT PARTICIPANTS

In this section, I compare the differences and similarities between the three cases reported above. The similarities and differences discussed are based on data from the ‘How I became computer literate’ narrative, the selection questionnaire and the lesson plan as well as the reflection of the lesson taught.

Subject

All three teachers were comparable in their personal characteristics. Only Mrs Fani had a leadership position of a principal. All three participants had been exposed to computers for a long time (at least 19 years) during which period they had taken various ICT training courses. These similarities account for the similar interventions that these three teachers conducted.

Community

All three teachers worked at schools that were relatively well resourced. All three schools had computer labs and only Mrs Fani’s school had Internet connectivity. At Mr Dali’s school, all teachers had laptops as well. In terms of support, all three teachers indicated that most teachers at their schools were computer literate except MrsFani’s colleagues who were all computer literate. Mrs Fani’s school was the first site of the Siyakhula Living Lab in Dwesa and all teachers at the school had been trained as part of the programme. This shows that these three teachers would be supported in their ICT integration efforts at their school as highlighted by Mrs Efi who had a colleague sit in while she taught her lesson and gave her feedback afterwards.

Tools

There were differences in the manner in which ICT was integrated and used in the three teachers' classrooms. Firstly, ICTs were used in only two of the classrooms (Mrs Efi and Mrs Fani's classrooms). Mr Dali did not integrate ICT in his classroom at all. Mrs Efi used ICT as a representational and information gathering tool. She presented her lesson using PowerPoint and allowed for her learners to work in groups to find information on the Internet.

Object

As the process of planning was part of the course for these three key participants as a course requirement, all students submitted their lesson plans twice, first for feedback and then the final version. The lesson plan template (see Appendix K) was detailed in questions and required students to think deeply about the lesson and appropriate ICT resources to use. The objectives were clearly outlined in all three cases and the outcomes met.

Division of labour

In all three classrooms (Mr Dali, Mrs Efi and Mrs Fani) work was divided amongst the teacher and learners. All three teachers mentioned that they faced challenges with time and classroom management. Although Mr Dali took a leading role in his classroom, learners were actively involved in the learning process. In all three classes, learners either had to discuss in groups and present (Mr Dali and Mrs Efi) or answer question and complete a classroom exercise (Mrs Fani's class).

Rules

Group work seemed to work best in two of the cases because learners had to share resources. Although I cannot comment on other rules that teachers might not have indicated on their lesson plans, it would seem teachers required participation from their learners and instructed them to do so, either individually or in groups.

8.5 SUMMARY

In this chapter I discussed findings from the in-service BEd-ICT course which replaced the in-service ACE-ICT course. The course still attracted similar teachers working in the same kind of schools. After reflecting on the findings from the in-service ACE-ICT classroom interventions, changes were made to the ICT integration activity for the in-service BEd-ICT course. I presented findings from three examples which showed that teachers used ICT mainly as a productivity or representational tool. All teachers had prior experience with ICT and were personally invested in the use of ICT in the classroom. Teachers who had support at their schools appeared to have more meaningful classroom interventions compared to those that did not. In the following chapter, reflections, recommendations and concluding remarks will be given.

CHAPTER NINE: DISCUSSION OF FINDINGS

In this chapter, I discuss the findings presented in chapters 5 to 8 of this thesis, drawing on the literature and theoretical framework discussed in chapters 2 and 3. The discussion is guided and presented in sections, divided according to the three research questions posed in chapter 1. The three research questions are:

1. What are teachers' perceptions of using computers in teaching?
2. What are teachers' first experiences using ICT in the classroom?
3. What challenges do teachers encounter when they use computers in the classroom?

In section 9.1, I discuss the perceptions held by teachers in marginalised Eastern Cape schools, with a particular focus on those who took the in-service ACE-ICT and in-service BEd-ICT courses. In section 9.2, I discuss the experiences of six key participants using computers in their Social Sciences classrooms. In section 9.3, I discuss the challenges the six key participants faced. The chapter ends with a summary in section 9.4.

9.1 PERCEPTIONS

In this section, I answer the first research question which is, "What are teachers' perceptions of using ICT in teaching?" Perceptions are discussed in relation to the two main components of the Technology Acceptance Model (TAM), perceived ease of use and perceived usefulness. Attitudes or dispositions and anticipations were theorised using the Teacher Cognition theory as well as Hawkridge's (1990) rationales for ICT use. In section 9.1.1 I discuss the perceived ease of use of computers and in section 9.1.2 I discuss the perceived usefulness of computers.

9.1.1 Ease of use

Perceived ease of use has been shown to influence positive attitudes towards using computers which in turn influence behavioural intention to use ICT in teaching (Davis, 1986; see figure 3.3). Table 5.1 shows that 141 (77%) of the questionnaire respondents perceived computers as easy to use. TAM acknowledges the role of personal characteristics in mediating between individual differences and technology acceptance (Davis, 1986) but past findings on the influence of personal characteristics on perceived ease of use are inconclusive (Agarwal et al., 1999; Thompson, Higgins and Howell, 1994). Contrary to some literature discussed in chapter 2 (Baek et al., 2008; Kay, 2006; Baubeng-Andoh, 2012) in the present study gender, age and teaching experience did not correlate with perceived ease of use (see tables 5.6, 5.7 and 5.8). The only significant correlation was that with subject taught (which had a p-value 0.00755, see table 5.8), whereas a higher percentage (84%) of teachers who taught in one discipline claimed that computers were easy to use compared to 64% of those who taught across disciplines. The latter are likely to work at schools with low enrolments, usually located in rural areas (Ramatlakana, 2013). These findings suggest that context influences perceived ease of use as much as if not more than personal characteristics.

In the present study, teachers' general positive attitudes do not appear to reflect actual use and, even less so, their confidence in using computers for teaching. An overwhelming majority (170 or 93%) of questionnaire respondents enjoyed using the computer and 160 (87%) thought it was fun but only 128 (70%) claimed to use computers daily to a few times a week. Moreover, less than half of the questionnaire respondents (84 or 46%) claimed that their computer skills were good to very good and only an equal percentage had the confidence to try teaching with ICT on their own (see figure 5.8 and table 5.3). These findings question the claim by Venkatesh et al. (2000) that the more users enjoy using computers or think computers are fun, the more likely they are to use them. Past findings on the relationship between gender and ICT use in the classroom are contradictory (Yukselturk et al., 2009; Kay et al., 2006; Norris, 2003; Adam, 2002; Volman et al., 2001). Quantitative data showed that a higher percentage of males (74%) claimed to use computers frequently (mostly for personal use) than females (68%). A higher percentage (62%) of males had sufficient confidence to try teaching with ICT than females (38%). Classroom interventions discussed in chapters 7 and 8 seem to contradict this trend as female teachers (Mrs Chamu and Mrs Efi) used ICT more in their teaching than the male teachers – Mr Asiya and Mr Dali (see section 7.1.4, 7.2.4, 7.3.4, 8.2.1, 8.2.2 and 8.2.3 for evidence). However, these particular female participants, Mrs Banda and Mrs Chamu, were actively involved in communities of practice as an ICT champion and an IT representative respectively. They enjoyed support for ICT related matters within their schools and from external experts. These findings suggest the influence of external rather than internal variables (see figure 3.3).

The positive attitudes held by participants can be explained by their prior experience with computers and mobile phones, as documented in the literature and discussed above (see Agarwal et al., 1999; Tondeur et al., 2008). In the adapted TAM (see figure 3.3) discussed in chapter 3, prior experience is one of the internal variables that influence perceived ease of use and positive attitudes. Both quantitative and qualitative data show that participants in this study had extensive prior experience with computers and mobile phones (see figures 5.1.1 and 5.12 as well as sections 6.1.2; 7.1.1; 7.2.1; 7.3.1; 8.2.1; 8.2.2 and 8.2.3 for evidence). Such prior experiences seem to refer to personal rather than professional use as a teacher. All six key participants evaluated their computer skills as good to very good and highlighted that they had been exposed to computers for at least five years (see sections 7.1.1; 7.2.1; 7.3.1; 8.2.1; 8.2.2 and 8.2.3 for evidence). The six key participants perceived using computers in their personal lives as easy as outlined in their narratives of how they became computer literate but felt that teaching with computers was not easy. Such claims are consistent with their accounts of their experiences and of the challenges they faced, elaborated upon in sections 9.2 and 9.3 below.

9.1.2 Usefulness

Teachers perceived computers as useful for reducing their workload as teachers and for preparing lessons rather than for meaningful use in the classroom. Quantitative findings show that questionnaire respondents generally perceived computers as useful (see section 5.2.2 for evidence). An overwhelming majority (163 or 89%) of the questionnaire respondents felt that computers would be useful in their jobs as a teacher particularly as a productivity tool, information gathering tool and a representational tool. It should be noted that the use of computers as productivity and information gathering tools referred to administration and lesson planning or preparation rather than classroom use. For example, questionnaire respondent number 112 said, *"...presentations, administration work such as schedules, reports can be done through them [computers]"* while ACE-ICT student teacher 16 said, *"this year I am doing the in-service ACE-ICT and I bought my own computer and can use it for preparation." I also do schedules, report forms and class lists."* The findings on the usefulness of computers as an information gathering tool are also in reference to the teachers as they prepare for lessons and not for their learners as a learning tool. For example questionnaire respondent number 8 said, *"…when you are using the Internet you gain a lot of information and as an educator there are so many classroom activities you can get."* I found similar findings for the usefulness of computers as representational tools. Both quantitative and qualitative data suggest that participants were particularly interested in the prospect of computers reducing their workload. For example, questionnaire respondent 181 said, *"it saves time and it gives you an opportunity* *to keep your work forever, easy to effect changes, will always stay there for a long time"* while in-service ACE-ICT student teacher 9 said:

> I have five Grade nine Natural Sciences groups [classes]. When they come to class, I have to write on the board repeatedly. By the time group 3 comes, I am exhausted and doing a disservice to them sometimes by leaving out some important stuff which I have already mentioned to others. In this instance [using a computer], I will have one well prepared presentation for all the groups and they will have it too [Student teacher 9, MCL questionnaire – September 2010].

As discussed in the following sections, productivity, information gathering and representation were the three uses of ICT tools by the six key participants (see sections 7.4 and 8.4 for evidence, and also see sections 7.1.4, 7.2.4, 7.3.4, 8.2.1, 8.2.2 and 8.3.3 for evidence specific to the preparation of PowerPoint presentations). These findings are consistent with past research (see Van Fossen, 2001; Acikalin et al., 2005) and support the conclusion made by McPherson (2001) that "computers are commonly used to support learning through reducing time spent on mechanical tasks such as rewriting, helping find information, helping to organize information, making it easier to share information and ideas with others" (p. 2). The in-service ACE-ICT participants, for example, had the expectation that the course would help them support learning. In-service ACE-ICT student teacher 17 said she was *"confident that the ACE-ICT course will empower me so that I can use computers in teaching"* [Student teacher 17, Application – December 2008] (see sections 6.2.2 and 6.3.2 for more evidence).

While the focus was on teachers, participants referred to the usefulness of ICT for learners, though mainly in the personal sphere rather than for learning. The quantitative data show that a small percentage (24 or 13%) of the responses to an open ended question made reference to the pedagogic use of ICT by learners (see section 5.2.2 for evidence). The in-service ACE-ICT student teachers stated that it was necessary to prepare learners for life – making reference to what Hawkridge (1990) called social and vocational rationales but no reference was made to the catalytic rationale (see section 6.2.1 for evidence). The six key participants also perceived computers as useful for their learners (see sections 7.1.3, 7.2.3, 7.3.3, 8.2.1, 8.2.2 and 8.2.3 for evidence). However, as discussed in section 9.2 below, only Mrs Chamu and Mrs Efi let their learners use ICT in the classrooms for learning.

9.2 EXPERIENCES

Findings discussed in this section answer research question 2, that is, "What are teachers' first experiences using ICT in the classroom?" Positive perceptions towards ICT are an important determinant of the kind of experience a user will have while using ICT (Elwood et al., 2006). Given the generally positive perceptions reported above, the expectation for the six key participants was that they would have positive experiences of teaching with computers in the classroom. However, I undertook this study fully aware that often perceptions do not align with lived experiences and intended to interrogate this tension. The discussion in this section focuses on how ICT was used by the six key participants in their respective classrooms drawing on the six elements of CHAT. I explain why computers were used in a particular manner drawing on the adoption and diffusion of innovation theories. Based on a comparison of the six cases discussed in chapters 7 and 8, I make several claims regarding ICT use in marginalised classrooms. In section 9.2.1, I discuss the subject, in 9.2.2 the community, in 9.2.3 the tools, in 9.2.4 the division of labour, in 9.2.5 the rules and in 9.2.6 the object and outcome.

9.2.1 Subject

Findings in this study highlight a difference between the roles of teachers who taught in a teacher-centred as opposed to a learner-centred way. For Mrs Chamu and Mrs Efi, their teaching method aligned with the constructivist perspective and their role in the classroom was that of a facilitator and not the sole source of knowledge. Mr Asiya, Mrs Banda and Mrs Fani used PowerPoint as a mere replacement of the chalkboard and Mr Dali did not use ICT in his classroom (see sections 7.1.4, 7.2.4, 8.2.1 and 8.2.3 for evidence). Wilson-Strydom et al. (2005) argue that the use of the PowerPoint to represent information in another medium does not lead to the generation or construction of new knowledge. For an example, Mr Asiya, Mrs Banda and Mrs Fani, used PowerPoint to show their learners notes only. Such use of ICT was a surprising finding as these teachers had completed in-service qualifications that focused on cross curriculum ICT integration (the ACE-ICT and the BEd-ICT courses) in which learning theories and their implications for teachers as they integrate ICT into their teaching were discussed. In particular, teachers were taught to develop activities that promote higher order cognitive thinking and to encourage learner participation and collaboration in the classroom. The Teacher Cognitions theory helps explain the behaviour of some of the key participants by stating that teacher training "does not always result in teachers implementing what they have learnt, nor does it necessarily result in a change of attitudes or beliefs" (Borg, 2003, p. 89).

The six key participants were at different levels of ICT adoption. Gladhart (2001) states that levels of adoption are not static. As such my interpretation of the level of adoption of these teachers must only be understood in the context of the lessons discussed in this thesis. I allocated the six key participants to different levels based on observations of how they used ICT in their classroom and according to the teacher development framework (DoE, 2007 pp. 9-15). Mr Dali was at the entry level of adoption. Consistent with this first level of ICT adoption, Mr Dali was aware of computers and had the skills to use them but did not use them in his lesson. (see section 8.2.1 for evidence). According to Rogers (2003) Mr Dali operated as laggards on the Diffusion of Innovation categories. He held on to his traditional approach to teaching (see section 3.2.3). Mr Asiya, Mrs Banda and Mrs Fani were at the second level of

ICT adoption. Consistent with Dwyer et al. (1992) and the teacher development framework (DoE, 2007) descriptions, these three teachers were starting to use ICT to support traditional teaching methods and both used ICT for interacting with knowledge only (see section 7.2.2 and 8.2.3 for evidence). These findings confirm those of Ndlovu & Lawrence (2012) who also found that teachers at the lower levels of ICT adoption mainly use ICT for limited knowledge generation or interaction only.

Mrs Banda and Mrs Fani operated as early adopters according to Rogers' (2003) Diffusion of Innovation categories. Both teachers were respected in their communities and served as role models for other teachers (see section 3.2.3). Mrs Efi was at the 3rd level of ICT adoption, i.e. the adaptation level, because she developed a lesson that incorporated a high level problem solving activity (see section 8.2.2 for evidence). Only Mrs Chamu was at the fourth level of ICT adoption, i.e. the appropriation level. She incorporated the mobile computer lab in her lesson and in line with how Carr (2006) describes teachers at this level, Mrs Chamu used collaborative group work in her lesson. She also used the learner-centred approach. Mrs Chamu and Mrs Efi operated as innovators according to Rogers' (2003) Diffusion of Innovation categories. These two teachers were willing to try new ideas and developed activities that allowed their learners to use computers in the classroom (see section 3.2.3). The adoption levels reported in this section were the highest reached by each teacher during their lessons.

9.2.2 Community

The external variable of support, positively influences ICT use in teaching Social Sciences (see section 2.3.2 and figure 3.4). Findings discussed in chapter 7 confirm the importance of support for ICT integration. Firstly, leadership support, Baubeng-Andoh (2012) states, is crucial for direction. At Mrs Chamu's school, the school management team (principal and deputy) supported ICT use at the school and had put measures in place (such as the school ICT policy) to manage ICTs. The school also had an IT representative (one of the teachers) who managed access and maintenance of ICT resources at the school. This kind of support was not available for the other two in-service ACE-ICT key participants. At Mrs Banda's school, although the principal was not involved in the day-to-day running of ICT matters, he was supportive of the Siyakhula Living Lab initiative. Mr Asiya did not enjoy the support of his school leadership team. These findings suggest that leadership support plays a central role in encouraging the use of ICT at schools.

Teachers who worked within a community of practice benefitted from the support of colleagues in their ICT integration efforts. Mrs Banda and Mrs Chamu both had colleagues trained in ICT integration at their schools. They indicated that they were able to speak about their experiences with ICT and seek help from these colleagues when needed (see sections 7.2.2 and 7.3.2). Mrs Banda and Mrs Chamu's experiences suggested that it is important for at least two teachers from the same school to attend professional development courses in ICT integration so that they can support one another. Conversely, Bingimlas (2009) argues that colleagues who have negative attitudes to ICT and resist adopting ICT can cause barriers to ICT integration. With the in-service BEd-ICT student teachers, a guided community of practice was implemented by encouraging group work based on the subject and grade teachers taught. The groups' space provided students with colleagues they could rely on for support.

9.2.3 Tools

Using ICT as a combination of different tools is an effective strategy for ICT integration and it is crucial to know when to use what. In the two classrooms where ICTs were used with learners, teachers used ICT as more than one tool (see sections 7.3.4 and 8.2.2 for evidence). In both

Mrs Chamu and Mrs Efi's classrooms computers were used as an information gathering, productivity and representational tool. These two teachers used PowerPoint presentations to introduce the topic before handing over the rest of the lesson to the learners. In both classes, learners used the computers to gather information and generate knowledge which they then presented to the rest of the class using PowerPoint presentations. The findings from these two classrooms (Mrs Chamu and Mrs Efi's) indicated the importance of teachers knowing what and when to use ICT in the classroom as suggested by Eady et al. (2013). Even in classrooms where a computer is used as a representational tool, it is possible for the overall learning process to be aligned with the constructivist perspective.

As the Internet grew, computers became more and more used in Social Sciences classrooms (Whitworth et al., 2003). Findings confirm the central role of the Internet in Social Sciences classrooms. All six key participants used ICT as an information gathering tool to search for information on the Internet as they prepared for their lessons (see sections 7.1.4, 7.2.4, 7.3.4, 8.2.1, 8.2.2, 8.2.3 for evidence). For example, Mrs Efi searched for videos which she showed her learners in her class, Mrs Fani sourced weather information such as photographs and graphs that learners had to interpret, and Mrs Chamu selected websites which learners used in offline mode in the classroom. ICTs were used to mediate classroom discussion with learners leading the dialogue. These findings highlight an innovative way of using web pages offline for schools without access to the Internet. Offline access to web content provided access to information to learners who would otherwise not have had access to such information. The use of the mobile computer lab which was populated with 12 netbooks also highlights another innovative way of using a limited number of computers in large classrooms. Mrs Chamu used the 12 netbooks effectively with her class of 36 learners through group work, as discussed in the next subsection.

9.2.4 Division of labour

Group work seems appropriate in classrooms where there are resource limitations or large class sizes that might hamper ICT integration. For example, learners in Mrs Chamu's class were not all computer literate or able to use the computer to find information (see section 7.1.4 for evidence). She resolved the challenge of computer illiterate learners being unable to do the work assigned by putting them in groups with learners who were computer literate. Group work was also useful for encouraging a more constructivist approach in the classroom. For example, Mrs Chamu shifted the focus of her teaching from the traditional teacher-centred to a learner-centred one by putting learners in groups and allowing them to work on the netbooks to construct their own understanding of the South African nationalism topic. Similarly, in Mrs Efi's classroom, the learners worked in groups to understand the climate and weather topic in a geography lesson (see section 8.2.2 for evidence). From these two examples, it would seem that teachers wanting to change their teaching approach from a traditional teaching method to a constructivist one can employ group work. Group work forces the teacher to divide the work in the classroom between themselves as the teacher and the learners and change the rules of how learning takes place.

In the four classrooms (Mr Asiya, Mrs Banda, Mr Dali and Mrs Fani's) where the traditional approach informed the teaching method, the teacher did most of the 'labour'. The teacher was in charge and was the sole source of information/knowledge. There was no sharing of ideas amongst learners and learners did not actively participate in the learning process (see figure 4.1 and sections 7.1.4, 7.2.4, 8.2.1, 8.2.3 for evidence).

9.2.5 Rules

The CHAT rules element highlighted the different ways in which teachers experienced classroom management. Classroom management changed based on the teaching method used in the classroom. In constructivist classrooms, group work changed the dynamics of classroom management; therefore, Mrs Chamu and Mrs Efi had to manage learner talk without breaking the flow of ideas and the sharing of knowledge (see sections 7.3.4 and 8.2.2 for evidence). In classes where the teaching method remained traditional, i.e. in Mr Asiya, Mrs Banda and Mr Dali's classrooms, the learners were passive and unresponsive to the teachers (see sections 7.1.4, 7.2.4 and 8.2.1 for evidence). Mr Asiya, for example, had to resort to randomly selecting students to answer his questions as none of the students were engaging with him or raising their hands to answer questions. He indicated in the stimulated recall interview that his learners were not always like that saying, *"I told them [about the observation] but some of them only show interest when it is just us…they were a bit scared of you… I am sure they will talk after you leave"* [Mr Asiya, SR interview – April 2013]. All six key participants acknowledged that they had to change their classroom management strategies when they integrated ICT into their lesson. For example Mrs Chamu said, "*…they were a little bit excited also, so that made them to be loud"* [Mrs Chamu SR interview, August, 2013].

9.2.6 Object – outcome

All six key participants had clear objectives for their lessons – in line with the Curriculum and Assessment Policy Statement (CAPS) document. This was expected as the Social Sciences CAPS document specifies what teachers teach every day with expected outcomes for each lesson, including the number of hours set aside for each topic (see DBE, 2011). All six key participants stated that the students understood the content and that the outcome of the lesson had been achieved (see sections 7.1.4; 7.2.4; 7.3.4; 7.4.4; 8.2.1; 8.2.2; 8.2.3; 8.4.4 for evidence).

All six key participants outlined how they wanted to integrate ICT in their teaching. With the exception of Mr Dali (who did not use ICT in his teaching - see section 8.2.1 for evidence), the key participants integrated ICT in their teaching.

Findings show that teachers' experiences teaching with ICT depend on how well they set clear specific plans for ICT use in their classroom. Mr Asiya limited his objective for ICT use to exposing his learners to ICT. He said:

> I do all this for my learners, so that they can be exposed, and when I do all this I show them that this is what we are talking about when we speak of computers so that they too can develop an interest in computers. [Mr Asiya teacher interview, February, 2013].

Mr Asiya only took five minutes to show the learners the features of the netbook and did not allow his learners to use it beyond this. Mrs Banda and Mr Dali shared general expectations of how ICT would help them as teachers making reference to personal benefits such as online banking and use of ICT for preparation (see sections 7.2.4 and 8.2.1 for evidence). In these three classrooms (Mr Asiya, Mrs Banda and Mr Dali's) teachers did not plan for ICT use in the classroom with the learners in mind. In contrast, Mrs Chamu, Mrs Fani and Mrs Efi planned to use ICT with their learners to enhance their learners' understanding of the content. Mrs Chamu said that she wanted to *"encourage learners to investigate, discover and create answers for themselves, rather than wait for the teachers to give the answers"* [Mrs Chamu, teacher interview – July 2013]. It was evident from her lesson that she was able to achieve this goal (see section 7.1.4 for evidence). Similarly, Mrs Efi who had planned for her learners to use ICT in class reflected on the outcome of her lesson saying, *"Learners were hands on throughout the lesson"* [Mrs Efi, reflection – August 2017]. On the other hand, Mrs Fani reflected on her lesson saying, *"the use of the projector during my lesson presentation helped a lot in arousing learner's interest and improving their concentration"* [Mrs Fani, reflection – August 2017].

These findings support those of Whyburn et al. (2012) who found that lesson planning is crucial and an important step in ICT integration.

9.3 CHALLENGES

The discussion in this section answers the third research question, “What challenges do teachers encounter when they use computers in the classroom?” The typologies of barriers to ICT integration discussed in section 2.4 above were used to make sense of the data on challenges observed and reported in this study. The challenges highlight a discrepancy between policy and its implementation. In section 9.3.1, I discuss the lack of infrastructure while in section 9.3.2 I discuss the constraint of time.

9.3.1 Infrastructure

Teachers in marginalised contexts in South Africa still face first order barriers (external to self) as outlined by Ertmer (1999), such as lack of ICT infrastructure and resources. The latest NEIMS figures show that in the Eastern Cape only 23% of schools have a computer centre (see figure 2.1), the lowest in the country (DBE, 2018). Although 67% of the in-service ACE-ICT student teachers worked at schools with a computer lab, they lamented the lack of access to these resources (see section 6.1.2 for evidence). The design of this study sought to eliminate these first order barriers by providing the mobile computer lab and support from the researcher. Findings appear to confirm Ertmer’s (1999) conclusion that the elimination of first order barriers does not automatically lead to ICT integration. It should be considered, however, that the provision of the mobile computer lab created an artificial environment and a once off experience which did not lead to sustained ICT integration after the interventions as infrastructure and resource limitations persisted. The follow up with the three ACE-ICT key participants in 2018 showed that five years after the teachers’ first experience using ICT in the classroom, access to ICT was still a challenge (see 8.1.1 for evidence). Although Mrs Banda's school had received 20 more computers for their computer lab and Mrs Chamu's school had received a mobile computer lab trolley with 20 laptops for learners' use, teachers and learners at these schools had limited or no access to these resources. Reasons vary from the limited number of computers versus the number of learners in a class to gatekeeping by principals afraid that the computers would break (see section 8.1.1 for evidence and also see Katulo, 2010). At Mr Asiya's school there was still no ICT available although the school now has electricity.

Mobile technology is widely available yet South Africa has no national policy on mobile learning (Aluko, 2017; O'Hagan, 2013) which has resulted in the use of mobile phones being banned in most schools (Mavhunga et al., 2018; Ngesi et al., 2018; Porter et al., 2016; Hawi, 2016). Teachers are unable to use mobile phones, which are readily available in their context (Porter et al., 2016; Dalvit & Gunzo, 2014; Gunzo & Dalvit, 2012; Kreutzer, 2009). For example, Mr Asiya explained that at his school *"learners are not allowed to use their cell phones at all around the school premises"* and that if a learner is caught with a cell phone *"we confiscate the cell phone…and sometimes we keep it until after the end of the term"* [Mr Asiya interview, April, 2013]. A ban on mobile use is often enforced even when not formalised in policy. At school C, the principal said:

> …about the cell phone policy, we haven't got to that. But our learners know that they are not allowed to use their cell phone, or to text etc. You can't change from one class to the next using your phone, and in the exam, it's also not allowed and those who bring it will have to leave it at the front on the table and get it afterwards, so they know. [School C Principal Interview, July, 2013].

Evidence suggests that such a position was challenged by some in-service BEd-ICT student teachers. One such student teacher said:

> In the school policy there was a clause that prohibited students to come to school with cell phones because they [school management team] believed they were not good. I was able to convince them to edit that clause because I have seen the importance of ICT in teaching and learning.

In particular, this student teacher elaborated that she had seen her learners googling for information on their cell phones. The White Paper on e-Education (DoE, 2004) encourages the use of the Internet "wherever possible" (p. 9). In marginalised contexts, the Internet is mobile-first, mobile-centric and often mobile-only (ICASA, 2019; Donner, 2008) but policy and practice at the school level may hamper its use in the classroom.

Lack of infrastructure in schools is often blamed for teachers' inability to satisfy ICT cross-curriculum integration policy requirements. The White Paper (DoE, 2004) aimed at providing ICT infrastructure to all schools by 2013 but the National Integrated ICT Policy (NIPP) White Paper of 2016 acknowledges that "infrastructure [remains] poorly located, inadequate and under maintained" (DTPS, 2016, p. 9), posing a challenge for ICT integration. All six cases confirm existing challenges with availability and or access to ICT resources (see sections 7.4.4 and 8.2.4 for evidence). Policies and interventions by the Government appear to focus on physical access to ICT resources and on ensuring that teachers and learners are computer literate (DoE, 2004, p. 17). Although the expectations spelled out in the White Paper that all teachers and learners would become competent users of ICT in the school context by 2013 were not met, efforts such as the Teacher Laptop Initiative discussed in section 2.1 may have contributed to the relatively high level of prior experience with ICT noted in section 9.1.1, at least among teachers. The majority of learners at Mr Asiya and Mrs Chamu's schools had either never seen or used a computer before or cannot be described as competent users of ICT (see sections 7.1.2 and 7.3.2 for evidence). While some strides have been made, a nuanced look at both physical and epistemological access for teachers as well as their learners highlights potential pitfalls for ICT use in the classroom.

There appears to be some ambiguity in the policy regarding cross curriculum ICT integration. Vandeyar (2015) states that the government missed an opportunity in 2004 and again in 2012 (when changes were made to the curriculum documents) to "dovetail the national curriculum policies with the e-education policy as two complementary coherent policies to achieve maximum impetus for ICT integration" (p. 355). While the White Paper on e-Education (2004) supports the use of ICT in the classroom, the CAPS (DBE, 2011) document does not provide guidelines on how this should be done and does not make specific provisions for the use of ICT use in the classroom (see Vandeyar, 2015; DBE, 2011; DoE, 2004). Such ambiguity may contribute to explain the position in which teachers appear to find themselves, i.e. being encouraged to use ICT in their teaching without being in a position to do so effectively.

9.3.2 Time

Time, included as a first order barrier to ICT integration by Ertmer (1999), appears to be crucial for ICT integration. On the one hand, all participants (questionnaire respondents, 40 in service ACE-ICT student teachers, 74 in-service BEd-ICT student teachers and the six key participants) in this study viewed ICT as time saving, noting the advantage of not rewriting notes on the board for learners and the possibility to reuse the same PowerPoint presentation over and over again (see sections 5.2.2; 6.3.2; 7.4.3 and 8.4.3 for evidence). On the other hand, teachers' positive perceptions towards computers as time saving as discussed in section 9.1 did not align with their lived experience, as previously noted by Tilfarlioglu et al.'s (2006) findings. The reasons given by five percent of questionnaire respondents for not using ICT in teaching were related to time constraints. For example, questionnaire respondent number 81 said, *"You need to put more time to work with a computer, and for you to understand it you need to put effort".* The key participants themselves also noted that preparing for ICT integration was time consuming; for example, Mrs Banda said, *"...the computer is time consuming but it* [using the computer] *makes you prepare your lesson properly"* [Mrs Banda teacher interview, February, 2013]. I observed that teachers spent a lot of time in order for them to use ICT in the classroom - from time spent planning, preparing (looking for appropriate content), to setting up the laptop and data projectors before lessons could begin (see sections 7.1, 7.2 and 7.3 for evidence). In the actual lessons, Mrs Chamu and Mrs Efi needed more than the 45 minutes allocated to a lesson to allow their learners time to experiment, try and practice with ICT as they constructed their own knowledge and understanding of the content (see sections 7.3.4 and 8.2.2 for evidence).

All six key participants went over the time allocated for their lesson. The CAPS document outlines what teachers should teach per grade and subject, when subject topics should be taught and how learners should be assessed (DBE, 2011). In particular, time allocation is suggested for each topic and sub-topic. For example, Social Sciences is allocated 15 hours for History and 15 hours for Geography per term (DBE, 2011). Although the DBE (2011, p. 15) states that "the time allocations indicate the weighting or the depth of investigation required for each topic relative to other topics and that this is simply a guide, not to be implemented rigidly", teachers regard these as prescriptive, top-down and not user-friendly (see Nkosi, 2018; Maharajh, Nkosi, & Mkhize, 2016; Mbatha, 2016).

The strict time restrictions set out in the curriculum document leave little room for teachers to experiment with content or teaching methods, have an opportunity to reteach a lesson if deemed necessary or the ability to deviate from the set content. As an unintended consequence, teachers may view ICT integration as yet another additional task requiring their time.

9.4 SUMMARY

In this chapter I discussed the findings of this research. Using both quantitative and qualitative data, literature reviewed and the theoretical framework, I have discussed the findings that provide answers to the research questions posed at the beginning of this study. The discussion has shown that perceptions do not align with lived experiences (Tilfarlioglu et al., 2006). The perceptions teachers held did not support the way in which ICT was used in the classroom or the experiences teachers had. I found that teachers at the lower levels of ICT adoption use computers mainly for generating and interacting with information only. Evidence presented in this chapter shows that computers are often used as productivity, information gathering and representational tools. Discussion in this chapter also highlighted that first order challenges which exist in marginalised schools affect meaningful ICT integration.

In the next and final chapter, I present a summary of the key findings and outline the contribution this study makes to the ICT in the education field and well as reflect on the research process and provide some suggestions for future research.

CHAPTER TEN: REFLECTIONS, RECOMMENDATIONS AND CONCLUSION

In this final chapter, I draw conclusions and present some recommendations and reflections. The chapter begins with a discussion of the original contribution this research makes to knowledge in section 10.1. Based on the original contribution this study makes, I make some recommendations in section 10.2. In section 10.3, I reflect on the research process. The chapter ends with suggestions for future research in section 10.4.

10.1 CONTRIBUTION TO KNOWLEDGE

The overarching goal of this study was to examine perceptions and experiences of teachers using computers to teach Social Sciences in marginalised classrooms. The main research question was "How do perceptions, experiences and challenges influence ICT use in marginalised Social Sciences classrooms in South Africa". In order to answer this question, the following three research questions were posed:

1. What are teachers' perceptions of using computers in teaching?
2. What are teachers' first experiences using ICT in the classroom?
3. What challenges do teachers encounter when they use computers in the classroom?

These questions were answered in detail in chapter 9. In this section, I discuss the original contribution this study makes to knowledge based on the key findings of this research.

ICT availability in the schools does not necessarily entail ICT use in the classroom. Most schools in marginalised contexts still do not have access to basic ICT infrastructure, particularly in the Eastern Cape Province where the vast majority of schools still do not have a computer centre. In schools where ICT resources are available, access remains a challenge as school principals do not allow teachers to use them for fear that they will break. The mobile lab innovation used in this study was meant to address the infrastructure and resource limitations in schools. Despite having the mobile computer lab at their disposal, not all teachers used it in their classroom. Five years after the intervention schools had access to more infrastructure and computer resources but these were not being used for teaching and learning. Even when mobile technology is available, school ICT policy or practice hamper its use in the classroom. The context (e.g. support) as an external variable makes a positive difference in ICT integration.

Through the classroom interventions teachers understood the actual practical limitations and issues of using ICT in the classroom. Teachers had positive perceptions towards computers in general. They thought computers were easy to use in their personal lives but not in their professional lives. After the classroom interventions, all the teachers agreed that using the computer in the classroom was not as easy as they thought but maintained positive attitudes. The classroom interventions provided a space for teachers to be creative and implement innovative ideas such as group work and the use of off line web pages. Courses such as the ACE-ICT and BEd-ICT discussed in this thesis provided teachers with the space to meet and build relationships in communities of practice (COP) with other teachers teaching the same subject and grade. Within these COPs teachers supported each other and shared ideas and experiences of teaching with ICT in the classroom. Teachers had the opportunity to practice and come back to a contact session and discuss, share and learn from colleagues and lecturers, thereby advancing their knowledge and confidence.

Time constraints hamper cross-curriculum ICT integration. Teachers in this study used ICT either in their personal lives or in their professional lives to reduce the amount of time they spent on what they were already doing. On the one hand computers were considered an efficient tool to perform administrative and teaching activities, but on the other hand teachers' realised ICT use for teaching would entail some extra effort and a steep learning curve. This means that ICT was not being used to transform teaching but to support established practice. Teachers do not have time to experiment with ICT in the classroom or to prepare for lessons that integrate ICT and spent hours after work browsing the Internet for relevant information they could use in their classrooms. When they integrated ICT in the classroom none of them finished their lesson in the allocated time period as they lost time either setting up ICT equipment at the beginning, taking learners to the computer lab or allowing learners to construct their own learning in groups. If teachers are to shift from the traditional teacher centred teaching method to a learner centred one as stated in the White Paper on e-Education of 2004 then teachers need to have the time to experiment teaching with ICT and try out innovative ways of integrating ICT in the classroom.

10.2 RECOMMENDATIONS

Teachers should be allowed and encouraged to use technology (such as computer labs and mobile phones) already available at their disposal in their context and the ICT policy should be amended to reflect/allow this. As a coordinator in a teacher professional development programme focusing on ICT, I am acutely aware of infrastructural challenges and lack of technological resources in schools. The efforts of externally funded projects such as the SLL, though commendable, are not always scalable or sustainable. Public private partnerships have been proven successful in other sectors and may represent a way forward in the future. For the time being, the curriculum of courses such as the in-service BEd-ICT should take into consideration the challenges teachers face in most South African schools and focus on exploiting ICT resources which are already available. The South African Government launched Operation Phakisa to accelerate ICT integration in schools. Some of the findings in this study seemed to suggest that some teachers were not taking full advantage of the technology which had been put at their disposal such as mobile phones. Teachers should also be advised and encouraged to consider ICT training as a lifelong endeavour, one that requires ongoing training and retraining in order to stay abreast with the ever-changing ICT field. The diffusion of personal laptops among teachers should be also complemented by the provision of reliable electricity supply, affordable network connectivity and related technology (e.g. data projectors).

Professional development could act as a catalyser for increased use of computer laboratories, which are currently kept locked, for revisions of current school ICT policies which forbid mobile phone use and for a more extensive use of laptops and other personal devices owned by teachers to contribute to teaching and learning. In addition, teacher training should explicitly foster the creation of communities of practice as a safe space to share concerns, experiences and best practices. A focus on cross-curriculum ICT integration not only in ICT integration specific courses but for all professional development courses would be very important. Recent announcements of the government's intention to provide tablets for all learners open the possibility for a more meaningful ICT integration within core school activities, taking into consideration the recommendations made above regarding time. More recently, the country has jumped on the 4th industrial revolution bandwagon. I would caution against blindly following this latest call to join this latest 'revolution' which in my view only serves to reinforce the rural-urban digital divide in the country. This study has shown that in the marginalised contexts in South Africa, we are witnessing an evolution towards ICT use in education, not a revolution, due to the slow uptake of ICT integration in the classroom. While this slow process unfolds, efforts should go towards removal of impediments such as the lack of time that seem to be pulling teachers back.

The South African government should create space in the curriculum for the use of ICT in the classroom. This would mean/require some trade-offs with what teachers are already doing, for example, a reduction in the content covered. While I am cognisant of the bad connotations people have towards curriculum review in South Africa, I believe a curriculum revolution that gives teachers more time for ICT integration is what South Africa should be focusing on. Teachers are overburdened by administration and this has been acknowledged by the government and led, in part, to the revision of the curriculum policy. The introduction of CAPS promised less administrative work for teachers and more time to teach. However, due to the manner in which the CAPS policy appears to regulate teaching by providing specific teaching areas/lessons and specific time allocations, the more it inevitably erodes the flexibility that ICT integrations needs to flourish. What the policy does not allow for at the moment is the opportunity for teachers to plan/prepare ICT integrated activities, try out teaching with technology, time to practice and reflect and gain confidence/experience teaching with ICT. I believe that without this time government will continue to make financial investments towards ICT infrastructure in schools and to train teachers but the benefits of these investments will remain elusive. The SA government needs to make time available to teachers, particularly those in marginalised contexts, who find themselves working in conditions (such as multiples grades and multiple subjects and multiple classes) that constrain them when compared to their urban counterparts.

10.3 REFLECTIONS ON THE RESEARCH PROCESS

I started my PhD studies in 2010. The research project involved extensive engagement with ICT in Education literature, exploration of teachers' perceptions and expectations concerning cross-curriculum ICT implementation, as well as observation and reflection on ICT classroom interventions over an extended period of time. While thoughts about ICT in Education, and particularly in teaching and learning, have progressed with the times, some of the seminal work published one or even two decades ago appears remarkably relevant today. The past ten years were characterised by significant technological developments. As an example, the netbooks used for classroom interventions by some of the ACE-ICT student teachers, though novel at the time, can now be considered mainstream if not obsolete. Some of the findings (particularly in chapter 8) appear to suggest that in an age of ubiquitous mobile technology the educational potential and relevance of a computer laboratory may itself be in need of scrutiny. Considering the significant changes brought about by ICT in almost every aspect of daily life, observing some relatively similar experiences by teachers using technology in class at a five year interval constitutes an interesting finding in itself. The time it took to complete my doctoral journey means that some of the findings and discussion may appear dated. However, I believe that my sustained engagement with the topic of ICT use for teaching in marginalised South African schools during an extended period of time contributes to scholarly understanding of significant changes (or lack thereof) in teachers' experiences in relation to digital technology.

My relationship with the research participants requires reflection. As a lecturer and course coordinator for the in-service ACE-ICT and in-service BEd-ICT courses, I had the opportunity to establish contact with numerous teachers working in rural and township schools. This gave me access to a large number of potential research sites and participants and helped me to familiarise myself with their context and challenges. I could foresee that power dynamics would have to be managed, e.g. by being transparent and open about my research topic and goals, by emphasising that participation was voluntary and would not affect assessment and by adhering to ethical research practices. In particular, I only conducted classroom observations with teachers who had already graduated and with whom I no longer had any institutional relationship. In some cases, this meant that student teachers who had originally committed to take part in my study withdrew and had to be replaced. Some of the findings suggested that past roles and perceived status differentials may have influenced some of the participants. In particular, as somebody connected with the university, I was perceived as a potential source of ICT support and/or equipment. My own background knowledge of the student teachers, though a valuable additional source of contextual information, may have affected my expectations and introduced a possible bias. While as a researcher my goal was to interpret findings from the participants' point of view, as a lecturer I was hoping to see my own efforts reflected in classroom interventions. I tried to manage bias by keeping a reflexive journal and by being clear about my two separate roles.

The student teachers considered in this study were representative of teachers in marginalised schools in South Africa in many respects. However, for over a decade Grahamstown East and Dwesa have been the sites of ICT-for-development projects and training endeavours aimed at promoting and supporting ICT use and skills. Such a context cannot be easily replicated in other parts of the country and the findings of this study cannot be uncritically generalised. The concept of 'fuzzy generalisation' as described by Bassey (2001) appears suitable. He makes a distinction between scientific generalisation, which refers to how "particular events leading to a particular consequence", and fuzzy generalisation which means "particular events may lead to particular consequences" (pp. 5-6). A structured intervention to promote cross-curriculum ICT integration as part of teacher professional development may highlight challenges, promote self-reflection and lead to experimentation of ICT use for teaching. In other contexts, or under different conditions, such use may be sustained over time. Based on my findings, reliance on ICT which is already available in the schools is preferable to technology brought in from outside.

10.4 FUTURE RESEARCH

Over the past ten years, the Education Department at Rhodes University has contributed to the ICT professional development of close to 300 teachers working in marginalised schools in the Eastern Cape (mainly in the Grahamstown and Dutywa districts). It would be important to take stock of the impact of such training on classroom practice. This could be done through a comprehensive questionnaire of past in-service ACE-ICT and in-service BEd-ICT graduates. Its scope should include reflections on one's participation in the course, perceptions and actual experiences in cross-curriculum ICT integration. Analysis should take into account gender, age and experience as well as subjects and grades taught. The latter two dimensions can be expected to present particular challenges such as teachers teaching across subjects and grades but are likely to yield interesting results. The urban/rural difference also appears very relevant in terms of contextual influence.

The study discussed in this thesis could be replicated with the next cohort of in-service BEd-ICT student teachers. An action research could focus on classroom interventions for ICT integration within the in-service BEd-ICT curriculum. Student teachers in different years could be supported in planning and implementing the use of ICT as different tools (instructional, representational, information gathering, cognitive, etc.) in different years. Course outcomes could also be aligned with different levels of adoption of innovation. The issue of time required for meaningful use emerged as particularly significant in this research and should be given special attention. Assessment could be in the form of reflections on a cross-curriculum integration portfolio. It must be taken into account that this assumes student teachers have some kind of ICT available to them in schools, and this may affect course requirements. A similar model could be selectively employed in other professional development courses targeting in-service teachers. Active participation by student teachers in a research project would be beneficial in terms of their own growth as reflexive practitioners. The findings of such a study could potentially inform professional development in the Education Department at Rhodes and other universities.

Student teachers in the in-service ACE-ICT and in-service BEd-ICT programmes appear to be part of a complex ICT ecosystem. Focusing on selected case studies, future research could investigate the interrelationship between computers, mobile phones and other ICTs across the professional and private sphere. Internet access and use appear to be of increasingly paramount importance. Digital literacies and academic uses of ICT by teachers themselves, as well as their learners, colleagues and principals, should be included. The foregrounding of the importance of support in this research calls for better understanding of communities of practice and personal learning networks. A holistic investigation of the relationship between ICT use and culture at the level of the classroom, school and surrounding community promises to yield fascinating results.

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APPENDICES

Appendix A: Permission letter to the districts

Rhodes University
Education Department
Post Bag 94, **Grahamstown, 6140**

15 March 2013

The District Education Officer
XXX Education Department
XXX

Dear Sir/Madam

<u>REF: Permission to conduct research at schools in the XXX region</u>

I write to seek for permission to conduct research at schools in the Idutywa education district. I am a PhD student at Rhodes University in Grahamstown working on a research project in the ICT in education field.

Last year, 20 teachers from the Dwesa region successfully completed a two year programme with Rhodes University and will be graduating with an Advanced Certificate in Education in April 2013. My research project seeks to understand teachers' perceptions and experiences teaching for the first time with computers in Social Sciences classrooms and focuses on the twenty aforementioned teachers as key participants. In order to understand the teachers' perceptions and experiences with computers, I will need to understand the learners they work with and as such, learners will be involved in this research. I explain in detail all this and more, in the attached research proposal which has been approved by the Rhodes University Education department's higher degrees committee.

The schools that I would like permission to work with are:

- School A, B or C

If you require any further information, feel free to contact me or my research supervisor, Professor Lorenzo Dalvit whose contact details are below:

Professor Lorenzo Dalvit
Room 108 School of Journalism and Media Studies
Rhodes University
PO Box 94, 6140 Grahamstown
Tel: +27 (0)46 603 7157
Cell: +27 (0)78 187 0143
Email: l.dalvit@ru.ac.za

Your assistance in this regard will be greatly appreciated.

Sincerely,

Fortunate Takawira Gunzo

PhD Student- Rhodes University

Appendix B: Permission letter to principals

Rhodes University
Education Department
P Bag 94
Grahamstown, 6140

15 March 2013

The Principal
Address removed

Dear Mr XXX

REF: Permission to conduct research at your school

I would like to ask for permission to conduct a research study at your school. I am a PhD student at Rhodes University in Grahamstown working in the ICT in Education field. As you are aware, you have just completed an in-service ACE-ICT with Rhodes University, which amongst other things trained you to use ICT tools such as computers in their everyday teaching.

In my research project I would like to explore the initial phases of cross curriculum integration in the classroom. My focus is on grade 9 Social Sciences classrooms. Specifically, I would like to understand the teacher's perceptions of using computers for teaching and their experiences after using computers to teach Social Sciences. I will need to be in your school for approximately a month on and off, during which time I will conduct interviews with the teacher, run a questionnaire with learners and observe three lessons. I have requested that teachers organise for these 'special classes' in the afternoon to avoid disrupting the normal school day if needs be.

Please feel free to contact me or my supervisor Professor Lorenzo Dalvit, whose contact details are below, if you need any further information.

Professor Lorenzo Dalvit
Room 108 School of Journalism and Media Studies
Rhodes University
PO Box 94, 6140 Grahamstown
Tel: +27 (0)46 603 7157
Cell: +27 (0)78 187 0143
Email: l.dalvit@ru.ac.za

Your assistance in this regard will be greatly appreciated.

Sincerely,

Fortunate Takawira Gunzo

PhD Student- Rhodes University

Cell: 072 525 8559

Email: g08g6256@campus.ru.ac.za

Appendix C: Informed consent form

RHODES UNIVERSITY

Education Department

CONSENT FORM

Teachers' perceptions and experiences of using ICT in teaching in marginalised classrooms in South Africa

I, **Fortunate Gunzo** (the researcher), promise to ensure that all the information obtained during this research study will remain confidential

Signature: ______________________________

I, ____, agree to participate in Fortunate Gunzo's research project[5] in which she seeks to understand teacher's perceptions and experiences using computers for teaching grade 8 Social Sciences. I give her permission to record[6] me as part of her data collection process. I understand that transcripts from the recordings will be made and that she may use extracts in the final report. I understand that I have the right to withdraw from this research at any time.

I understand that all information gathered from this research study will be kept private.

Signature: ____________________ **Date:** ______________________

[5]Either in an interview or being observed during teaching

[6] Either audio and video recording depending the nature of my participation in the study

Appendix D: Teacher questionnaire

Questionnaire for teachers

Please answer all the questions. Follow the instructions given on some of the questions.

No.	Question	Response	Code
	Part A: Teacher profile/Demographic data		
1.	Gender	Male Female	1 2
2.	Age	Less than 25 Between 26 and 35 Between 36 and 45 Over 46	1 2 3 4
3.	How long have you been teaching?		
4.	What subjects and grades do you currently teach?	Subjects Grades	
5.	Do you have any special role in the school? e.g. HoD If yes specify……………………………………………………	Yes No	1 2
6.	Does your school have computers for teaching and learning**?**	Yes No	1 2
	Part B: Computer knowledge, access, skills and experience		
7.	Do you own a computer or laptop?	Yes No	1 2
8.	How often do you use a computer?	Daily A few times a week Once a week Once in two weeks Never	1 2 3 4 5
9.	What software application do you normally use?	Word processor e.g. OO writer or Ms Word Presentations e.g. PowerPoint Spreadsheets e.g. Excel Other, specify………………………………………..	1 2 3 4
10.	How would you evaluate your own computer skills	Very good Good Moderate Weak Very poor	1 2 3 4 5
11.	Have you ever used a computer to do any of the following?	Have done this before	Have never done this
	Searching for information on the Internet		
	Send and receive email		
	Social networking e.g. Mxit, Facebook, Whatsapp		
	Play games, music, videos		
12.	Is it worth the effort, time and money to use computers for teaching?	Yes No	1 2
13.	Explain your answer to 12:		
14.	Given the opportunity and resources, would you use computers for teaching the subjects you teach	Yes No	1 2
15.	Who do you consult for advice and guidance on technology related issues	colleagues The IT/technology coordinator	1 2

		The school principal Experts from outside the school No one Other specify	3 4 5 6

Part C: Experience with cell phones

16.	What is the brand and model name of your cell phone? (e.g. "Nokia 1280)		
17.	How long have you had your current cell phone?	6 months or less One Year 2 or 3 years More than 3 years I'm not sure	1 2 3 4 5

18. Have you ever used a cell phone to do any of the following?	Have done this before	Have never done this
Searching for information on the Internet		
Send and receive email		
Social networking e.g. Mxit, Facebook, Whatsapp		
Play games, music, videos		

Part D: Attitudes and perceptions towards computers

	Please tick one for each question	Strongly disagree	Disagree	Unsure	Agree	Strongly Agree
19.	I enjoy using the computer					
20.	It is fun to use the computer					
21.	I get anxious when I have to use a computer					
22.	Using the computer will complicate my life as a teacher					
23.	I find the computer is easy to use					
24.	It takes up much time for me to find things on the computer					
25.	Overall, I find the computer useful in my job as a teacher					
26.	Using the computer for teaching saves me time					
27.	I do not have sufficient confidence to try teaching with computers alone					
28.	I find the computer difficult to use					
29.	My learners do not have access to the required ICT tools outside of the school premises					
30.	There is too much work involved in using computers in teaching					
31.	I do not have the time to develop and implement ICT related activities					

32.	ICT is not considered to be useful in my school					
33.	Using the computer makes it easier to do my job as a teacher					
34.	I find it easy to get the computer to do what I want to do					
35.	My learners do not possess the required ICT skills					
36.	My school does not have the required ICT infrastructure					

Thank you for your time

Appendix E: In-service ACE-ICT data collection tools

Appendix E1: In-service application form – page 3

APPLICATION FOR ADMISSION TO **ADVANCED CERTIFICATE IN EDUCATION** (IN-SERVICE/ 2 YEARS, PART-TIME)

1. PROFESSIONAL DETAILS

NO. OF YEARS TEACHING EXPERIENCE		PLEASE **X** PHASE IN WHICH YOU PRESENTLY TEACH	FOUNDATION	INTERMEDIATE	SENIOR	FET
DESCRIPTION OF PRESENT POST (grade, level, HOD, etc)						
LEARNING AREAS/ SUBJECTS PRESENTLY TAUGHT						
ADDITIONAL SCHOOL RESPONSIBILITIES						

2. ADDITIONAL INFORMATION

6.1 WHY HAVE YOU CHOSEN **RHODES UNIVERSITY**?
2.2 WHY SHOULD YOUR APPLICATION BE CONSIDERED FOR ACCEPTANCE? PROVIDE A BRIEF MOTIVATION.
6.3 WHAT PERSONAL AND/OR PROFESSIONAL ASPIRATIONS DO YOU HAVE? WHAT DO YOU HOPE TO DO ONCE YOU HAVE COMPLETED THE CERTIFICATE?

Appendix E2: How I became computer literate assignment

Write **at least 2pages** on the following topic “How I became computer literate”. In this essay you must tell the story of your journey with ICT, where it began and where you are now. You can also include where you would like to be in the future.

Appendix E3: Mobile computer lab proposal assignment

Mobile computer lab proposal

Write a proposal in which you motivate for the use of the mobile computer lab at your school. Your proposal should have the following sections:

1. **Context** – explain your school context including infrastructure and resources already available at your school.

2. **Target group** – explain who you would like to target with the mobile computer lab (e.g. learners, administrative staff, teachers, SMT). You need to motivate why you have chosen that targeted group.

3. **What you want to do** – outline what you would like to do. Remember, the mobile computer lab will only be at your school for a day. Please make realistic, achievable proposals for the use of the lab in the time frames given e.g. you cannot plan for an activity that will last 2weeks or a month. Be specific in what you would like to do, you can consider this as a lesson plan for the day.

4. **Potential benefits and challenges** – take time to consider the possible benefits and challenges of mobile computer lab at your school. Articulate how you will address the challenges mentioned. You can include here the expected reaction of people at your school.

Appendix E4: Mobile Computer Lab questionnaire [online]

Mobile lab questionnaire [online]

1. What were your first impressions after seeing the netbooks?
2. What do you understand the concept of the mobile computer lab (MCL) to mean?
3. What impact do you think the MCL will have at your school and in your class?
4. In your opinion, do you think that the MCL will be a good idea at your school and why?

5. Who do you think should be given priority to use the MCL at your school (teachers, administrative staff, learners, managements)? Choose one and explain why.
6. What challenges do you think you will face while using the MCL?

Appendix F: Interview questions

Teachers before the first lesson

1. Tell me briefly how you became computer literate?
    a. Did your teachers use any technology when you were at school? When you trained to be a teacher?
    b. Have you attended any professional development courses or workshop excluding the ACE-ICT
2. What made you decide to do the ACE-ICT?
3. What made you volunteer to participate in this research project whereby you will teach lessons using the mobile computer lab?
    a. What is your motivation for wanting to use computers on your classroom?
4. Do you have access to a computer?
    a. What do you use it for mostly?
5. Have you ever used ICT tools such as a computer for teaching?
    a. If yes, when, how and which tools and do you currently use computers to teach the subject(s) you teach?
    b. If not, have you ever considered using ICT tools in your classroom before? Explain what stopped you
6. In what ways do you think computers can help children learn?
7. What is the general feeling at this school (colleagues, SMT etc) towards the use of technology for teaching and learning?
    a. Is your school supportive or not of the use of ICT for teaching?
8. What are your thoughts towards the use of technology for teaching and learning?
9. In your opinion, do you think children learn better in a classroom with or without computers? explain
10. What do you think is the role of the teacher in a classroom with computers for teaching?
11. What is the role of the learner in a classroom with computers for teaching and learning?
12. How are you planning to use the mobile computer lab in your class
    a. How did you arrive at this decision?
    b. Did you or are you consulting anyone for help as you prepare for your lessons?
13. What are your expectations for the 1st lesson you will have?
    a. What do you think will be the reaction of your learners to using computers in the classroom?
14. What are some of the challenges you anticipate facing? How are you planning to deal/address with those challenges?
15. What lessons have you learnt (if any) while preparing for the project (using computers in your classroom?)

Teachers after each lesson

1. What was your experience as you prepared for this lesson which involved the use of technology? What differences did you note when compared to than preparing for a lesson which does not include the use of technology?
2. In your opinion which is easier - teaching with/without technology?

3. How did the lesson go? Did the lesson go according to plan? Did you achieve your aim/objective of the lesson?
4. How do you think the use of computers hindered or aided/enabled/helped you to reach the goal you set for the lesson? How did they do this?
5. What did you enjoy most/least about the lesson?
6. What challenges/problems/difficulties did you face during the lesson?
    a. How did you deal with the challenges?
7. What do you think about the use of computers in teaching SS now that you have taught a lesson with computers in your classroom?
8. What did you learn from today's lesson?
9. Is there something you would like to do differently next time? Why?
10. Based on your experience today would you use/not use computers in your classroom in the future?

Principal questions

1. How long have you been a principal? At this school?
2. Ask for the number of learners at the school and teachers
3. What technology does the school have? Which of these are used directly for teaching and learning? Which of this technology is accessible by learners and for what?
4. Any technology related program(s) currently run for learners?
5. What is the school policy regarding cell phones for both teachers and learners?
6. As for a copy of the ICT policy if the school has one
7. What are the school future ICT plans?

IT representative questions

1. Do you have formal training in ICT/computers?
2. How has this [answer to question 1] impacted on your role as the IT coordinator/rep?
3. Can you tell me what the position of the ICT coordinator/representative entails?
4. What do you so as the ICT coordinator/representative?
5. How long have you been doing this [ICT rep?
6. How does the school and your colleagues support you in your role as the ICT coordinator?
7. What ICT resources are available at the school? [ask for a specific list, ask condition e.g. if they work]
8. Do teachers and learners have access to these ICT resources? [ask specific arrangements for the use of the resources]
9. Do teachers and learners actually use the ICT resources? [Ask how, if they know]
10. During your time as the IT rep has the school initiated ICT related programmes directly targeting learners, teachers or support staff?
11. What would you say are some of the highlights/ lows for you so far in this position?

Follow up interview with the 3 IN-SERVICE ACE-ICT key participants

*Questions directed by the video.

Appendix G: Classroom observation guide

Teacher…... Number of learners in the classroom…………………
Date………………………………… Lesson topic…………………………………………..

Areas to focus on	**Comments**
Comment on the school and classroom environment. Take note of what is available in the classroom.	
Sitting arrangement?	
Lesson plan submitted?	
Comment on lesson plan – clear outline of the lesson etc.?	
What is the objective and expected outcome of the lesson	
List tools used by both the teacher	
Comment on how are the tools used?	
What rules or regulations are governing the class? Any class rules?	
Who is doing what during the lesson? Comment on what the teacher and learners are doing.	
How are the roles organized?	
Comment on the overall classroom intervention	
Note areas to bring up with the teacher during the SR interview	

Appendix H: Sample Field notes

Classroom observation at School B on the 16th of July 2013

The class started with children moving in from another class, the teacher asked them to close their eyes and to bow their heads and do the Lord's Prayer. The teacher introduced the researcher and explained that they were going to conduct some research in groups on Nationalism. She then divided the class into groups, gave them the question they had to answer as a group and directed the learners to the turn the netbooks on. Once on, she told the learners where to find the offline websites she had preloaded for the learners. The teacher then gave instructions on how the activity was to be done – that each group had to read and summarise and answer the question given. Each group also had to prepare to present their answer to the rest of the classroom. There was a lot of activity in class once they were told to begin. The learners quickly organised themselves and allocated each other responsibilities, e.g. note taker, presenter, computer person etc. there were a number of questions from the class for the teacher to assist, those closer to the researcher asked for help with the computers for example help with locating the page they had to read from.

Observations/Lessons learnt today

- Need for stricter planning, to really get down to the detail of what will happen in a class.
- The Internet/websites are good but difficult to ensure that all learners get an opportunity to use the computers as groups opted to get the person comfortable with computers to operate it.
- Tasks that involve looking for information, and then making meaning of it and then presenting to others takes time and cannot happen during the normal 45minute period. The teacher struggled with time today and had to postpone it to tomorrow in order to finish with the presentations.
- Group work can be good especially when technologically weak students are paired with those who are tech savvy- the others watch and see what those can do are doing and helpfully learn something. I saw that group work was effective in this class today.
- Managing a class with computers can be a bit challenging – the teacher struggled today. It is not easy for one teacher to keep track of what all the learners are doing, even if they are given some deadlines, sometimes it's not easy to finish on time.
- There is need to avoid such a lesson being about just retrieving the information that the teacher needs. I like one question where you asked learners to make a link between industralisation and nationalism. That question forces leaners to read two texts and make meaning of each before they apply themselves, in other words, before they reflect, and reflection is important.
- Learners sat and did not write notes as the teacher was teaching- would it not better to write notes and the lesson progresses? When do they get to write down notes?
- Tools used: Liked that she did not only rely on the computer but asked learners with textbooks to also open and contribute to the topic. Referred the map in the introduction as she tried to explain which part of Africa is southern Africa.
- Used question and answer to involve the learners, like what does AD/BC mean to try and show how far back the things she was talking about were?

Appendix I: Learner questionnaire

Questionnaire for learners

Please answer all the questions.

Follow the instructions given on some of the questions.

Number	Question	Response	Code
Part A: Demographic data and social context			
1.	Gender	Male Female	1 2
2.	How old are you?		
3.	Do you have electricity at home?	Yes No	1 2
4.	Which of the following do you have at home?	Computer or laptop Television Radio	1 2 3
Part B: Experience with cell phones			
5.	Do you have access to a cell phone?	Yes No (if no, please go to question 8)	1 2
6.	What is the brand and model name of the cell phone? (e.g. “Nokia 1280)		
7.	How long have you had your current cell phone?	6 months or less One Year 2 or 3 years More than 3 years I’m not sure	1 2 3 4 5

8. Have you ever used a cell phone to do any of the following? *(you can tick more than one)*	Have done this before	Have never done this before
Searching for information on the Internet for school		
Send and receive email		
Social networking e.g. Mxit, Facebook, Whatsapp		
Play games, music, videos		

Part C: Prior knowledge of computers/computer awareness & knowledge			
9	Have you ever seen a computer?	Yes No	1 2
1	Have you ever used a computer? *(If **NO** go to question **17**)*	Yes No	1 2
1	When was the 1st time you used a computer?		
1	Who first taught you how to use a computer?	Teacher Classmate/peer Parent Sibling (brother or sister), I taught myself I have never learnt how to use computers Other (Specify)_______________________________	1 2 3 4 5 6 7

1	Where do you use a computer? *(you can tick more than one)*	At home At school At someone else's home At public place like a library or Internet café Other: I never use a computer	1 2 3 4 5 6
1	Have you ever used a computer in the classroom during a lesson **not** in a computer lab?	Yes No	1 2
1	How often do you use computers in the classroom?	Daily A few days in a week Once a week Once in two weeks Once a month Never	1 2 3 4 5 6
1	What challenges do you face in using computers?		

17. Have you ever used a computer to do any of the following?	Have done this before	Have never done this
Searching for information on the Internet for school		
Send and receive email		
Social networking e.g. Mxit, Facebook, Whatsapp		
Play games, music, videos		

Part D: Attitudes and perceptions towards computers

	Please tick one for each question	Strongly disagree	Disagree	Unsure	Agree	Strongly Agree	I don't know
18.	I use the computer to learn things						
19.	The computer is easy to use						
20.	I am scared to use the computer						
21.	It is necessary and important for me to know how to use computers?						
22.	I look forward to using the computer						

Thank you for your time

Appendix J: In-service BEd-ICT Selection questionnaire

Rhodes University

Professional development Centre

BEd-ICT 2015 Selection

Full name…………………………………………………

Age………………………………   Gender………………

Name of School …………………………………….....

Area/village where school is located…………………......

Question	**Yes**	**No**
My school has a computer lab		
There is Internet at my school		
There is electricity at my school		
There is at least one computer at my school		
We are going to receive computers at my school in the next 3 years		
I teach in the senior phase		
I teach in the Intermediate phase		
I have Internet at home		
I own a laptop/computer		
I am computer literate		
There are teachers in my school who are computer literate		

Appendix K: Lesson plan template

<table>
<tr><td colspan="2">Subject:</td><td>Grade:</td><td colspan="2">No. in class:</td></tr>
<tr><td colspan="2">Topic:</td><td>Lesson duration:</td><td colspan="2">Date:</td></tr>
<tr><td colspan="5">Prior knowledge (Assumed knowledge of learners):
An explanation of the knowledge, skills, values and attitudes the children have that will provide the foundation for new learning</td></tr>
<tr><td colspan="5">Aim of the lesson:
What the teacher wants the children to be able to do, know or develop (such as skills and attitudes) by the end of the lesson.
By the end of this lesson the children should be able to:-</td></tr>
<tr><td colspan="5">Forms of assessment during the lesson:
Observation, questioning, listening, marking, reading, etc.</td></tr>
<tr><td colspan="5">Support materials / teaching aids / resources:
List of learning and teaching aids / materials.</td></tr>
<tr><th>Stages of the lesson</th><th colspan="3">Teaching procedures and teacher’s language</th><th>Learner activities</th></tr>
<tr><td>Introduction
▪ Whole class
▪ Groups
▪ Individuals</td><td colspan="3">A brief explanation / description of how the lesson will be introduced, providing a link with previous lessons.
Should be attention grabbing.
The introduction usually sets the tone for the rest of the lesson, therefore needs to make an impact.
Strategies used to ‘connect’ children to the lesson topic.</td><td>Give an indication of what the learners will do.</td></tr>
<tr><td>Lesson development (Body of lesson)
▪ Whole class
▪ Groups
▪ Individuals</td><td colspan="3">(The hard yards)
How the lesson will be developed step-by-step
Stages and transitions in the lesson
Explicit reference to how the projected aim will be reached
Explicit accounts of teaching / learning approaches
List / describe questions you intend asking</td><td></td></tr>
<tr><td>Consolidation / conclusion
▪ Whole class
▪ Groups
▪ Individuals</td><td colspan="3">(Drawing the lesson in – pulling the threads together)
Applying little conclusions as the lesson develops
How closure will be reaching; overview and summary of what has been learned
Not setting homework!!!</td><td></td></tr>
<tr><td>Extension activity / early finishers</td><td colspan="3">What activities will be provided for the children that complete the lesson activities quickly</td><td></td></tr>
<tr><td>Accommodating children with learning barriers</td><td colspan="3">How will you ensure that all learners are catered for in your lesson?</td><td></td></tr>
<tr><td colspan="5">Preparation check list (check personal preparation for each stage of the lesson)
1. Introduction
2. Body of the lesson
3. Consolidation / conclusion
4. Extension activity / early finishers
5. Assessment
6. Have you got all your resources</td></tr>
<tr><td colspan="5">Assessment of the children
Must link to the aims of the lesson (this is about the children). Were the aims of the lesson met, if so how? If not, you may have to reteach this lesson.</td></tr>
<tr><td colspan="5">Lesson evaluation
This is about the teacher. Evaluation of actual lesson – ask the following questions based on each component of the lesson (introduction, body of lesson, conclusion), what went well, what didn’t go well, what can be improved or amended?</td></tr>
</table>

Appendix L: Lesson Plan and reflection online questionnaire

Rhodes University

BEd-ICT – Cross Curriculum Integration and Implementation

Lesson planning and reflection questionnaire [online]

Question	Yes	No
1. Do you plan your lessons in your everyday teaching		
2. Do your colleagues plan their lessons/prepare lesson plans?		
3. I have been taught how to plan a lesson.		
4. Is it necessary to reflect on your teaching?		
5. Lesson planning and reflection on your lesson is time consuming.		
6. Lesson planning and reflecting on your lesson gets in the way of finishing the syllabus.		
7. Lesson planning and reflecting on your lesson is not that necessary as long as you cover the syllabus		
8. It is enough to refer to the teacher guide/CAPS document just before my lesson.		
9. I generally do not reflect on my teaching		
10. Lesson planning and reflecting on your teaching is time consuming		
11. How often do you prepare a lesson plan or plan for your teaching?		
12. In your everyday teaching, how often so you reflect after a lesson?		
13. In your opinion, is it important to prepare a lesson plan every day?		
14. If you answered no to either question 1 or 2, what do you think are some of the reasons you and or your colleagues do not you’re your lessons/prepare lesson plans?		
15. On a typical day, what do you do after a lesson/after your classes?		

Appendix M: BEd-ICT lesson plan and reflection assignment

Assignment

1. Download the CAPS document for your phase and subject selected. Individually read the CAPS document first term content and identify topics/lessons that you think ICT can be integrated.

2. Choose a topic in the 3rd term, 4^{th} or 5^{th} week. Draw up a lesson plan on the selected topic. Submit this lesson plan on RUConnected *'Term 3 Lesson Plan'*.

3. Teach the lesson you planned in your classroom in week 4 or 5. Then, write and submit your reflection on the lesson your taught.

Appendix N: Publications

During this PhD, the following full conference papers were peer reviewed; presented at conferences and published in conference proceedings:

1. Dalvit, L., & Gunzo, F. (2014). One year on: A longitudinal case study of computer and mobile phone use among rural South African youth. In J. Steyn, & D. Van Greunen (Eds), *ICTs for inclusive communities in developing societies. Proceedings of the 8th International Development Informatics Association Conference*, held in Port Elizabeth, South Africa. ISBN: 978-0-620-63498-4 (pp. 164-173).
2. Gunzo, F., & Dalvit, L. (2014). *In-service teachers' experiences of teaching with computers in rural South African classrooms*. EDULEARN14 Proceedings- Paper presented at the 6th international conference on Education and New learning technologies. 7-9 July. (pp. 3859-3866). ISBN: 978-84-617-0557-3.
3. Gunzo, F., & Dalvit, L. (2013). Teaching educators to use computers in their Social Sciences classrooms: A South African experience. Paper presented at the *International Association for Media and Communication Research (IAMCR)* conference. 25-29 June 2013, Dublin (Ireland).
4. Gunzo, F., & Dalvit, L. (2012) A survey of cell phone and computer access and use in marginalised schools in South Africa. Paper presented at the *3rd International conference on Mobile communication for development (M4D)*, 28-29 February, New Delhi, India.
5. Gunzo, F., & Dalvit, L. (2011). Assessing teachers' and learners' experience of a mobile lab intervention: a case study. Paper presented at the *Kenton Conference*, 3-6 November, Cape Town.
6. Gunzo, F., & Dalvit, L. (2011). Bringing ICT to the community: mobile labs in a developmental context. Paper presented at the *Community Engagement Conference*, 8-9 November, East London.
7. Gunzo, F., & Dalvit, L. (2011). Exploring the potential of a mobile computer lab in a developmental context: the educators' perspective. Paper presented at the *10th European Conference on e-Learning (ECEL)*, 10-11 November, Brighton (United Kingdom).