Cape Peninsula
University of Technology

THE ABILITY OF NEWLY QUALIFIED TEACHERS TO INTEGRATE TECHNOLOGY INTO THEIR PEDAGOGICAL PRACTICE

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Thesis submitted in fulfilment of the requirements for the degree
of
DOCTOR OF EDUCATION

in the Faculty of Education

Cape Peninsula University of Technology

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Mowbray

November 2018

DECLARATION

I, **Chantyclaire A. Tiba,** declare that the contents of this dissertation/thesis represent my own unaided work, and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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Signed **Date**

ABSTRACT

Growing numbers of urban and rural South African classrooms are now occupied by learners accustomed to, or could easily learn how to use technology that they have been described as 'digital natives'. In order to design lessons that facilitate knowledge acquisition in a way that is familiar and relevant to these digital natives in the 21st century classroom, teachers have to integrate technology into their daily practice.

In response to this situation, the National Department of Higher Education (NDoHE) has drafted an e-Education policy to inform schools about the use of technology for innovative teaching and enhanced learning. Provincial education departments are expected to drive this policy. In the context of the historically entrenched socio-economic inequalities in South African schools, the use of technology could be a key instrument in closing the gap between privileged and underprivileged communities. Currently the Western Cape Education Department is involved in many initiatives to make technology more available and accessible. Although some public schools in the Western Cape have been provided with various forms of technology for teachers to use in their teaching, much more needs to be done to encourage newly qualified teachers (NQTs) to adopt, adapt and use technology effectively in the classroom.

This study aims to answer the key research question: What factors influence NQTs' ability to integrate technology into their pedagogical practice? In order to explore these factors, concepts from the TPACK and UTAUT2 models, which constitute the conceptual framework of the study, were used to collect, analyse and interpret data.

From a review of the relevant literature, it emerged that although the factors that influence NQTs' ability to integrate technology into their pedagogy have been extensively investigated internationally, few studies have been conducted in South Africa as a whole, and even fewer in the Western Cape; which makes this a pioneering local study. Because of the importance of technology in the 21st century classroom, factors that influence teachers' use of technology need constantly to be monitored in order for school leaders to formulate programmes to encourage more teachers to integrate technology into their lessons effectively.

This is a qualitative study set within an interpretive paradigm. To explore NQTs' perceptions of factors that encouraged them to use or eschew technology, and to ascertain *why* they did or did not use technology in their teaching, a sample of newly qualified Intermediate Phase (IP)

teachers was selected. All these teachers graduated from a Teacher Education Institution (TEI) in 2013 and completed technology courses, projects and assignments requiring them to use technology during their pre-service training. It was expected of these teachers that they would be able to integrate technology into their professional practice at the schools to which they were first posted. Elements that obstructed such integration answer the main concern of this thesis, which seeks to determine what factors deter or accelerate teachers' ability to integrate technology into their pedagogical practice.

Seventy-four NQTs responded to the online survey; ten teachers were involved in the semi-structured one-on-one interviews and six teachers agreed to be observed in their classrooms while they taught with technology. The data collected via these instruments were analysed using a deductive approach shaped by concepts derived from the conceptual framework and the literature review. The researcher was open to unexpected themes arising from the data analysis.

While NQTs from fee-paying schools had numerous resources that encouraged them to use technology regularly in their teaching, teachers at no-fee-paying schools lacked technological resources. These teachers sometimes bought their own technological resources to use in their teaching. Subject area was an important factor influencing NQTs ability to use technology. For instance, they felt that English First Additional Language (EFAL) concepts were difficult for learners to comprehend since English was their second language. They consequently made use of video clips because the visual component and animation served to enhance learners' understanding of difficult concepts.

The majority of teachers at no-fee paying schools did not have the ability to teach effectively with technology: they could not blend the technology with the pedagogy and content knowledge required for effective teaching. Teachers from fee-paying schools, however, were able to use constructivist, interactive modes of instruction because such schools could afford to purchase, protect and maintain technology while training teachers in its use. Teachers from fee-paying schools had the ability to use a variety of technological equipment to engage learners in their classrooms, and sometimes gave learners tasks that required them to develop new projects. Though teachers from fee and no-fee-paying schools received the same input during their pre-service training (2013), the schools where they were employed for their first professional practice, had varying degrees of technological resources. Resources, was one factor, that influenced teachers' ability to integrate technology in their teaching and learning.

From the findings, the researcher developed the "Acquisition and Integration of TPACK Model" which could be used when motivating and up-skilling teachers in this study to teach effectively with technology. By developing this model, the researcher has contributed to the field of technology integration. She hopes it will improve the skills of NQTs in this study, to enable them to adopt and teach effectively using technology. Based on the findings of the study, the researcher presents recommendations for policy, practice and future research.

ACKNOWLEDGEMENTS

I wish to thank the following individuals and organisations:

- To God for his countless blessings throughout the journey of completing this thesis.
- Professor Janet Condy, my supervisor for her patience, encouragement, love and academic guidance throughout this journey. You made my doctoral journey enriching and fulfilling.
- Associate Professor Agnes Chigona, co-supervisor: I sincerely appreciate the rigour with which you read my work and your critical insights.
- Ms Nyarai Tunjera, for your endless discussions on technology integration. You kept my spirits high.
- Sam Dyasi, Roger Mukadi and Petrozanne de Jager: your advice, spiritual, moral and constructive comments kept me focused.
- The following staff at Cape Peninsula University of Technology for your support and constant encouragement: Dr Cina Mosito, Liteboho Adonis, Gerard Thomas, Pippa Campbell, Sharon Panayiotou, Robert Meyer and Dr Sue Pather (UWC).
- My grandparents, Mr Chrysanthus Nde and Margret Nde, who encouraged me to complete this thesis. Your calls uplifted my spirit and made the doctoral journey easier.
- My parents, Gladys Azwe Kumsi, Batholomius Kumsi, Charles Mundi, Victor Tiba, Kerian Ebot Agbor and Ngwa Richard, for believing in me. Without your support, completing this thesis would have been impossible.
- My siblings: Derick, Jenkins, Humphrey, Edith, Clarisse and Romeo; may this inspire you to pursue your dreams.
- My extended family members and friends for their unwavering support: Mary Ndakweh, Divine Chick Tiba, Mildred Afor, Jacky Ndlovu, Victorine Tiba, Dorothy Tiba, Florence Tiba, Febe Tiba, Roger Mundi, Emilia Mundi, Emmanuel Mundi, Jude Mundi, Marion Kafuko, Linda Musi and Relindys Scott.
- The Western Cape Department of Education for granting me permission to conduct this research at its schools.

- The NQTs who participated in this study and allowed me to collect data in their classrooms.
- The National Research Foundation (NRF) and South African Association of Women Graduates (SAAWG) for your valuable funding contributions towards the research investigation.

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LIST OF ABBREVIATIONS

B Ed	Bachelor in Education
CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
CPD	Continuing Professional Development
CPUT	Cape Peninsula University of Technology
C-TPB-TAM	A Combined Theory of Planned Behaviour/Technology Acceptance Model
DoE	Department of Education
DVD	Digital Video Disk
EFAL	English First Additional Language
FP	Foundation Phase
ICT	Information Communication and Technology
IDT	Innovations Diffusion Theory
IP	Intermediate Phase
ITE	Initial Teacher Education
IT	Information Technology
MEC	Member of the Executive Council
MM	Motivational Model
MPCU	Model of Personal Computer Utilization
MRTEQ	Minimum Requirement for Teacher Education Qualification
NDoE	National Department of Education
NDoHE	National Department of Higher Education
NQT	Newly Qualified Teachers
NRF	National Research Foundation
NST	Natural Science and Technology
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SA	South Africa
SAAWG	South African Association of Women Graduates
SCT	Social Cognitive Theory
SMS	Short Message Service
SMT	School Management Team

TAM	TPACK Acquisition Model
TCK	Technology Content Knowledge
TEI	Teacher Education Institution
TK	Technology Knowledge
TPACK	Technology Pedagogical Content Knowledge
TPB	Theory of Planned Behaviour
TPK	Technology Pedagogical Knowledge
TRA	Theory of Reasoned Action
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
UTAUT2	Unified Theory of Acceptance and Use of Technology2
WCED	Western Cape Education Department
WiFi	Wireless Fidelity

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

Growing numbers of urban and rural South African classrooms are now occupied by learners accustomed to, or could easily learn how to use technology that they have been characterised as "digital natives" (Prensky, 2001:1). Some of these learners are able to use technological equipment for entertainment and communication with confidence, ranging from mobile phones and laptops to television and digital video disk (DVD) players. Learners from affluent backgrounds are often familiar with social media such as Facebook, Twitter, Instagram and WhatsApp. For teachers to design lessons that facilitate knowledge acquisition in a way that is familiar and relevant to these digital natives in the 21st century classroom, they need to integrate technology into their daily classroom practice. Relevant literature shows that learning can be enhanced when teachers integrate technology into their teaching (Carver, 2016; Hsu, 2016; Mtebe et al., 2016). The National Department of Education (NDoE), in South Africa (SA), supports this learning trend by affirming that "ICTs have the potential to improve the quality of education and training" (South Africa. DoE, 2004:8).

Because technology has substantial potential to increase the quality and speed of knowledge acquisition, narrow the socio-economic gap that exists between those still suffering the divisive effects of apartheid, the National Department of Higher Education (NDoHE) recognises the crucial role of technology in education in the predicament of South African education. For this reason, the NDoHE drafted a policy on the Minimum Requirements for a Teacher Education Qualification (MRTEQ) which stipulates that teacher education students must know how to use ICTs for "innovative teaching and enhanced learning" (South Africa. NDoHE, 2011:9). The aim of the policy is to inform curricula and up-skill pre-service teachers for teaching in 21st century classrooms. Given the historically entrenched socio-economic inequalities in South African schools, the use of technology is perceived to be a key instrument in closing the gap between privileged and underprivileged communities.

Another NDoHE initiative to ensure the use of technology in schools was the drafting of the e-Education White Paper. This document seeks to "build digital and information literacy so that all learners become confident and competent in using technology to contribute to an innovative

and developing South African society" (NDoE, 2004:5). Partly in response to this, the Western Cape Department of Education (WCED), through the Khanya project launched in 2001, has provided technological equipment to some public schools in the province and trained teachers in its use (Khanya Annual Report, 2008). Teachers have been expected to use this technological equipment for teaching and learning. The sampled schools for this study had varying degrees of technological resources provided by the WCED, which teachers could integrate in their teaching and learning. For example, the fee-paying schools had many technology resources, while the no-fee-paying schools had limited or no resources. The aim of the current study is to explore factors that influence newly qualified teachers (NQTs) to use technology in their teaching and learning, so that the WCED and its public schools can be informed about these factors and formulate programmes to encourage more teachers to use technology in their classrooms.

This chapter is structured as follows:

Section 1.2 outlines the rationale and context for the study;
Section 1.3 states the research questions and objectives of the study;
Section 1.4 cites the assumptions of the study;
Section 1.5 discusses the significance and contribution of the study;
Section 1.6 clarifies concepts and terms;
Section 1.7 provides a brief motivation for the approach adopted by the study;
Section 1.8 discusses the limitations and challenges of the study; and
Section 1.9 provides an outline of the study.

1.2 RATIONALE AND CONTEXT FOR THE STUDY

In South Africa, the Western Cape Government has provided technology in the form of tablets phones, laptops and computers to a selected number of schools (Guest, 2014). It has been reported that 92% of schools in the Western Cape have at least one computer for administrative purposes, 28% of schools are using computers or other devices for teaching and learning, and 49% of schools are connected to the internet (Alfreds, 2016). In his speech at the Innovation Africa Summit in Cape Town in 2012, Donald Grant, then Western Cape Minister of Education, revealed a number of strategies that the provincial government planned to ensure the introduction and use of more technology in schools. These strategies comprised:

- providing technology to new schools and upgrading technology at existing schools;

- researching and evaluating the use of e-Education methodologies and cutting-edge technologies;
- training teachers in how to use Information Communication and Technology (ICT);
- sourcing, procuring and provisioning digital resources through multiple access points, and on-going support of e-Education at all schools (Grant, 2012).

The WCED has been involved in many technology-related projects. An example of this was the Khanya Project, launched in 2001 (South Africa. WCED, 2001), which provided technology, such as computer laboratories, to some public schools (Khanya Annual Report, 2008). By 2008, 59% of schools had computer laboratories, 70% of teachers had been trained to use technology for teaching and learning, and 70% of learners had access to technology in their schools (Khanya Annual Report, 2008). At present, the aim of the broadband initiative in the Western Cape is to ensure that all public schools are connected to broadband services (South Africa. Western Cape Government. MyBroadband, 2016). This deployment aims to reduce the socio-economically-driven digital divide by equipping teachers with access to broadband services (Chigona, 2017).

Despite this investment in and commitment to the use of technological equipment, studies conducted in the Western Cape report that many teachers have been reluctant to use technology for curriculum delivery (Chigona & Chigona, 2010; Van Wyk, 2011; Sherman & Howard, 2012; Chigona, 2017). Zhu (2010) notes that although many schools and higher education institutions have invested in technology, some teachers do not use it in their teaching. Mahmood et al.'s (2014) study conducted in Malaysia reveals that technology was not used by teachers despite its availability, while other studies have reported that teachers used technology mainly for administrative purposes (Ndibalema, 2014; Bozdoğan & Ӧzen 2014; Chigona, 2017). These teachers used Microsoft Word to type reports and letters, and Excel sheets to enter learners' assessment scores (Chigona, 2017). The under-utilisation of technology was earlier described by Cuban (2001, cited in Petko, 2012), who observed that policymakers had focused on providing technological equipment to schools rather than on ensuring its useful employment in the classroom.

Though Cuban was describing the situation regarding technology in 2001, in the Western Cape today some teachers remain reluctant or unable to use technology. In some cases, this is despite the availability and accessibility of technology for teaching and learning at their schools

(Chigona & Chigona, 2010; Sherman & Howard, 2012; Chigona, 2017). Vrasidas (2015) agrees with Hennessy et al. (2010) that there is a common misconception that the mere availability of technology in schools is sufficient to persuade teachers to adopt and use it for curriculum delivery. Evidence shows that teachers, in many cases digital immigrants, are reluctant to use technology because of a variety of factors:

- lack of self-efficacy;
- lack of time;
- teachers' age;
- lack of interest from school principals;
- lack of professional development training;
- lack of hardware and software programs;
- electricity shortages;
- lack of competence; and
- a lack of technical support.

(Gode, Obegi & Macharia, 2014; Mathipa & Mukhari, 2014; Vrasidas, 2015; Nikolopoulou & Gialamas, 2016; Khodabandelou et al., 2016; Al-Awidi & Aldhafeeri, 2017).

According to Chigona (2015:488), "failing to integrate technology in the digital natives' classroom means that teachers and learners are not speaking the same language", which may mean that knowledge acquisition does not take place as quickly and as authentically as it might. This research project aims to identify what factors obstruct the integration of technology. In this sense, this study informs the WCED about the factors that influence NQTs to integrate technology into their pedagogical practice, so that when formulating technology-training programmes they will be able to recognise such factors and be in a better position to address them.

The teachers in this study graduated from a Teacher Education Institution (TEI) in the Western Cape in 2013. These teachers had four years of undergraduate experience, which included training in the use of technology for teaching and learning. The teachers had completed technology workshops, technology projects, assignments and presentations, using technological equipment. They were exposed to, and had experience in using technology for teaching and learning. They were expected to teach with technology during their professional

practice, as long as equipment was available, maintained, up-to-date, safeguarded and accessible in the schools to which they were first appointed.

NQTs are expected to use technology in their teaching since they have been trained in the 21st century, an age of information technology. It is generally believed that these teachers should be competent, comfortable and confident in their use of technology. Existing research (Andersson, 2006; Bozkurt & Ruthven, 2015) shows that some NQTs are interested in using technology and do use technology with confidence for a variety of purposes in their classrooms, having acquired the skills to do so during pre-service training. Such teachers use technology, for example, to search for up-to-date subject material and information. However, other studies report that many NQTs are reluctant to use technology, some of them integrating technology into their teaching but in a teacher-centred way that might have little impact on their learners (Gao et al., 2011; Ottenbreit-Letwich et al., 2010). Research has shown that when NQTs are faced with the school environment for the first time, they can experience 'reality shock' (Harju & Niemi, 2016). Russell et al. (2003) agree that the first few years of teaching can be particularly challenging, since teachers have to develop behaviour management techniques, become familiar with the curriculum, adapt to the new school culture, and become familiar with assessment systems. All these challenges may render the use of technology for teaching and learning more demanding. Espino (2012) and Elstad and Christopherson (2017) observe that teachers' first experiences in the school environment can be stressful, in terms of work overload and extra-curricular responsibilities. Teachers might not have the time to engage with technology because of their already demanding workload (Gode et al., 2014; Sulungai, Toili & Amadalo, 2012; Ahmad, 2014). In this study, the research aims to explore factors influencing NQTs' use or neglect of technology in their teaching, as well as the question of *why* NQTs use technology in their teaching and learning.

Though factors that influenced teachers to use technology had been extensively investigated, aforementioned studies have revealed that NQTs were reluctant to integrate technology into their professional practice. This study is unique as it was conducted with NQTs in the Western Cape, who had less than three years of teaching experience and who had been trained to use technology during their pre-service training. It was believed by the researcher, that these teachers were skilled in the use of technology. It interested her to follow-up these teachers with the hope of unravelling new factors that may have influenced them to use technology in their classrooms. These teachers had all received the same training but now they were teaching in

fee-paying schools with an abundance of technological resources, and no fee-paying schools with inadequate or no technological resources.

1.3 RESEARCH QUESTIONS AND OBJECTIVES OF THE STUDY

The question informing the current investigation is as follows:

> What factors influence NQTs ability to integrate technology into their pedagogical practice?

The investigation addresses the following sub-question:

> Why are NQTs integrating technology into their pedagogical practice?

The objectives of this study include:

- To identify and explore factors that influence NQTs' use of technology in their pedagogical practice within the Western Cape, SA;
- To discover, and give an account, of *why* NQTs use technology for curriculum delivery; and
- To develop a model, based on the findings, of how teachers in this current study can be guided to acquire the knowledge and skills needed for effective teaching with technology.

1.4 ASSUMPTIONS OF THE STUDY

This study makes the following assumptions:

- The availability of technology in schools determines NQTs' use of technology for their teaching and learning;
- NQTs are using a variety of technologies in their teaching and learning;
- NQTs are not pressured by their schools, but voluntarily use technology because of its benefits to their teaching and learning; and
- NQTs use technology innovatively with learner-centred strategies in their classrooms.

1.5 SIGNIFICANCE AND CONTRIBUTION OF THE STUDY

It has been established that many teachers are unable to deploy technology because it is unavailable, while some teachers who do have access to technology remain reluctant to incorporate it in their teaching and learning (Chigona & Chigona, 2010; Sherman & Howard, 2012), while nonetheless making use of it for administrative purposes (Chigona, 2017). With the increased financial investment on the part of the WCED in providing technological equipment to schools, and given the fact that teachers need to stay relevant in the classroom through the regular use of new technology, it is important to ascertain the factors that influence NQTs to use or neglect technology in order to inform the WCED of these factors. Furnished with this information, the WCED will be better placed to formulate technology programmes to encourage more teachers to effectively use technology in their teaching.

Bytheway, Sadeck, Dumas, Chigona, Chigona, Mooketsi, Rega and Fanni (2010) state that many schools are yet to realise the effective use of technology, meaning that widespread practical implementation of technology in the classroom has not yet occurred. Zhou et al. (2017) as well as Al-Awidi and Aldhafeeri (2017) studies have shown, that teachers' pedagogical practices; included teacher-centred use of technology in a traditional way, which may not have enhanced cognitive learning. Conversely, other researchers have suggested that blended teaching with technology may enhance learning as learners explore, experiment and learn in a creative environment under the guidance of the teacher (Kucharcikova & Tokarcikova, 2016; Al-Awidi & Aldhafeeri, 2017). The teachers in these settings have incorporated independent and collaborative practices to enhance teaching and learning as their learners took active responsibility for their own learning during lessons in which technology was used. According to Obiri-Yeboah, Kwarteng and Kyere-Djan (2013), Blackwell et al. (2014) and Quarles et al. (2015), if schools possess technology equipment, it is critical to guide teachers in the effective use of technology during curriculum delivery. This study hopes to contribute to the field of Education methodology and integration of technology by developing a model, which could be used to develop NQTs in this study, knowledge and skills needed for effective teaching with technology.

1.6 CLARIFICATION OF CONCEPTS AND TERMS

The following terms are explained to ensure a shared understanding of how they have been used in this study:

1.6.1 Technology

According to Koehler et al. (2013), technology encompasses digital as well as less recent technologies. Al-Faki and Khamis (2014) clarify this by stating that technology refers to hardware and software used in education settings to enhance teaching and learning. Examples include interactive white boards, computers, Internet, WiFi, laptops, podcasting, e-Learning platforms and photostory (Al-Faki & Khamis, 2014; Goyal et al., 2010; Kotrlik & Redmann, 2009). In this study, 'technology' is used as an umbrella term to denote technological hardware and software that teachers use in their classrooms to enhance teaching and learning.

1.6.2 Technology use

According to Olofsson et al. (2011), 'uptake', 'adoption' and 'use' are vague terms that are not rigorously defined in the literature. In this study, technology 'use' indicates teachers' actual application and integration of technology to achieve specific learning outcomes (Chigona et al., 2010; Vrasidas, 2015).

1.6.3 Pedagogical tools

To define 'pedagogical tools', it is important to define 'pedagogical knowledge' (PK) which "is the set of skills that teachers must develop in order to manage and organise teaching and learning activities for intended learning outcomes" (Koehler et al., 2013:3). From this definition, it may be deduced that the phrase 'pedagogical tools' refers to technological equipment that teachers use in the classroom in order to achieve a lesson outcome.

1.6.4 Digital natives and digital immigrants

Prensky (2001:1) coined the term "digital natives" to refer to younger generations who have grown up with technology such as computers, video games and the Internet. As suggested above, in this study the term "digital natives" refers to younger teachers as well as learners who have grown up with technology and find it comparatively easy to learn how to use a particular form of technology. "Digital immigrants" are older teachers, born before the advent of the new technology and not trained to use it in teaching and learning.

1.6.5 Quintiles: fee-paying and no-fee-paying schools

Schools in SA are classified using the 'quintile system'. The poorest schools (no-fee-paying schools) are in quintile one and the wealthiest schools are in quintile five (fee-paying schools). The poorest schools receive up to six times more funding than the wealthiest schools (South Africa. WCED, 2007). Parents of learners in quintile one, two and three schools do not have to pay fees. Quintiles four and five comprise fee-paying schools. The ranking considers the surrounding community and infrastructure. Quintile one, two and three schools are likely to lack technological resources to aid teaching and learning because the school community is unable to afford them. These schools largely depend upon the government for funds to acquire resources.

1.6.6 Newly Qualified Teachers (NQTs)

The terms 'beginning teachers', 'novice teachers' and 'NQTs' have often been used vaguely to mean teachers with little or no experience in teaching. According to Kim and Roth (2011:4), a novice teacher has "less than five years of teaching experience". In this study, 'NQTs' refers to qualified teachers with less than three years of professional practice.

1.6.7 Blended learning

Procter (2003:1) defines blended learning as "an effective combination of modes of delivery, models of teaching and styles of learning". Blended learning occurs when an educator deliberately combines different instructional methods and tools, in order to achieve curriculum goals. The term 'blended learning', as used in this study, refers to contexts in which NQTs thoughtfully combine technology, pedagogy and content knowledge during curriculum delivery. In a blended learning environment, learners take responsibility for their own learning by creating new technological projects, while their teacher guides the learning process. This method of teaching grants control to learners as they are given the opportunity to develop their projects both at school and at home.

1.6.8 NQTs ability

The word 'ability' has generally been used to mean someone's capability to do something. Teacher's ability refers to their skills to effectively integrate technology during curriculum delivery (Ilomäki et al., 2011). In this study, when discussing NQTs ability to use technology,

the researcher focuses on teachers' actual knowledge, competence and confidence to exploit the available technological resources for teaching and learning.

1.7 THE APPROACH TO THE STUDY

This is a qualitative study set within an interpretive paradigm. The interpretive paradigm influenced the choice of instruments used to collect data. The researcher used an online survey to collect data pertaining to teachers' perceptions of factors that influenced them to use technology. The aim of using an online survey was to gain an overall picture of the phenomenon under study, as well as to identify participants for the one-on-one interviews and classroom observations that comprised the core methods of data generation.

The sample consisted of Intermediate Phase (IP) teachers teaching at schools in the Western Cape, SA. The sample was purposively selected on the grounds of having had some teaching experience, and having been exposed to the use of technology for teaching and learning during their four-year training at a TEI. These teachers were knowledgeable about the topic under study. All the teachers who participated voluntarily agreed to be part of the study. Out of 94 teachers recruited, 74 responded to the online survey, 10 agreed to be interviewed one-on-one, and six were observed in their classrooms while using technology in their teaching. Concepts derived from the conceptual framework guided the researcher when identifying categories in relation to the research questions, resulting in deductive analysis. The researcher remained receptive to emerging themes that assisted in answering the research questions, but were not necessarily linked to the conceptual framework or literature. When reporting on the findings in Chapters 5 and 6, the researcher synthesises information from the online survey, one-on-one interviews and classroom observations and reports it thematically in relation to the research questions. Holliday (2007:93) notes that "taking a purely thematic approach, in which data is taken holistically and rearranged under themes which emerge as running through its totality, is the classic way to maintain the principle of emergence". With thematic analysis, the researcher organised and described factors that influenced NQTs to use technology, and broached the question of *why* they used technology in their teaching.

To achieve trustworthiness, all transcribed interviews were returned to the teachers for feedback. Nine teachers were satisfied with their transcripts and asked the researcher to continue with the information provided, while one teacher made minor grammatical and semantic changes. By using three instruments, online survey, interviews and observation

schedules, the researcher was able to triangulate the information and confirm data sources. This section would be further discussed in Chapter 4.

Permission to conduct this research was received from the University Ethics Committee (Appendix A). Two letters of permission were received from the WCED, the second extending the time for the researcher to work in their schools (Appendices B and C). Teachers were approached and asked to participate in this study (Appendix D), and they signed a consent letter agreeing to be part of the study. In the consent letter, teachers were informed of their rights in participating, all details of the research were explained, and confidentiality was assured. No teacher was coerced into taking part in this study.

1.8 LIMITATIONS AND CHALLENGES OF THE STUDY

This study was limited by the small size of the sample. The sample for this study consisted of IP NQTs only, who graduated from a TEI in 2013. Only 94 NQTs who began their teaching career in 2014 were contacted and invited to be part of this study.

This study was limited to NQTs' use of technology in their classrooms. The researcher was not interested in data on how teachers prepared at home to teach with technology. The focus was on how teachers blended technology, pedagogy and content while they taught in their classrooms with technology.

The data generation of this study was limited to the period August 2014 to September 2015 because the budget to conduct research was limited. The researcher was funded by the NRF; she had to complete her studies within a stipulated timeframe.

The online survey and interviews were all conducted in English. This may be a limitation as the majority of the participants, in this study, spoke English as a Second Language and may not have understood certain terminology in the online survey.

The process of collecting data was a challenge in some respects. It was difficult to persuade teachers to take part in the study since most of them indicated that they would not benefit from it. Only six teachers agreed to be observed in their classrooms using technology in their teaching. The teachers were more willing to be interviewed than to be observed: the reason for this could be that they were afraid of being judged since they were NQTs and perhaps not yet confident about their classroom management and teaching strategies. Four teachers chose to withdraw from the study rather than be observed using technology in their classrooms.

When the researcher called teachers to book an appointment for classroom observation, three of them indicated that they would call the next day to give a date but did not. This delayed the process of collecting data. Two teachers experienced personal problems, which obliged them to cancel scheduled appointments for interviews and classroom observations. This circumstance impacted on the study since the researcher had to extend the duration of her data generation (Appendix C).

No-fee-paying schools lacked infrastructures to support the use of technology. They lacked both basic and sophisticated technology. In some scenarios these no-fee-paying schools lacked simple cables and plugs to connect computers. As a result, the teachers sometimes used their own equipment, which did not always work. This difficulty delayed the process of collecting data because lessons had to be postponed.

1.9 OUTLINE OF THE STUDY

This study is divided into seven chapters.

Chapter One introduces the study, discusses its rationale and context, outlines the research questions and objectives, sets out the assumptions, significance and contribution to knowledge, clarifies concepts and terms used, briefly discusses the research approach employed, describes the limitations of the study and the challenges the researcher faced during data generation, and outlines the project as a whole.

Chapter Two clarifies the conceptual framework that underpins the study. The chapter provides a justification for the two theoretical frameworks that guided the research. The researcher first discusses the TPACK and UTAUT2 models, and then the conceptual framework.

Chapter Three focuses upon related and relevant literature pertaining to those factors that enable or obstruct teachers' use of technology.

Chapter Four describes the research methodology in more detail, and includes discussion of research methods and data analysis procedures, trustworthiness, and ethical considerations.

Chapter Five presents and discusses the findings regarding factors that influenced NQTs' ability to integrate technology into their pedagogical practice.

Chapter Six presents the findings in respect of *why* NQTs used technology in their classrooms. The researcher introduces a model for how teachers could acquire the knowledge and skills needed for effective teaching with technology.

Chapter Seven is titled Conclusions and Recommendations. It draws conclusions from the discussion in Chapters 5 and 6. Recommendations are made pertaining to policy, practice and for future research.

CHAPTER TWO

CONCEPTUAL FRAMEWORK

2.1 INTRODUCTION

The aim of this study is to identify and explain the factors that govern NQTs' ability to integrate technology into their teaching. To achieve this aim, the research is theoretically grounded upon a synthesis of two systems: the Technology, Pedagogical, and Content Knowledge [TPACK] (Mishra & Koehler, 2006) and the Unified Theory of Acceptance and Use of Technology2 [UTAUT2] **(**Venkatesh et al., 2012).

The TPACK model is used to ascertain the knowledge required for effective teaching with technology. For teachers to teach effectively with technology, they need to be able to integrate or blend technology, pedagogy and content knowledge (Mishra & Koehler, 2006). Using TPACK, the researcher interviewed teachers to establish what pedagogical issues facilitated or impeded their deployment of technology in the classroom.

TPACK does not provide insight into ambient social factors that enable or disable a prospective user from embracing new technology and integrating it into lesson plans. The researcher therefore used the UTAUT2 model as a complementary structure to TPACK. By synthesising the TPACK and UTAUT2 models, it was possible to create a viable basis on which to conduct an empirical study; drawing upon both analytical and socially responsive aspects of the identified area of concern to ask the central question of the thesis: what factors enable or disable teachers' attempts to integrate or blend technology with their daily lesson plans? The synthesis of two already recognised systems created a dependable framework within which to review relevant literature, design data generation instruments, and to collect and analyse appropriate data.

This chapter is organised as follows:

Section 2.2 discusses the nature, applications and uses of the TPACK model;

Section 2.3 shows in what ways the UTAUT2 model can supplement the TPACK model;

Section 2.4 demonstrates how a conceptual framework emerges from a synthesis of the TPACK and UTAUT2 models; and

Section 2.5 summarises Chapter Two.

2.2 TECHNOLOGY PEDAGOGICAL CONTENT KNOWLEDGE (TPACK)

TPACK is a model that sets out the nature, forms and types of knowledge that teachers need to integrate technology successfully into their daily practice (Mishra & Koehler, 2006). TPACK builds upon and extends Shulman's (1986; 1987) theory of Pedagogical Content Knowledge (PCK) (1987:8) which:

> … identifies the distinctive bodies of knowledge for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction.

Mishra and Koehler (2006) contend that when Shulman made his arguments for PCK, technology was not as widespread or fully assimilated into the social, industrial, communicative and psychological aspects of human activities, as it is today. With increased dependence upon technology at all levels of human transaction and interaction in the 21st century, it has become clear that learners respond better to, anticipate and are in some senses programmed for the use of technological hardware and software at home, in school and among themselves. Education has to recognise this fundamental shift in communication world-wide by adapting teaching to learners who are increasingly techno-savvy and techno-dependent; learners who expect to receive information in a technologically-based format.

Shulman's initial conceptualisation of PCK had to be updated to include technology knowledge (Angeli & Valanides, 2009). Mishra and Koehler (2006) broadened the parameters of PCK to form the new term TPACK. According to Mishra and Koehler (2006), for teachers to integrate technology into their teaching effectively, there should be interplay among seven domains: Content Knowledge (CK); Pedagogical Knowledge (PK); Pedagogical Content Knowledge (PCK); Technological Knowledge (TK); Technological Content Knowledge (TCK); Technology Pedagogical Knowledge (TPK) and Technology Pedagogical Content Knowledge (TPACK).

These seven domains are discussed briefly in the following section in order to provide a general understanding of the TPACK model.

2.2.1 Content Knowledge (CK)

CK refers to subject matter within a given field (Cox & Graham, 2009; Koehler et al., 2013), such as teachers' knowledge of topics in Science or Mathematics. Harris, Mishra and Koehler (2009) explain that it is important for teachers to understand the content of the subject they are teaching because each subject has its own specific mode of knowledge. In this research investigation, issues such as curriculum knowledge and teachers' confidence in introducing technology were more easily comprehensible in terms of the CK concept.

2.2.2 Pedagogical Knowledge (PK)

Mishra and Koehler (2006) and Cox and Graham (2009) define PK as strategies or methods teachers use in their classrooms when teaching specific subject matter. PK involves techniques or methods of teaching, as well as teachers' understanding of their learners' academic abilities, and the strategies they use to evaluate learners' understanding of the material taught (Mishra & Koehler, 2006). Mishra and Koehler report that a teacher with deep PK understands how students acquire, construct and come to own knowledge, and this profoundly shapes the way in which he or she envisages, structures and presents a particular lesson. In this study, the strategies and activities utilised by teachers in their classrooms were observed in the light of PK.

2.2.3 Pedagogical Content Knowledge (PCK)

Mishra and Koehler (2006:1027) define PCK as:

> … the ability of a teacher to know what teaching approaches fit a content and also knowing how elements of the content can be arranged for better understanding of learners. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding.

According to Shulman (1986; 1987), PCK is a critical skill which distinguishes expert teachers in a subject area from subject area experts. Shulman avers that it is not enough for teachers to know the subject matter and be acquainted with teaching strategies: they must know how to teach subject matter by using a range of different pedagogical strategies, and be able to assess which among them is the most effective. This is what renders PCK a distinctive body of

knowledge. This study sought to determine whether or how teachers used different pedagogical strategies to enhance their learners' understanding of the content.

2.2.4 Technology Knowledge (TK)

Compared to content and pedagogical knowledge, TK is in a state of constant flux, always changing in nature, application and structure (Harris et al., 2009). Harris states that the pace of technological development is so rapid worldwide that any definition of technology knowledge is in danger of becoming outdated or obsolete almost as quickly as it is put into words (Mishra & Koehler, 2009). Cox and Graham (2009) and Pamuk (2012) refer to TK as teachers' ability to blend education and technology in the modern classroom. The researcher investigated how and *why* teachers selected and used a range of technologies for their teaching and learning, or were prevented from doing so.

2.2.5 Technology Content Knowledge (TCK)

Mishra and Koehler (2006) and Harris et al. (2009) explain that content and technology are often conceptualised separately because technologists develop technology equipment and content experts develop curricula. It is often challenging for teachers to blend technology and content in the classroom (Cox & Graham, 2009). According to Mishra and Koehler (2006), teachers need to know the subject matter they teach thoroughly as well as which aspects of the subject matter can best be taught using technology. For example, learners can learn about the relations between geometric shapes and angles by touching and playing with these concepts on the screens of portable devices (Koehler et al., 2013). In engaging with the TCK concept, the researcher focused upon the hardware and software that teachers used to teach specific topics, and how their use of this technology aided learners' understanding.

2.2.6 Technology Pedagogical Knowledge (TPK)

TPK describes the relation between technology and pedagogy (Koehler et al., 2013) and denotes all pedagogical activities using technology in the classroom (Cox & Graham, 2009). For instance, teachers can use technology to motivate learners in their classrooms to learn subject matter more quickly, easily and permanently (Cox & Graham, 2009). Of particular relevance to this study was how teachers used technology in pedagogical activities designed to motivate learners in the classroom.

2.2.7 Technological Pedagogical and Content Knowledge (TPACK)

TPACK is a dynamic framework for understanding the modes, types and nature of knowledge needed for effective teaching with technology. Mishra and Koehler (2006) argue that effective teaching should exhibit an interplay among three dominant fields of knowledge: technology, pedagogy and content. Thompson and Mishra (2007:38) describe the comprehension of all three areas of learning as the "Total PACKage" required for improving teaching and learning. Koehler et al. (2013) agree that successfully integrated or blended teaching comprises interaction among content, pedagogy and technology. According to Harris et al. (2009), TPACK is a mechanism for identifying, locating and typifying professional knowledge, whether technological, pedagogical or curriculum-oriented, that skilled teachers use when they teach. The effective classroom blending of technology is significantly more complex than knowledge of the technology itself (Earle, 2002, in Harris & Hofer, 2011). Blended teaching demands that the teacher adapt technology, whether in the form of a visual presentation, interlinked laptops or wide-screen viewing, to elements such as a thorough knowledge of content, effective instructional practice, sensitivity to the religious, socio-economic and linguistic characteristics of individual learners, and the social environment and community surrounding a school. Mishra and Koehler (2006:1029) define TPACK as:

> … the basis of good teaching with technology [that] requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.

Other studies define TPACK as the integration of subject matter knowledge, technological knowledge and knowledge of teaching and learning (Niess, 2005); and the blend of technology, pedagogical and content knowledge with a focus upon how technology can uniquely be made to meet the pedagogical needs of teachers (Koehler et al., 2013). Angeli and Valanides (2009) conclude that all existing views on TPACK share the principle that effective teaching with technology requires a blend of technology, pedagogy and content. In this study, the researcher sought to determine whether or how teachers were able to employ some variant of technology within constructive or learner-centred activities so that learners could more easily and permanently acquire, construct and own new knowledge in an authentic and enduring way.

TPACK is diagrammatically represented below.

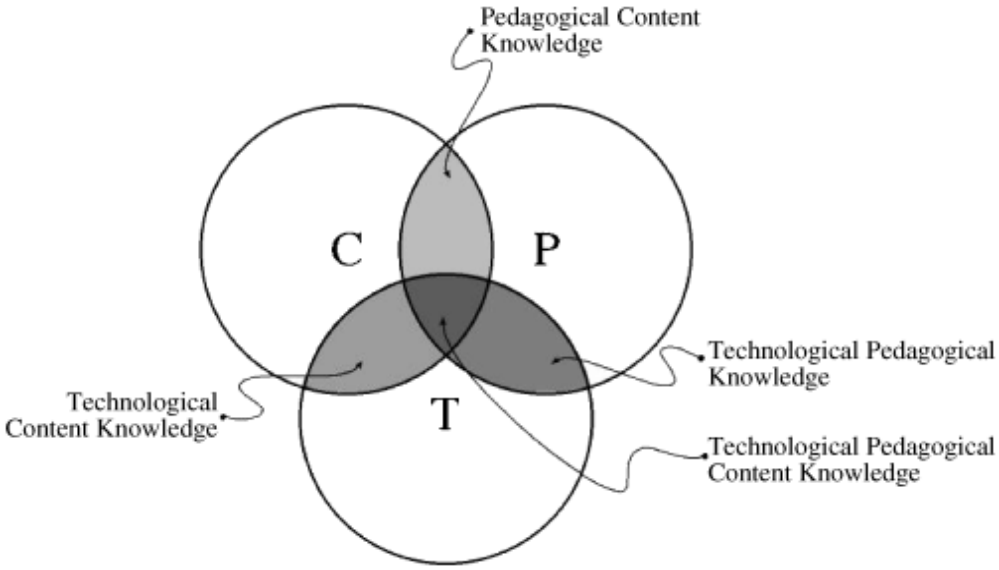

Figure 2.1: TPACK model (Mishra & Koehler, 2006:1025)

As illustrated in Figure 2.1, TK, PK and CK intersect and overlap in the form of TPACK.

A synthesis of the complementary systems TPACK and UTAUT2 formed a viable and dependable framework within which to discuss and arrange the literature review, the data generation and interpretation, and the analysis of factors influencing teachers' ability to integrate technology into their teaching. Some questions in the online survey (Appendix G), interview (Appendix H) and observation schedules (Appendix I) were framed around concepts from the TPACK model. But because TPACK did not comprehensively explain ambient social factors that significantly impact upon teachers' readiness to blend technology into their daily lesson plans, the UTAUT2 was used to provide a third dimension to complement the analytical aspects of the TPACK model.

2.3 THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY2 (UTAUT2)

The UTAUT2 model (Appendix M) was developed by Venkatesh et al. (2012) to assess and predict users' acceptance of, readiness to deploy, and ability to integrate technology. UTAUT2 builds upon the antecedent model UTAUT (Venkatesh et al., 2003). The UTAUT model (Appendix L) consolidates eight technology acceptance models to measure, account for and interpret an organisation's acceptance of, and ability to introduce and integrate technology. These eight models include Theory of Reasoned Action [TRA] (Ajzen & Fishbein, 1980);

Technology Acceptance Model [TAM] (Davis, 1989); Motivational Model [MM] (Davis et al., 1989); Theory of Planned Behaviour [TPB] (Ajzen, 1991); Combined Theory of Planned Behaviour/Technology Acceptance Model [C-TPB-TAM] (Taylor & Todd, 1995); Model of Personal Computer Utilisation [MPCU] (Thompson et al., 1991); Innovations Diffusion Theory [IDT] (Rogers, 1995); and Social Cognitive Theory [SCT] (Bandura, 1986).

In the UTAUT model, Venkatesh et al. (2003) named four key constructs that could influence behavioural intention with respect to the use of technology: 'performance expectancy', 'effort expectancy', 'social influence' and 'facilitating conditions'. But these constructs do not comprehensively explain factors that influence the use of technology in a consumer context. Venkatesh et al. (2012) extended the UTAUT model to include three new constructs: 'hedonic motivation', 'price value' and 'habit'. The new model was designated UTAUT2. The selection of UTAUT2 for the current study is justified in so far as it provides insight into factors that cannot be identified by TPACK on its own.

The following sections define the seven constructs embodied in the UTAUT2 model.

2.3.1 Performance expectancy

Performance expectancy is defined as "the degree to which using a technology will provide benefits to consumers in performing certain activities" (Venkatesh et al., 2012:159). Venkatesh et al. (2003:447) previously characterised performance expectancy as "the degree to which an individual believes that using a system will help them to attain gains in job performance". In the context of education, Lewis et al. (2013) explain that performance expectancy is the degree to which an instructor believes that existing and emerging technology improves job performance. In line with these definitions, issues relating to the usefulness of technology for teaching and learning were examined during the one-on-one interviews.

2.3.2 Effort expectancy

Venkatesh et al. (2003:450) define effort expectancy as "the degree of ease associated with the use of a system". In the context of education, Lewis et al. (2013) refer to effort expectancy as the degree to which lecturers perceive technology use to be free of effort. These definitions are similar to Davis's technology integration theory (1989:320) of "perceived ease of use". Davis defines "perceived ease of use" as "the degree to which a person believes that using a particular system would be free of effort". According to Venkatesh et al. (2012), effort expectancy is a

significant predictor of a user's intention to use technology. The less effort is required to utilise technology, the more likely is the user to use it. In relation to this concept, during the one-on-one interviews, teachers' competence and confidence in using technology were assessed.

2.3.3 Social influence

According to Khechine et al. (2014), there is more likelihood of people using technology if they are supported by their friends, family, teachers and peers. In an earlier study, social influence was defined as "the extent to which consumers perceive the importance of others who believe they should use a particular technology" (Venkatesh et al., 2012:159). In an education context, Lewis et al. (2013) refer to social influence as the degree to which, for instance, deans of faculty expect members of faculty to make use of or fully blend technology in their teaching. In the terms of this study, Lewis's definition refers to the extent to which principals of schools, for instance, expect and support teachers to make use of, be familiar with, integrate or blend technology into their daily lesson plans, activities and learning schedules.

2.3.4 Facilitating conditions

Teachers are encouraged by the fact that the WCED provides technology for them to integrate into their teaching (NDoE, 2004). Venkatesh et al. (2003:453) refer to facilitating conditions as "the degree to which an individual believes that an organisation or technical infrastructure exists to support the use of a system". In an education context, Lewis et al. (2013) define facilitating conditions as the extent to which a faculty member believes there is sufficient technical infrastructure at the school to support the integration of new technology. In this study the existence, availability and condition of technology resources at selected schools were identified as potential motivating factors in their effective integration into the classroom.

2.3.5 Hedonic motivation

Hedonic motivation is defined by Venkatesh et al. (2012:161) as "the fun or pleasure derived from using a technology": a consumer is more inclined and likely to purchase and employ new technology if the consumer has enjoyed using it on trial, through accidental exposure or in the course of employment. Indrawati and Haryoto (2015) detect a positive relation between hedonic motivation and users' decision to buy, adapt and use technology. Participants in their study averred that television streaming was primarily associated with fun, since it provided entertainment that afforded viewers pleasure. Yang's study (2013) claims that hedonic

motivation is the most significant factor in undergraduate students' use of mobile learning. Students in Yang's study were entertained while using mobile technology because of its features, such as 'chatting' software. Yang's observation was linked to the interviews conducted during the course of this study: teachers were probed about whether they derived personal satisfaction and enjoyment from using technology.

2.3.6 Price value

Ventekash et al. (2012:161) define price value as "consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost of using them". Price value is the cost that a consumer incurs while using technology. Teachers were asked whether they incurred personal costs while using technology in their classroom.

2.3.7 Habit

Limayem et al. (2007:709) conceive of the term 'habit' to associate existing familiarity with technology and use: "people automatically will use technology because of prior learning". This view confirms the argument of Venkatesh et al. (2012). In this study, the concept of 'habit' is linked to teachers' spontaneous use of technology as a result of their past experiences. Habit was relevant to this study in that the term conditioned understanding of the extent to which teachers' past exposure to different forms of technology influenced them to use technology.

2.4 CONCEPTUAL FRAMEWORK: TPACK AND UTAUT2 MODELS

This study is based upon a unique theoretical synthesis of the TPACK (Mishra & Koehler, 2006) and UTAUT2 (Venkatesh et al., 2012) models. The central concepts from TPACK and UTAUT2 were melded to form a mechanism for observing, characterising and discussing factors that influenced NQTs' ability to integrate technology into their lesson plans and daily teaching. The rationale for adapting both models to generate a conceptual framework was that the TPACK model did not take into account certain social factors that would generally influence someone to use technology. The researcher thus made use of the UTAUT2 model (Venkatesh et al., 2012) in order to add depth to the analysis. Venkatesh et al.'s (2012) empirical study suggested seven factors that influence an individual to use technology. These factors are:

1. Performance expectancy;
2. Effort expectancy;
3. Social influence;

4. Facilitating conditions;
5. Hedonic motivations;
6. Price value; and
7. Habit.

The following table summarises the variables derived from the conceptual framework to explore factors that influenced NQTs' ability to integrate or blend technology into their teaching. The table is effectively a summary of the applicability of the TPACK and UTAUT2 models.

Table 2.1: Applicability of the TPACK and the UTAUT2 models

Constructs (TPACK and UTAUT2 Models)	**Applicability to this study**
Content knowledge	Teachers' knowledge of the curriculum and confidence to teach the curriculum.
Technology knowledge	Teachers' technology ability or competence.
Pedagogical knowledge	Pedagogical techniques teachers use in their classrooms.
Pedagogical content knowledge	Different teaching strategies teachers use to teach subject matter in order to enhance learners' understanding of content.
Technology content knowledge	Blending of content and technology, e.g. using software applications to teach specific subject matter.
Technology pedagogical knowledge	Pedagogical activities teachers engage with when teaching with technology.
TPACK knowledge	Teachers' ability to engage learners in constructive or learner-centred activities when they use technology.
Performance expectancy	Teachers' use of technology because of its benefits to teaching and learning.
Effort expectancy	Teachers' use of technology depends upon the effort required to use or to learn how to use it.
Social influence	Teachers' use of technology because of the influence or support from other people.
Facilitating conditions	Teachers' use of technology because of enabling factors such as resources which are in place at their schools.
Hedonic motivations	Teachers' use of technology in their classrooms because of internal satisfaction.
Price value	Price value is the cost incurred for using technological equipment.
Habit	Teachers' past experience will encourage them to use technology in their classrooms.

The combination of variables from the two complementary models, TPACK and UTAUT2, provided a unique, efficient and verifiable means of identifying, interpreting and analysing factors that govern NQTs' ability to integrate technology into their classrooms. By synthesising variables from TPACK and UTAUT2, the researcher discovered, formulated and tested a way of investigating factors that govern NQTs' ability and preparedness to implement technology in their teaching practice.

2.5 SUMMARY OF CHAPTER TWO

This chapter sets out the synthesis and significance of TPACK and UTAUT2 as a verifiable, consistent and effective conceptual framework for key dimensions of this study: searching for literature, designing the data generation instruments, interpreting and analysing data.

In Chapter Three academic sources germane to the topic selected are gathered, collated and rigorously compared in terms of (i) the conceptual framework established for the thesis and (ii) the wider ambit of dominant discourses on technology integration in the 21st century classroom.

CHAPTER THREE

LITERATURE REVIEW

3.1 INTRODUCTION

In this chapter academic sources germane to the thesis topic are gathered, collated and rigorously compared in terms of (i) the conceptual framework established for the thesis and (ii) the wider ambit of dominant discourses on technology integration in the 21st century classroom. International literature on the selected topic is gathered and interpreted in terms of local conditions and current research in the area. The critical issue determining the selection of sources was the presence of any information on factors that enhance or impede teachers' ability to integrate technology successfully into their daily lesson plans and overall teaching trajectory.

The aim of reviewing the sources relevant to this topic is to locate the study within the context of a larger body of knowledge, and in this way gain a broader perspective on the issues under scrutiny. In the course of the review, four dominant factors emerged regarding the question of what influenced teachers' effective integration of technology into their teaching and learning. These factors are (i) the usefulness of the technology; (ii) support from individuals such as principals, colleagues and learners; (iii) the availability of infrastructure; and (iv) past experiences.

This chapter is organised as follows:

- Section 3.2 outlines factors that have been identified by researchers as enabling teachers to integrate or blend technology into their teaching;
- Section 3.3 sets out the factors that inhibit teachers' successful assimilation of technology; and
- Section 3.4 provides a summary of the chapter.

3.2 FACTORS THAT ENABLE TEACHERS TO INTEGRATE TECHNOLOGY INTO THEIR TEACHING

Researchers have revealed that teachers will use technology if little effort is required to use it (Goyal et al., 2010; Baz, 2016). According to Martin et al. (2013:135), "if an innovation is too difficult to use, an individual is likely not to use it". Kumar et al. (2008:1131) explain that

teachers' daily activities in schools are tightly scheduled, monitored and often stressful. Teachers have taxing administrative tasks to complete, such as setting and marking examination questions, keeping students' personal data and achievement results up to date, writing reports and preparing daily lesson plans. Hooper and Rieber (1995) claim that teaching is a demanding job: apart from teaching in the classroom, teachers are expected to be managers, psychologists, counsellors, custodians, community ambassadors and entertainers. Technology can assist teachers to complete this complex range of tasks and duties more quickly, reliably and accurately, but teachers are only likely to turn to this assistance if they can access it easily (Sadaf et al., 2011; Govender & Dhurup, 2014; Chigona et al., 2014; Lambić, 2014).

Studies have shown that, given the quantity of work that they are expected to complete each day, teachers are more inclined to use technology in their classrooms if the features are easy to operate and if minimal training is required for the purpose (Aypay et al., 2012; Callum et al., 2014; Chimbo & Tekere, 2014). Technology integration theorists such as Rogers (1995) and Davis (1989) mention that an individual is more likely to use technology if it is not complex, daunting or time-consuming. This is confirmed by Martin and Parker's study (2014), in which it was reported that teachers used virtual classrooms, such as audio chat, text chat, emoticon, Webcam and E-board because the technology was accessible and required minimal training to use. Teachers are mostly prepared to navigate and 'click' for information or when presenting course materials (Baek et al., 2008; Teo et al., 2015; Goyal et al., 2010; Baz, 2016; McGill et al., 2014). Baz's (2016) results indicate that teachers are more motivated to use technology if their learners find the technology easy to use and need minimal support from them.

3.2.1 Usefulness of technology

Teachers are more likely to use technology if it can readily be seen to enhance their teaching and increase their learners' understanding of the subject matter. Studies by Obiri-Yeboah et al. (2013), Chigona et al. (2014) and Blackwell et al. (2014) indicate that teachers come to rely upon technology and integrate it into their tuition habits if it is obviously beneficial to learning. In identifying factors that encourage teachers' use of technology, many educators ranked 'benefits of technology' as the most significant factor (Ertmer et al., 2007; Walker & Shepard, 2011; Kisirkoi, 2015).

In relation to the concept of the 'usefulness' of technology as a factor encouraging teachers' successful deployment, integration and reliance upon technology, four sub-themes will be discussed:

- Multimedia has the potential to capture learners' interest;
- Technology has the potential to save instructional time;
- Technology gives learners their own 'voice'; and
- Teachers use technology to teach abstract or difficult concepts.

3.2.1.1 Multimedia has the potential to capture learners' interest

Multimedia aspects of technology such as animations, audio and video clips, have the potential to capture learners' attention and interest, making lessons enjoyable and entertaining (Carver, 2016; Hsu, 2016; Mtebe et al., 2016). Gilakjani (2013) offers evidence that multimedia captures learners' interest. He found that English First Additional Language (EFAL) learners were more engaged during lessons as a result of attractive pictures, animations and sounds. Dinh (2009) notes that learners from rural communities are especially captivated by the use of multimedia because they are not familiar with the technology; for them technology is something new, exciting and capable of heightening their engagement with content knowledge. Zhou et al. (2017) discuss teachers' introduction of YouTube videos into their lessons, to revise previously taught lessons and to illustrate concepts. The videos were visually appealing and immediately captured the learners' interest; inducing them to participate more actively and intently in class activities, retain information longer and attend class more regularly (Boadu et al., 2014; Kalanzadeh & Valizadeh, 2015; Al-Awidi & Aldhafeeri, 2017). Several studies have demonstrated that when teachers effectively integrate technology into their teaching, learning is enhanced (Kisirkoi, 2015; Clarke & Abbott, 2016).

The inclusive nature of technology encourages teachers to use it for teaching and learning. Mirzajani et al. (2016), Carver (2016), and Khodabandelou et al. (2016) acknowledge that learners have different ways of learning; some are visual, others are auditory, tactile or kinaesthetic. Technology, however, has the potential to cater for varying learning styles (Schrum et al., 2008). This is evident from the study conducted by Boadu et al. (2014), which notes that because some learners did not like reading texts in History, the teachers used videos with animation to cater for them. Since learners retain information in different ways, Boadu et

al. (2014) recommend that teachers adopt instructional strategies involving technology, to cater for all learners in their classrooms and create an inclusive environment.

Similarly, Sabzian and Gilakjani (2013) maintain that technology has the potential to create an inclusive learning environment that engages all students; regardless of their dis/ability, background, and learning style. To model an inclusive environment, teachers in studies by Mueller and Wood (2012) and Clarke and Abbott (2016) assigned their learners tasks involving the use of computer educational programs, but at different levels, according to their academic abilities. Schrum et al. (2008) and Collins and Bronte-Tinkew (2010) state that special programs were installed on computers in their school laboratory, so that learners could select appropriately graded tasks according to their academic abilities. To accommodate the learning needs of both the academically weak and the academically strong, a teacher in Liu's (2016) study used videos that he could pause in order to explain the content to slower learners. In this way, he could make sure that all learners were following the lesson in comprehensible stages. Al-Awidi and Aldhafeeri (2017) note that learners who are academically weak are excited to learn when the teacher uses technology as a pedagogical tool.

Some teachers in Liu's study (2016) used microphones during lessons to cater for learners who had hearing impairments, while Baek et al. (2008) report a teacher's adjusting visual texts on the smart board to accommodate learners who had problems with their eyesight. Technology enables teachers to increase or reduce the font size of texts to improve visual clarity in the presentation of class notes.

Today's learners in more affluent and urban environments tend to be 'digital natives' who expect to be taught with technology: such privileged learners use social media and are fully familiar with the internet and the basic routines of computer use. Teachers need to prepare their lessons accordingly; that is, they need to know about and respect the learning patterns, habits and media exposure of learners as a result of socio-economic and other contexts (Prensky, 2001; 2005). Learners who are already proficient in technology need teachers to recognise and develop their technological skills, in order to sustain their interest. Collins and Bronte-Tinkew (2010), Mueller and Wood (2012) and Eze and Olusola (2013) agree that using ICT in the classroom prepares learners for careers in an increasingly technological world. As Amedzo (2007) observes, a person without technological skills finds it almost impossible to function in the technology-driven society of today.

The increasing penetration of technology in the 21st century means that it is widely used in teaching and learning. For example, in studies by Tong and Trinidad (2005), ChanLin et al. (2006), Chen and Reimer (2009) and Condy et al. (2012), project-based approaches were devised, in terms of which learners were required to select topics that interested them, gather and organise information from the web and other resources, and produce a completed technology-based project. The learners took an active role and were responsible for acquiring their own technological skills.

According to Eze and Olusola (2013), learners enjoy this form of learning as they are able to learn at their own pace. Kucharcikova and Tokarcikova (2016) and Pema et al. (2017) indicate that the style of instruction must change from 'teacher-centred' to 'learner-centred'; in which learners are actively responsible for their own learning. Mai and Hong (2014) describe the range of skills that learners in their study attained when teachers involved them in learner-centred activities as including lifelong learning, teamwork and collaborative skills. Learner-centred strategies, in terms of which learners are actively involved in their own learning, are the most beneficial for their overall development (Al-Awidi & Aldhafeeri, 2017). The constructivist theorist Piaget (1972) believes that learners learn best when they are actively involved in constructing and owning knowledge, while the teacher merely guides the learning process. Table 3.1, below, displays the distinctive principles of constructivist classrooms in contrast to traditional classrooms.

Table 3.1 Summary of constructivist versus traditional classroom principles (adapted from Olusegun, 2015)

Traditional classroom	**Constructivist classroom**
Knowledge exists outside the student	Knowledge exists within the student
Teacher-centred	Student-centred
Passive learners	Active learners
Individual activities	Interactive activities
Competitive	Cooperative
Search for correct answers	No right or wrong answers
Memorization of facts	Conceptual change
Reliance on textbooks	Students construct meanings

3.2.1.2 Technology has the potential to save instructional time

Technology has the potential to save instructional time when it is used to deliver the curriculum (Boadu et al., 2014; Al-Awidi & Aldhafeeri, 2017; Chen & Reimer, 2009; Baek et al., 2008; Lambić, 2014; Liu, 2016). These researchers all indicate that the teachers in their studies preferred to use technology to deliver their lessons because it saved time, as compared with traditional methods of writing notes on the chalk or whiteboard. Studies highlight the benefits for teachers of using technology to deliver their lessons (Mahmood et al., 2014; Kalanzadeh & Valizadeh, 2015): teachers had more time in their classrooms to explain, present and search for information on the subject matter of lessons, guide learners during lessons, attend to the individual needs of learners and cover more content. But a number of researchers (Kalanzadeh and Valizadeh, 2015; Liu, 2016; Zhou et al., 2017; Al-Awidi and Aldhafeeri, 2017) note that some teachers use technology but continue to teach in a traditional way, without involving their learners in classroom activities. The focus of these teachers was on the technology tool alone (Mishra & Koehler, 2006) rather than on the authentic integration of technology to enhance the teaching and learning process.

A study by Martin et al. (2013) reveals that time is saved when teachers re-use technologically-prepared course materials that they have archived. In emphasising the fact that technology saves time, a participant in Baek et al.'s (2008:228) study explained that "once prepared, [teaching material] can be used again and again". Another study reported that teachers used Wimba, a virtual tool, to archive information to which both the teachers and the learners had access (Martin et al., 2013). A South African study conducted by Ng'ambi (2013) made a similar finding. With archived course materials, teachers had access to information at any time and place, which was obviously highly convenient (Kucharcikova & Tokarcikova, 2016; Izmirli & Izmirli, 2015; Pema et al., 2017).

Teachers use technology for assessment because it is easier, faster and saves time (Baek et al., 2008; Goyal et al., 2010; Mwalongo, 2011; Liu, 2011b; Tedla, 2012). Three out of the six teachers interviewed in Martin et al.'s (2013) study indicated that they used virtual classroom software programs because they enabled content to be accessed from anywhere. Feedback was immediate and in 'real-time' (Izmirli & Izmirli, 2015; Zhou et al., 2017). Teachers in Chigona et al.'s (2010) study used a Cami Mathematics software program to do revision and consolidate lessons because the program made assessment easier and faster. Similarly, 91.8% of teachers

acknowledge that technology is an appropriate time-saving tool for the completion of revision exercises (Baz, 2016).

A counter-example is cited in Chen and Reimer's (2009) study, in which teachers maintained that technology was not an efficient tool for assessment. The task was to prepare Grade 12 learners for their final examinations, which were manually tested. All the participants in this study considered technology alone inadequate for preparing students for high-stakes tests. As a result, they used the traditional method of teaching, which they insisted was more effective in preparing their learners for examination.

3.2.1.3 Technology gives learners a voice

Technology can be used as a tool to give learners a voice in the classroom. Tiba et al. (2015) define 'voice' as a situation in which learners are given an opportunity for self-expression. By using online platforms such as Skype, blogs, Google docs and Wiki during teaching, teachers can give learners a 'voice' and an opportunity for self-expression (Ertmer et al., 2012; Collins & Bronte-Tinkew, 2010).

ChanLin et al. (2006) elaborate on the concept of 'voice' by describing how a participant in their study used her own websites to post students' artwork. By doing this, she gave them a voice, and learning was enhanced because students saw their peers' artwork and could improve their own. Similarly, a teacher in an elementary school used her blog to improve her students' literacy levels. As learners wrote of their experiences of a hurricane on the blog, they were given a voice (Glewa & Bogan, 2007). Al-Awidi and Aldhafeeri (2017) report that a teacher used Edmodo (a software application) to post her class materials, interact with her students, and conduct online quizzes. This strategy gave her learners a voice since they were able to share opinions on the subject matter. As distinct from posting learners' tasks online, studies by Dang (2008), Palao et al. (2015) and Baz (2016) found that teachers gave learners a voice by recording their presentations. Learners were encouraged to correct their peers because the entire class watched the recorded lessons and feedback was provided. This reciprocity gave learners the opportunity to listen to their presentations and improve on them.

3.2.1.4 Teachers use technology to teach abstract or difficult concepts

Hibbing and Rankin-Erickson (2003) report that, in their study, pictures helped students to understand subject matter more thoroughly. This finding anticipates Burmark's (2004)

contention that people learn faster and retain information longer when they are taught using images. According to both Hibbing and Rankin-Erickson (2003) and Burmark (2004), digital imagery has the potential to enhance learners' understanding of subject matter because using videos to teach helps create mental images of the material (Kajder & Swenson, 2004; Liu, 2016).

Goyal et al. (2010) reveal that teachers can use technology effectively to teach abstract concepts. Multimedia aspects of technology make abstract concepts more comprehensible and concrete, so enhancing students' learning (Boadu et al., 2014; Kisirkoi, 2015). This finding correlates with that of Kulasekara et al.'s (2011) study on learners' perceptions of using multimedia in mastering abstract concepts in Science. They found that animations helped to clarify learners' misconceptions about bacterial genetics. The learners watched the microbial process 'live', as it were, something not possible using traditional teaching methods. These simulations enabled learners to grasp the microbial processes involved more quickly and clearly. A study by Zhou et al. (2017) used simulation to explain molecular levels in Chemistry. It was difficult for the teacher to explain the concept using traditional teaching approaches since learners needed to see the measurement to determine the pH value of the solution. Zhou et al. (2017) add that the use of video material to portray scientific experiments was important as it visually demonstrated phenomena that students were unable to observe in a traditional classroom. Hands-on activities are still important in the teaching of Science, so Zhou et al. (2017) recommend that teachers make use of both technological and non-technological approaches when teaching Science concepts.

Some concepts are not abstract but are nevertheless difficult to comprehend. The literature shows that teachers are using technology to enhance learners' understanding of challenging subject matter (Perrotta, 2013; Baz, 2016). Mueller and Wood (2012) and Sulungai et al. (2012) acknowledge that Mathematics and Language subjects in particular manifest complex conceptual challenges. A recent empirical study conducted over three years ranked Science and English as the subjects in which teachers most frequently used videos, because some concepts were considered too difficult to explain using verbal promptings alone (Howard et al., 2015). Among many examples is ChanLin et al.'s (2006) study, where a teacher reported that animation on video enhanced learners' understanding of Geometry in Mathematics. Heafner (2004) and Boadu et al. (2014) argue that Social Studies' concepts are complex since the focus is on remote causation and past events. Teachers thus use videos to enhance their learners'

participation in History lessons. Boadu et al. (2014) argue that teaching with videos helps learners to recall historical events more easily and spontaneously; enabling them to debate issues more easily.

In this section, the researcher has reported on the usefulness of using technology for teaching and learning. The focus was on how technology: captures learners' interest, saves instructional time, gives learners 'voice' and teachers use technology to teach abstract and difficult concepts. These findings can be linked to Venketesh et al.'s (2012) concept of 'performance expectancy'. They reported that an individual would use technology if it is beneficial or it eases their daily activities.

3.2.2 Support from other individuals

In this section, the following three themes are discussed in more detail: influence from principals, from colleagues and from learners.

3.2.2.1 Influence from principals

Studies have revealed that support from principals is an enabling factor in teachers' successful integration of technology into teaching and learning processes (Kisirkoi, 2015; Liu, 2016; Francom, 2016). Singh and Muniandi (2012) report that, in their study, the principal supported teachers by circulating important information regarding ICTs. By receiving relevant and up-to-date information from their principals electronically, teachers were encouraged to use technology in their classrooms. This finding is similar to that of Cubukcuoglu (2013), who explains that teachers would more frequently use technology if they were encouraged by their principals; for example, by making ICT facilities available to them. Principals have an important role to play in stimulating teachers to use technology for teaching and learning.

Musarrat et al. (2013), Mahmood et al. (2014) and Mirzajani et al. (2016) found that some principals pressure their teachers to use technology during teaching. But Czerniewicz and Brown (2009) warn that teachers do not use technology effectively if they are forced to do so. Cubukcuoglu (2013) explains that ICT use for teaching could be made obligatory, but recommends that teachers should rather be monitored by the School Management Team (SMT) to determine whether they are effectively integrating technology into their teaching. Cubukcuoglu suggests that while teachers might initially use technology because it is compulsory, they might later come to realise its real benefits. Recent studies conducted by

Mirzajani et al. (2016), Khodabandelou et al. (2016) and Francom (2016) agree that teachers should be trained and monitored by the SMT because, when faced with challenges, they could easily revert to using traditional teaching approaches with which they are comfortable but which are increasingly alien to their techno-savvy learners.

Many studies have shown that a lack of interest on the part of principals negatively affects teachers' use of technology in their classrooms (Raman & Mohamed, 2013; Mathipa & Mukhari, 2014; Nikolopoulou & Gialamas, 2016; Francom, 2016). This is evident in a study conducted by Boadu et al. (2014), where a teacher mentioned that her principal did not procure technology resources because he was not interested in the use of technology for teaching and learning. This principal did not understand why teachers needed to use technology when they could use traditional methods of teaching. Similarly, in Mwalongo's (2011) study, some principals actually prevented teachers from using technological equipment because they were afraid that it could be damaged. Earlier, Totolo's (2009) study found that principals who were not interested in the use of technology for teaching did not send their teachers for professional development training. In sum, studies have shown that when principals are not interested in the use of technology, there was no clear plan to assist teachers to integrate ICT into their teaching (El Semary, 2011; Al-Faki & Khamis, 2014).

3.2.2.2 Influence from colleagues

Several studies have suggested that teachers are more likely to use technology if they are supported by their colleagues (Martin & Parker, 2014; Sulungai et al., 2012; Mirzajani et al., 2016). Eze and Olusoladu (2013) describe teachers as members of a learning community; learning from each other by exchanging ideas. A teacher in Francom's (2016) study indicated that she had learned more from colleagues on how to use technology than from professional development training sessions. She had meetings with colleagues where they shared their experiences and discussed how to use different technology materials. Oncu et al.'s (2008) and Wadmany's (2011) findings corroborate this; indicating that teachers who had training meetings with their colleagues became aware of the benefits of technology for teaching and learning, while being taught how to use the technology. In other studies, colleagues taught teachers how to 'troubleshoot' technical problems (Schrum et al., 2008; Wadmany, 2011; Mai & Hong, 2014). But some technically skilled teachers complained about the loss of teaching time as a result of assisting colleagues (Schrum et al., 2008). These techno-savvy teachers were frustrated as they spent many hours per week helping colleagues with technology-related

queries. Lau and Sim (2008) suggest that schools should provide teachers with technical assistants for support rather than have them rely upon or even exploit colleagues in dealing with technical problems. This assistance might include having a centralised database or ICT network to facilitate the sharing of materials and to post important announcements and events regarding ICT (Lau & Sim, 2008). Dinh (2009) concurs, recommending that teachers, administrators and technical personnel should work together, using online platforms to facilitate dissemination of technological resources. Perrotta (2013) and Farrukh and Singh (2014) maintain that communities of practice are important in building teachers' capacity and in encouraging them to use technology for teaching and learning.

3.2.2.3 Influence from learners

Studies have shown that learners tend to support their teachers' use of technology in the classroom (Dinh, 2009; Martin et al., 2013; Martin & Parker, 2014). According to Chigona et al. (2010), Tong and Trinidad (2005), Liu (2011b) and Mahmood et al. (2014), it is likely that learners will be more knowledgeable about the use of technology than their teachers. These 'digital natives' use technology on a daily basis for communication and entertainment, and can easily learn how to use technology in the classroom. In support of this, El Semary (2011) and Ertmer et al. (2012) report that learners frequently assist teachers who experience technical problems in their classrooms. More recently, 46.7% of teachers in Al-Faki and Khamis's (2014) study agreed that they depended on their students to assist them to solve smart board problems during their teaching.

Several studies report that some teachers are willing to ask for assistance (Schrum et al., 2008; Ale & Chib, 2011; Walker & Shepard, 2011). These teachers prefer to dominate in their classrooms and do not want their authority to be undermined by appearing helpless or incompetent (El Semary, 2011). This authoritarian attitude is apparently common among teachers who are not computer-literate (Ale & Chib, 2011). King and Boyatt (2014:1276) found that colleagues were afraid to say "I don't know" or "I don't understand"; especially if they were senior members of staff. Studies conducted by Martin et al. (2013) and Wang (2017) reached similar conclusions – that teachers were afraid to make mistakes in front of their learners, or for their learners to see that they were incompetent in the use of technology. Kandasamy and Shah (2013) argue that policymakers should equip teachers with a similar level of technological knowledge as that of their students; to prevent them from adopting defensive or even aggressive attitudes.

Chigona (2013), Hoda et al. (2014), and Clarke and Abbott (2016) affirm that learners with high levels of technological expertise often assist their peers during technology projects. Wang (2008) alleges that sometimes learners come to rely upon their peers to do their work for them rather than taking responsibility for their own learning. A study completed by Chigona et al. (2014) reveals that learners who lacked computer skills relied on their teachers for assistance, which made them reluctant to use technology because of the pressure they were under to finish the curriculum within a stipulated time. In this study, teachers spent more time teaching learners how to use technology than they did on teaching content with technology.

Kaleli-Yilmaz (2015) comments that if learners are not competent in the use of technology, teachers' waste valuable instructional time explaining technical issues. In his study, some students had never used a computer, which made it difficult for their teachers to use one in class. A teacher in Hsu's (2016) study faced a similar situation. Learners lacked basic skills: they could not log on to a computer, access files, work and save on Microsoft Word, or edit documents. The research of Palao et al. (2015) obtained a similar result but emphasised that there was a need to explore ways to assist learners during technological projects so that they would not rely so much on teachers.

This section reports on other individuals, as an enabling and disabling factors to teachers use of technology in their classrooms. These individuals were principals, colleagues and learners. The findings are linked to the concept 'social influence' of the UTAUT2 model. According to Ventekesh et al. (2012), people will more easily use technology because of support from other people.

3.2.3 Availability and accessibility of infrastructure

Under this rubric, four sub-themes were identifiable in the literature: availability and accessibility of technological hardware, software programs, technical support, and ICT policy.

3.2.3.1 Technological hardware

The availability of technology hardware in schools influences teachers' use of it in their classrooms (Martin & Parker, 2014; Mai & Hong, 2014; Carver, 2016). When technology is available and accessible, teachers make an effort to use it more frequently in their teaching (O'Dwyer et al., 2005; Kotrlik & Redmann, 2009; Mwalongo, 2011). In a recent survey conducted by Mirzajani et al. (2016), teachers were asked whether having ready access to

technological equipment influenced them to use it, and they all responded that they were motivated by this to use technology in their teaching.

But studies undertaken by Gode et al. (2014), Bozdoğan and Ӧzen, (2014), Badariah and Ahmad (2014) and Carver (2016) have shown that a lack of computer hardware in schools hindered teachers' use of technology in their teaching. Hennessy et al. (2010:41) state that "… despite a great deal of recent progress and optimism that many more learners can benefit from access to ICT, the infrastructures necessary for deploying technological resources are lacking in low-income countries". Mathipa and Mukhari (2014) agree that developing countries face a challenge in terms of the availability and affordability of technological resources. In several East African countries there is a lack of infrastructure to support technology use, especially in poor rural areas (Tedla, 2012). Tedla notes that such areas lacked basic resources such as chairs, blackboards and water. Working under these conditions demotivates teachers and obstructs their use of technology in teaching. Eze and Olusoladu (2013) confirm the existence of logistic challenges in Botswana, such as the high costs of PCs, lack of electricity in many rural locations, and high charges for Internet usage.

The general paucity of resources at many quintile 1-3 schools limits access to technological resources, which in turn impedes teachers' basic use of technology, and any hope of integrating it into their teaching and learning (Tedla, 2012). In studies by Sang et al. (2011), Sulungai et al. (2012), Nikolopoulou and Gialamas (2016) and Elemam (2016), teachers remarked that there were insufficient computers and physical space for learners to work in the computer laboratories. A participant in Ndibalema's (2014) study indicated that their school had only one computer laboratory that was used by both teachers and learners: individuals therefore struggled to gain access to the computers when or if there was Internet connectivity. Mueller and Wood's (2012) study revealed that, due to inadequate infrastructure, teachers had to carry technological equipment from one classroom to another. The equipment took time to set up and this discouraged them from using it. Boadu et al. (2014) report that the problem is not inadequate infrastructure in their university so much as that some departments (e.g. History) were not provided with technological resources such as projectors and computers and had to borrow from other departments.

In studies by Mereku et al. (2009) and Dinh (2009) conducted in Ghana and Vietnam, respectively, inadequate infrastructure obliged schools to devise schedules and rules for sharing computers; and teachers had to book technological equipment when they wanted to use it. The

problem with sharing equipment is that the process of booking and allocation can easily become too complicated (Singh & Muniandi, 2012; Kalanzadeh & Valizadeh, 2015). Oncu et al. (2008:30) argue that when rules for common use were put in place, clashes "occurred with other teachers who [wanted] to use the same resources at the same time". Dinh (2009) reports that to solve this problem, a participant in his study had to book equipment well in advance on a first-come-first-serve basis. Some teachers in Cubukcuoglu's (2013) study asked that they be given access to the computer laboratory, as opposed to the *status quo* in terms of which it was reserved for IT teachers only.

Studies show that inaccessibility is a barrier to teachers' use, integration and imaginative development of technology for teaching and learning (O'Dwyer et al., 2005; Mirzajani et al., 2016; Francom, 2016). According to Ertmer et al. (2007), if teachers cannot access ICT resources readily, they will be less likely to use it in their classrooms. In discussing the concept of 'accessibility', a teacher in Mueller and Wood's (2012) study indicated that the computer laboratory was a lengthy walk from their classroom and to visit it reduced available instructional time. Educators were initially assigned 30 minutes of computer time per lesson, but this was later reduced to 20 minutes because of the time it took learners to walk to the laboratory.

Due to the shortage of resources that is characteristic of developing countries, Mathipa and Mukhari (2014), Chigona et al. (2014), Francom (2016) and Nikolopoulou and Gialamas (2016) report that computer laboratories in their studies were overcrowded, which made teachers reluctant to use them; there were always more learners than computers in the laboratory. Mueller and Wood (2012), Cubukcuoglu (2013) and Mai and Hong (2014) observe that it is difficult for teachers to use technological tools when the infrastructure does not cater for all the learners in a classroom. In a study by Chigona et al. (2010), the high learner-to-computer ratio discouraged teachers from deploying technology in their classrooms. The school in their study had over 700 learners with only 25 computers, which meant that the computer laboratories were always overcrowded. In their opinion, the high ratio of learners to computers made it difficult for teachers to manage their classrooms and involve all their learners in tasks (Nikolopoulou & Gialamas, 2016; DelliCarpini, 2012). Classroom management was a challenge because it was difficult for the teachers to control students' noise levels in the computer laboratory. Aslan and Zhu (2015) argue that provision should be made for each learner in a classroom to be allocated a personal computer.

Another challenge that many researchers mention is that technological hardware in schools is often dated, dysfunctional, poorly maintained or simply obsolete (Kaleli-Yilmaz, 2015; Nikolopoulou & Gialamas, 2016; Liu, 2016; Khodabandelou et al., 2016; Elemam, 2016; Al-Awidi & Aldhafeeri, 2017). Poor equipment inhibits teachers' use of computers, and militates against their development of computer skills. In a study by Boadu et al. (2014), it was revealed that most of the electrical sockets in the classrooms were faulty, and that teachers had to buy and bring in their own cables and plugs. A teacher in Chen and Reimer's study (2009) spent 45 minutes of her lesson trying to solve technical problems before she could teach content. Such impediments severely disrupt the teaching programme as a whole and dissuade teachers from investing time and effort in acquiring the sort of technological skills that their learners need; especially in developing countries, to keep up with markets and professions.

Because technological equipment is so often limited and out of date in schools in developing countries, teachers can invest a lot of their own money each year in purchasing technological resources for use in their classrooms (Schrum et al., 2008). A teacher in this study explained that she spent approximately one-fourth of her yearly salary on purchasing personal technology equipment. Teachers are obliged to invest in such equipment because it is increasingly a part of every facet of modern living, from banking to hospital care and social structures (Martin et al., 2013; Mai & Hong, 2014). Teachers find that their self-esteem is higher when they are able to teach with technology (Schrum et al., 2008).

The challenges of buying, learning to use and storing personal equipment are compounded by the fact that it could be stolen on school premises; as mentioned by Mathipa and Mukhari (2014). At their schools, classrooms were burgled and computers and printers stolen. In the Gauteng province in South Africa, it was reported by a Member of the Executive Council (MEC), Panyaza Lesufi, that more than 100 of the 18 000 smart boards installed in classrooms had been stolen (Gedye, 2016). El Semary (2011) recommends that funding for technological equipment should cover maintenance of the equipment and security for the building where it is to be housed.

Since owning technology resources encourages teachers to use them (Kahveci et al., 2011), it has been suggested that administrators and policymakers should provide funding for teachers who cannot afford to buy personal computers (Kahveci et al., 2011). Alternatively, schools could provide affordable payment options to teachers who feel obliged and are willing to acquire their own technology equipment (Almekhlafi & Almeqdadi, 2010; Kahveci et al.,

2011). According to a teacher in Dang's (2008) study, technological equipment is prohibitively expensive, the average price for a notebook laptop being equal to two months' salary. Chigona et al. (2010) report that teachers in their study were economically challenged and could not afford to purchase a computer themselves. An incentive in the form of a laptop could well encourage teachers to familiarise themselves with technology and develop the skills necessary for teaching and learning (Salleh & Laxman, 2014).

Another challenge mentioned in the relevant literature is power supply. Chigona et al. (2014) point out that when teachers use technology for teaching and learning, they expect to work without any technical or power failures. But, Eze and Olusoladu (2013), Obiri-Yeboah et al. (2013) and Aslan and Zhu (2015) found that electricity cuts or shortages in rural schools were a barrier to teachers' reliance upon, and integration of, technology. By contrast, a survey conducted by Sulungai et al. (2012) found that only 1.4% of teachers reported that a lack of electricity prevented them from using technology. In other studies, conducted by Tedla (2012), Mai and Hong (2014), Sulungai et al. (2012), Kaleli-Yilmaz (2015), Khodabandelou et al. (2016) and Baz (2016), temporary cuts in the electricity supply negatively impacted on teachers' use of technology in their classrooms. Kisirkoi (2015) and Al-Awidi and Aldhafeeri (2017) suggest that for teachers to use technology in curriculum delivery, the issue of inadequate electricity had to be addressed by the government. In the event of power failures, teachers have to switch to using traditional teaching approaches that will not necessarily assist their learners to become global competitors, equal in skills to first-world learners (Liu, 2016).

3.2.3.2 Software programs

One key factor enabling teachers to use technology is the availability of software programs (Badia et al., 2014; Gode et al., 2014; Martin & Parker, 2014; Mai & Hong, 2014). Cubukcuoglu (2013) remarks on a prevalent tendency for schools to focus on providing technological hardware but not software. Hardware and appropriate software are equally important in encouraging teachers to use technology in their teaching. A research project conducted by Martin et al. (2013) reveals that Wimba, a free virtual tool (software program), was available for teachers to experiment with in their computer laboratory. There were no restrictions as to how long teachers could use the computer laboratory or how many people could log onto the software program simultaneously. Chigona et al. (2014) note that software programs can be used by learners to plot graphs faster and more neatly than they can do manually.

Mai and Hong (2014) found that teachers were encouraged to use computer laboratories because of the educational software programs installed on the computers; a circumstance that served to amplify the teaching and learning of subject matter. In some cases, learners played educational games and completed exercises using software applications (Kotrlik & Redmann, 2009; Mueller & Wood, 2012). Many studies recognise that educational software programs encourage teachers to use them with their learners, though of course some schools are not able to install educational programs on computers due to a lack of funding (Ertmer et al., 2012; Miima et al., 2013). Other schools have educational software installed on their computers that are not in line with the teachers' curriculum goals (Wadmany, 2011; Nikolopoulou & Gialamas, 2016). Gode et al. (2014), Yeung et al. (2014), Mai and Hong (2014), and Aslan and Zhu (2015) recommend that schools should choose educational programs that enhance learners' understanding of topics in the curriculum. El Semary's (2011) study suggests that schools develop a formal process for selecting appropriate software to aid teachers in achieving their lesson outcomes.

Another factor that contributes to teachers' reliance upon and willing deployment of technology, and integration of it into their teaching, is the availability of the Internet or Wifi in schools (Badia et al., 2014; Vrasidas, 2015). Some teachers have access to the Internet both in their schools and at home; a privilege that offers them an additional incentive to use it (Kotrlik & Redmann, 2009; Song et al., 2013). Without the Internet, teachers face difficulties operating technological hardware. A participant in an investigation by Song et al. (2013) describes the Internet as an invaluable tool. Access to the Internet allows access to a variety of up-to-date, readily available information, so teachers use the Internet to search for course materials and thus enrich their lesson plans (Mirzajani et al., 2016; Al-Awidi & Aldhafeeri, 2017; Pema et al., 2017). The results of studies by Baek et al. (2008) and Mwalongo (2011) corroborate these findings by maintaining that teachers use the Internet to search for information on subject matter with which they are not familiar. Due to the importance of the Internet, Agbatogun (2010) and Young (2016) suggest that schools should ensure constant Internet connectivity if they want to encourage teachers to use technology in their classrooms.

Extrapolating from these observations it may be noted that learners' access to the Internet encouraged teachers to use it more for teaching and learning (Boadu et al., 2014; Chigona et al., 2014). Learners use the Internet to access course materials online (Tong & Trinidad, 2005; Musarrat et al., 2013; Eze & Olusola, 2013). Some teachers in Kucharcikova and Tokarcikova's

(2016) study reiterated that, with the help of the Internet, they were able to share course materials with a large number of learners, and this encouraged feedback on the subject matter taught. Access to the Internet helps to improve social interactions between learners and teachers: communication via online platforms is convenient, feedback is faster and learners co-operate better (Kaware & Sain, 2015; Izmirli & Izmirli, 2015; Mirzajani et al., 2016). Eze and Olusola (2013) warn that since the Internet exposes learners to a variety of information, the role of the teacher should be to teach learners how to search for credible information.

Researchers such as Ertmer et al. (2012), Quarles et al. (2015), Nikolopoulou and Gialamas (2016) and Al-Awidi and Aldhafeeri (2017) report that the absence of access to the Internet in schools prevents or at least inhibits teachers from using technology. When there was no Internet, for example in Ndibalema's (2014) study based in Tanzania, teachers used the computer to type student examinations and write up administrative reports. A teacher in Al-Awidi and Aldhafeeri's (2017) study reported that the availability of computers is useless unless teachers have ready access to the Internet. Some schools have Internet connections that are unreliable because connectivity is slow (Quarles et al., 2015; Hsu, 2016; Balakrishnan et al., 2017). With poor connectivity, learners cannot submit their assignments by email or access course materials online (Dang, 2008; Gode et al., 2014; Ndibalema, 2014).

Due to no or irregular Internet connectivity, and a lack of funding, software programs are not being regularly updated (Wang, 2008; Mai & Hong, 2014; Al-Faki & Khamis, 2014; Elemam, 2016) and computers are not protected against threats. Sherman and Howard (2012) confirm that computer viruses are the most significant challenge. School laboratory computers transfer viruses onto teachers' memory sticks. Teachers prefer to use their own personal equipment because they are afraid of losing their documents. Groff and Mouza (2008) suggest that it is important for schools to make plans for updating software programs in order to encourage teachers to use technology.

The availability of funds for technology-related activities encourages teachers to use technology for teaching and learning (ChanLin et al., 2006; Goyal et al., 2010; Gode et al., 2014). According to Goktas et al. (2009), Kaleli-Yilmaz (2015), Al-Zahrani (2015) and Elemam (2016), schools with enough money can acquire ICT infrastructure, protect and safeguard valuable equipment, pay for subscription fees for software applications, set up ICT networks for computers, update and upgrade ICT infrastructure, provide training for technical assistants and incentives for teachers, as well as organise workshops to raise awareness about the benefits

of using technology for teaching and learning. This finding corroborates the view of Singh and Muniandi (2012) that, with sufficient money, routers can be bought so that the whole school has access to wireless Internet, students as well as staff. The use of technology is costly (Oncu et al., 2008; Groff and Mouza, 2008), so that Kahveci et al. (2011), Shamim et al., (2011) and Gode et al. (2014) suggest that administrators and policymakers seek funding from sponsors. Such funding should be sustainable (El Semary, 2011).

3.2.3.3 Technical support

Technical support encourages teachers' use of technology. Yilmaz (2011) states that along with hardware and software, it was important to provide schools with technical assistance to maintain the equipment and programs in order to prevent breakdowns. A teacher in a research project conducted by Chen and Reimer (2009) was concerned about how to handle unexpected breakdowns of technology while continuing to attend to her learners' behaviour in class. According to ChanLin et al. (2006), teachers naturally worry about their ability to overcome possible technical problems, which make them insecure and reluctant to use technology for teaching and learning. Having technical assistants in schools to maintain equipment and minimise breakdowns encourages teachers to use technology in their teaching (Kotrlik & Redmann, 2009; Goyal et al. 2010; Singh & Muniandi, 2012; Obiri-Yeboah et al., 2013). Technical assistants can train teachers to use technology (Bingimlas, 2009).

Reliable technical assistants encourage teachers to use technology for teaching and learning (Walker & Shepard, 2011; Singh & Muniandi, 2012; Mai & Hong, 2014; Francom, 2016). Technical assistants can be swift in responding to technical glitches and prevent time-wasting lapses in teaching time. A teacher in a study by Obiri-Yeboah et al. (2013:17) used the word "trust" to explain how reliable a technical assistant was in responding to technical problems. Another teacher in a study conducted by Tong and Trinidad (2005:10) used the phrase "just-in-time". Buckenmeyer (2010) observes that equipment malfunctions lead to frustration and stress; reliable technical assistants are needed to encourage teachers to use technology. According to Walker and Shepard (2011), when teachers plan to teach with technology they must be prepared for technical problems. A teacher in their study recommended there should always be a Plan B: the lesson should not stop because of unpredicted technical problems. This recommendation responds to the caution of Martin et al. (2013:133) that "… even if a faculty member has mastered a technology, there is always the possibility of internet disconnection, systems crashing, or a feature malfunctioning and this might interrupt live class delivery". But

Kalanzadeh and Valizadeh (2015) insist that technical assistants be provided in schools to fix technical problems; freeing teachers to use technology for their teaching and learning.

A lack of technical support hinders teachers' use of technology in their classrooms (Elemam, 2016; Carver, 2016; Hsu, 2016; Nikolopoulou & Gialamas, 2016). Without technical support, teachers are less motivated to use technology, because they are obliged to fix technical problems themselves (Schrum et al., 2008; Teo, 2011, Chigona et al., 2014). Such situations lead to frustration (Wadmany, 2011; Kopcha, 2012; Mueller & Wood, 2012). Schrum et al. (2008) found that teachers were unwilling to use technology because they feared it would not work properly and they would waste valuable instructional time fixing technical problems. In line with this finding, Buckenmeyer (2010:34) observes that "if equipment is not going to work, and if no one is available to help when the inevitable operational problems occur, then even the teachers who use technology may become frustrated and abandon these beneficial tools".

Studies have found that unreliable technical assistance can stand in the way of teachers' use of technology in their classrooms (Franklin et al., 2001; Al-Faki & Khamis, 2014; Wang, 2008). Chigona et al. (2010; 2014) report that some teachers did not receive prompt technical support. As a result, they planned their lessons without integrating ICT, unsure if the technology would be in good working order or if they could get assistance in case of a technical fault. In a more recent study by Al-Awidi and Aldhafeeri (2017), teachers were asked whether their schools provided them with technical support. The majority reported that technical support was not prompt or reliable; with the result that they had to attend to technical problems themselves in their classrooms, cutting into teaching time. In some schools, technical personnel are expected to be on call for both teachers and learners, which makes it difficult for them to respond timeously to all technical queries (Marwan, 2008; El Semary, 2011; Al-Faki & Khamis, 2014). A study conducted by Franklin et al. (2001) showed that technical personnel in certain schools were only available on certain days of the week which made it impossible for teachers to get assistance when they needed it. Since technical assistants are sometimes unreliable, Dinh (2009) recommends that teachers be trained during professional development sessions to resolve their own technical problems rather than depend solely on technicians.

3.2.3.4 Information Communication and Technology policies

According to Pando, in the foreword to the e-Education White Paper (NDoE, 2004:1), ICTs "are central to the changes taking place throughout the world. Digital media has revolutionised

the information and society and advances in ICTs have dramatically changed the learning and teaching process". Where technology resources are available, reliable, well maintained and kept secure at schools, teachers are increasingly integrating technology into their pedagogy to enhance the quality, and accelerate the speed, of their teaching and learning. Many countries with sufficient resources have responded to the spread of technology in education by formulating ICT policies to foster its adoption and use.

Studies by Baek et al. (2008) and Goyal et al. (2010) have demonstrated that teachers' ability to deploy technology is influenced by the availability of policies. A large-scale study conducted in Korea found that the most significant factor that influenced teachers to use technology was pressure from the Ministry of Education through its ICT policies (Baek et al., 2008). In India, teachers were more likely to use technology because of the existence of a national government policy to evaluate the effectiveness of ICT use (Goyal et al., 2010). Sang et al. (2011) and Tedla (2012) assert that having technological policies in place is not enough on its own; teachers need to be thoroughly acquainted with such policies before they can benefit from them.

Many teachers are not aware of ICT policies in their country, although an awareness of key documents could have guided and amplified their teaching with technology. In Dang's (2008) study conducted in Vietnam, it was reported that schools lacked ICT vision. Since there was no policy, 81.6% of the respondents claimed that they had never seen or read an ICT policy; while 82.5% agreed that if such a policy existed, it had not been disseminated to teaching staff. Some administrators in a survey conducted by Gode et al. (2014) in Norway reported that there was a lack of proper ICT policy informing teachers' use of technology. Fifty-two percent of teacher trainers reported that their colleges did not have access to ICT policies to inform their obligation to use technology for teaching and learning. Nchunge et al.'s (2012) study from Kenya, Cubukcuoglu's (2013) study from Cyprus, and Mathipa and Mukhari's (2014) study from South Africa produced similar findings. According to Gode et al. (2014), teachers are more willing to use technology if there are policies in place to explain the reasons and provisions for that use. Yeung et al. (2014) recommend that for schools to ensure that teachers use technology, management should develop policies that make the use and integration of technology obligatory in the classroom.

3.2.3.5 Information Communication and Technology policies in South Africa

Due to the rapid proliferation and penetration of technology in the education sector, the South African government has developed policies, such as MRTEQ and the e-Education White Paper, to inform and ensure the use of technology in schools. The provincial departments are mandated to implement the vision of these government ICT policies.

The revised MRTEQ (South Africa. DoHE, 2015:6) document stipulates the minimum requirements for "the construction of core curricula for Initial Teacher Education (ITE), as well as for Continuing Professional Development (CPD) Programmes that accredited institutions must use in order to develop programmes leading to teacher education qualifications". The aim of the MRTEQ document is to ensure that TEIs train and graduate quality teachers who are able to instil in learners a knowledge of the skills that are needed for them to have meaningful and productive professional lives in a competitive, technologically-driven 21st century society. They are expected to use instructional strategies during professional practice that help to bridge the digital divide both nationally and internationally. The MRTEQ (DoHE, 2015:11) specifies that:

- all teacher education programmes [are] to address the critical challenges facing education in South Africa today, such as the legacies of apartheid, by incorporating situational and contextual elements that assist teachers in developing competences that enable them to deal with diversity and transformation; and
- [they must bring] the importance of inter-connections between different types of knowledge and practices into the foreground, as well as the ability of teachers to draw reflexively from integrated and applied knowledge, so as to work flexibly and effectively in a variety of contexts.

These stipulations have substantial implications for TEIs: teacher educators need to use instructional tools such as those technologies made available since they have the potential to address diversity, transform teaching and learning, equip future learners with employable technological skills, create jobs and narrow socio-economic divisions. The DoBE (South Africa. DoBE, 2007:1) states that "ICT is fundamental to the implementation of e-Education and offers greater opportunities to access learning, redress inequalities, improve the quality of teaching and learning and provide personalised learning experiences". TEIs need to ensure that pre-service teachers are able to use technology to address the goals of the MRTEQ policy document.

In 2004, the South African national government promulgated the e-Education White Paper (NDoE, 2004) which defines and prescribes the use of technology in schools. This policy document centres upon use of ICTs to facilitate learners' understanding of the curriculum, to instil the knowledge, skills and values needed for them to work in the 21st century workplace, and to foster national goals. The e-Education policy envisages that learners will acquire the following abilities:

- to apply ICT skills to access, analyse, evaluate, integrate, present and communicate information;
- to create knowledge and new information by adapting, applying, designing, inventing and authoring information; and
- to function in a knowledge society by using appropriate technology and mastering communication and collaboration skills (NDoE, 2004:14).

In order to achieve these goals, teachers need to use technology constructively to enrich learners' experiences in their classrooms, so that they in turn become competent and confident in their use of technology. The benefits of technology can be achieved when it is appropriately integrated into the curriculum (United Nations Educational, Scientific and Cultural Organisation [UNESCO], 2012).

To respond to the South African government's ICT vision, the WCED and many donor agencies have embarked on initiatives to make technology available and accessible. The Khanya project, the e-Learning unit (NDoE, 2004), the South African SchoolNet and Intel Tech programmes, and Operation Phakisa, were set up to provide broadband services (South Africa. Department of Communications, 2010:1; South Africa. DoBE, 2015).

It is evident from these initiatives that the WCED and private sponsors have been involved in deploying technological equipment to schools and training teachers in its use. Technology has been provided to many schools in the Western Cape, but challenges remain in the form of lack of money, security and support/training staff in rural schools (Chigona et al., 2014). Rural schools require investment for the purchase and maintenance of equipment and for the provision of technical assistants and security.

The findings in Section 3.2.3, are in line with the concepts 'effort expectancy' and 'facilitating conditions' of the UTAUT2 model. Teachers used technology because of 'facilitating conditions' put in place by their schools which ease their use of technology, hence less effort

was required to learn how to use, prepare lessons and teach with technology. These 'facilitating conditions' include: availability and accessibility of technological hardware, software programmes, technical support and ICT polices. These factors may inhibit teacher's use of technology in rural schools and developing countries.

3.2.4 Training

Three themes are discussed in this section: the influence of professional development training, the influence of pre-service training, and the relation between teachers' teaching and their school experience.

3.2.4.1 Influence of professional development training

Professional development training enhances teachers' use of technology in their teaching. Baylor and Ritchie (2002:398) assert that "regardless of the amount of technology or its sophistication, technology will not be used unless faculty members have the skills, knowledge and attitudes necessary to infuse it into the curriculum". Professional development is a significant factor in equipping teachers with the skills necessary to teach effectively with technology (Hennessy et al., 2010; Singh & Muniandi, 2012; Nyambane & Nzuki, 2014; Vrasidas, 2015). Teachers in Kaleli-Yilmaz's (2015) study claimed that professional development training plays an important role in encouraging teachers to use technology: in their experience, before receiving training, they did not have the skills to use technology properly in their courses. Teachers' competence with technology encourages its use in the classroom. Marwan (2008) and Cubukcuoglu (2013) caution that the availability of technology in schools does not in itself facilitate teachers use of it; competence in the use of technology motivates teachers to adopt, integrate and use it in their teaching and learning (Aslan & Zhu, 2015; Mohamad et al., 2015; Kisirkoi, 2015). A participant in Francom's (2016) study reported that her motivation for using technology was her proficiency, her ability to use any technology that she came across. Lau and Sim (2008) and Pan and Franklin (2011) confirm that teachers who are competent in the use of technology use it regularly for teaching and learning.

In Espino's (2012) study, teachers who attended professional development training complained of contextual factors such as work overload, organisational problems, the constant suspension of lessons and pressure stemming from the limited time available to cover the syllabus. These factors imply that after professional development training, teachers could use their newly

acquired skills in their teaching; provided such factors were taken into account by schools. Ertmer et al. (2007) refer to this issue stating that professional development is rated the most significant extrinsic factor that influences teachers to use technology for teaching and learning: for 'digital natives', professional development updates their technological skills, while for 'digital immigrants' not exposed to technology during pre-service training, professional development develops their technology skills. Eze and Olusoladu (2013) point out that if teachers are not properly trained in the use of technology during pre-service training, the gap can be filled through professional in-service development training.

The findings of recent studies add a new dimension; by showing that training, as well as, 'regular' or 'on-going' professional development training encourages teachers to integrate technology in their classrooms (Nikolopoulou & Gialamas, 2016; Mirzajani et al., 2016). According to Franklin et al. (2001), the more teachers are exposed to the use of technology, the more willing they are to use it in their classrooms. Schools need to ensure that there is continuous professional development training in order to encourage teachers to use technology frequently and keep abreast of new developments (Teo, 2011; Sabzian & Gilakjani, 2013). A recent study re-states the need for continuous professional development by emphasising that sustainable systems should be put in place to ensure that teachers go on regular professional development training courses (Al-Zahrani, 2015).

Some studies have reported that teachers who had received professional development training were not adequately trained because the focus was on the technological tool and not on pedagogy (Dinh, 2009; Espino, 2012). Teachers in Schrum et al.'s (2008) study reported that professional development, due to a lack of funding, focused purely on the basic use of a computer. These findings suggest that the development training did not go beyond the basic use of technology; further training was required in the more advanced use of technology (El Semary, 2011; Miima et al., 2013). Tong and Trinidad (2005), Ndibalema (2014) and Cubukcuoglu (2013) caution that professional development training should focus not only on instilling basic computer or technical skills but should also model various pedagogical strategies that teachers can deploy in their classrooms to engage learners.

Numerous studies have recommended that teachers need to be trained in the pedagogical use of technology (Ndibalema, 2014; Salleh & Laxman, 2014; Al-Awidi & Aldhafeeri, 2017). Nikolopoulou and Gialamas (2016) argue that professional development programmes should be carefully designed in order to instil in teachers' skills that are required for them to teach

effectively with technology. When professional development is well designed, it increases teachers' competence, and consequently boosts their confidence in teaching with technology (Young, 2016). Ertmer and Ottenbreit-Leftwich (2010:261) argue that "although knowledge of technology is necessary, it is not enough if teachers do not also feel confident using that knowledge to facilitate student learning". It has been demonstrated that confidence on the part of teachers can help persuade them to use technology for teaching and learning (Goyal et al., 2010; Miima et al., 2013; Callum et al., 2014; Blackwell et al., 2014). In a study carried out by Cubukcuoglu (2013), both competence and confidence proved to be significant factors for promoting teachers' use of technology: if a teacher lacked competence, he or she may not feel confident enough to integrate technology into their teaching.

According to Lawless and Pellegrino (2007), adequate professional development should include:

- ensuring that professional development activities are longer in duration than is typically the case (contact hours allocated for the training, plus follow-up activities);
- providing access to new technologies for teaching and learning;
- actively engaging teachers in meaningful and relevant activities for their individual contexts; and
- promoting peer collaboration and community building among teachers.

Walker and Shepard (2011:33) are of the opinion that adequate professional development training should be hands-on: teachers reported that hands-on experiences that engaged them in activities were more helpful than the "sit-and-get" sessions where there was no participation or interaction between themselves and the facilitator. Walker and Shepard (2011) and Nyambane and Nzuki (2014) indicate that teachers are more likely to integrate technology into their classrooms if professional development training allows them time to practise using the technology, and to learn and to collaborate with colleagues.

Tong and Trinidad (2005:6) recommend that during professional development training, teachers' levels of technological ability should be taken into consideration. They suggest that the "one-size-fits-all" approach, whereby all teachers are taught at the same level during workshops, does not encourage teachers to use technology. Vrasidas et al. (2010) emphasise that a one-size-fits-all model is a typical error made by professional development programme designers, schools and teachers; because teachers are all at different levels of technology

integration. They recommend that professional training in the use of technology be carefully planned, taking into account teachers' individual needs and experiences, their learning styles, the contexts of their schools, and the stage they have reached in their careers. This finding confirms Kalanzadeh and Valizadeh's (2015) suggestion that training be provided in accordance with teachers' technological knowledge, experience and individual needs. This is in line with the UNESCO (2012:11) framework that describes the different stages of teachers' development in respect of technology. These stages include: "technology literacy", "knowledge deepening" and "knowledge creation". With "technology literacy", teachers use technology at the most basic level. They use technology in a traditional manner without going into any depth with the features available. Teachers at the stage of "knowledge deepening" should be able to use collaborative strategies and the advanced features of a technology to teach content. Reaching the stage of "knowledge creation", teachers should be able to create new tasks or projects using technology. The activities at this stage are mostly learner-centred.

In Chapter Six of this study, the researcher develops and presents a model indicating how teachers can be guided through different stages to acquire the knowledge and skills needed for effective teaching with technology. This model contributes to the current theoretical understanding of technology integration in schools.

In some studies, teachers reported that they had not received any training on the use of technology (Palao et al., 2015; Khodabandelou et al., 2016; Hsu, 2016; Dogan & Akbarov, 2016). In the absence of this training, even with available resources, teachers will seldom use technology for teaching and learning (Sulungai et al., 2012). Other studies report that teachers were not being sent for regularly professional development training (Mirzajani et al., 2016; Nikolopoulou & Gialamas, 2016). According to Chigona et al. (2010), teachers in disadvantaged schools were less likely to attend regular professional development training due to a lack of resources. Without regular training, there is a likelihood that teachers will not be sufficiently confident or knowledgeable to integrate or blend technology into their teaching (O'Dwyer et al., 2005; Collins & Bronte-Tinkew, 2010).

Kotrlik and Redmann (2009) study conducted in Louisiana argue that many teachers are intrinsically motivated to use technology for teaching and learning. In their study, they found that 95.5% of teachers who integrated technology into their teaching were self-taught. They had apparently learned to use technology on their own since their schools lacked the funds to send them for training. A more recent study by Mirzajani et al. (2016) found that teachers searched

for materials from online sources, which they used to train themselves to integrate technology into their classes. The findings of Kotrlik and Redmann (2009) and Mirzajani et al. (2016) suggest that if there is a sufficiently powerful inner drive, teachers will find a way of equipping themselves to blend technology into their teaching.

3.2.4.2 Influence of pre-service training

In a study conducted in Turkey, 70.4% of teachers suggest that all pre-service teachers be tested on their technological knowledge before graduating from university (Baz, 2016). Empirical evidence shows that teachers who were trained during pre-service training were impelled to use technology in their teaching (Chen, 2010; Mathipa & Mukhari, 2014; Bozdoğan & Ö̈zen, 2014; Mtebe et al., 2016).

Studies conducted in Taiwan and California report that pre-service teachers learned how to use technology specifically from mentor teachers during teaching practice (Liu, 2011a; Liu, 2016). These mentor teachers were already using technology in their classrooms, so were able to demonstrate the benefits of teaching with technology and thus motivate the student teachers to do likewise. Other studies have found that mentors show pre-service teachers how to navigate technical problems and so increase their self-efficacy (Franklin et al., 2001; Kopcha, 2012). These studies confirm an earlier observation made by Grove et al. (2004) that pre-service teachers would learn how to use technology if they have mentors who are knowledgeable about technology and use it for teaching and learning. Although mentors play a useful role in training teachers how to use technology, Liu (2016) warns that student teachers should not merely imitate them but find their own style of teaching with technology by deploying it creatively.

Many other research studies found that pre-service teachers were not trained to use technology for teaching and learning. For example, in Sulungai et al.'s (2012) study conducted in Kenya, respondents were asked whether they had received any training in how to integrate computers into Mathematics classrooms during their pre-service courses. The results indicated that the majority of the teachers (96.6%) had had no training; with only a small proportion (3.4%) responding in the affirmative. Because of the importance of pre-service training in encouraging teachers to use technology, Sang et al. (2009) and Goktas et al. (2009) recommend that TEIs should create environments that direct pre-service teachers in the effective integration of technology.

Some studies have reported that pre-service training sessions are inadequate to prepare teachers to teach effectively with technology (Liu, 2011a; Tedla, 2012; Bozdoğan & Ὂzen, 2014). Liu (2011b) suggests that the reason for this is that technology, pedagogy and content are being taught separately. Pre-service teachers in Aslan and Zhu's (2015) study complained that their computer training modules did not adequately prepare them to teach with technology; since the focus was on the basic use of computers and they were not engaged in practical activities. They indicated that the time allocated to the teaching of technology skills was limited (Aslan & Zhu, 2015). Some participants suggested that the ICT periods at universities be increased. This discourse correlates broadly with an earlier study by Ertmer et al. (2007), in which teachers rated pre-service training as the least important factor that influenced them to integrate technology into their teaching.

Goktas et al. (2009) found that some university teacher educators did not use or model the use of technology for teaching and learning. But teacher educators need to role-model the use of technology during their teaching in order to encourage pre-service teachers to use it in their own professional practice. Cantrell and Visser (2011:281) argue that "if technology is not well adopted and integrated in the curriculum and the daily teaching, instructors [teacher educators] may view the use of ICT's as an 'add-on' and not as an integral component of teaching and learning".

3.2.4.3 Teachers' teaching and past school training

When discussing factors influencing teachers' ability to integrate technology into early childhood education, Blackwell et al. (2014) found that years of teaching experience encouraged teachers to deploy technology into their teaching. This resonates with Lau and Sim's (2008) finding that older teachers frequently used technology for teaching and learning since they had extensive teaching experience, sound classroom management skills and good knowledge of the curriculum. Bakar and Mohamed (2008) and Schrum et al. (2008) obtained a similar finding. But, Khodabandelou et al. (2016), Young (2016), and Al-Awidi and Aldhafeeri (2017) report that older teachers with considerable teaching experience were reluctant to use technology in their classrooms because they had not been trained to use it. Younger teachers with less teaching experience were encouraged to use technology because they were trained to do so during their pre-service training (Schrum et al., 2008; Goyal et al., 2010; Kahveci et al., 2011; Tedla, 2012; Mahmood et al., 2014; Kalanzadeh & Valizadeh, 2015). In Francom's

(2016) study, teachers in their 20s and 30s claimed that they found it easier and less time-consuming than not to employ technology in planning and preparing their lessons.

Literature relevant to integration of technology suggests that teachers tend to use technology in proportion to their prior experience of using it (Mai & Hong, 2014; Aslan & Zhu, 2015; Mirzajani et al., 2016). According to ChanLin et al. (2006) and Venkatesh et al. (2012), there is a likelihood that individuals who have had positive prior experience with technology will be more comfortable with using it. In Park's (2009) study, a teacher was encouraged to use technology because of his own exposure to its use at high school. This seems to corroborate the findings of Thompson et al. (2002) and Hoover (1996), who assert that most teachers teach the way in which they were taught.

In Section 3.2., it is reported that teachers were encouraged to use technology because of training. Teachers had both positive and negative experiences during professional development, pre-service trainings, and years of teaching and past-school experiences with technology. These findings are related to the concept 'habit' of the UTAUT2 model.

3.3 BARRIERS TO TEACHERS' ABILITY TO USE TECHNOLOGY

Nikolopoulou and Gialamas (2016) define a 'barrier' in this context as any factor that prevents or hinders teachers' use of ICTs in their classrooms. In this study, the words barriers/challenges/obstacles are used interchangeably to denote the negative factors that teacher's face and the negative experiences that they undergo when integrating technology into their teaching. These negative experiences discourage teachers from making optimal use of technology for teaching and learning. The barriers selected for discussion in the following sections are teachers' lack of competence and the shortage of available time.

3.3.1 Teachers' lack of competence in the use of technology

Studies have shown that teachers who lack competence do not use technology for teaching and learning (Nikolopoulou & Gialamas, 2016; Young, 2016; Balakrishnan et al., 2017; Hassall & Lewis, 2017): this incompetence can be technological or pedagogical in nature.

With regard to a lack of technological competence, Pelgrum (2001:167) posits that "if teachers do not have technological skills, it would be difficult for them to integrate technology into their teaching". For example, in Kenya, in the Kakamega South District, teachers' lack of computer

skills discouraged them from using computers in their teaching of Mathematics (Sulungai et al., 2012), with 78.4% of teachers reporting that they had no computer skills; as against only 21.6% who claimed to have some. Chigona and Chigona (2010) note that in South Africa, low levels of ICT skills among teachers impair their use of technology. They explain that, although the schools in their study had computers which could have been a vital resource for teaching and learning, not many teachers were incorporating technology during curriculum delivery because they were not skilled enough to do so. This observation is similar to the findings of Mathipa and Mukhari (2014), Nikolopoulou and Gialamas (2016), Khodabandelou et al. (2016) and Al-Awidi and Aldhafeeri (2017), which indicate that a lack of technological skills prevented teachers from using technology for teaching and learning. In Boadu et al.'s (2014) study, a teacher took a long time to master simple technological tasks because of her lack of appropriate skills. She was discouraged from using technology for teaching and learning because it appeared to be eroding her teaching time. Martin et al. (2013) found that teachers could manage some technology but lacked the skills to use complex features, which inevitably limited its usefulness in their classrooms.

Turning to the question of pedagogical skills, the majority of participants in Aslan and Zhu's (2015) study indicated that in addition to technological competence, pedagogical competence is necessary for teachers to effectively integrate ICT into their teaching. This finding corroborates Mwalongo's (2011:45) assertion that "ICT per se cannot make learning happen; it is how ICTs are used that makes the difference". In Malaysia, some Science teachers used technology in a lecture style (Ahmad, 2014). They used PowerPoint to deliver content and to explain difficult concepts without interaction with the learners. It appears that these teachers lacked the pedagogical skills to be able to engage their learners in creative and meaningful learning through using PowerPoint. The same goes for Vietnamese educators who used technology to replace the chalkboard, because their lessons were still not interactive (Peeraer & Van Petegem, 2010). Some teachers used word processing programs to type content-related information and presentation software for lecturing (Peeraer & Van Petegem, 2010). This adherence to traditional ways of teaching, according to Ndibalema (2014), can be attributed to a lack of pedagogical competence. From studies conducted by Peeraer and Van Petegem (2010), Ahmad (2014), Ndibalema (2014), Al-Awidi and Aldhafeeri (2017), it emerges that teachers lack the imagination, experience or basic competence to use technology for anything but traditional methods of instruction.

According to Mishra and Koehler (2005), technology as well as pedagogical knowledge are important for teachers to be able to teach effectively with technology. Teachers need to know which technology and pedagogical strategies they can incorporate in their lessons.

3.3.2 Lack of time

Technology integration takes time: to learn how to use technology and time to prepare lessons (Afshari et al., 2009; Musarrat et al., 2013; Obiri-Yeboah et al., 2013; Francom, 2016). The majority of teachers in Vrasidas's (2015) study indicated that integrating technology into the classroom requires more planning and takes up more time than traditional lessons. Several studies have identified a lack of time as a barrier to teachers' ability to integrate technology into their classroom tuition (Hsu, 2016; Young, 2016; Elemam, 2016; Al-Awidi & Aldhafeeri, 2017). Kopcha's (2012) report maintains that even when teachers have access to technology equipment and appropriate professional development training, their attitude remained consistently negative since they had no time to prepare technology-based lessons. A teacher in Dang's (2008) study reported that an hour's lesson employing technology required three to four hours' preparation. Most respondents (73%) in Schrum et al.'s (2008) study estimated working a minimum of one extra hour every day to integrate technology into their teaching. A respondent in a different study stated that she prepared technology lessons during weekends or came to school early or left late in order to prepare these lessons (Francom, 2016). Vrasidas et al. (2010) and Zhou et al. (2017) noted that teachers were spending time after school hours one or two days a week looking for appropriate videos to meet their lessons' objectives. Using technology in the classroom requires teachers to invest extra personal time and effort because they do not have the time during normal school hours to prepare such lessons.

Vrasidas et al. (2010) reported that a significant proportion of the teachers they surveyed, 81.4%, indicated that the load of the curriculum to be covered within the school year prevented them from using technology for teaching and learning. Teachers are under such pressure to cover the syllabus within the designated time, before standardised tests occur that they can seldom find time for technology training (Chigona et al., 2014; Al-Awidi & Aldhafeeri, 2017; Chen & Reimer, 2009; Mueller & Wood, 2012). Miima et al. (2013) found that some teachers felt the integration of ICT into the teaching and learning of the Kiswahili language was time-consuming and could hinder them from completing the curriculum. Raman and Mohamed (2013) reported that teachers were not using technology because of the amount of time required to prepare students for high stakes testing. According to Heafner (2004), in a pressured

environment, teachers sacrifice the use of technology to ensure that they cover the syllabus content. Buckenmeyer (2008) confirms that when time is inadequate or limited, teachers tend to resort to teaching strategies with which they are familiar, because these take less time.

In some studies, a majority of teachers did not think that using technology would prevent them from completing the curriculum on time (Boadu et al., 2014); preferring to believe that technology would enable them to complete the curriculum and improve the quality of their lessons. Teachers skilled in the use of technology do not regard time as an obstacle because they enjoy using technology for teaching and learning (Schrum et al., 2008). A lack of time may be a constraint for teachers, and this is certainly exacerbated in schools where there are no supportive ICT-enhanced curriculum materials to facilitate the use of technology (Sulungai et al., 2012; Vrasidas, 2015). When the curriculum and school manuals do not include ICT integration, teachers can spend excessive periods of time finding, assessing, revising and adjusting learning materials, activities and technological tools to suit the needs of their students and their curriculum objectives (Vrasidas et al. 2010).

Another factor is the limited time allocated by school management to teachers for the use of technological facilities, which prevents them from using such resources as frequently as they would like to (Tedla, 2012; Ahmad, 2014; Boadu et al., 2014; Mirzajani et al., 2016). In Chigona et al.'s (2010) study, the school had a structured timetable for teachers to use the computer laboratory, which gave all of them an equal opportunity to access the facility. In a more recent study by Chigona et al. (2014), a teacher felt that the time allocated for their subject was not enough, and prevented optimal use of the computer laboratory; teachers were neither consulted nor asked for their input during the drafting of the timetable for use of the computer laboratory. In Mueller and Wood's (2012) study, a teacher complained that she would have used technology more frequently, were it not for the restricted time allocated to her to do so. When there was a timetable in place, teachers could not have access to the computers whenever they wanted to. Similar findings by Aslan and Zhu (2015) and Mirzajani et al. (2016) resulted in their recommendation that teachers be allocated more time, to encourage them to use these facilities.

Although time can be increased, Mueller and Wood (2012) argue that it is important to consider teachers' experience when drafting timetables. An inexperienced teacher needs more time than a teacher who is competent in the use of technology. Al-Awidi and Aldhafeeri (2017) recommend that school management make access to technology flexible and not limit teachers

to rigid timetables. If management needs to create timetables, they should provide more time for planning and teaching with technology.

In this section, researchers have reported that teachers did not use technology because of a lack of time to learn how to use, and prepare to teach with technology. It was further reported that in schools were there were no technology-enhanced materials, teachers spent more time searching for appropriate course materials to include in their lessons, which discouraged them. According to Ventekesh et al. (2012), an individual will use technology when less effort is required to use it. This is link to their concept 'effort expectancy' of the UTAUT2 model.

3.4 SUMMARY OF CHAPTER THREE

This chapter has reviewed in detail the literature relating to factors exerting influence on teachers' ability to integrate technology into their pedagogical practice. From this review it is apparent that while these factors have been extensively investigated internationally, only limited studies have been conducted in South Africa; and in the Western Cape in particular. Due to the importance of technology in the 21st century classroom, factors influencing teachers to use technology need to be constantly investigated to enable school leaders to encourage more teachers to make effective use of it in their classrooms.

This literature review suggests that it is important to investigate '*how*' teachers teach with technology. The reason is that the pedagogical strategies that teachers use can enhance learning and prepare the learners for the 21st century workplace. From the literature, it was seen that some teachers taught passively or in a less constructive way, failing to interact with their learners. There is therefore a need for teachers to be assisted to acquire the knowledge and skills they require for effective teaching with technology. This will be discussed further in Chapter Six.

An important observation arising from this literature review is that most studies have had recourse to the UTAUT2, which is a consumer study model. By using the TPACK, which is an education model, together with the UTAUT2, this investigation has widened the range of factors thought to influence teachers' ability to integrate technology in their teaching.

Chapter Four discusses the research design and methodology used in the study.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

The WCED is committed to providing technology to schools and has invested considerable funds in such provision (WCED, 2001; Guest, 2014; Chigona, 2017; Khanya Annual Report, 2008). Despite this commitment, however, research conducted in the Western Cape has shown that there is a worrying divide between teachers who are able to successfully integrate technology into their lesson plans, and other teachers who remain reluctant or simply unable to blend technology. Some employ technology for administrative purposes only, not even attempting to integrate it into their teaching (Chigona & Chigona, 2010; Sherman & Howard, 2012). Given the socio-economic inequalities that prevail in the Western Cape, technology integration offers a realistic way of closing the socio-economic gap by accelerating the progress of underprivileged schools and communities. It is precisely this potential for social upliftment and equalization that the WCED recognises and which prompts the WCED to commit substantial resources to purchasing and distributing technology. But at many poor schools in the Western Cape this technology remains out of reach: it is too often inadequate, or damaged, poorly maintained, or not stored in a secured locality away from burglars and vandals. Such conditions inhibit or discourage teachers from deploying it in their classrooms. The literature review showed that in many developing countries similar difficulties exist, while in developed countries technology is mostly available and reliable, and integrated with teaching and learning in innovative, imaginative, productive and time-saving ways. South African society is one of the most socio-economically polarised societies in the world: there is a rift between the affluent, who enjoy easy and reliable access to technology at school, the workplace and home, and the poor, who lack technology or have technology that is outdated, semi-functional or poorly secured against theft and vandalism. South African society is therefore a microcosm of the larger global divide; between so-called developed and developing countries. Research into the integration of technology in the classroom in South Africa is therefore particularly valuable, since global issues resonate in a country that is effectively first world and third world at the same time. An investigation such as this into factors that influence NQTs' ability to integrate technology into their teaching is of both national and global significance. Solutions found here may be identifiable or even replicable elsewhere in the world.

The NQTs selected for this project were exposed to various forms of technology during their pre-service training. The challenge of this research initiative was to discover *why* technology was integrated into teaching at some schools while at others it was neglected, ignored or employed in a purely perfunctory manner for administration.

To explore and understand these issues, a qualitative approach was used to collect data, which meant that the research concentrated on "depth" before "breadth" (Smith & Osborn, 2008:56). The aim was to gather in-depth data from a small sample of participants (Lodico, Spaulding & Voegtle, 2006). At all times, however, the phenomenon under investigation was consciously framed by the range of issues identified and discussed in Chapter Three.

This chapter comprises the following sections:

Section 4.2 outlines the research methodology;
Section 4.3 discusses the research methods;
Section 4.4 presents the data analysis procedures;
Section 4.5 discusses how trustworthiness was achieved;
Section 4.6 discusses ethical considerations; and
Section 4.7 presents a summary of the chapter as a whole.

4.2 THE RESEARCH METHODOLOGY

4.2.1 Qualitative research within an interpretive paradigm

This is a qualitative study set within an interpretive paradigm (Henning et al., 2004; Blaxter et al., 2010). The qualitative approach guided the development of the instruments used to collect data. The researcher used an online survey, interviews and observation schedules to explore, understand and explain the social phenomenon under investigation (Myers, 1997; Lodico et al., 2006). According to Creswell (2009), qualitative researchers do not rely on only one method, but have recourse to multiple methods when collecting data. During the interviews, which comprised the core data generation method, NQTs were asked to reflect on their everyday experience in their various schools and consider what factors influenced their ability to use technology for teaching and learning. The use of interviews is justified by Cohen et al. (2005:19), who aver that "the social world can only be understood from the standpoint of the individuals who are part of the on-going action being investigated". In order to furnish a holistic picture of the phenomenon being studied, the information gathered during these interviews was

corroborated by data collected from the classroom observations and the online survey. It should be noted that the online survey collected qualitative data that is reported in a quantitative way in Chapter Five; where the researcher used percentages for clarity and ease of understanding.

This study is in line with qualitative methodology in that it sets out to gather data from the "natural setting" (Denzin & Lincoln, 2000:3). Researchers have shown that human behaviour is influenced by its natural setting (Fraenkel et al., 2012). Bless et al. (2013) concur that researchers need to take into account the context or setting in which human behaviour occurs in order to understand the experiences, opinions and reflections of the people within that setting. In this study, the broader national and global context of this specific, detailed examination of NQTs' behaviour was kept in sight at all times and conditioned the design, interpretation and regulation of the instruments for data generation. The immediate context of NQTs' exposure to technology was of significance: teachers' prior experiences both in the school and outside the school context greatly influenced their adoption and use of technology. This immediate context is discussed in more detail in Section 4.3.2.

Since each individual constructs her or his 'world' differently, qualitative researchers seek to understand and report findings from the unique perspective of each participant (Fraenkel et al., 2012). To ensure that their perspectives were apprehended and reported accurately, the researcher carefully probed teachers during the interviews to record their subjective experience; in the form of factors that motivated them to use technology to teach subject content. Saunders et al. (2003:84) explain that it is important "to explore the subjective meaning motivating people's action" since each individual interprets situations differently. The teachers participating in this study were drawn from varying socio-economic contexts: some schools had an abundance of technological resources and others did not. This means that teachers had varying experiences integrating technology during curriculum delivery, hence different factors motivated teachers to use technology in their teaching. In reporting the qualitative data, the researcher included relevant *verbatim* comments to support the conclusions drawn (Bless et al., 2013).

Another reason for deploying a qualitative approach was the need for a "thick description" or "in-depth" account of the participants' experiences of the phenomenon under investigation (Henning et al., 2004:142; Struwig & Stead, 2013:127). To collect in-depth data in this study, the teachers were purposively selected on the basis of having been trained during their pre-service training to teach with technology. All had completed ICT courses and technological

projects, so they were ostensibly knowledgeable about the topic under examination. The researcher was acquainted with the participants and on good terms with them because she was part of a technological project in which they were involved in their fourth and final year at the TEI (Lodico et al., 2006). This acquaintance and trust enabled her to collect in-depth data in an atmosphere of confidence: the teachers were relaxed in her presence, and freely discussed enabling factors and barriers to their integration of technology in the classroom. The interviews were recorded, notes were taken on both the verbal and the non-verbal behaviour of the interviewees, and the physical environment of each school during classroom observations was described. All these factors contributed to a holistic picture of the phenomenon.

4.3 RESEARCH METHODS

4.3.1 Sampling

When selecting the teachers for this study, the researcher purposively chose IP NQTs who had graduated from a teacher education institution in 2013. According to Dane (2011), purposive sampling targets certain group of people because of particular characteristics and knowledge pertinent to the focus of the investigation. This group of people characteristics suited the research topic because the participants had had four years' training in a local teacher education institution on how to integrate technology into teaching and learning. They were knowledgeable about this research topic (Arthur et al., 2012).

During these NQTs' final year at the teacher education institution, the researcher was involved in training them in the use of digital storytelling as a tool for teaching, learning and self-insight. This experience added to their ability to use a variety of different items of technological equipment for teaching and learning. All these pre-service teachers went through the process of creating their own digital stories, which are a blend of image and text that focuses on personal biographies or tales "from the heart" (Hayes, 2011:291). Stenhouse et al. (2013:134) observe that "digital stories provide a creative way for people to tell their stories using a mixture of voice, image and music". This preliminary exposure to technology may have had a bearing on the factors that influenced these NQTs to use technology in the classroom when they became teachers.

Since the researcher was familiar with the teachers (Bless et al., 2013), and to avoid possible bias, the survey was administered to all 94 teachers who graduated in 2013. All the IP teachers had an equal opportunity to take part in this study (Cohen et al., 2008): all were sent the online

survey web link (https://cput-efywf.formstack.com/forms/tibac) through their personal emails and on their mobile telephones. Both emails and telephones were used because some email accounts were inactive. In the survey, the 94 teachers were asked if they would like to be contacted for interviews and classroom observation. Seventy-four teachers responded to the online survey; ten teachers volunteered to be interviewed one-on-one, and six teachers agreed to be observed in their classrooms while they taught with technology.

4.3.2 Description of sampled teachers

The following section describes the ten teachers who were interviewed one-on-one about their experiences of integrating or attempting to integrate technology into their teaching. These teachers' prior experiences motivated them to blend technology and in many ways conditioned the way they integrated technology into their classrooms.

All ten NQTs interviewed in this study were South Africans teaching Intermediate Phase learners at schools in the Western Cape. Three of these teachers were so-called Coloureds: 'Coloured' is a term accepted by the population group itself and used in South Africa to describe a certain mixed race ethnic group. Brown (2000:198) refers to 'Coloureds' as "mixed-blood" since they are "descendants of Black-White, Black-Asian, White-Asian, and Black-Coloured unions". Three of the ten teachers selected were black and four were white (see Table 4.1).

The majority (eight out of ten) of these teachers were digital natives, aged between 21 and 30. Only Teachers 6 and 8 were digital immigrants. Teachers 2, 4 and 5 taught at fee-paying schools which had substantial resources: there were desktop computers and smartboards stationed in every classroom, Teachers 1, 3, 6, 7, 8, 9 and 10 taught at no-fee-paying schools that lacked the resources to support their teaching with technology.

The following table features the teachers, the types of school in which they taught, the geo-economic classification of their schools, their gender and which ones were interviewed and/or observed.

Table 4.1: Details of the research participants

Pseudonyms names of teachers	Types of school	Classification of school	Gender	Race	Teachers interviewed	Teachers observed
Teacher 1	No-fee-paying school	Township	Male	Black	Interviewed	
Teacher 2	Fee-paying school	Urban	Male	White	Interviewed	
Teacher 3	No-fee-paying school	Township	Female	Coloured	Interviewed	
Teacher 4	Fee-paying school	Urban	Male	White	Interviewed	Observed
Teacher 5	Fee-paying school	Urban	Female	White	Interviewed	Observed
Teacher 6	No-fee-paying school	Township	Female	White	Interviewed	Observed
Teacher 7	No-fee-paying school	Township	Male	Black	Interviewed	
Teacher 8	No-fee-paying school	Township	Female	Coloured	Interviewed	Observed
Teacher 9	No-fee-paying school	Township	Male	Coloured	Interviewed	Observed
Teacher 10	No-fee-paying school	Township	Female	Black	Interviewed	Observed

4.3.3 Data collection process

To collect appropriate data that answered the research questions, the researcher used an array of instruments that included an online survey, interviews and classroom observation schedules. They were deemed the most appropriate means for gathering the requisite data for answering the research questions. The following section provides information on how the researcher designed, piloted, administered and collected data using these data generation instruments. There is also discussion of their relative advantages and disadvantages.

4.3.3.1 Online survey

An online survey (Appendix G) was used (i) to collect demographic data; (ii) to identify such enabling and disabling factors as had been suggested by the literature and (iii) to establish how

and *why* teachers used technology in their teaching and learning. The purpose of the online survey was to gather initial comprehensive data about teachers' experience of using technology in their teaching and learning, and to refine the interviews and observation schedules. The survey served as a means of identifying teachers who were prepared to be contacted for one-on-one interviews and classroom observation, the core methods of data generation (Cohen et al., 2008; Khan, 2009). The questions in the survey were shaped by (i) the elements and socio-economic challenges of technology integration cited in the literature review and (ii) the priorities of the conceptual framework.

To design the online survey, the researcher had recourse to the 'formstack' application. She followed three steps when developing the questions using this application (Cohen et al., 2000:257; 2008).

Step one: The aim of questions 1-5 was to secure the interest of the NQTs and enable them to feel comfortable about completing the survey. The questions were factual, comparatively straightforward and easy to respond to (Dane, 2011; Cohen et al., 2008). The teachers answered questions about their age, gender, the phase they were currently teaching, the type of schools they taught at (fee-paying or no-fee-paying), and how often they used technology.

Step two: Questions 6, 7 and 8 included both closed and open-ended questions. The closed question items were adopted in part from previous studies and adapted to suit the needs of this project and conditions in South Africa (Dinh, 2009; Chen, 2010; McGill et al., 2014; Mai & Hong, 2014). The aim was to determine, through a frequency count, enabling and disabling factors in respect of NQTs' ability to integrate technology into their tuition, the central topic of this enquiry.

Step three: In the open-ended sections in Questions 6, 7 and 8, teachers were asked to suggest other items applicable to them not listed in the survey. Questions 9, 10 and 11 were open-ended. Cohen et al. (2000:255) observe that "it is the open-ended responses that might contain the gems of information that otherwise might not be caught in the questionnaire". Question 12 invites NQTs to work further with the researcher by providing individual email addresses.

Before the online survey was sent to the selected NQTs, it was piloted in July 2014. Two in-service teachers, who were not part of the sample, were asked to complete the questions. After they had completed the questions, they were given a blank sheet of paper on which to comment on the following issues:

- Poorly worded questions;
- Questions that could be misunderstood;
- Unclear choice of options;
- Clarity of instructions;
- Whether the language in the survey was consonant with the reading ability of the population;
- Whether questions were visually appealing; and
- Whether categories were appropriate (Fraenkel et al., 2012:401; Lowe, 2007:58; Lodico et al., 2006:112).

By piloting this online survey, the researcher was able to determine the time it took to open the web link and respond to the questionnaire. It took between ten and fifteen minutes to download and complete the questionnaire (Cohen et al., 2008; Arthur et al., 2012; Lambert, 2012). The following issues were addressed as a result of the two teachers' responses:

- The survey was divided into five sections with headings for easy understanding (structure);
- The researcher adjusted the font size and spacing of the survey questions in order to make reading them easier;
- A sentence was added at the end of the survey asking respondents to check that they had completed all the questions and thanking them for their participation. This added sentence improved the structure of the online survey; and
- A new theme termed 'pre-service training' was added to the survey, arguably refining its content.

In August 2014, this once-off, online survey (https://cput-efywf.formstack.com/forms/tibac), together with approval letters from the University Ethics Committee (Appendix A) and WCED (Appendix B), was sent to 94 teachers through their emails and mobile telephones. The introduction to the email invited teachers to respond to the survey within a month.

Seventy-four (78.7%) teachers responded to the survey. The high response rate may be attributable to three aspects: (i) the introduction explained the significance of the study. According to Bless et al. (2013) providing an introduction that convinces respondents of the importance of the study can raise the response rate; (ii) confidentiality was guaranteed (Morrell & Carroll, 2010; Dane, 2011; Fraenkel et al., 2012); and (iii) questions were simple,

straightforward, the length of the questionnaire was limited to two and a half pages, and the layout was clear.

The online survey was convenient for the teachers to reply to: participants could respond to it at any time and place, as long as they had data bundles or access to the Internet. The majority of teachers were digital natives who used technology daily for communication and entertainment, and therefore had no difficulty about responding online. Regular reminders via telephone calls and emails may have increased the response rate (Cohen et al., 2008). The anonymity or "non-traceability" of the questionnaire encouraged NQTs to respond, though some of them did not seek anonymity and provided their emails to be contacted again (Cohen et al., 2000:246). All participants were involved in a technological project during their pre-service training that had ostensibly equipped them to teach with technology. This exposure may have increased their readiness to complete the online questionnaire (Lodico et al., 2006).

The chief advantage of using the online survey was that it was more economical to administer to 94 teachers than conventional post: the online web link was sent to teachers' emails and mobile telephones (Gill & Johnson, 2002; Blaxter et al., 2010). Online surveys are inexpensive since there is no cost involved in printing or posting letters. The survey included closed questions that were quick to answer. Because participants could complete the survey at their convenience, the teachers had enough time to think deeply before responding to the open-ended questions (Lowe, 2007; Fraenkel et al., 2012). The data from the survey was automatically imported into an Excel program which saved time. The researcher would otherwise have been obliged to capture the data manually (Cohen et al., 2008; Dane, 2011; Fraenkel et al., 2012). E-mail responses reduced the possibility for human error associated with the manual capture of data (Cohen et al., 2008).

Against the many advantages of using the online survey, one distinct disadvantage was that the researcher could not be present to answer questions from individual respondents, explain instructions that may have been misinterpreted (Dane, 2011) or assess unwritten aspects such as body language, facial expression or tone of voice. To address the issue of misinterpretation, the researcher provided the respondents with her contact details in the introduction to the survey. Complex terms were defined in the survey for the sake of clarity (Lodico et al., 2006). For example, 'technology' was defined as "all educational technology hardware and software programs that teachers use for teaching and learning". Instructions in the survey were formulated in simple English and made as clear as possible.

4.3.3.2 One-on-one interviews

Dane (2011) and Bless et al. (2013) define an interview as a purposeful conversation during which the researcher asks interviewees questions concerning their experiences of a certain phenomenon. Guided by the findings of the online survey, the researcher developed a semi-structured interview schedule (Appendix H). One-on-one interviews were conducted once with each of the ten teachers who had voluntarily indicated on the online survey that they were willing to be contacted. The interview questions explored teachers' perspectives on factors that influenced their ability to integrate technology into their teaching.

In formulating the questions for the semi-structured interview schedule, the following steps were considered (Lambert, 2012:123-124):

1. Simple start: The researcher asked factual questions (Question One). The aim of having factual questions at the beginning of the interview was to encourage teachers to feel relaxed, interested and comfortable when responding to the questions (Lambert, 2012; Bless et al., 2013).
2. Meaty middle: Questions 2 to 6 focused on the main issues in this study. The responses to these questions assisted the researcher in answering the research questions on factors that influenced teachers to use technology in their teaching and learning (Lambert, 2012:123-124).
3. Rounding off: Questions 7 to 9 sought additional information. The aim was to explore new information that may have emerged and for the teachers to provide recommendations concerning the issues they had raised (Lambert, 2012:124).
4. Closure: Question 10 brought each interview to an end. The researcher concluded the interview by asking teachers whether there was anything they wished to add or ask. The interviews were terminated with the researcher thanking each teacher and explaining that the transcripts would be made available to them through email (Henning et al., 2004).

The researcher piloted the interview schedule in September 2014 with two in-service teachers who were not part of the sample group surveyed for the final project (Tuckman, 1994). These teachers were interviewed because they were practising teachers who had experience of using technology in the classroom. The interviews were audio-recorded and then transcribed. From

the findings, the researcher made the following structural and content changes to the interview schedule:

- The questions were sequenced in a more logical order;
- The terminology in some questions was changed in order to use 'everyday' language for clarity;
- Complex questions were simplified;
- Ambiguous questions were made clearer;
- 'Leads' or themes were devised from the pilot interviews; and
- Loaded questions were revisited and their structure changed.

Piloting the interview schedule enhanced the researcher's interview techniques by (i) giving teachers more time to discuss issues during the actual interview; and (ii) paying attention to non-verbal behaviour when making notes during the interviews (Smith & Osborn, 2008). Piloting the instrument enabled the researcher to determine that it took 45 minutes on average to complete an in-depth interview schedule.

The interview schedule was emailed to all ten teachers who agreed to be interviewed. The purpose of this preliminary email was to permit the participants to familiarise themselves with the questions, reflect upon them, and be in a position to provide in-depth responses (Henning et al., 2004). The participants chose a date, time and venue (Appendix J) which suited them for the interview (Henning et al., 2004).

The principals at some schools offered their offices for the researcher to conduct the interviews, which was convenient and comfortable for both the interviewee and the interviewer. Other teachers were interviewed in teachers' classrooms, in school staffrooms and in a computer laboratory. Some teachers preferred to be interviewed at the researchers' university because the interviews were scheduled during the vacation. One of the teachers was interviewed at a restaurant for safety reasons because her school was located in a gangster-ridden area. Eight interviews were conducted after school during term time and two during the vacation (Appendix J), in September and early October 2014.

The researcher began each interview by thanking the teacher who had agreed to be interviewed. The study was briefly introduced and its aim and significance explained. The researcher produced approval letters from the University Ethics Committee and WCED and assured the

interviewee of the confidentiality and anonymity of the interview. She then asked the NQT if s/he was still willing to be interviewed. Since a tape recorder was used to capture the interviews, teachers were asked to sign a consent form (Appendix E). All the participants agreed to the use of the recorder. Fraenkel et al. (2012:457) explain:

> No matter what kind of interview one conducts, and no matter how carefully one prepares the interview questions, all will be to no avail if the interviewer does not capture what the interviewee actually says.

Using a digital recorder made it possible to focus upon the interview questions and answers rather than taking detailed notes that could have been distracting (Bloor & Wood, 2006). While the recorder was running, it was possible to assess non-verbal body language of the interviewees (Blaxter et al., 2010).

The advantage of a semi-structured interview was that the researcher was able to cover the issues under investigation more concisely because the discussion was guided. The researcher encouraged participants to elaborate upon, and clarify, issues that they regarded as important, facilitating the natural emergence of key themes. Punch and Oancea (2014) observe that probing during interviews helps to explore participants' perceptions of a certain phenomenon in depth.

A disadvantage of the one-on-one interviews was that the majority of teachers scheduled their interviews for after school hours at their various schools. The teachers were physically and mentally tired after a long working day (Cohen et al., 2008), and the researcher provided them with refreshments after the interview; as a token of appreciation. Travelling to schools for interviews and classroom observations was costly in terms of time, and the researcher made many trips. Twice the researcher arrived at a school to find that the teacher had cancelled the scheduled appointment despite several reminders.

4.3.3.3 The classroom observations

Classroom observation was chosen as a data generation method because the researcher sought to determine how and *why* teachers taught with technology in the "natural setting" of their classroom (Denzin & Lincoln, 2000:3). A semi-structured observation schedule (Appendix I) was formulated with spaces left open for factual information such as the teachers' names, schools observed, grades observed, date observed and a brief description of the physical environment of the school. The classroom observation schedule had predetermined themes

drawn from the findings of the online survey and the one-on-one interviews (Cohen et al., 2008). The predetermined themes enabled the researcher to identify issues of interest during the observations. The researcher left a space in the observation schedule open where she could make notes on emerging themes not previously established (Henning et al., 2004).

From the ten teachers interviewed one-on-one, only six voluntarily accepted to be observed in their classrooms while teaching with technology. Permission to observe teachers in their classrooms was sought from the six principals; both in writing and telephonically (Appendix F). Once this permission had been granted, the teachers were contacted to establish convenient dates and times for the researcher to observe their lessons. A day before each classroom observation, the researcher sent an SMS reminding the teachers of their appointments. During the classroom observations, the researcher was a non-participant observer who did not take part or become involved in any class activities (Bless et al., 2013). The researcher sat in the classroom and made notes in relation to pre-determined and emerging themes (Fraenkel et al., 2012). Further detailed notes were made after each observation session in order to retain details of events that had occurred in the classrooms. The lesson observation afforded the researcher a first-hand opportunity to "watch, record and analyse" activities in the classroom (Blaxter et al., 2010:199).

After each lesson had been completed, the researcher interviewed the teachers. The purpose of these interviews was for the teachers to reflect upon their motives for using a particular technology in their classrooms. This information was used in conjunction with the notes made by the researcher in the observation schedule.

A total of 34 lessons were observed between March 2015 and September 2015 (Appendix K). Teachers 4, 5 and 10 were observed seven times; Teacher 6 five times; and Teachers 8 and 9 four times. The differences in the number of lessons observed was as a result of data "saturation" (Punch & Oancea, 2014:154; Arthur et al., 2012:171): if no more new information emerged, it was understood that the level of saturation had been reached. The majority of the observations lasted 35 minutes or the duration of one class period, while others spanned two or more periods because special projects were being conducted.

Two advantages of using the semi-structured observation schedule were identified. First, it guided the researcher on "what to observe" and note while trying to reduce personal bias (Lodico et al., 2006:117). According to Lambert (2012:106) researchers "may see what they

wish to see and ignore what does not fit their prior ideas". Second, since the categories had been predetermined (Cohen et al., 2008), analysis proceeded faster than would otherwise have been the case.

The disadvantage of this method of data generation was that there was a possibility that the teachers may have changed their behaviour due to the presence of the researcher (Cohen et al., 2008; Bless et al., 2013). The researcher's presence in the classroom aroused curiosity and attention among teachers and learners. To address this issue, the researcher introduced herself to the entire class on the first day of each teacher's classroom observation and explained the purpose of her study, assuring the teachers and learners that nobody would be inconvenienced or penalised. The researcher emphasised that she was there purely to observe how the teachers taught with technology, and that the data would be reported using pseudonyms. After a few observation sessions, the teachers and learners grew used to the researcher's presence in the classroom and began to act naturally (Cohen et al., 2008; Fraenkel et al., 2012).

4.4 DATA ANALYSIS

To analyse data for this study, the researcher used both deductive and inductive approaches. The concepts from the TPACK and UTAUT2 models, which formed the conceptual framework, guided the researcher when identifying codes that later converged into themes: the endpoint of deductive analysis (Struwig & Stead, 2013). The researcher remained receptive to any new themes that might emerge naturally in the process of the research; which allowed the inclusion of inductive analysis (Struwig & Stead, 2013). Punch and Oancea (2014) advise that although researchers may be guided by predetermined themes, they should be alert and receptive to any unexpected categories that happen to emerge from scrutiny of data. Throughout the process of analysing the data in this study, the researcher sought evidence of factors that either disabled or enabled teachers to integrate technology into lesson plans; and how and *why* NQTs used technology in their teaching. The researcher consciously eschewed predetermined themes. Themes that did not fit with the conceptual framework and the literature reviewed were seen as possible sources of new information. The following section explains how the researcher analysed each of the units of data collected.

The formstack application was used to develop the online survey and automatically import teachers' responses into an Excel spreadsheet. The researcher printed the responses and manually counted how many teachers ticked an item in the demographic and closed-question

sections. The raw scores of this data were converted into percentages and are presented numerically and in graphs, in Chapter Five (See Figures 5.1, 5.2 and 5.3).

The responses to the open-ended questions in the online survey and the interviews were qualitatively analysed. The recordings of the one-on-one interviews were transcribed and analysed manually, since there were only ten of them. The researcher followed certain steps in the process of analysing the data (Altricher et al., 2008:122):

1. The researcher repeatedly listened to the audio recordings while reading the transcribed data on the computer (in a Word document), in order to ensure verbatim accuracy, to familiarise herself with the data and to be reminded of non-verbal behaviours and the tone of a teacher's voice during an interview (Henning et al., 2004). By the end of this process, the researcher had acquired an overall picture of factors that influenced these teachers' ability to use technology in their teaching (Bhattacherjee, 2012).
   The researcher printed the transcripts and carefully read through these again and again. Certain sentences and paragraphs were highlighted in the transcripts and codes were assigned to them in the margins using different colour pens. For instance, codes relating to 'technological knowledge/TPACK' were coloured purple. Table 4.2 is an example of the coding system, the colours used, and the emerging themes.

Table 4.2: Researcher's process of analysing one-on-one interviews

Concepts from conceptual framework	Codes	Colour used	Themes
Technological, pedagogical and content knowledge	Competent Confidence Subject area	Purple	Knowledge
Facilitating conditions	Availability of technological hardware Availability of technological software programs Educational software programs Technical support ICT-integrated manuals Electricity supply Ownership of technological equipment	Blue	Resources
Performance expectancy	Saved time Re-use teaching materials Presentation of lesson Accessibility of information	Red	Advantages over conventional method of teaching
Social influence	Support from principals Support from colleagues Support from families Support from learners	Yellow	Encouragement from others
Habit/Effort expectancy	Professional development experiences Pre-service experiences Prior job and school experiences	Green	Past experiences

2. After assigning codes to all ten interviews, the researcher went back to each response and checked that the code appropriately described the comment. From reading through the codes and notes in the margins, some codes were revised and combined in recognition of their similarity. The aim was to reduce the codes to smaller, more "meaningful units" (Henning et al., 2004:127). From the codes, themes were developed in relation to the phenomenon of interest.

3. The researcher describes and presents each theme in Chapter Five, using narratives, *verbatim* comments, figures and tables (Morrell & Carroll, 2010:124). These themes have been read and interpreted at all times in terms of (i) the salient features of technology integration that emerged from the literature review; and (ii) the conceptual framework.

4. The classroom observation schedules, where notes were made in respect of both predetermined and emerging themes, were analysed in the same way as the one-on-one interview data. Information gathered from all the data sources was triangulated and synthesised, and is reported thematically in Chapters Five and Six.

4.5 TRUSTWORTHINESS

Trustworthiness, in this study, is associated with the strategies that the researcher deployed to collect quality data. According to Henning et al. (2004), researchers should question the extent to which their research can be trusted and depended upon by readers. To obtain quality data, issues of credibility/dependability and confirmability were considered (Lincoln & Guba, 1985; Shenton, 2004).

4.5.1 Credibility

With regard to credibility, the researcher was concerned with how consistent findings derived from the study were with her participants' realities (Merriam, 1998). In this respect, the following considerations were germane: purposive sampling, prolonged engagement, building trust, debriefing, triangulation and member checking.

Purposive sampling is a technique aimed at enhancing the credibility of the study. Punch and Oancea (2014) refer to purposive sampling as a deliberate selection of participants based on certain criteria. The teachers that were purposively chosen for this study were knowledgeable about the phenomenon under study: they had been taught during their teacher training how to integrate technology into their daily tuition. The NQTs had completed projects and ICT courses that equipped them to teach with technology. All the participants who voluntarily agreed to be part of this study were included in the sample cohort (Khan, 2009). This process was strictly adhered to, in order to eliminate, or at least restrict, personal bias.

As regards classroom observation, the researcher spent extensive time in the field to obtain in-depth data that adequately addressed the core issues of interest. This strategy is referred to by Lincoln and Guba (1985:256) as "prolonged engagement" in the field. The researcher observed teachers until a point of "saturation" was reached (Punch & Oancea, 2014:154), when, after 34 classroom observations sessions, no new information was emerging (Appendix K). According to Creswell (2009:192), the more time researchers spend in the natural setting of their research, "the more accurate or valid will be the findings."

Due to repeated visits to the participants' natural classroom setting, the researcher grew acquainted with them and established cordial relations of trust. Trust began to build when the researcher explained in detail the nature and purpose of the study and assured the participants that they had the right to withdraw at any point and without providing any reasons for doing so. The participants already knew the researcher because she was part of a technology workshop during their fourth year of teacher training when they were shown how to integrate technology into their teaching. Participants gained the trust of the researcher and *vice versa*, and they freely discussed why they taught with technology in a particular way, with no apparent fear of exposure or loss of credibility (Shenton, 2004).

Because data were collected by means of an audio recorder, the researcher's supervisors had the opportunity to listen to some of the recordings and engage on issues of interest. The researcher held debriefing sessions with supervisors after each set of data was collected and analysed. "Debriefing" refers to the process whereby the researcher engages with someone who is knowledgeable about issues relating to the research project (Hadi, 2016:6). The supervisors helped to ensure that the data were interpreted from the participants' perspectives and that the themes reported were appropriate. This form of guidance enhanced the quality of the study.

Another form of developing credibility was through peer debriefing. The researcher presented her work at two local conferences: the South African International Conference on Educational Technologies, 24-26 April 2016; and the Educational Students' Regional Research Conference, 30 September-2 October 2016. The researcher published some aspects of the work in a peer-reviewed journal [Appendix N] (Shenton, 2004), which exposed her work to public scrutiny. These platforms enabled the researcher to debate issues regarding data generation instruments, while feedback received helped to fortify her written arguments.

Triangulation ensured credibility. Triangulation is the process of using more than one source to collect data (Shenton, 2004; Yin, 2009). Through the method of triangulation, the "weaknesses" in one instrument "were compensated by the other" (Lambert, 2012:138). The online survey lacked depth, by its very nature, and the researcher could not use it to probe for more information. This two-dimensionality in the survey structure was compensated by the one-on-one interviews and classroom observations. The three data sources were triangulated.

To achieve trustworthiness, the researcher used the strategy of member checking (Shenton, 2004:68). Member checking is the process whereby information is sent back to the participants

for confirmation, or to verify that the information was captured adequately and reflected their experiences (Creswell, 2009). All the transcribed data from the one-on-one interviews was emailed to the ten teachers for feedback (Arthur et al., 2012). Teachers were invited to add to, remove from or otherwise correct the transcribed data (Blaxter et al., 2010; Bless et al., 2013). The researcher was interested in gleaning teachers' opinions on whether the transcribed data correctly captured and represented their views or experiences. Nine out of ten teachers were satisfied with the transcribed data, while one teacher made syntactical and semantic corrections.

4.5.2 Confirmability

When discussing confirmability, Shenton (2004:72) posits that "decisions made and methods adopted should be acknowledged within the research report. The reasons for favouring one approach when others could have been taken should be explained and weaknesses in the techniques actually employed admitted." The reasons for selecting three instruments for collecting data have already been discussed: the online survey, interviews and observation schedules. The disadvantages of using each instrument were set out, as well as how these disadvantages were mitigated (Shenton, 2004; Gray, 2009). Another decision made during the process of collecting data was that after each lesson was observed (on the same day), detailed notes on classroom activities would be made and filed (Cohen et al., 2008). Hopkins (2014:127) explains that "the greater the time-lapse between the event and recording it, the more difficult it becomes to reconnect problems and responses accurately and retain conscious awareness of one's original thinking." By making notes immediately after each observation, accurate data were reported and the researcher could vividly remember events that had occurred in the classrooms (Lambert, 2012).

4.6 ETHICAL CONSIDERATIONS

Ethics entail "guidelines or [a] set of principles for good professional practice" (Bloor & Wood, 2006:64). In this study, the researcher conscientiously followed ethical precepts (Cohen et al., 2008; Thomas, 2011; Bless et al., 2013; Punch & Oancea, 2014). The following section discusses two ethical principles to which the researcher strictly adhered: informed consent, and confidentiality or protection of the participants' rights.

According to Bless et al. (2013), before a study is conducted, the researcher must submit a detailed proposal, to be reviewed by a committee, on how ethical issues will be dealt with in the study. For the purposes of this study, the researcher sought permission to conduct research

from the Faculty Ethics Committee (Appendix A) and from the WCED (Appendix B, the initial letter of permission, and Appendix C, granting the researcher an extension for the data generation). Permission was granted, based on the following factors:

- Principals, teachers and learners were under no obligation to assist in this investigation;
- The participants were assured of anonymity in terms of their names and schools when the results of the investigation were reported;
- All arrangements concerning this investigation were made by the researcher;
- The schools' academic programmes were not interrupted; and
- No research was conducted during the fourth term (12 October to December).

The approval letters from the University Ethics Committee and WCED, together with a letter requesting their participation (Appendix D), were emailed to all the teachers. Ten teachers agreed to be interviewed one-on-one and six teachers agreed to be observed in their classrooms. These teachers signed an informed consent (Appendix E) form, agreeing to participate in this study on the following conditions:

- Their participation in this study was voluntary;
- They were free to "opt out of the research" without any explanation (Arthur et al., 2012:168) ; and
- They were briefed on the nature of this study, significance of the research, and that all information gathered from them would be used solely for research purposes (Bloor & Wood, 2006).

Obtaining consent from the teachers was ongoing throughout the period of data generation, in the sense that the researcher sought permission each time she used the audio recorder. All relevant information regarding the study was disclosed to the participants so that they could make informed decisions. No participant was coerced, and all freely chose to be part of the study (Cohen et al., 2000).

The researcher abided by the principle of protecting participants' identity. All participants were assured that the information gathered would be reported using pseudonyms (Bloor & Wood, 2006; Bless et al., 2013), assigning them numbers when reporting the interviews and classroom observation findings (Chapters 5 and 6).

The recordings of the interviews were stored on the researcher's computer. Only the researcher had access to the computer as it was password protected (Lambert, 2012). Arthur et al. (2012:168) note that participants' information should be kept in a "strictly private" place and nobody should have access except the researcher, in order to maintain strict security.

4.7 SUMMARY OF CHAPTER FOUR

This is a qualitative study set within an interpretive paradigm and framed by quantitative elements identified in the literature review. The interpretive paradigm conditioned, shaped and determined the data generation instruments: the online survey and the interview and observation schedules. The researcher was intent upon ascertaining factors that influence NQTs ability to integrate technology into their pedagogical practice. This chapter has discussed the research methodology, data analysis procedures, trustworthiness and ethical considerations in detail. In Chapter Five, findings are presented and discussed in respect of the first research question; factors that influenced NQTs use of technology into their pedagogical practice.

CHAPTER FIVE

RESULTS AND DISCUSSIONS: RESEARCH QUESTION ONE

5.1 INTRODUCTION

This study investigates factors that enhance or inhibit the ability of NQTs to integrate technology into the classroom. This chapter presents the findings of the research investigation, as they emerged from the online survey, one-on-one interviews and classroom observations. The use of three instruments to collect data provided a holistic understanding of the phenomena under examination.

Research Question One:
What factors influence NQTs' ability to integrate technology into their pedagogical practice?

5.2 FACTORS INFLUENCING NQTs' ABILITY TO INTEGRATE TECHNOLOGY INTO THEIR TEACHING

To collect, analyse, interpret and discuss data in relation to factors that influenced NQTs' use of technology, the researcher relied upon key concepts from the TPACK and the UTAUT2 models. These formed the conceptual framework of the study, as was discussed in Chapter Two. The researcher remained receptive, however, to information emerging from the data that did not relate to the conceptual framework. Section 5.2 identifies themes constituted by NQTs' perceptions of factors that enabled or disabled their successful integration of technology in their teaching. These themes include:

5.2.1 Teachers' knowledge of technology;
5.2.2 Availability of resources in schools;
5.2.3 Advantages of technology over conventional methods of teaching;
5.2.4 Encouragement from others;
5.2.5 Past experiences; and
5.2.6 Subject area.

Although the themes are reported and discussed separately, they are interrelated in various ways. For the sake of authenticity, grammatical errors in the teachers' comments have not been corrected.

5.2.1 Teachers' knowledge of technology

In the context of this study, teachers' technological knowledge refers to their ability to use and integrate some kind of technology into their teaching (Ilomäki et al., 2011). From the online survey, 40 (54%) out of 74 teachers indicated that they used technology because they were competent to deploy it. This profession of competence could partly be explained by the fact that 80% of the teachers who responded to the online survey were 'digital natives' (see Figure 5.1), i.e. they were born after the advent of cyber technology (Prensky, 2001;2005). A general sentiment shared by eight out of the ten teachers interviewed was that they were young and they had the ability to learn any technology they came across. From the researcher's classroom observations, it appeared that all six teachers were comfortable with technology: they could use it with ease and deal with minor technical problems that occurred while they were teaching. Teachers 5 and 7 commented during interviews:

> Yes, I've grown up with computers and technology … I am 22, so that was why I used it, you know, yes, … I was taught how to use a computer from a young age. I did projects using PowerPoint [and] Excel, which I think some people only learned later, so it took less time for me to learn any new technology …
>
> … because I grew up in this generation of technology … I am 23 and I understand how technology works and if I didn't know how to use it, I went to YouTube and I learned it like fast-fast-fast, it was as easy as that ….

Goyal et al. (2010), Tedla (2012) and Kalanzadeh and Valizadeh (2015) aver that younger teachers are more inclined to use and integrate technology into their teaching because they were trained to do so at tertiary level, and they rely upon it daily for social communication, banking, internet searches and entertainment. Evidence from Mahmood et al.'s (2014) study shows that younger teachers who recently graduated from university were interested in the use of technology for teaching and learning because they were given ample training and practice, so it took less time for them to prepare and teach with technology.

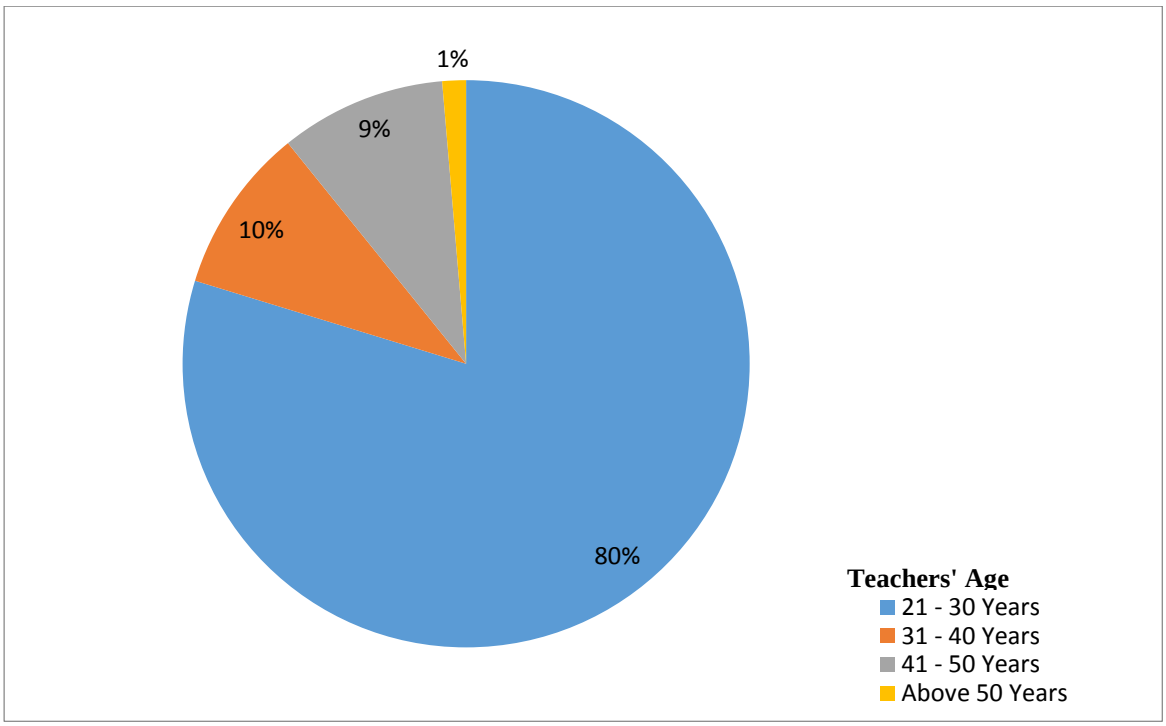

Figure 5.1: Teachers' ages taken from the online survey

Figure 5.1 reveals that the majority (80%) of teachers who responded to the online survey were aged between 21 and 30: 10% were aged 31-40, 9% were between 41-50 and 1% were above 50. Based on this finding, it is evident that the majority (80%) of teachers were young and had been exposed to, or could easily learn how to, use technology for teaching and learning.

During the one-on-one interviews, two teachers who were over 40 years old reported that their age was not a deterrent to their use of technology. Teacher 8, one of the digital immigrants, mentioned that in her school older teachers were reluctant to use technology in their teaching because they were not trained to do so. According to Teacher 8, "older teachers were scared of technology" and "got headaches" when they saw technology.

The two older teachers who were interviewed (Teachers 6 and 8), were observed in their classrooms while they taught content; using videos downloaded from YouTube. These teachers were confident in their ability to integrate technology into the lesson. Their ability to do so is what impelled them. Their confidence could be attributed to their exposure to technology during pre-service training, since they had graduated in 2013. It was observed that these older teachers could use simple equipment such as a data projector connected to a laptop. The functions of the laptop were used at the most basic level to enhance learners' understanding of subject matter such as EFAL.

From these findings, one might deduce that teachers' confidence and technical proficiency are crucial factors in the ability of NQTs to integrate technology into their teaching and learning. According to Deniz (2007), teachers who are confident in their use and knowledge of technology are more likely to use it. This is confirmed in the studies of Cubukcuoglu (2013), Callum et al. (2014) and Mirzajani et al. (2016), where teachers used technology in their classrooms because they were confident to do so. A recent study by Young (2016) recommends that professional development training programmes should build up teachers' competence and confidence, and in this way motivate teachers to utilise technology.

During the one-on-one interviews, teachers were asked whether their competence to use technology influenced them to integrate it into their teaching and learning. All ten teachers were unanimous in responding affirmatively. They were asked to rate their competency level in the use of technology from 1-5; with 1 being very poor, 2 poor, 3 average, 4 good and 5 excellent.

Table 5.1: Teachers' levels of competency to use technology

Competency level	**Number of teachers**	**Percentage (%)**
Very poor (1)	0	0
Poor (2)	0	0
Average (3)	3	30
Good (4)	4	40
Excellent (5)	3	30

In Table 5.1 it can be seen that three out of ten (30%) teachers described their ability to use technology as 'excellent', four (40%) 'good' and three (30%) 'average'. It has to be acknowledged that there is a high level of generalisation here, and that teachers could be competent in the use of a particular technology, but not all technologies. Teachers were asked to indicate which form of technology they were competent in and how often they used it. The results of this inquiry are presented in Table 5.2.

Table 5.2: Type and frequency of technology use

Teachers	Technological tools	Frequency
Teacher 1	Smart board	Occasionally
Teacher 2	Smart board	Every day
Teacher 3	Data projector connected to a laptop	Occasionally
Teacher 4	Smart board	Every day
Teacher 5	Smart board	Every day
Teacher 6	Data projector connected to a laptop	Occasionally
Teacher 7	Data projector connected to a laptop	Occasionally
Teacher 8	Data projector connected to a laptop	Occasionally
Teacher 9	Data projector connected to a laptop	Occasionally
Teacher 10	Smart board	Occasionally

Table 5.2 indicates that Teachers 2, 4 and 5, teaching at fee-paying schools with resources to support their teaching with technology, indicated that they were 'competent' in the use of the smart board and used it every day. Teachers 3, 6, 7, 8 and 9, from no-fee-paying schools, which generally lacked resources, were 'competent' in the use of the data projector connected to a laptop and used it occasionally. Teachers 1 and 10, from no-fee-paying schools, were 'competent' in the use of a smart board and used it occasionally. During the researcher's classroom observations, all six teachers used equipment that was available in their schools. Only two teachers (Teachers 4 and 5) of the six observed were fully competent in integrating technology into their teaching practice; that is, only two were able to use it constructively by engaging learners in collaborative and project-based learning.

A caveat regarding this finding is that teachers at no-fee-paying schools are at a disadvantage because technology is scarce there. Had teachers at no-fee-paying schools enjoyed comparable access to technology, they may have been able to master it and integrate it into their teaching, so benefitting those learners most in need. Having access to technology does not automatically enhance teacher's integration of technology into their teaching and learning. At all times, therefore, as suggested in the literature review, the findings are conditioned by the socio-economic rift in the Western Cape, the country as a whole, and the global community, which is split between developed nations that are advancing at a fast rate in technological expertise, and

developing nations that are in relative terms falling behind. Learners, teachers and schools in poor areas of Cape Town are therefore doubly penalised: first they are impoverished by the after-effects of apartheid and now they are denied access to the very technology that could help liberate them from the cycles of poverty and unemployment.

From the online survey, 37 (50%) of the 74 teachers used technology because it was 'easy to use'. This finding relates to the concept of 'effort expectancy' of the UTAUT2 model, in terms of which an individual will be more likely to use a technology if it is easy to do so. Researchers explain that teachers' workloads are substantial; they have demanding administrative and teaching tasks to complete daily (Kumar et al., 2008; Martin et al., 2013). According to Dang (2008), an hour's lesson using technology requires three to four hours of preparation. Teachers are more willing to use technology if it makes their daily tasks easier and if the features of the technological equipment are easy to use; that is, if less effort is required to use, or learn how to use it (Lambić, 2014; Govender & Dhurup, 2014).

All the participants in this study were NQTs, within their first three years of teaching. Russell et al. (2003) note that novice teachers face daily challenges as they become familiar with the daily routines of the schools and organise the subject matter for teaching. In this study, all the teachers indicated during the one-on-one interviews that they used technology because it was easy to prepare and deliver lessons. They used phrases such as: "drag-and-drop activities," "I just flash games," "I flip back to the page and then save it" and "copy and paste" to indicate their familiarity with the processes involved in preparing and teaching with the aid of technology.

Technology integration theorists such as Davis (1989), Rogers (1995) and Venkatesh et al. (2012), report that an individual will adopt and use technology if its features are not too complex. Similarly, Kumar et al. (2008), Tong and Trinidad (2005), Park (2009) and Balakrishnan et al. (2017) indicate that teachers will be more likely to use technology if it is user-friendly and flexible. These findings are in line with the UTAUT2 construct of 'effort expectancy'. According to Venkatesh et al. (2012), the less effort required to learn how to use technology, the more likely a person is to use it. The researcher concludes that if some equipment or program has complex features that will require some time to master it, it is unlikely that a teacher will be drawn to adopt it for teaching.

During the researcher's observations, all teachers deployed technological hardware (radios, recorders, computers, smart boards, projectors) and presentation tools such as PowerPoint because it was relatively easy for them to navigate these tools. Teachers 4 and 5 reported that it was easy to use the touch screen of the smart board because it was modern. The teachers used phrases such as "the touch screen was familiar which makes it easier," "compared to the mouse and key board, the touch screen was better, it was modern." Research into factors that influence the use of technology reveals that teachers used technology when it was easier to 'click a button' and navigate for presentations than to use the chalk board (Baek et al., 2008; Goyal et al., 2010; Baz, 2016).

The ease of using technology was observed in this study to be a significant factor that influenced teachers to do so, especially those who taught in more affluent areas. It was observed that Teachers 4 and 5 frequently gave learners innovative technology project-based tasks because they had the technology available and learners had acquired a basic knowledge of computers. These teachers had technical support to assist both themselves and their learners. The two teachers had the knowledge and ability to use technology to achieve their lesson goals. They had the ability to blend technology, pedagogy and content knowledge during curriculum delivery.

An interpretation drawn from these results is that these teachers used technology because they were competent and comfortable with it (technology knowledge). These teachers were young, familiar with technology as they used it on a daily basis, and had experiences using technology during pre-service training. These teachers believed that by using technology for other purposes such as preparing course materials and presentations, and using technology during curriculum delivery, they were competent, but they could not blend technology, pedagogy and content (TPACK), which is used for effective teaching with technology. They had embraced the benefits (performance expectancy – UTAUT2) without teaching competently.

5.2.2 Availability of resources in schools

Five sub-themes appear under this heading: the availability of hardware, software programs, technical support, ICT-integrated school manuals, and electricity shortages.

5.2.2.1 Availability of technology hardware

The availability of hardware influenced teachers to use technology in their teaching and learning. Of the 74 teachers who responded to the online survey, 41 (55%) indicated that the availability of technological hardware in their schools allowed them to use it for their teaching and learning. These teachers were asked in the online survey to identify technological tools that were available in their schools. The teachers' responses are shown in Figure 5.2.

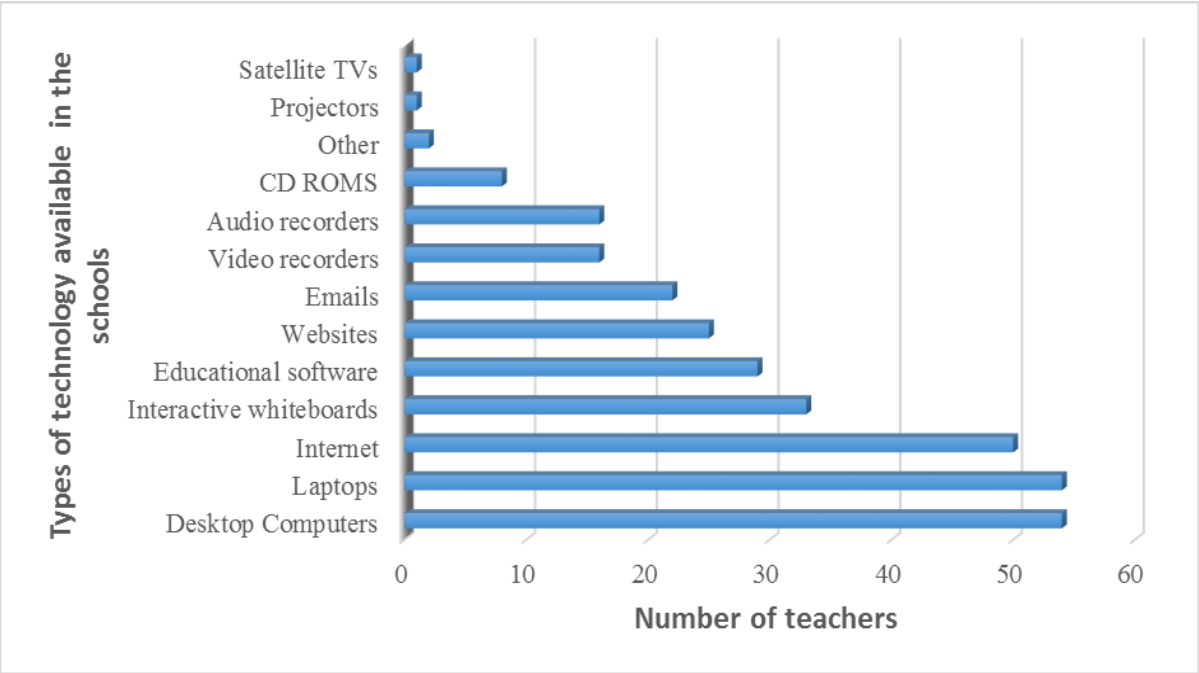

Figure 5.2: Types of technology available in schools

From Figure 5.2, it is evident that desktop computers and laptops are the most widely available technological tools in the schools, while satellite television is the least. Some 4% of teachers (3 out of 74) reported using another technological device used, not listed in the online survey, which was the tablet phone.

From the interviews and corroborating classroom observations, the researcher characterised the schools at which the ten teachers taught as having either a 'high level' of availability, referring to teachers who had more technological resources to support their teaching and learning, or a 'low level' of availability, referring to teachers who had limited or no technological equipment in their schools.

Teachers 2, 4 and 5 taught at fee-paying schools described as 'high level of availability'. From the researchers' observations, Teachers 4 and 5 (Teacher 2 was not observed) had access to a

variety of technological equipment. They had large computer laboratories which were sufficient to meet both learners' and teachers' computer needs. All the classrooms had smart boards which were connected to computers and the Internet. Corroborating these findings, the literature has revealed that the availability of technological equipment influences teachers to use it in their teaching (Goyal et al., 2010; Ahadiat, 2005; Ertmer et al., 2007; Martin et al., 2013; Carver, 2016). On this issue, Teachers 2 and 5 commented:

> I have a smart board in my class. I have a laptop, computer in my class … we subscribed to Evalue-net … [Educational software program]. The school provided all this equipment which made it less strenuous to teach with technology.

> … like we all [all teachers in the school] have our own desktop, we have Wi-Fi. They've given us everything [technological resources] – if we don't use it they would not exactly be happy. We have the resources and we are forced to use it. Basically, my everyday teaching is on a smart board.

These excerpts reveal that some schools were wealthy enough to invest in technological hardware and software programs which encouraged teachers to use them for their teaching and learning. According to the researchers' classroom observations, Teachers 4 and 5 were exposed to a variety of hardware and integrated it regularly. This observation correlates with that of Mirzajani et al. (2016), who note that teachers with access to a variety of suitable technological equipment used it frequently in their classrooms. Venkatesh et al. (2012) found that 'facilitating conditions,' which in this study means primarily the availability of technology hardware, enabled individuals in their study to use technology.

Teachers 2, 4 and 5 repeatedly mentioned that technological facilities were 'accessible' because they had unique access to the equipment in question and could use it at any time without booking in advance. Stressing this point, Teacher 5 explained:

> We have two computer labs in my school. I could use it any time I want with my learners if no one is using it. I don't have to book it or something like that … booking equipment is stressful.

A similar sentiment was reported by Martin et al. (2013): the teachers in their study indicated that there were no time restrictions on how long they could use the computer laboratory and Internet with their learners. Liu (2011b), Martin et al. (2013), and Mirzajani et al. (2016) found that access to sufficient technological equipment enabled teachers to use it in their teaching.

Teachers 1, 3, 6, 7, 8, 9 and 10 had limited or no technological resources, characterised as a 'low level of availability.' Some of the schools observed (Teachers 6, 8 and 9) even lacked

basic infrastructural resources such as plugs, sockets and cables. From the online survey, 45 (60%) of the 74 teachers indicated that a lack of technological hardware negatively impacted upon their use of technology for teaching and learning. This was corroborated in Teacher 6's comment during the one-on-one interviews:

> We do not have technological resources, my school is not … it's not in a well-to-do community, and it's not in a well-to-do area. The budgets were very tight. Basically, we are pen-and-paper teachers.

Consistent with this finding, Hennessy et al. (2010) and Eze and Olusoladu (2013) assert that it is typical for low-income countries, such as Botswana, to lack technological resources because of funding constraints. In the current study, Teachers 6, 8 and 9 spent 'thousands of rands' on their own technological equipment for use in the classroom, including data projectors, mobile screens for projectors, laptops, tablet phones and audio recorders. Without buying it for themselves, teachers would not have been able to use such technology at all, or would have been obliged to use it sparingly. Almekhlafi and Almeqdadi's (2010) study indicates that teachers who owned their own technological equipment were more likely to use it for teaching and learning. Linking this concept to the UTAUT2 model, the construct of 'price value' (Venkatesh et al., 2012) was not an important factor in influencing teachers' use of technology. They were committed and enthusiastic enough to purchase their own technology.

This finding is not surprising: in 2013, all the participants in this study graduated from a TEI which taught technology skills. NQTs in this study were aware of the benefits of using technology for teaching and learning. In the online survey, 39 (52%) out of 74 teachers reported that they used technology because they owned personal technological equipment. Teachers 3 and 6 reported during their interviews:

> I have my laptop at home. I'm fortunate to have one at home. If I didn't have it, that would have been terrible ….

> I am using my own projector and screen and internet. I spend so much money on data bundles because I have the passion for technology.

Teachers at no-fee-paying schools were obliged to use their personal equipment. During the classroom observations and interviews, Teachers 6 and 7 reported that learners experienced difficulty with seeing, reading and hearing the lesson:

> The disadvantage with using my laptop and projector was that the screen was small. Also, sometimes it was the audio, the voice in the audio was too soft. So, it was

> difficult for the whole class to listen or grasp what the narrator was saying when I showed them videos.
>
> The learners sometimes are chaotic in my lessons 'cause I used my tablet [phone] which was too small. If I had a bigger tool, it would have been better … that is my main challenge.

Teachers 3 and 8, who used their own equipment, reported these challenges:

> I did not allow my learners to touch my laptop most of the times because I am scared for it to be broken. So, I am very cautious with my personal equipment.
>
> I won't say I gave learners equal opportunities, you know, because like I said earlier, technology is limited in my school. I do not really give them the opportunity to interact with my personal stuff because … what is going to happen if it is broken? I'm going to be the loser, because nobody will repair it.

Teachers 3 and 8 were afraid that their equipment might be broken and they would be personally responsible for repairing it: these teachers reported that they often resorted to using teacher-centred methods of teaching with technology, which may not enhance learning by exploiting the potential of the medium.

A further concern, cited by Teachers 6, 7, 8 and 9, was that their personal equipment might be stolen on the school premises or they could be robbed on their way to school. These schools were located in gangster-ridden communities where the crime rate was high. The school premises were frequently burgled and technological equipment stolen. Teachers 3 and 6 explained:

> ... smart boards, I think, were installed in the school but there was a problem. I heard people from the community broke into the school and stole stuff, the projector and all that. There are some classes now in the school that got smart boards but they don't have projectors because they were stolen. I could not bring my laptop to school every day because I was scared of being robbed.
>
> … I have got a frame for a screen – you know, those pull-down screens, but my thing is, we get such a lot of break-ins at the school. The school is situated in the heart of gangster land. So, I could not bring my projector to school every day ….

It was evident that these teachers were concerned about the security of their possessions on the school premises. On one particular day, the researcher could not observe Teacher 6, because classes were interrupted by gang-related shootings outside the school. Studies conducted by Mathipa and Mukhari (2014), Gedye (2016) and Pelgrum (2001) reported equipment stolen from schools, and the researchers predictably suggested that schools should make plans to reduce theft and vandalism on the school premises. The e-Education Policy document (2004)

that guides the use of technology in the classroom focuses only on the availability and the training of teachers in the use of technology to address national goals.

Another disabling factor for technology integration at schools described as 'low-level of availability' was that computer laboratories were over-crowded. Evidence in Teacher 10's school showed that computers were limited in the laboratory and that some of these were not even functional. During interviews, Teacher 10 reported that she had 15 functional computers and about 40 learners in her class:

> The computers in the lab could not cater for all the learners in my class. I had about 40 learners with about 15 functional computers, which was a challenge.

Mathipa and Mukhari (2014), Aslan and Zhu (2015), Francom (2016) and Elemam (2016) attribute teachers' resistance to using technology to large classes in which there were too few computers for the number of learners. Chigona et al. (2010) found that over 700 learners were expected to use 25 computers, which unsurprisingly discouraged teachers from using them. In 2014, the majority of teachers in a study by Chigona et al. indicated that their schools did not have sufficient computers for all the learners to use.

Teachers 8 and 9 taught at the same no-fee-paying school and were concerned about accessibility to the limited technological hardware they had in their school. School management gave priority to the Foundation Phase (FP) teachers to use the limited technological equipment they had because they believed that these learners had a greater need to be visually stimulated than learners in the Senior Phases. The FP teachers kept most of the equipment in their classrooms and other teachers had to book to borrow it from them. Teacher 8 stated that:

> FP teachers used TVs and plugs on a regular basis … The principal told us, 'you can't use it … it is the Foundation Phase's radio, you can't use it …' That is why I brought my own things [technological equipment] when I taught these learners, no stress!

In their study, Ertmer et al. (2007) indicate that teachers are reluctant to use technology if it is not accessible. Similarly, Mirzajani et al. (2016) and Francom (2016) found that a barrier to teachers' use of technology was access to technology equipment.

In discussing accessibility issues, Teacher 3 mentioned that the technology equipment in her school was old, and that she experienced technical problems when she used it, thereby wasting instructional time. She explained:

> My external challenge would be the quality of computers that we have in the school. They were very old–old–old–old [*emphasis that the technological equipment were outdated*] and they were not maintained. Those computers sometimes froze while I taught with it …

Khodabandelou et al. (2016) and Al-Awidi and Aldhafeeri (2017) mention that one of the concerns of the teachers in their studies was that technological equipment was not maintained, which affected its functioning and frustrated the teachers.

In a school with inadequate technological equipment, Teacher 3 indicated that they booked technology equipment from the administrators who had a diary with specified dates and times. The booking system gave all teachers in the school equal opportunity to access the limited equipment there was. However, Teacher 3 was concerned with the time it took to set up technology equipment in her classroom, which wasted instructional time*:*

> It is worth it to book to use the projector if I know I am going to use it a lot or for the whole day, but now if I am setting up to use it [*technology*] for five minutes … it's … it's annoying, it's a waste of time transporting it back and forth. My class is a bit far from the admin building ….

Teacher 3 further expressed her fears about the dangers of booking and transporting technology equipment to her classroom.

> … but my issue with booking technology is that, what if something happened to the projector while I am transporting it [*technology*] to my classroom? Or if a teacher had used it before me and something went wrong and they [*administrator*] didn't picked it up and then I took it to my classroom, and suddenly it doesn't want to work, they would say I damaged it ….

Teacher 3 expressed other concerns about the 'booking system':

> There are three CD players which the whole school have to use. Each time I wanted to use it, it was not available. I kept the one CD player in my cupboard without the administrator's knowledge you know, which is still in my cupboard as we speak. I didn't tell anybody I had the CD player and the remote cause I used it for my classes [*laughing*].

From this excerpt, it is clear that Teacher 3 was not able to use the technology equipment whenever she wanted to. Oncu et al. (2008) acknowledge that when rules are put in place for the use of limited technology resources, there are bound to be several teachers who want to use the same resources at the same time. Without the knowledge of the administrator, Teacher 3 kept the school's CD player in her classroom, preventing other teachers from using it.

The availability and accessibility of technological hardware can be linked to the concept 'facilitating conditions' of the UTAUT2 model. Through inductive analysis, it was discovered that teachers used technology because they had bought their own personal equipment. Though available technology can motivate teachers to use it, many teachers struggled with the disruptions that it caused in the beginning of a lesson, which reduced instructional time. No-fee-paying schools did not have resources, which put a strain on teachers, however, it is important to mention that teachers who are competent, may not need abundance of technology to be able to teach innovatively.

5.2.2.2 Availability of software programs

In the online survey, 22 (29%) out of 74 teachers reported that the availability of software programs encouraged them to use technology in their teaching. In the interviews, four of the ten teachers explained that educational programs installed on the computers in the laboratories encouraged them, to use it with their learners. Teachers extended the class teaching by assigning learners to undertake exercises that improved their literacy levels. Teacher 2 explained:

> The computers in the labs have got literacy programs, so learners could either do games or exercises. I mean, there're a whole lot of activities that they could do using computers which improved their literacy levels.

During the researcher's classroom observations, she noted that Teachers 4, 5 and 10's schools (Teacher 2 was not observed) subscribed to many software programs which were used in teaching and learning. Teacher 4 used the 'Readers are Leaders' program during one of the researcher's classroom observations to improve learners' literacy skills. In Teacher 10's school, the Khanya project had installed Science and Literacy programs on the computers in the laboratory where teachers were obliged to take their learners regularly to complete exercises.

Although teachers had educational software programs, one teacher was concerned that some of these programs were not in line with the curriculum, which made her reluctant to use them since her priority was to finish the curriculum. This teacher suggested that technology experts should develop programs that align with the CAPS curriculum, to encourage more teachers to use technology in their teaching. Teacher 10 explained:

> … because right now some of the applications in the computers were not relevant to the curriculum. I wanted a scenario where … for instance, I teach Algebra and learners could go to the lab and do exercises on Algebra – this will encourage me,

> you know. Maybe technology experts need to develop relevant applications that are in line with the CAPS curriculum.

Gode et al. (2011) notes that the lack of specific educational software programs to aid learners in understanding topics in the curriculum is a hindrance to teachers' use of technology. Some teachers in this study believed that using the existing software was a waste of time because the programs were not aligned with their curriculum. In line with this finding, teachers interviewed in Vrasidas's (2015) study indicated that the educational games to which they had access were not relevant to their curriculum: these games were used to reward students who completed their assignments on time. Goktas et al. (2009), Goyal et al. (2010), Yeung et al. (2014) and Mai and Hong (2014) recommend that schools should install relevant software programs that can enhance learners' understanding of the curriculum.

Only three teachers (Teachers 2, 4 and 5) interviewed had uninterrupted access to the Internet. The Internet speed observed in classes of teachers who taught at fee-paying schools (Teachers 4 and 5, Teacher 2 was not observed) was faster and they could use it to do a variety of things such as formatively assess learners using the smart board. According to Teacher 5, access to the Internet was the most significant factor that persuaded her to integrate technology into her daily lesson plans.

> … I mean, my entire teaching is based on the Internet – our school has got uncapped Internet … to me accessibility to Internet is the biggest one (*most significant factor that influenced her to use technology*) as I went to search engines to look for materials for my classes.

Ertmer et al. (2007), Lau and Sim (2008), Cubukcuoglu (2013) and Gode et al. (2014) all found that the availability of Internet or Wifi is a significant factor that influenced teachers to use technology in their teaching. The Internet affords access to a variety of up-to-date information that teachers can use when preparing their lessons (Al-Awidi & Aldhafeeri, 2017; Pema et al., 2017).

Two teachers (Teachers 1 and 10) reported during the one-on-one interviews that they had intermittent access to the Internet and that the connection was slow. It was difficult for these teachers to access and download information, since clicking on the computer to open a page took some time. Teachers 3, 6 and 7 had no Internet access and Teachers 8 and 9 had Internet available in their school, but only administrators and principals were allowed to use it because of the cost. Regarding Internet connectivity, Teacher 1 reported:

> With regards to internet, the internet is gone now and I don't know when it's going to come back. When the internet is back, the connection is slow, one can't download anything online. We have deadlines and we have to prepare lessons and we can't ... we have to do research on our lessons but we can't … I use books more to get information.

Many no-fee-paying schools had no or interrupted Internet access, and anti-virus programs were not updated regularly. Such factors made teachers reluctant to use school equipment as they were afraid of losing important documents on their memory sticks because of a computer virus. Sherman and Howard (2012) found that teachers in their survey did not use the schools' technological equipment because of viruses that affected the functioning of the computers. A similar finding was reported by Wang (2008), Kopcha (2012), Miima et al. (2013) and Al-Faki and Khamis (2014). Teacher 8 commented:

> … we had few computers in the lab but they were very slow to use because anti-viruses were not regularly updated. We had no technical assistant, so teachers who were experienced in the use of technology sometimes updated software programs ….

From the schools observed, it was evident that the WCED, through the Khanya project, has provided technological hardware and software programs to some public schools, but a significant challenge was to update the equipment and the software. In schools where software was not being updated, teachers used their own personal equipment in order to avoid infecting their memory sticks with viruses. These teachers thus used their own equipment irregularly, and mostly only for administrative purposes. In the online survey, 52 (70%) out of 74 of teachers reported that a lack of software programs hindered their use of technology.

These findings are linked to the concept 'facilitating conditions' of the UTAUT2 model. Some schools have invested in purchasing software programs and updating them; which encouraged teachers to use it in their teaching and learning. The software programs, according to the teachers, provided opportunities for learners to learn content in a more interesting manner and improve their literacy skills. According to some of the teachers interviewed, they were discouraged to use technology because educational software programs were not in line with the curriculum, slow connectivity of internet, and viruses affected computers. Installing educational software programmes in schools for learners to use is important, but they need to be taught how to use basic features of technology first, in order not to waste time allocated for the programs.

5.2.2.3 The availability of technical support

Another factor affecting teachers' use of technology was the availability of technical support. In the online survey, 27 (36%) of the 74 teachers responded that they had access to technical support, which meant that almost two-thirds of them had no technical support. These numbers correspond to the division represented in Figure 5.3, which shows that the majority of teachers were from 'no-fee-paying schools' which lacked resources.

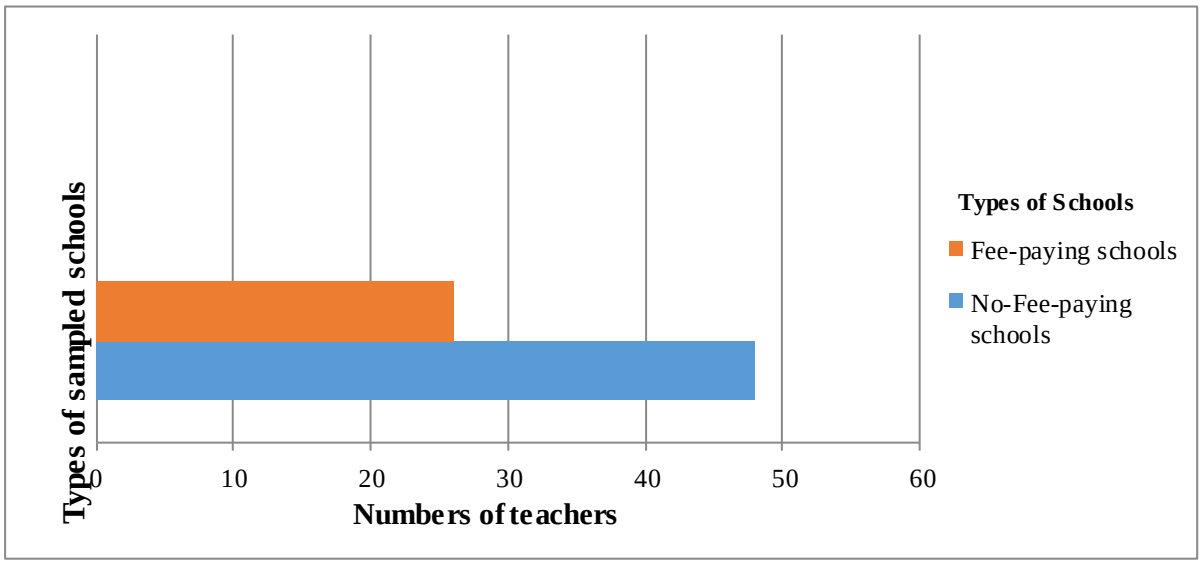

Figure 5.3: Types of sampled schools

Figure 5.3 shows that the majority of teachers, 48 out of 74 (65%), were placed at no-fee-paying schools, while 26 out of 74 (35%) were from fee-paying schools.

During the one-on-one interviews, the teachers from schools described in Section 5.2.2.1 as 'high level' schools with freely available hardware and software, revealed that they had technical assistants to support them when they taught with technology. These teachers frequently mentioned that the 'regular maintenance' of technological equipment and 'reliability' of technical assistants facilitated their use of technology, allowed them to develop their knowledge of technology and integrate it into their teaching with greater confidence and in more innovative, time-saving ways.

During the interviews, three teachers indicated that there were technical assistants who were permanent employees at their schools. These technical assistants helped in updating software programs and maintaining hardware, preventing or minimising breakdowns during teaching. Teacher 2 commented:

> … the IT guy [technical assistant] was employed by the SGB. Part of his job was to repair all the hardware on the school premises, from computers, smart boards and updating software.

Teacher 4 indicated:

> We have IT support in my school. The technical assistant constantly updates software programs and fixes computers in the labs and in our classrooms, which reduces breakdowns during teaching.

Teacher 5 explained:

> Mr X [a pseudonym] is the IT expert, he maintains all the hardware and updates the software and that just takes away the stress from teachers ….

According to ChanLin et al. (2006), it is normal for teachers to be worried about the breakdown or malfunction of technology equipment during teaching as it wastes teaching time. Thus having technology support staff in schools to maintain the equipment helps teachers to use technology for teaching and learning (Goyal et al., 2010; Teo, 2011; Singh & Muniandi, 2012).

Confirming what was said in the one-on-one interviews, it was observed by the researcher that Teachers 4 and 5 (Teacher 2 was not observed) had technical assistants, who helped the teachers to resolve technical problems in their classrooms. Besides providing assistance to the teachers, the technical assistants helped learners to log onto the computers in the laboratory. This finding endorses Teo's (2011:2438) comment that when teachers feel technical support is "available, accessible, and timely," they will be more likely to use technology for teaching and learning.

Schools that employ technical assistants need them to be reliable. Teachers 2, 4 and 5 commented that the technical assistants at their schools were reliable and responded swiftly to technical queries, thereby saving instructional time. At some schools, the technical assistants were permanent employees who worked normal school hours from 8:00am to 14:30pm from Mondays to Fridays. These findings correlate with the researcher's classroom observations. On the first day of the researcher's classroom observation, Teacher 5 requested assistance from the technical assistant when her laptop would not connect to the smart board. The response from the assistant was prompt, and the teacher continued her lesson without losing much teaching time. These findings are corroborated by Mueller and Wood (2012), and Francom (2016). In their studies, IT assistants responded to technical problems swiftly. Chigona et al. (2014) confirm that, without readily available support, teachers are reluctant to use technology for

teaching and learning since simple technical problems take too much time to be resolved. As Teacher 2 remarked:

> … sometimes there were technical problems in my classroom … since the technical assistant was always on the school premises [he is a full-time employee], he fixed the technical problem with an insignificant loss of my teaching time. His promptness in responding to queries also motivated me.

Teacher 4 emphasised:

> … our IT guy is reliable; he comes in the morning and leaves at the end of the day, so he is always there to help …

As part of having reliable technical support, Teacher 5 reported that the technical assistant at her school ensured that learners in the computer laboratory did not go into social networks but engaged with the task given by the teachers:

> When I gave them [learners] a project and they were working in the computer lab, the technical assistant helped them to log onto the computers, also made sure they didn't go to social network sites …

When teachers in this study were asked to describe the services of the technical assistant, only two teachers stated that technical assistants sometimes trained teachers to use equipment and software programs. Teacher 2 commented:

> Our actual computer facilitator is skilled in Word, skilled in Excel, he developed his own websites ... he is a programmer so … he is kind of the go-to guy if there is anything teachers need to know, and he also trained teachers.

Teacher 4 emphasised that "the IT guy is also involved in training teachers every term ….". In Mereku et al.'s (2009) study, a teacher reported that technical assistants were willing to provide training to teachers.

In summary, Teachers 2, 4 and 5 were placed at WCED 'fee-paying schools' and had reliable technical assistants. These teachers were able to make use of technology as technical problems were addressed with minimal loss of instructional time.

Teacher 10 reported that her school had a technical assistant, but this was not in itself enough to encourage her to use technology in her classroom. She used phrases such as "not reliable," "not prompt," "not always there" to describe this technical assistant. The person concerned was a volunteer from the community.

There is substantial evidence in the literature that unreliable technical assistants hinder teachers' use of technology (Al-Faki & Khamis, 2014; Hsu, 2016; Al-Awidi & Aldhafeeri, 2017). In a study by Chigona et al. (2010), teachers lacked readily available technical support and it took time to resolve technical problems in the classroom. As a result, a number of teachers in their study indicated that they usually planned their lessons without integrating ICTs because they were not sure if the technology would be in good working condition or that they would get assistance in the event of a technical hitch. This observation lends support to a finding by Schrum et al. (2008) that teachers eschew technology if they fear it will not work properly in class, and that they may waste instructional time fixing the problem.

Teachers 6 and 7 had no technical assistance since they had no resources in their schools. They used phrases such as "I would prefer us to first have the equipment before we can talk about an assistant"; "technical support, no – no – no [*emphasis*] we do not have such a thing here …" to characterise their lack of technical assistance. This finding corroborates the results of the online survey: the majority of teachers, 47 (63%) out of 74, indicated that a lack of technical support hindered their use of technology for teaching. Researchers agree that a lack of technical support is another key barrier to teachers' use of technology (Lau & Sim, 2008; Goktas et al., 2009; Miima et al., 2013; Nikolopoulou & Gialamas, 2016; Hsu, 2016). Buckenmeyer (2010) reports that if no-one is available to assist teachers when they face technical problems, even teachers who habitually use technology may grow frustrated and stop using it for teaching and learning.

In this section, teachers in fee-paying schools used technology because they had available and reliable technical assistants, who were permanently employed in the schools. The technical assistants trained teachers in the use of technology. This relates to the concept of "facilitating conditions" of the UTAUT2 model. However, in the no-fee-paying schools, either there were no technical assistants, or they were unreliable as there was no available funding.

5.2.2.4 ICT-integrated school manuals

A factor that encouraged one of the ten teachers interviewed was the availability of ICT-integrated school manuals. The school manuals provided information about the curriculum in relation to CAPS, so as to guide a teacher developing lesson plans. The manual suggests how technology may be incorporated into the teaching of particular content in the curriculum so that teachers need not spend excessive time searching for appropriate technological course materials (Vrasidas et al., 2010; Kaleli-Yilmaz, 2015). Teacher 4 commented:

> … the school manual suggests technological tools I could use with my learners when teaching a particular content. This makes teaching easy, you know, as I don't have to spend time searching for course materials.

When Teacher 4 was probed further, he reported that all the teachers in his school used technology because they were indirectly forced to do so by their school's policy. He commented:

> Well, at my school I had to use technology, I was forced to use technology. During my interview for this job in 2013 … I was told I had to use technology.

Similar findings were reported by Baek et al. (2008), Mahmood et al. (2014) and Mirzajani et al. (2016). They found that teachers used technology in the classroom because it was mandated by the school. But, Czerniewicz and Brown (2009) warn that teachers should not be forced to use technology if they are not fully able or willing to do so, because they are likely to use it ineffectually.

When teachers were asked whether they were aware of ICT policies, five out of the 10 teachers claimed to be unaware that there were official policies outlining an ICT vision for the country. Using technology for teaching and learning was for them a matter of choice: they did so because they were aware of its benefits to their learners. On the issue of ICT policies, five teachers made the following comments:

> "… I don't know …"
>
> "Is there any policy?"
>
> "We were not given any policy …"
>
> "I don't know any policies about technology. I used it because I felt like using it ... and I know it is not illegal to use it …"
>
> "Basically, we don't have a policy but just no cell phones. The learners can't come with cell phones".

Research studies from Vietnam, Norway, South Africa and Kenya report that teachers are not aware of policies that set out the ICT vision for their countries (Dang, 2008; Gode et al., 2014; Mathipa & Mukhari, 2014; Nchunge et al., 2012).

In South Africa, the e-Education White Paper maps out the ICT vision (WCED White Paper on e-Learning, 2004). One of the aims of this White Paper is for teachers to integrate technology into curriculum delivery in order to prepare learners for the technology-driven 21st-century

workplace. The teachers interviewed in this study were unaware of this document. Two of them reported that their schools had their own policies to enforce the use of technology in curriculum delivery. These schools had resources to support technology use in the classroom, including school manuals in line with the CAPS document. The manuals suggested software applications that could be used to teach a particular topic. This finding can be associated with the concept of 'effort expectancy' explained by Venkatesh et al. (2012), who found that an individual will use technology when less effort is required of them to do so.

It is evident that the South African government has developed ICT policies to foster access and implementation of technology equipment in both urban and rural public schools. In response to these policies, some fee-paying schools had created ICT-integrated manuals with the objective of guiding teachers when preparing and teaching with technology. While this may create "facilitating conditions" (UTAUT2) for teachers in fee-paying schools' uptake and use of technology, in no fee-paying schools', availability and accessibility of technology remain a problem. Therefore, it is impractical for policymakers to have policies without ensuring that all schools have technology resources.

5.2.2.5 Electricity shortages

Power supply problems were identified as another barrier to teachers' use of technology in their teaching. The researcher did not ask teachers during the online survey whether a lack of electricity affected their use of technology. However, during the one-on-one interviews, all ten teachers unanimously agreed that power failures negatively affected their teaching with technology. Teachers 2 and 5 stated:

> Every single day when the lights go off there is a bit of a problem … we had a power failure just the other day and it was such a twiddling of thumbs because I could not teach my lessons ….
>
> … I have become too reliant on technology – so much so that when there was a light failure, my entire lesson was messed up … because for me my everyday lesson was geared towards technology … so when there was power shortage, my lessons were a flop.

This result correlates with studies by Aslan and Zhu (2015), Khodabandelou et al. (2016), Baz (2016) and Al-Awidi and Aldhafeeri (2017), which found that a lack or intermittent supply of electricity in schools is a barrier to teachers' use of technology. Kisirkoi (2015) recommends that governments support schools by ensuring a reliable delivery of essential services.

It should be noted, that during the period of data generation, there were temporary electricity cuts, known as 'load-shedding' in South Africa, which did not lead to "facilitating conditions" (UTAUT2). When there was no electricity, instructional time was lost: some teachers indicated that they had no alternative teaching plans, while others switched to the more traditional method of blackboard teaching.

5.2.3 Advantages of technology over conventional methods of teaching

All the teachers used technology because of the benefits associated with it. From the online survey, 60 (81%) out of 74 teachers indicated that they used technology because of the value it added to their teaching and learning. Research findings (Ertmer et al., 2007; Miranda & Russell, 2012; Martin et al., 2013) corroborate this, ranking the benefits to be derived as the most significant factor that influenced teachers to use technology in their teaching.

All of the six teachers observed used technology to deliver their lessons because it saved time compared to when they wrote notes on the chalkboard. These teachers prepared lessons at home on their laptops and presented them by using a projector or smart board. During the one-on-one interviews, the teachers reported that, because instructional time was saved when they taught using technology, they were able to spend more time engaging with learners in their classrooms. This issue is highlighted in Teacher 2's comment:

> With technology, I always completed my curriculum on time. I prepared my lessons at home using my laptop and then I just flashed on the smart board. I don't write notes on the board, which could waste instructional time, you know. So, I always had enough time during lessons to explain and discuss content with my learners.

The literature (Ertmer et al., 2012; Lambic, 2014; Liu, 2016) confirms that teachers use technology in their classrooms because it has the potential to save instructional time when used appropriately to present lessons. These researchers note that the advantage of saving instructional time is that teachers cover subject matter faster and have more time to address the academic needs of their learners.

Teacher 1 taught different classes in the same grade. Rather than laboriously copying notes onto the board in each classroom, he used archived course materials on a flash drive to save time. The researcher's classroom observations indicated that all six teachers archived their notes on flash drives and/or computers, which made them easy to re-use when needed. When discussing the benefits of using technology, Teacher 1 explained:

> I've got three Grade 5 classes with about 43, 44 and 44 learners. Preparing lessons and saving them on a flash [drive] made my life easier as I could use the same notes in all my classes. Just imagine if I had to copy notes on the board in all my classes, that could have been terrible and a waste of time, you know.

One infers from this that it is more convenient and requires less effort to teach with technology. Baek et al. (2008), Chen and Reimer (2009), Mwalongo (2011) and Mohamad et al. (2015) acknowledge that it is easier for teachers to re-use teaching materials that they had archived. In Martin et al.'s (2013) study, teachers used Wimba, a virtual tool, to archive information, and this made course materials easily accessible. When a lesson is technologically prepared, teachers do not have to write it up on the board "again and again," which wastes instructional time (Baek et al., 2008:228). Some teachers in this study added that technologically prepared course material gave teachers the opportunity to reflect upon and revise their course materials.

In the one-on-one interviews, two teachers indicated that technology relieved them of the burden of talking in their classrooms. Teacher 6 commented:

> I mean, one hundred percent of the time I am explaining things to learners. I really get tired talking all the time. The first truth is I get tired of talking, you know ... I get tired of having to read when I can just press a button and let them listen and then we chat about the issues. So, technology alleviated the burden of talking as I showed them videos and from the videos we discussed issues.

As confirmed by the researcher's observations, these two teachers used a teacher-centred method of teaching as they mostly explained content to learners with little or no engagement from them. Showing videos to learners relieved the monotony of lecturing. The teachers showed videos to illustrate a concept and afterwards engaged their learners in discussion.

Because Teacher 4 could not write clearly on the chalkboard, he prepared his lessons on PowerPoint and presented them on a smart board. He increased the font size to ensure the clarity and legibility of the material:

> … I typed my lessons 'cause my handwriting sucks ... I'll rather let them see the correct spelling than ask me '… Sir, which letter is this?'

It should be noted that all the teachers placed at no-fee-paying schools indicated during the interviews that if they had technology resources available and accessible, they would prefer to type their lessons rather than write them up on the chalkboard. A teacher in Baek et al.'s (2008) study reported that he used technology because it allowed him to adjust text for visual clarity.

Two of the ten teachers interviewed indicated that they sometimes posted notes on Blackboard, an online teaching and learning platform, because it was convenient and required minimal effort. Although these teachers were observed in their classrooms, this information could not be confirmed. By using Blackboard, the teachers claimed that class notes were made accessible; a learner who was absent from school or one who had problems focusing in class, could go to the Blackboard site and download lesson materials. Teacher 4 reflected:

> I posted materials (class notes) on Blackboard. This means that a learner who wasn't there on a particular day when a lesson was taught could still have access to what I taught in the classroom. A learner who wasn't focusing, a learner who was sick actually, had access to what was taught.

This finding correlates with recent studies by Izmirli and Izmirli (2015) and Pema et al. (2017). They reported that the benefit of teachers using technology was that it was flexible, that learners could access information regardless of time and distance. This flexibility seemed to make learners more motivated to learn (Mahmood et al., 2014; Izmirli & Izmirli, 2015) and added to the "performance expectancy" (UTAUT2) of the both teachers and learners.

All ten teachers interviewed used technology, although to a varying extent, to instil technological skills in learners. Teachers are in this way preparing learners for the technology-driven 21st century workplace. Teacher 3 reported:

> My school is not in a very well-to-do community. It is a previously disadvantaged community, so because many of the learners did not have technology at home, they were not used to technology. So, I tried as much as possible to incorporate some kind of technology in my lessons, just to give them that exposure.

Teacher 3 indicated that she used technology because she wanted her learners to be at the same level as their peers from other schools who were exposed to an abundance of resources. Ahadiat (2005), Kumar et al. (2008) and Chen and Reimer (2009) argue that, as is the case in this study, teachers use technology because it is a 21st century trend and part of the new pedagogy. Teacher 5 reported:

> South Africa, the world is growing technologically – most classrooms are paperless, my colleagues are using technology. Not knowing how to use technology for teaching or not using technology would have been a disaster, you know ….

From this excerpt, it could be inferred that teachers were satisfied that they were doing the right thing by using technology. This finding might be associated with the construct of 'hedonic motivation' of the UTAUT2 model, and the idea that people would use a technology because they derived satisfaction from it. All six teachers observed by the researcher in their classrooms

were spearheading the use of technology in their various schools, which gave them personal satisfaction.

Although the teachers were using technology in their classrooms because of its benefits, when probed by the researcher, two of them indicated that the TEI from which they had graduated did not adequately prepare them to teach with technology, since the focus of their training had rested mainly on content acquisition. Teacher 6 stated:

> … at varsity to a lesser extent we were taught how to use technology. Emphasis was placed so much on content. Now my school did not send us on professional development training on technology because there are no resources. I mean we have nothing in the school. I teach with my personal equipment … So, my technological level is hanging in there, you know [meaning technological knowledge is low].

It was evident during the researchers' classroom observations that the majority of teachers (Teachers 1, 8, 9, 10) lacked the ability to use any of the advanced features of the technology employed. In sum, they were not able to blend technology, pedagogy and content knowledge in the ways required for effective teaching with technology (Mishra & Koehler, 2006). This finding contrasts with the interviews, where the majority of teachers (see section 5.2.1) reported that they were competent in the use of technology. This discrepancy between stated competence and actual lack of competence seems to result from a lack of self-awareness on the part of the teachers, an unawareness of what it means to integrate technology into curriculum delivery effectively. It could be inferred that the teachers thought that by being skilled in the use of a particular application (for, say, communication and entertainment), they were competent in using technology for teaching and learning.

Baylor and Ritchie (2002) report that teachers will not use technology for teaching and learning if they do not have the skills to do so. For instance, in Chigona and Chigona's (2010) study conducted in South Africa, some teachers – although they had the resources to support its use – did not use technology for teaching and learning because they were not sufficiently skilled to do so (see also Boadu et al., 2014).

The majority of teachers (seven out of ten) in the current study declared that they were more confident in their content knowledge than in their pedagogical knowledge of how to teach with technology. Researchers (El Semary, 2011; Liu, 2011b; Al-Faki & Khamis, 2014; Ndibalema, 2014) acknowledge that one barrier to teachers' use of technology for teaching and learning is a lack of pedagogical skills. Teachers in these studies could not effectively use technology to

enhance teaching and learning. The following excerpts from two teachers in the current study explain this point:

> … I'm trained as a middle-school teacher – Intermediate Phase teacher – so content knowledge was certainly not a problem, but yes, there was a bit of a pedagogy problem with technology 'cause of the kind of professional development training we had. I sometimes struggled to harness pedagogy and technology. (Teacher 1, interview)

> … there is nothing that stopped me from using technology in other subjects like Maths, I just don't know … I'm just not sure how to integrate technology with other subjects. I have not been taught. I have the content knowledge but definitely not the pedagogical knowledge. (Teacher 6, interview**)**

From these excerpts, it can be deduced that these teachers lacked pedagogical knowledge. In fact, four of the six teachers observed in the study (Teachers 6, 8, 9, 10) lacked appropriate pedagogical skills. They used PowerPoint to present subject matter and ready-made videos from YouTube, with little or no engagement with their learners. Technology was used to replicate the conventional method of teaching with a chalkboard. Some of these teachers (from no-fee-paying schools) appeared to be unable to design interactive lessons involving technology. Mishra and Koehler (2006) emphasise that for teachers to teach effectively with technology, they must be able to blend technology, pedagogy and content.

During classroom observations it was evident that two teachers (Teachers 4 and 5) had TPACK skills. These teachers gave learners interactive activities that required them to take responsibility for their own learning (see Chapter Six). The learners were given opportunities to collaborate and complete technological projects. It should be noted that these two teachers taught in fee-paying schools and were sent on regular professional development training in technology: they may have acquired TPACK skills during their training. Regarding TPACK skills, Teacher 4 commented during the one-on-one interviews:

> We have had so many professional development trainings on technology, so it [TPACK] comes naturally when I teach because I am confident of my content, pedagogical and technology knowledge. I know, for example, if I want to teach listening skills, I know exactly which technology and activities I could use with my learners.

When Teacher 4 was asked to briefly describe a project that blended technology, pedagogy and content, he explained:

> … like most often I gave learners tasks that required them to work in groups, search for information on the internet and present to their peers. I believe this learner-centred method/way of teaching enhanced learning.

This finding was corroborated during the researcher's classroom observations. As already mentioned, Teachers 4 and 5 engaged learners in hands-on activities that required them to search for information on the Internet, to write their assignments and collaborate with their peers to develop new projects. These two teachers had the ability to blend technology, pedagogy and content in the ways requisite for effective teaching with technology (Mishra & Koehler, 2006).

5.2.4 Encouragement from others

Teachers in this study received support from others when they prepared lessons and taught with technology. This aspect is discussed in terms of four themes: support from principals, colleagues, family members and learners.

5.2.4.1 Principals

Support from principals encouraged teachers to use technology in their teaching. From the online survey, 18 out of the 74 teachers (24%) responded that they received support from their school principals. Approximately three quarters of the teachers received no support from their principals. One possible reason for this finding is that the principals could be 'digital immigrants' who were not trained to use technology, and thus not interested in supporting their teachers to do so. In the one-on-one interviews and classroom observations, it was confirmed that most principals were in their 40s or 50s. Studies have revealed that older people resist the use of technology because they were born and grew up before its advent (Mathipa & Mukhari, 2014; Ndibalema, 2014; Al-Awidi & Aldhafeeri, 2017).

From their responses in the interviews, it is evident that some of the teachers in this study were encouraged to use technology because of positive remarks from their principals. Some principals even allocated time for all the teachers in their schools to use the computer laboratory since Science subjects were given priority. These findings pertain to the construct 'social influence' in the UTAUT2 model. Venkatesh et al. (2012) found that support from others encouraged the use of technology.

Teacher 7 indicated that he regularly used his personal technological equipment for teaching and learning because of positive remarks or acknowledgements from his principal. The

principal acknowledged the effort that he made in using technology since the school lacked resources. The principal's acknowledgement was thus an incentive for Teacher 7 to use technology in his teaching:

> My principal studied a long time ago, like they wrote on slates and stuff like that! But now it is different times because teachers are using technology in their teaching. The principal knows technology is important for teaching and learning. She is impressed, and she said during staff meetings … she made some positive remark: 'Mr … I know you are doing great with the children in your class, keep it up!"

Teacher 6 explained:

> Well, when my principal heard about this project and that you [the researcher] were coming to my class, it made quite an impression on her because we don't have resources. She engaged me in conversations, in the corridor, concerning how I used technology in my classroom. To me, she recognised the effort that I put in when I taught with technology, which motivated me to regularly use it.

Teachers 6 and 7 did not have any resources to support their teaching with technology. They lacked basic resources such as cables, plugs and connection sockets. Teacher 7's school still had pre-fabricated buildings. Though these teachers lacked physical resources, they were incentivised by their principals' comments to use technology. The principals were excited because these teachers had put in extra effort to teach with technology. Studies have shown that incentives encouraged teachers to make frequent use of technology for teaching and learning (ChanLin et al., 2006; Goktas et al., 2009; Goyal et al., 2010; Cubukcuoglu, 2013).

From the researcher's classroom observations, it was obvious that Teachers 4 and 5, who taught in fee-paying schools, were supported by their school principals. From school funds the principal bought the teachers personal laptops, which they used to plan their lessons, both at home and at school. As a result of this kind of support provided by the principals, Teacher 4 indicated, in an informal conversation, that all the teachers in his school were using technology for teaching and learning. The principal made the school environment conducive to this. Teacher 5 commented:

> … we have personal laptops, which was like a boost for me to use technology – we were not given a laptop to put it in a box and cover it, it was for us to use in the classroom … so I used it most of the time to prepare lessons at home, which was convenient for me.

A similar sentiment has been recorded in studies reporting that owning a personal laptop was an enabler of teachers' using it in their classrooms (Dinh, 2009; Yeung et al., 2014). Due to the

importance of owning personal laptops, Kahveci et al. (2011) advocated that schools should explore funding opportunities in order to provide teachers with personal computers.

At Teacher 10's school, the principal created a timetable which gave all teachers an equal opportunity to use the computer laboratory. The reason was that the Science teachers had previously been given priority to use the computer laboratory. This gesture by the principal made technology accessible. But, Teacher 10 reported that teachers in her school were still not happy because the time allocated for use of the computer laboratory, was limited. Teachers could therefore not make optimal use of it. And the fact remained that Science was still privileged because most of the educational software installed on the computers in the laboratory was related to the sciences:

> In our school the computer laboratory was assigned to the Khanya subjects [the Khanya project gave priority to Science subjects], only these subject teachers could use the computer lab, but the principal came up with a timetable and this gave equal opportunity to all the teachers, even though the time allocated for teaching was too little.

A structured timetable to give teachers access to technology would seem to be a good, even-handed strategy in contexts where there is a shortage of resources. This links to the UTAUT2 concept 'social influence'. But Mueller and Wood (2012) found that teachers felt restricted by these structured timetables. A teacher in this study complained that had the time allocated to use technology facilities not been restricted, she could have used technology more frequently for teaching and learning. Mirzajani et al.'s (2016) study revealed a similar finding. Teachers did not have sufficient time to use the computer laboratory constructively. They were allocated an hour only, which they felt was not enough. The teachers in Chigona et al.'s (2014) study felt that if they had been consulted on the scheduling of the timetable, they could have requested more time, which might have enabled them to use technology more frequently in their teaching and learning.

5.2.4.2 Colleagues

Other teachers who taught in the same schools as teachers in this study supported them when they used technology for teaching and learning, which was a form of encouragement. This finding is linked to the construct of 'social influence' in the UTAUT2 model. From the online survey, it appeared that 36 out of 74 teachers (49%) reported that they received support from colleagues; which influenced them to use technology in their teaching. It emerged from the

interviews that out of sheer goodwill, colleagues at two schools who were skilled in the use of technology voluntarily ran workshops for their peers. According to Teacher 5, these workshops created better staff relations. This kind of collegiality makes it easier for teachers to ask for technical assistance. Teacher 5 commented:

> … we have a teacher in our school, she is really … very experienced with technology, she kind of voluntarily runs workshops. So, she is kind of the head of the punk kiddos [excellent in technology] if I can say that. These workshops have developed cordial relationships between teachers in the school.

This finding is supported by a number of previous studies (ChanLin et al., 2006; Dinh, 2009; Liu, 2011b; Mirzajani et al., 2016). In Kopcha's (2012) and Francom's (2016) studies, teachers gained confidence in their ability to use technology by working with colleagues who were more knowledgeable than they were.

Teachers from no-fee-paying schools reported that they sometimes assisted their colleagues when technical problems arose since their schools had no technical assistants. For example, Teachers 9 left his class unattended for about 15 minutes, just before one of the researcher's classroom observations, to assist a colleague who faced a technical problem. Though Teacher 9 lost teaching time, he mentioned informally that he enjoyed helping his colleagues. In contrast to this finding, Schrum et al. (2008) mention a techno-savvy teacher who was frustrated by calls to troubleshoot and assist his colleagues, as he lost teaching time. Lau and Sim (2008) suggest that schools should employ technical assistants to provide teachers with both technical and pedagogical support, rather than expect them to depend solely on their colleagues, which takes up valuable teaching time.

During the one-on-one interviews, two participants remarked that they used technological material prepared by colleagues. The reason, according to Teachers 4 and 5, was that they lacked content knowledge in Afrikaans subject matter since they were second language speakers. Teacher 4 indicated:

> For me Afrikaans was too difficult. I haven't really grasped it that much. I taught with what my colleagues had created in Afrikaans. So sometimes I got technological lessons from her [colleague] and I taught with it … next year it would be taken completely off my shoulders.

Teacher 5 reported:

> I don't prep Afrikaans. I got them [lessons] all the time from my colleague and every single activity, so I taught with what I had been given – worksheets or PowerPoint, whatever material she gave me, I used it.

As Teachers 4 and 5 had limited content knowledge of Afrikaans, they relied on colleagues to share prepared materials. In line with this, Espino (2012) and Martin and Parker (2014) found that techno-savvy teachers shared technologically-prepared course materials with their colleagues. These methods of collaboration made it easier for the teachers and encouraged them to use technology in their classrooms. Due to the importance of sharing materials among colleagues, Lau and Sim (2008) recommend that a centralised database or ICT network for teachers should be created to facilitate the dissemination of course materials.

5.2.4.3 Family members

In relation to the construct 'social influence' in the UTAUT2 model, support from other individuals – in this context, family members – encouraged teachers to use technology in their classrooms. Teachers were not asked during the online survey if family members influenced them to use technology for teaching and learning. However, the researcher set out to remain open to unexpected yet significant evidence. It emerged during the one-on-one interviews that family support motivated Teacher 8 to use technology in her teaching. Her son, who was studying at a pre-service institution, was willing to discuss with her the use of specific technology and share family technological equipment. Teacher 8 reported:

> … yes, the family had just one laptop, me and my son used the same laptop, since he is at varsity and had to do assignments with that same laptop, but sometimes he sacrificed [it] and I brought it to school and I taught with it ….

Teacher 8 continued:

> We discussed how technology fits in a lesson, how best I could use it, and which technology I could use to teach what content. He has been a great help.

Despite conducting Google-wide searches on the Internet for appropriate international and national literature on the theme of 'family support' as a motivating factor in teachers' use of technology, the researcher found nothing. Previous studies have not emphasised the importance of the family in encouraging teachers to use technology in their teaching. This theme is nonetheless important, especially in the case of teachers who are not skilled in the use of technology: support from home may help to build their confidence in dealing with technology. During her interview, Teacher 8 frequently mentioned the contribution from her son as having

encouraged her to use technology. It is noteworthy to mention that Teacher 8 is a 'digital immigrant,' but trained to use technology during her pre-service studies (she graduated in 2013).

5.2.4.4 Learners

Learners who were skilled in the use of technology assisted their peers and teachers in the classroom. Though the matter was not raised in the online survey, all the teachers interviewed claimed that they did not need their learners to encourage them to use technology. When probed further, in scenarios where teachers were using their personal equipment, they admitted that their learners did assist them in setting up before a lesson, which saved instructional time. An interesting observation made by the researcher was that learners from no-fee-paying schools were eager to assist their teachers to set up their technological equipment. These learners, who were hardly exposed to technology at school or at home, had figured out how to operate some of the equipment, helping teachers to connect plugs and cables to the laptop. Teacher 6 explained:

> My learners are good with technology. Immediately I take out my equipment from my bag; they want to help me set up. I allow them to do that, so within a few minutes we are done setting up.

Teacher 6 continued:

> Learners are very confident with modern technology. The other day, in fact last week, they took down my screen and I thought 'Oh they're going to break the legs of the screen [mobile]'. They took the screen down, they were not afraid, you know.

According to Chigona et al. (2010), Mahmood et al. (2014) and Al-Faki and Khamis (2014), it is likely for learners who are 'digital natives' to be more knowledgeable about the use of technology than their teachers. In their studies, as in the observations conducted in this study, learners who were *au fait* with technology assisted teachers in the classroom. It was evident in Al-Faki and Khamis's (2014) study that teachers actually depended on their learners to assist them to use the smart board, and solve such problems as they arose.

There is evidence from this study, as well as from those by Dinh (2012), Chigona (2013), Hoda et al. (2014) and Clarke and Abbott (2016) that teachers depend upon learners who have the requisite know-how to assist peers with tasks involving simple technology during projects. Learners in this study supported their peers in developing their technological skills as they worked together in completing their tasks. Teacher 1 reported:

> In my class we had different levels of learners, I mean their technological knowledge, and for some of them, their technological skills were very low, while others [were] high. Those that had high technological abilities were assigned to work with their peers during projects to develop their skills and help complete their tasks.

Elaborating further, he explained:

> I think it is such a beautiful thing for learners to help each other, you know. They felt good when they helped their peers. They felt they had done something good.

Though teachers welcomed the fact that skilled learners helped their peers to complete their technology projects, researchers such as Wang (2008) have cautioned that the disadvantage of this is that skilled learners could end up doing the entire technological task.

The interview data revealed that two of the ten teachers were concerned about teaching learners with low levels of technology skills. According to these teachers, when they assigned learners tasks involving technology, they most often ended up teaching learners how to use the technology, to the detriment of attention to the content. This worried the teachers as they were under pressure to complete the curriculum within a stipulated time frame. As Teacher 3 observed:

> I told my learners do this, close the page and click here, they don't know. I had to show them how to do it. Before I knew it, 35 minutes was gone and I had not taught any content. I was worried because I didn't finish what was planned for the day. Learners' technological skills were a barrier.

Similarly, in Chigona et al.'s (2014) study, some teachers focused on teaching learners the technical aspects of technology as their learners were not skilled, which prevented them from completing the curriculum. Palao et al. (2015) highlight that there is a need to impart technology skills to learners in order for them to become independent and not have to rely upon their teachers.

5.2.5 Past experience

Teachers were encouraged to use technology by previous exposure to it. Previous exposure made teachers familiar with technology, so they were able to integrate it into their teaching and learning. Four sub-themes will be discussed: professional development, pre-service training, previous employment, and school experiences.

5.2.5.1 Professional development training

Schools send teachers on professional development training in order for them to update their professional knowledge. In this study, exposure to professional development training on the use of technology encouraged teachers to apply it in their teaching. In the online survey, 30 out of the 74 teachers (40%) stated that they were exposed to professional development training in technology. This low figure could be explained by the fact that the majority of teachers were from no-fee-paying schools (Section 5.2.2.1) that had no or limited IT resources or lacked the funding to send teachers for regular professional development training.

During the interviews, three of the ten teachers were dissatisfied that they had had so few workshops regarding the use of technology for teaching and learning. Teacher 3 explained:

> We go on professional development training but I cannot remember when last we were sent to workshops on technology, you know. Since I have been in this school, they had organised just one training session because there were no funds ….

Dogan and Akbarov (2016) and Nikolopoulou and Gialamas (2016) report that irregular professional development training can undermine teachers' commitment to using technology. Without regular training, teachers may not acquire the necessary skills to do so (O'Dwyer et al., 2005; Collins & Bronte-Tinkew, 2010). There is, therefore, a need for continuous professional development in order to skill and update teachers in the use of technology for teaching and learning (Al-Zahrani, 2015).

Consistent with the findings of several previous studies (Francom, 2016; Khodabandelou et al., 2016; Hsu, 2016; Elemam, 2016), three of the ten teachers interviewed acknowledged that they had not been sent on professional development training because their schools lacked the necessary funds and/or resources. Teacher 6 explained:

> … staff members in my school were encouraged to go on professional development courses. In fact, we had professional development every term but the challenge was that there was nothing on technology. We don't have resources.

From the researcher's classroom observations, it can be confirmed that Teachers 6, 7 (he was interviewed at his school), 8 and 9 were not sent on professional development training because their schools lacked the necessary resources. This was logical because there was no infrastructure or equipment for them to practise with after training.

Contrary to these findings, four out of the ten teachers interviewed (those appointed to fee-paying schools) had regular professional development training on technology. Teacher 4 commented:

> We most often had training in technology during the weekends outside the school; we had been on smart board and many software trainings [sessions]. These exposures built my confidence and intensified the drive to integrate technology in my teaching.

According to Teacher 4:

> The school always sent us on professional development training … they [the school] always arranged things like that. Sometimes it would be school exchange programmes where we went to other schools and learned how they taught with technology, or experts were invited in the school.

From these findings, it is evident that teachers learned how to use technology through three means: workshops which were organised during weekends outside the school premises, school exchange programmes where they learned from how other schools used technology, or from experts invited to the school to train them. Teacher 5 commented:

> ... the school paid for technology trainings. Some of our technological trainings have been at B..... High school. The principal at B..... High School is smart board trained. He knows a lot and he do the Maths courses and English. We went there on smart board courses for that … activities and things one could do in a classroom, ideas on how to use the smart board … integrate it into Maths and English lessons.

Teacher 5 indicated that her principal made arrangements for teachers in her school to attend training sessions or workshops which were paid for with school funds. She expressed her gratitude for this opportunity to receive training, which encouraged her to use technology in her teaching.

These findings correlate with the results of international studies conducted by Walker and Shepard (2011), Al-Zahrani (2015) and Vrasidas (2015). They reported that professional development training encourages teachers to use technology in their classrooms. According to Baylor and Ritchie (2002), technology may be available, but teachers use it only if they have been trained to do so. In expressing their gratitude for professional development training that furnished them with the necessary skills to be able to teach with technology, teachers in Kaleli-Yilmaz's (2015) study stated that before they received this training in the use of technology, they could not use it adequately in their courses. Professional development appears to be a significant factor in encouraging and training teachers to teach effectively with technology.

Though teachers in this study were not asked what kind of technology training was most effective for them, it became evident in one teacher's interview (Teacher 5) that she preferred hands-on training because it was flexible – she could play with technology and learn in the process. Teacher 5 reported:

> We did short courses on how to use a smart board ... we had two or three sessions this year. It was practical stuff … we developed a lesson and taught colleagues, that was practical stuff.

From this excerpt, it can be deduced that professional development training in Teacher 5's school was designed in such a way that they were given activities that required them to interact with each other. In a study conducted by Walker and Shepard (2011), teachers indicated that hands-on experience with activities for them to practise was better than listening to a facilitator who explained how a form of technology could be used for teaching and learning. Studies such as that of Nyambane and Nzuki (2014) support this finding, insisting that teachers be given opportunities to practise with technology during professional development training.

Two teachers interviewed, who happened to be highly skilled in the use of technology, complained that sometimes their professional development training was not challenging enough as it focused on the basic use of computers. They felt that they sometimes did not benefit from the training as they already knew how to use a computer. Teacher 1 stated:

> … the last one [professional development training session] that I went to, was really good … some of the others, I kind of knew the stuff already from my childhood days as I was doing some of the basic computer stuff. I've been using it [technology] since my first year, during Teaching Practice, because during my Teaching Practice most of the time I was always at schools with smart boards. So, I'm quite clued up with technology … I found some of the training not very helpful because they taught basic computer stuff.

It appears that basic training in technology is important as a starting point, but it needs to progress from simple to more complex activities in order to challenge teachers' existing technology knowledge. Teachers would then be encouraged to attend professional development training and integrate technology into their teaching. Some teachers lack basic technology skills, so find introductory lessons beneficial, while others who have already mastered some skills should be able to join the training at a later stage where more difficult skills and concepts are being introduced.

In Schrum et al.'s (2008) study, schools lacked the funds to provide training beyond the basic use of the computer. Similarly, Sulungai et al. (2012), Ndibalema (2014) and Al-Awidi and Aldhafeeri (2017) found that professional development training remained focused on basic ICT skills rather than on pedagogy. This meant that teachers felt they still lacked the necessary confidence and knowledge to teach effectively with technology. Cubukcuoglu (2013) caution that training should not focus only on basic technology skills but should also develop teachers' pedagogical skills in order to be effectual.

All the teachers suggested that they should be supervised after training, to monitor problems that might arise in their classrooms and also to encourage them continuously to use technology in their teaching. This supervision could address certain challenges that discourage them from using technology. Teacher 1 explained:

> The WCED cannot continue buying computers and opening computer labs without properly training teachers. After training, school inspectors should be sent to schools to see if teachers are actually using the technology … challenges they have encountered and how they [subject advisors] could help teachers address these challenges … if this does not happen, teachers would be reluctant or stop using a technology when faced with challenges.

This recommendation is significant: some teachers reported that they had colleagues who attended professional development training sessions, but used technology only for administrative purposes or stopped using it after a while. Cubukcuoglu (2013) suggests that teachers should be monitored by education authorities to see if they are effectively integrating technology in their teaching, and be guided by them on best practice. Similarly, Khodabandelou et al. (2016) recommend that government should develop sustained programmes for the monitoring of teachers' use of technology in their teaching, lest they simply revert to more conventional instructional strategies when they encounter difficulties.

5.2.5.2 Experiences during pre-service training

Pre-service training prepares teachers for professional practice. Experiences during their pre-service training with technology encouraged teachers in this study to use technology in their teaching. In South Africa, pre-service teachers are typically exposed to technology training on a university campus with lecturers and during Teaching Practice in schools with mentor teachers.

In the online survey, 27 of the 74 teachers (36%) responded that their pre-service training enabled them to use technology. Half of the teachers were not influenced by their pre-service training. Research (Chigona, Condy, Gachago & Ivala, 2012; Tiba et al., 2015) has confirmed that TEIs do not adequately train teachers to teach with technology. This is similar to Ertmer et al.'s (2007) earlier finding, that participants rated pre-service training as the factor that least encouraged them to use technology. Research conducted by Liu (2011a) on factors influencing pre-service teachers' use of technology concluded that teacher education courses failed to prepare pre-service teachers to teach with technology.

In the one-on-one interviews, it became evident that the teachers' experiences during pre-service training on campus with lecturers and peers, and with mentor teachers during Teaching Practice, encouraged their use of technology. Regarding pre-service training on campus, Teacher 8 explained:

> **…** my experiences with the digital story [a technological project] influenced me very much because with the digital story I had to use a lot of stuff [technology equipment] to get that perfect digital story right ... After the project many of the students, not leaving myself out were encouraged as we learned how to search for information, use Photostory and summarise a text which increased my confidence to use technology.

All the teachers reported during the interviews that their experience with projects assigned them by their lecturers encouraged them to use technology in their teaching. Some lecturers devised technology projects that required them to use various technological tools. From using a range of equipment to complete their projects, they gained the confidence to use technology for teaching and learning.

Teacher 7 remarked:

> I was exposed to technology at varsity; most especially in the Geography class, we did many presentations using smart boards or projectors … so I had to somehow learn how to present my assignments using technology [smart board and projectors] after four years at varsity which encourage me to use it now with my learners …

A similar view was shared by Teacher 10:

> You know, most of my assignments during pre-service training, like 99%, were done using technology and in some instances, I presented it in class …

Teachers 7 and 10 explained that during their pre-service training, they were assigned activities that required them to search for information on the Internet and present their findings to their

peers using a data projector connected to a laptop or a smart board. After four years of making presentations they acquired the skills and confidence to use technology in their classes.

All the teachers interviewed acknowledged that they had had sporadic workshops on campus during their four years of pre-service training that focused on teaching them how to use technology for teaching and learning. These workshops motivated teachers: some of them (Teachers 6, 7, 8, 9 and 10) had little or no exposure to technology before their pre-service training. Teacher 6 explained:

> … we had computer workshops as well, with another man, and he showed us how to use the smart board. He explained how we could use it in the classroom … that motivated me because I saw things that a smart board could do.

Teacher 10 added:

> The instructor during computer training workshops showed me how to teach with technology because I came there [university] not knowing how to use a computer properly … so I did struggle but ... it was not an IT course so we didn't go deeper … but they [facilitator] taught us the basics, you know.

This finding concurs with the literature, that teacher training was instrumental in encouraging teachers to use technology for teaching and learning (Baek et al., 2008; Bozdoğan & Ὂzen 2014; Liu, 2016; Mtebe et al., 2016). According to Venkatesh et al. (2012), in terms of their construct of 'habit', teachers automatically use technology because of prior experience and exposure. However, one could infer from the findings in this study that the teachers often learned technology skills in isolation, and consequently found it difficult to blend them effectively into their teaching (Mishra & Koehler, 2006; Liu, 2011a).

Though they received training, two of the ten teachers interviewed were of the view that the training was inadequate in terms of the number of sessions in which they participated during their four years. Stressing this point, Teacher 1 commented:

> … I think it was a month or less than a month when a guy came and showed us how to use a smart board. One month for the whole year, in my opinion was too little to learn how to use a smart board.

Teacher 3 said:

> … we had [training] in our first year, second and third year as well … we had a computer course. It was not enough and in our final year we had the digital story project …

It should be noted that the ten teachers interviewed unanimously agreed that the training sessions provided by the university were insufficient for them to become familiar with, and skilled in, the use of a particular technology. According to Teacher 1,

> … because lecturers modelled how to use it [technology] and fellow students also modelled, I could see what they were doing and I learned from that.

And Teacher 8 added:

> … I taught … the Water Cycle exactly the same way my lecturer taught it at varsity. I showed the same videos to my learners.

According to these teachers, they learned to use technology from observing their lecturers, and were now replicating exactly the same pedagogy with their learners.

In contrast to this finding, Teacher 4 reported:

> … I was in my first year and there was no lecturer that said, 'Here let's open up a notebook', or for example, 'Let's do a lesson on a topic using a smart board'. So I mean, if I had not been shown how to integrate it [technology] into my lesson, how then could I now be expected to teach effectively with a smart board?

Teacher 8 reported that she learned how to use technology from her peers on campus during her pre-service training. She commented:

> I won't say we were adequately trained on how to use technology … some guy came in the second or third year, you know, he taught us how to use the interactive white board. He just showed us what it could do, he didn't show us how we could use it … Some of us were fortunate because we competed with friends when we were given tasks, like who got the best presentation and I asked them to show me how they did it.

With regard to training during Teaching Practice, three of the ten teachers in the study reported that they were fortunate to have been placed in schools where their mentor teachers used technology and were prepared to help them. Teacher 4 described his experience thus:

> No, I think I learned more about using technology in the classroom from my tutor teachers during Teaching Practice. I mean, I had one tutor teacher that was accomplished on the smart board and I learnt a lot from him. I think I would not have been this advanced without him.

This finding is consistent with that of Grove et al. (2004), to the effect that pre-service teachers learn how to use technology if they have mentors who are knowledgeable about it. This is evident in studies by Keating and Evans (2001) and Liu (2016): pre-service teachers were

encouraged to use technology as a result of modelling by their mentor teachers, especially how to design activities using technology.

On the other hand, Teacher 6 noted:

> … there were some schools which I went to but the mentor teacher was not using technology even though the school had a computer room ....

Not all teachers were exposed to technology during Teaching Practice because there were several schools where mentor teachers did not use technology in their teaching.

5.2.5.3 Experiences gained from previous employment

Another enabling factor, which became evident only in the interviews, is the training that a NQT acquired in his or her previous position or occupation. Teacher 1 had previous employment which required him to use technology. This experience made him comfortable with technology, so that it was easier for him to integrate it into his teaching. Teacher 1 asserted:

> … before I came to varsity … I worked in an IT company; we repaired hardware and also updated software … I learned how to use certain technology though not for teaching, but the experiences made it easier for me to use it [technology] in my classroom – I mean using technology was an unconscious decision.

This is similar to claims made by Aslan and Zhu (2015) and Mirzajani et al. (2016) that teachers' attitudes to the use of technology were influenced by past positive experiences. Studies conducted by Cox et al. (1999) and Kahveci et al. (2011) reveal that teachers who had past experience of regularly using technology were confident and comfortable and encouraged to use it for teaching and learning. The more experience teachers have with technology, the easier it is for them to integrate it into their teaching and learning (Lau & Sim, 2008). This finding is linked to the construct of 'habit' in the UTAUT2 model (Venkatesh et al., 2012). In their study, they found that an individual would automatically use technology if they had prior 'habit' of using it.

5.2.5.4 School experience of using technology

Four of the 10 teachers were privileged to have attended schools during their primary and high school careers in which their teachers used technology as an instructional tool. This early exposure to technology encouraged them to integrate it in their teaching. For example, Teacher 4 described his prior school experience of using technology thus:

> I was taught how to use a computer from a young age. In my primary and high school, I was already using computers. So I was quite lucky … I think that [experience] encouraged me.

Some of the teachers had learned how to use technology at school, but this did not necessarily prepare them to teach effectively with technology. Mishra and Koehler (2006) argue that teachers have to be trained to *blend* technology, pedagogy and content.

Nevertheless, Teacher 4's response suggests that when teachers are exposed to technology during their primary and high school careers, using technology in their teaching may become automatic because they have developed a 'habit' of using it. Teachers 2, 4 and 5 voluntarily and regularly used technology, partly because they were exposed to the use of technology from an early age, and certainly during their primary and high school days. This finding supports the idea that teachers will tend to teach in the way that they themselves were taught (Hoover, 1996; Thompson et al., 2002).

In contrast, Teacher 7 had no exposure to technology during primary and high school because the school he attended lacked resources. His experience of 'talk-and-chalk,', that is, the traditional method of teaching, encouraged him to use technology. The 'talk-and-chalk' method of teaching was not engaging, compared to the benefits of using technology that he experienced during his pre-service training. As he explained:

> I would say my primary and high school experiences motivated me to use technology … for instance, my primary and high school … it was chalk and board, chalk and board, chalk and board [emphasising the traditional method of teaching]. It was so boring and no interactions. I only experienced the benefits of technology during my pre-service training.

Teacher 7 described his experiences during the pre-service training programme:

> I remember when I was at tertiary – varsity … I found out that especially students who came from privileged backgrounds, they knew how to use these things [technology] … they were the ones always volunteering to do something with technology, while I found learners who came from disadvantaged backgrounds, like myself, they could not even press the computer … they would be like typing with one finger, one finger, one finger … that influenced me to teach my learners who were from poor communities, so that they do not go to varsity without any technological knowledge [laughing].

This finding echoes those of a number of studies showing that teachers' positive past experiences influence their use of technology for teaching and learning (Bakar & Mohamed, 2008; Mueller & Wood, 2012; Mai & Hong, 2014).

5.2.6 Subject area

Another significant factor encouraging teachers to integrate technology into their teaching was that of 'subject area.' All participants in this study had content knowledge, and taught IP subjects. These subjects include Life Skills, Mathematics, Social Sciences, Natural Sciences and Technology, Home languages, and First Additional Languages. From the researcher's classroom observations (Appendix K), it emerged that the majority of teachers used technology to teach EFAL. These teachers claimed during their interviews that English subject matter was difficult for their learners to grasp since most of them were second-language speakers. After a lesson observed, Teacher 8 commented:

> My learners are challenged as they cannot comprehend at a basic level because English is their second or even third language. I taught listening comprehension with a video because it was easier to interrupt it and explain the storyline to learners so that they would not get lost.

In studies by Kalanzadeh and Valizadeh (2015) and Mirzajani et al. (2016), technology was used more in subject areas such as Mathematics, Science, Geography, and Computer classes, because there were difficult concepts in these subjects. But, in South Africa, language poses a comparable challenge: SA is a diverse country with 11 official languages, which include Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sepedi, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga (Probyn, 2006; 2009). The teachers in the current study taught learners in widely diverse contexts. The visual components of technology such as simulations and YouTube videos enhanced their learners' understanding of complex English concepts.

5.7 CONCLUSION OF CHAPTER FIVE

This chapter has presented and discussed the findings relating to factors that influence NQTs' use of technology in their classrooms. On reflecting on the significance of these factors, the researcher found that all are crucial to encouraging NQTs to use technology in their teaching. Other significant themes emerging in this chapter that are not frequently mentioned in the literature, are that of ownership of personal technological equipment, family support, and primary and high school experience.

Consistent with the literature, the findings show that a lack of up-to-date hardware and software is still a disabling factor in many schools in the Western Cape. Teachers in this study were motivated to use technology. Some teachers appointed to no-fee-paying schools felt obliged to

use their own equipment. But this initiative failed because of a lack of safety, dangers of viruses, size of a laptop screen for a whole class of learners, a lack of security at schools and other factors. These generous teachers may have realised the significance of technology in the classroom because all of them, in this sample, had graduated from a South African TEI in 2013, where they were exposed to the use of technology for teaching and learning.

A noticeable outcome of this research was exposure of the discrepancy in the availability and accessibility of technology between high and low socio-economic schools. Teachers from high socio-economic or fee-paying schools had many resources to support their use of technology such as technical support, professional development training, modern technological equipment and support from colleagues and principals. They were therefore able to integrate technology or blend it imaginatively and effectively into their classroom practice. This answers the central question of the study. Schools from low socio-economic communities or no-fee-paying schools in this study lacked basic, modern technological equipment. Teachers in this context were largely not able to effectively integrate technology into their daily tuition.

Chapter Six presents the findings and discussion on the question of *why* NQTs used technology into their pedagogical practice.

CHAPTER SIX

RESULTS AND DISCUSSIONS: RESEARCH QUESTION TWO

Research Question Two:

Why are NQTs integrating technology into their pedagogical practice?

6.1 INTRODUCTION

Chapter Six presents the findings in respect of Research Question Two. The research results are discussed in terms of a conceptual framework that synthesises complementary elements of the TPACK and UTAUT2 models. An exemplary TPACK lesson is provided. To conclude the chapter, the acquisition and integration of TPACK Model, uniquely shaped by the findings of this research, is presented as a possible solution to enable NQTs to teach effectively with technology. It offers a way forward, to accelerate knowledge acquisition and enhance the quality of teaching and learning so as to narrow the gap between impoverished (no-fee-paying schools) and affluent communities (fee-paying schools).

6.2 WHY NQTs WERE OR WERE NOT ABLE TO INTEGRATE TECHNOLOGY WITH PEDAGOGY IN THE CLASSROOM

After observing and interviewing teachers in the course of the fieldwork involved in this research project, the researcher in Chapter 6 provides a comprehensive and holistic picture of *why* these teachers did or did not integrate technology into their teaching. The researcher collected data by observing NQTs, using a semi-structured observation schedule (Appendix G), while they taught with technology in their classrooms. To corroborate the findings, all the teachers were interviewed one-on-one after each lesson observed, on *why* they had used a particular technology to teach content or why they had been prevented from doing so. In order to discuss why teachers used this technology, some consideration of how they used it is incorporated into the discussion.

According to Earle (2002:8), in any discussion of teachers' use of technology in their teaching, the focus should be on how and why a particular technology is used. He explains:

> Integrating technology is not about technology – it is primarily about content and effective instructional practices. Technology involves the tools with which we

> deliver content and implement practice in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used.

Similarly, Angeli and Valanides (2009:154) mention that:

> … the issue is no longer whether teachers should integrate technology in their existing practices, but how to use technology to transform their teaching with technology and create new opportunities for learning.

Su (2009) argues that technology can transform teaching and learning by breaking down authoritarian boundaries and expectations, allowing for a more democratic exchange and sharing of knowledge as envisaged in the e-Education Policy (NDoE, 2004). Rather than using technology to reproduce the traditional method of teaching, teachers are in important ways liberated together with their learners to collaborate in the learning experience in a form of constructivist reciprocity.

The findings on why NQTs were or were not able to teach with technology resulted in the following four main themes:

6.2.1 Enhance learning using technology;
6.2.2 Facilitate collaborative learning;
6.2.3 Improve learner self-confidence; and
6.2.4 Greater sense of inquiry through using the Internet.

6.2.1 Enhance learning using technology

Teachers in this study enhanced learners' understanding of subject matter by using different types of technology. The effect was to spark learners' interest, logically explain Science procedures, and make abstract and difficult concepts more easily understandable. The following section explains these sub-themes in more detail.

The visual, audio and sequenced components of educational videos have the potential to spark and sustain learners' interest in a subject. It was observed in all six teachers' classrooms that learners were more attentive and engrossed when watching videos that clarified difficult concepts. When these teachers were interviewed after classroom observations, Teachers 6, 8, 9 and 10 reported that they taught at no-fee-paying schools where learners came from communities plagued with social issues such as gangsterism, poverty, drugs and alcohol abuse.

According to these teachers, learners were not interested in attending school. As a result, they tried to make their lessons more interesting and fun by using videos to capture the learners' attention and in this way enhance their understanding. From the researchers' observations, learners from all six teachers' classrooms observed were enthusiastic when technology was used, as could be seen from their body language and facial expressions. Teacher 8 stated:

> The learners in my class were not interested in school. They did not want to be in school. The attendance rate for classes was low. I had learners who were absent from school for a week or so. Using technology captivated their interest and made them interested in attending classes.

This finding corroborates the views of Boadu et al. (2014) and Francom (2016), who found that teachers used technology because it was entertaining and fun, and increased learners' willingness to attend classes and learn. Teachers in studies by Schrum et al. (2008) and Clarke and Abbott (2016) highlighted the importance of using technology to stimulate learners' interest: even learners who were reluctant to study acquired some enthusiasm for class activities and started to ask questions and debate issues arising from the subject matter. This finding bears out Prensky's (2001;2005) claim that today's learners are attracted to technology and will sit for many hours watching videos on a topic, but not read a textbook for half that length of time. This observation implies a change in the learning habits of learners who are routinely exposed to television, social media and the Internet, and who in a sense now expect pedagogy to be technologically based.

To enhance learners' understanding of Natural Science content, Teachers 4, 5, 6, 9, and 10 showed their learners videos. Teacher 9 taught a lesson on the process of making a cement brick. He claimed, during the interview, that certain Science procedures require a step-by-step explanation. He preferred using videos to support his own voice because (i) his voice alone seemed to have a soporific effect upon learners; and (ii) on his own he could get his explanation of the process mixed up and actually hinder the learners' understanding. This finding is similar to that of Chen and Reimer (2009) and Liu (2016), that teachers used videos to explain processes that were confusing, boring or even sleep-inducing when explained pure verbally for a length of time; especially for learners from affluent areas who have been conditioned to acquire knowledge by means of visual and audio stimulation.

According to Teacher 9,

> It was an NST [Natural Science and Technology] lesson; I showed learners the video of the process of making cement bricks – from mixing the cement to the actual brick, that is, from gathering and measuring of the ingredients to the final product. The video clearly showed the process because, for example, step two could not happen without step one. The pictures, I think, enhanced learners' understanding as well.

The video mentioned in Teacher 9's comment was useful because it described the process of making a brick in sequence and in detail. The video reinforced the teachers' explanation, as every step of making a cement brick had pictures and sounds to enhance the learners' understanding.

All six teachers observed taught their lessons in English, except for lessons in the content areas of isiXhosa and Afrikaans First Additional Languages. These teachers had diverse classrooms, though most learners spoke English as a Second Language. During the interviews, Teachers 8 and 9, who taught in the same school, reported that their learners struggled to comprehend lessons because English was their second or third language. As a result, these teachers taught listening comprehension by using videos because of the visual components that aided learners' understanding. It was easier for teachers to interrupt the videos and clarify the storyline to their learners, compared to when they merely read stories aloud. This pedagogical strategy, according to the two teachers, was appropriate and improved learners' understanding of the plot of the story, enabling them to participate more in class activities. Teacher 8 explained:

> My learners are challenged as they cannot comprehend at a basic level because English is their second or even third language. I taught listening comprehension with a video because it was easier to interrupt it and explain the storyline to learners so that they would not get lost.

This finding correlates with the results of Liu's (2016) study. A teacher stated that while learners were watching videos, he paused to ask questions and engage them in discussion in order to enhance their understanding of the concepts being taught. The researcher observed that Teachers 8 and 9 paused videos in class to ensure that all their learners were following the lesson. The researcher observed that in Teacher 8's classroom, after she stopped the video to explain a concept, the video would not continue playing and there was no technical assistant to aid her. This disruption caused a loss of instructional time, because it took a while for Teacher 8 to fix the technical problem. It was evident that these learners could not respond to higher order questions that required them to infer meaning in the course of comprehension exercises.

Two of the six teachers observed taught abstract concepts by using videos because they found it difficult to explain these relatively abstruse concepts verbally. Goyal et al. (2010) conducted a study by using a survey and found that some teachers used technology to enhance their learners' understanding of difficult and abstract concepts. Similarly, Mwalongo (2011) and Liu (2016) found that some teachers used multimedia because it made abstract concepts comprehensible. Kulasekara et al.'s (2011) study reported that teachers used animations to teach bacterial genetics. The colourful frames, careful sequencing and sound effects of an animated presentation of the microbial process enabled learners to gain a more immediate grasp and sustained understanding of the stages of this process than could be conveyed by the teacher's voice or use of a textbook. Teacher 4 commented:

> … a concept like electricity is difficult to explain. I mean, how do I explain to my learners the process [by] which electricity travels in a circuit? It is difficult without learners seeing it live. So I showed learners the video so they could see it live.

It appears that the educational video was appropriate in illustrating the phenomenon of electricity. Teacher 4 manually demonstrated how electricity travels in a close circuit, followed by a video, and then gave his learners activities to perform using static electricity. This three-stage strategy catered for the diverse learning styles of his learners, their differing pedagogic expectations, socio-economic backgrounds and languages. Zhou et al. (2017) recommend that teachers balance hands-on activities and technology when teaching Science concepts in order to achieve optimum results. This recommendation is particularly pertinent in a diverse society such as modern democratic South Africa, which extends hospitality to refugees and asylum seekers from many parts of Africa.

Walker and Shepard (2011) caution, however, that although it is important for teachers to integrate technology into their teaching, they need to appreciate when and how to balance technology with traditional methods of teaching. Technology cannot be used for the sake of using it, teachers need to use it as the best tool to meet the needs of their students.

Some subject matter is not abstract but nevertheless difficult for learners to comprehend, especially when they have no prior knowledge of it. Teacher 5 enhanced her learners' understanding of History concepts by introducing videos. She taught a lesson on Ghandi by reinforcing her verbal account with an educational video that provided useful contextual information. In Boadu et al.'s (2014) study, teachers felt that Social Studies was uninteresting

to learners if they simply described things that had happened in the past, so they used videos to make their lessons more lively and exciting (Boadu et al., 2014). Teacher 5 explained:

> … History for me is one of the most difficult subjects. Learners learn about countries and people they don't even know or they were not born when an event happened. That was why with the lesson on Gandhi today, I showed learners videos which I got from YouTube to make the lesson interesting. So learners were learning content in a more interesting way.

Teacher 5 added:

> In fact, subjects that I felt like, oh learners are going to struggle with because they had no prior knowledge, I tried to spice it [subject matter] up with videos in order to enhance their learning.

This finding confirms that of Baz (2016), who reported that 92.8% of the teachers whom he observed integrated educational videos into their lesson plans because such material facilitated the understanding of difficult concepts. Heafner (2004) states that learners were reluctant to participate in tasks they perceived to be difficult until teachers used technology to engage their interest in the subject matter.

According to Mishra and Koehler (2006), there is a tendency for teachers to focus upon technology rather than using technology to enhance the teaching and learning process. This assertion was supported by evidence in the current study, in that Teachers 9 and 10 consolidated some of their lessons by using PowerPoint to emphasise important issues in the subject matter they had just taught. According to teachers, through PowerPoint learners understood and retained subject matter more fully and more permanently. Teacher 10 reported:

> I used PowerPoint to emphasise important points so that learners would remember the content which I had taught. 'Wheat farming' is difficult because learners had no prior knowledge of farming you know.

This comment by Teacher 10 suggests that his focus was on the use of technology rather than the quality of teaching with technology. By using a chalkboard, this teacher could have conducted the same tuition as a PowerPoint presentation.

From this discussion, it is apparent that all six teachers observed sought to enhance their learners' understanding of subject matter by using videos – in different ways, with varying degrees of success and in different learning environments. Some of these videos were downloaded from YouTube. It appears that teachers were more comfortable using video clips during their teaching because it was easy to do so. When interviewed concerning this ease of

use (Venkatesh, 2012), teachers from no-fee-paying schools explained that it saved them time to download and use ready-made videos in their teaching rather than spend valuable preparation time developing their own. Kaleli-Yilmaz (2015) states that it takes considerable time to design computer-aided activities for each lesson. An ICT-related curriculum would facilitate technology integration, meaning that less time would be required to prepare for a lesson. This encourages teachers to use an ICT-related curriculum in the classroom (Tong & Trinidad, 2005).

6.2.2 Facilitate collaborative learning

From the researcher's observations, Teachers 4 and 5 involved their learners in collaborative learning when they taught with technology. These teachers often divided their learners into groups or pairs to discuss and complete an assigned activity presented on the smart board. For instance, Teacher 5 divided learners into small groups to discuss the process of making a sandwich in an Afrikaans First Additional Language lesson. Afterwards, she showed her learners a YouTube video that gave an explicit account of how a sandwich is made. To consolidate this lesson, each group came to the front of the class to put pictures of the different ingredients involved in making a sandwich on the smart board in sequential order. In this way, according to Teacher 5, learners actively participated in the learning process and took responsibility for their own learning.

> … I did group work with my learners, because learners learn best when they are given hands-on activities to work with their peers….

The learners were observed to be excited by the interactive nature of this activity and the chance to take individual responsibility for their own learning. Teaching with technology was challenging because some teachers did not assign each learners roles within the groups. There was no accountability, hence few learners took responsibility to complete project.

Learner-centred activities are shown in the literature to enhance learning (Mueller & Wood, 2012; Liu, 2016). Findings from studies by Eze and Olusola (2013), Gilakjani (2013) and Martin et al. (2013) suggest that learner-centred strategies, when teachers consciously integrate technology into the planned structure of their lesson for the day, are most likely to advance learners' understanding of a concept. Heafner (2004) insists that, to develop an interactive environment that enhances learning with technology, teachers need to integrate or blend learner-centred strategies into their pedagogy.

Teacher 4 placed academically strong learners in the same group as weak ones in a Geography lesson on 'Weather'. He introduced the lesson by showing a video in which learners saw how weather was reported by a meteorologist. After the video, his learners were grouped to deliberate on and present minimum and maximum temperatures in the different provinces in South Africa as shown on a mute-map; the sound of the video having been reduced on the smart board. In the interview that followed the classroom observation, Teacher 4 acknowledged that his learners had different academic abilities. Through their being placed in mixed ability groups, the learning of academically weak learners was supported by the clearer understanding of their academically stronger peers.

> … my learners are like day and night. I mean you [the researcher] could have observed that. While one group is stronger academically, the other group is weaker. The learners have different abilities and I tried to group them and this has really helped the weaker learners, I mean increased their performance as they were supported by their peers.

From this excerpt, it may be inferred that Teacher 4 was not solely responsible for learners' learning but that learners relied upon and learned from each other to present their task on the smart board. Teacher 4's philosophy of teaching was underpinned by constructivist principles: he gave his learners learner-centred activities to shift the focus from himself to them, and they then worked well in groups, using technology. The teacher guided his learners towards completing the task. When discussing collaborative learning, Teacher 4 remarked as follows:

> … let's be frank ... you know, group work is a problem with discipline. Besides, the active learners took over activities. Reflecting now, I think the best way to address this issue is to assign each learner in a group something to do. Learners should be given individual marks for their participation in a group task.

Teacher 4 thus suggested that each learner should be given a specific role to play in a group task, and that marks should be allocated for each learner's participation. He explained that to engage learners in a group task with technology was challenging to manage in the classroom, trying to ensure that all of them benefitted from participation in the task. In Teacher 4's lesson on 'Vegetation,' learners were shown educational videos on different forms of vegetation such as forest, fynbos, grassland, Karoo and savannah in South Africa. As observed by the researcher, it was difficult for Teacher 4 to control the noise level in the computer laboratory and to ensure that all learners contributed to the completion of the activity in which they were required to match words to pictures.

The findings in this section highlight an important point: that teachers' philosophies guided how they taught with technology in their classrooms. Teachers 4 and 5 believed that their learners learned best when they were given hands-on or learner-centred activities requiring them to take responsibility for their own learning. Their learners understood concepts better when they were given the opportunity to interact with their peers in a group, assisting each other. However, the researcher observed that not all learners benefitted equally from this arrangement: some learners dominated the discussion in their groups and the presentations on the smart board. The researcher endorses Teacher 4's recommendation that teachers should allocate a task to each learner when they are assigned peer group activities.

6.2.3 Improve learners' self-confidence

Technology was used by Teachers 4 and 5 as a strategy to increase learners' self-confidence in a lesson, since they were given the opportunity to express their individual understanding of concepts taught. To the extent that learners participated more in class discussion, this strategy was beneficial. Teacher 5 taught an EFAL lesson entitled 'Fable.' She first showed some educational videos that had moral lessons; then, each group typed their own original fables using a computer in the laboratory. Finally, they formulated the moral lessons of their stories. The fables were posted on the school's blog, a form of exposure that increased the learners' self-esteem. Teacher 5 stated:

> Most of my learners deal with so many social issues on a daily basis. It's either their parents got divorced or something happened at home, their self-esteem was always low. But when I posted their task on the school's blog and on the schools' notice board with their names as authors, they were so excited and their faces lit up – they were chuffed with their shoulders high.

From the researcher's observations, it was clear that learners took pride in playing the role of authors and having their stories published. Similar findings were reported by ChanLin et al. (2006) and Al-Awidi and Aldhafeeri (2017), who describe how teachers boosted their learners' self-confidence by posting their work online to global audiences. Ertmer et al. (2012) and Sabzian and Gilakjani (2013) are of the opinion that publishing learners' work online increases their self-confidence, encouraging them to learn further and hone their writing skills. These findings confirm those of an earlier study conducted by Heafner (2004), who argues that if teachers build up learners' self-confidence, learners and teachers will enjoy the fully reciprocal nature of a learning experience, and this will have a positive impact on academic performance.

Research conducted by Dang (2008) and Palao et al. (2015) reported that some teachers allocate tasks to learners that require them to record and correct each other's work. This seemed to make the lesson fun, interesting and informative. Leaners were flexible while learning content. The activity gave teachers great insight of students' understanding of content taught. Consistent with this finding, in this study it was found that Teacher 10, in an EFAL lesson on 'Prepared speech,' boosted her learners' self-confidence by audio recording their presentations and playing them back to the entire class. These recorded presentations made the class fun and interesting. When interviewed regarding this, the teacher responded:

> … I'm not sure, but what I know for a fact is that learners enjoyed it when I used the technology - the recorder - it was fun and interesting and I made the lesson relevant, you know. It was an amazing thing to do because they were interested and they gained confidence.

This finding confirms that the use of technology during teaching and learning can make a lesson interesting and fun, while sustaining the lesson's objectives (Mai & Hong, 2014; Mtebe et al., 2016). The researcher observed that all the learners enjoyed the technological aspect of the activity and were willing to appear in front of the class to present their speeches. Unexpectedly, during a subsequent informal conversation, the teacher remarked that the majority of her learners were struggling academically, and that their confidence levels were low. Nevertheless, these learners volunteered to deliver their speeches in front of the class.

6.2.4 Greater sense of inquiry through using the Internet

Due to the ubiquity of technology, learners are exposed to a variety of information on the Internet (Izmirli & Izmirli, 2015; Nikolopoulou & Gialamas, 2016). There is a need, therefore, to educate learners on how to access credible or reliable information on the Internet (Schrum et al., 2008). Teachers 4 and 5 were observed while they taught and demonstrated to their learners how to search for appropriate materials on the Internet to complete their assignments. Teacher 4 commented after one of his lessons:

> … you've got to teach them practical skills … how to search for authentic [credible] information. That was why I showed them [learners] that they have to go to a proper website not Wikis and also check sources. This is important as when they submit their assignments, I will see if they have done proper research.

Teacher 4 mentioned in his interview that he sometimes allocated his learners a period in the computer laboratory to search for a particular theme on the Internet: he termed this allocation of technology time "doing search for pleasure." However, he acknowledged that his learners

were at the same time acquiring a variety of valuable skills such as how to browse, to type using a keyboard and how to use the mouse. He added that his learners learned better when they were not being assessed or evaluated. He reported:

> I sometimes gave them themes to search on the internet, just for them to like … doing search for pleasure … I think learners learn better when they are not under pressure to submit assignments or projects. These learners were learning technological skills like how to use the keyboard and the mouse and how to browse ....

From the observation conducted in Teacher 10's class, it was evident that her learners asked questions that she had not anticipated during the preparation of her lesson. When such spontaneous questions were asked, Teacher 10 and the learners searched for the correct answers on the Internet. In a lesson on 'Wheat farming,' one of the learners spontaneously asked the teacher "Is rice a plant?" When interviewed, Teacher 10 stated:

> Learners can stump one with a funny question, like today. I was [like] I don't know [laughing]. We searched the correct answer from Google together, you know … I think it is more interesting and relevant when learners discover things for themselves.

From this excerpt, it was evident that learners acquired technological skills when they learned to type and search for materials about which they had no prior information. Researchers have acknowledged the importance of learners acquiring technological skills (Collins & Bronte-Tinkew, 2010; Mueller & Wood, 2012; Eze & Olusola, 2013), because teachers are preparing learners who will one day be integrated into a technology-driven workplace. Such an observation of course assumes that the learners belong to a developed society and is perhaps pertinent in South Africa but only to a privileged stratum of society.

Teacher 5 gave her learners homework that required them to search for information on the Internet to complete their tasks: in an EFAL lesson, learners were asked to (i) search for information on the Internet about how the telephone evolved, (ii) draw diagrams and (iii) complete activities on the topic in their books. When probed concerning this task, she explained:

> … the cultural context of the school allowed me to give learners technological tasks to do as homework. Using technology is prescribed here. The parents are working class and could afford to buy technological resources - data bundles. When I gave my learners work to do, I knew they had the resources at home and the parents could help as well.

During the observations, it was noted that only Teachers 4 and 5 gave their learners homework which required them to use technology, since only these two teachers could assume learners had technological resources to support them at home.

In summary, from the findings obtained through interviews and classroom observations, it was evident that the majority, four of the six NQTs, used technology at the most basic level. Learners were shown videos to complement the teachers' explanation of a concept, or where teachers uploaded materials on smart boards or projectors, displayed texts and played educational games. Learners were given limited or no opportunities to interact with or explore the concepts being taught using technology equipment. All the teachers who taught in this particular way came from no-fee-paying schools that lacked technological resources. They used their personal technological equipment in the classroom. These findings can be aligned with the UNESCO Framework (2012) which describes the stages of technology integration. These four teachers were at the 'technology literacy' stage, at which they did not utilise complex or sophisticated features of technology during their teaching. Although these four teachers used technology in their teaching, and it appeared to benefit the learners, there was no in-depth engagement in technology projects.

Teachers 4 and 5 assigned their learners tasks that required them to work collaboratively in developing new projects. The learners interactively engaged with the technology in an advanced manner to complete their projects. These two teachers were from fee-paying schools that had access to a variety of technological resources, and technical support for their teaching and learning. The benefits, for both learners and teachers, of using collaborative and project-based strategies were that:

- The learners took responsibility for their own learning as they creatively completed technological tasks;
- The learners freely engaged with technology but were guided by their teachers;
- The learners supported each other in their collaborative groups and worked in a flexible and encouraging environment;
- The learners had access to technical support if they needed it;
- The learners participated more in class activities;
- The teachers met learners' technology needs;
- By using technology, the teachers saved time because they could archive, tag and later; re-use their PowerPoint presentations;

- Teachers facilitated their learners' acquisition of knowledge in a more sustained way; and
- Online marking was easier and learners received immediate feedback.

These findings align with the UNESCO (2012:11) framework in the sense that these teachers were at the stage of "knowledge deepening" and "knowledge creation." They engaged learners in collaborative activities by assigning them to create new technology-based projects.

6.3 USING THE CONCEPTUAL FRAMEWORK (TPACK AND UTAUT2) TO DISCUSS THE RESULTS

The TPACK model was used to ascertain *why* teachers were integrating technology into their teaching and learning, or *why* not. The model explains the knowledge that is needed to teach effectively with technology. According to Mishra and Koehler (2006), for teachers to effectively teach with technology, they must be able to blend technology, pedagogy and content knowledge in a thoughtful and structured manner. Ertmer and Ottenbreit-Leftwich (2010:260) note that in order for teachers to teach effectively with technology, they "need additional knowledge of the content they are required to teach, the pedagogical methods that facilitate student learning, and the specific ways in which technology can support those methods." The TPACK model enabled the researcher to examine: (i) what teachers taught in their classrooms; (ii) the pedagogical strategies they used to deliver the curriculum; (iii) the content taught and how or whether they were able to blend technology, pedagogy and content into their lessons. The following section discusses the results in relation to the conceptual framework.

All six teachers used different technologies for teaching and learning, such as smart boards, data projectors, computers/laptops, recorders and software applications (TK), depending on their pedagogical objectives for particular lessons. These teachers used such technology (TK) as was available in their various schools; where schools lacked resources, teachers were committed to teaching with technology that they in many cases purchased the equipment needed themselves and used it in their classrooms. Although teachers from no-fee-paying schools (Teachers 6, 8, 9, 10) had CK, they used technology in a conventional manner in their classrooms (PK). For most of their lessons observed, learners were passively involved in their learning, sitting at their desks watching and listening to videos depicting a concept (TPK), and afterwards being assigned activities to be completed in their exercise books (PCK). This does not constitute blended technology tuition. This strategy of teaching is generally referred to as

the "banking" method of teaching, whereby teachers transmit knowledge to learners (Freire, 1970:58). This term was developed by Freire to critique the traditional methods of teaching in terms of which learners are seen as "containers" into which teachers pour knowledge. In the current study, this mode of tuition, although marginally enhanced by technology, did not perceptibly develop learners' critical thinking. Scant innovation, creativity or originality was evident in the lessons observed by the researcher. When these teachers were interviewed regarding their 'teacher-centred' style of teaching, it was evident that they lacked the skills to be able to combine technology, pedagogy and content knowledge in the way needed for effective blended tuition, as explained in Chapter One. Teacher 8 explained after one of her observed lessons:

> Using videos from YouTube was easy ... my main challenge was selecting, creating programs (software programs) and deciding on activities that links with my curriculum objectives …

It was evident that these four teachers could not blend technology, pedagogy and content convincingly or effectively when they taught with various types of technology. The teachers had knowledge in isolation and retained their status as knowers rather than sharers facilitating learning in a reciprocal constructivist sense. Nevertheless, their learners palpably benefitted from their efforts: the videos they showed captured the class's attention and engaged them (TCK) even if in a limited way. The learners were excited when technology was used to attract and sustain their interest.

Teachers 4 and 5, working in fee-paying schools where technology was plentiful, reliable, secure and well maintained, did not have to intuit the patterns of a learner-centred method: they were routinely able to teach in a constructivist manner, making appropriate use of technology to convey subject matter (CK). The teachers actively involved their learners in their own learning by engaging them in individual, pair or group (PCK) tasks supported by technology. Learners were sometimes assigned tasks that required them to innovatively create new technological projects (TPACK). The constructivist mind-set and pedagogic attitude of NQTs in this study encouraged them to teach with technology, the school context complemented their endeavours and they had sufficient technological support. Besides these three vital factors they had access to regular professional development training, technical support and smaller classes.

The researcher concludes that TPACK was evident in most of the lessons presented by Teachers 4 and 5. According to UNESCO (2011:8):

> ... the successful integration of ICT into the classroom will depend on the ability of teachers to structure the learning environment in new ways, to merge new technology with a new pedagogy, to develop socially active classrooms, encouraging co-operative interaction, collaborative learning and group work. This requires a different set of classroom management skills. The teaching skills of the future will include the ability to develop innovative ways of using technology to enhance the learning environment, and to encourage technology literacy, knowledge deepening and knowledge creation.

Successful and effective technology integration lies in the pedagogical strategies that teachers use in their classrooms, their awareness of pedagogic blending and technologically advanced learners. Two distinctive pedagogies can be identified from the findings: traditional teacher-centred and constructivist, learner-centred. In the traditional pedagogy, teachers used technology to present course materials and show learners videos with little interaction taking place. The teachers merely transferred knowledge to the learners. In terms of the learner-centred pedagogy deployed routinely by Teachers 4 and 5, learners were encouraged to take part in collaborative and project-based learning. This distinction between learning modes is of course over-determined: teachers at no-fee-paying schools could not afford technology or expect their learners to possess such equipment at home. Within their restricted learning environment, however, the teachers at no-fee-paying schools intuitively devised what approximated to teacher-centred tuition. In terms of restorative justice it may be asserted that these learners, teachers and communities have not been adequately recognised and compensated for the deprivation and after effects of a system (1948-1994) which condemned whole districts to poverty, unemployment, indignity, and the myriad of social ills that cluster about such wants. The WCED in its mandate to provide equitable and quality education for all needs to respect the basic terms of restorative justice and provide technology, training, security and support staff to enable blended learning to take place to help uplift those most in need.

All the teachers unanimously agreed during the interviews that the main reason for using technology was the benefit that accrued from its deployment in teaching and learning. This finding was corroborated by classroom observations. The teachers repeatedly made reference to terms such as ‘engagement,’ ‘fun,’ ‘capturing learners’ interest’ as reasons for using educational videos in the classroom. Teachers reported that integrating technology into their pedagogy made it relevant to today’s learners, who are digital natives who expect learning to have a digital dimension.

Because of the benefits of technology for teaching and learning, teachers from resource-rich, fee-paying schools, used it every day. These teachers described technology as an invaluable

tool. Teachers from no-fee-paying schools were obliged to buy their own technology equipment, but they infrequently used it for teaching and learning since their schools lacked secure buildings, a reliable electricity supply and suitable venues. These findings can be linked and are compatible, to the construct 'performance expectancy' in the UTAUT2 model: NQTs used technology because of its benefits to their teaching and learning.

6.3.1 An exemplary TPACK lesson plan

The following section provides an exemplary TPACK lesson plan, from Teacher 5. The plan shows how the lesson is rooted in the seven constructs of the TPACK model (TK, CK, PK, PCK, TCK, TPK, TPACK), and the construct 'performance expectancy' in the UTAUT2 model.

Table 6.1: An exemplary TPACK lesson plan

LESSON PLAN **(showing the integration of the TPACK concepts and 'performance expectancy' of the UTAUT2 model)**			
Grade: Five	Number of learners: 28	Date: April 24, 2015 Duration: Five periods	Subject: EFAL
Topic in Full	EFAL – to develop a fable		
Lesson Focus	For learners to write their own fable		
Lesson Objectives	• to define a 'fable'; • to explain the characteristics of a 'fable'; and • to create their own original story while considering the characteristics of a 'fable'.		
Resources	This lesson will take place in the computer laboratory. Two videos of 'fable' will be shown, a white board, computers, pen and papers will be used.		
How have you considered the different needs of the students and adapted your teaching strategies?	Weak learners will be paired with stronger learners. Videos will be used to cater for diverse learning styles such as – visual, auditory, kinaesthetic etc. The learning tasks will appeal to the more visual learners (pictures will be selected from the internet) as well as the more cognitively strong learners. (they will attend to the genre and flow of the story)		
Points for introduction	• The teacher will begin the lesson by explaining the meaning of a fable' (CK). • The teacher will explain the oral tradition of telling stories and its importance (CK). • She will explain the characteristics of a 'fable' (CK).		
Prior-Lesson Questions to ask.	1) What is a fable? 2) Do you know of any fables? 3) Have you heard of the fable "The Fox and the Crow" or "Little Red Riding Hood"? 4) Please share with the class what fables your parents have read to you? 5) What did they like about the fables?		
Points for Body of Lesson	• The teacher shows two video clips (TCK) to learners. • Learners are divided into groups of two to discuss the characteristics of a fable; • One person from each group reports back about the characteristics they identify in the two video clips (PCK); • This person writes the characteristics on the white board (PK); • Now move to working on the computers. In pairs the learners write their own original fable using Microsoft word, remembering to refer back to the characteristics of a fable (TPK); • Each group looks on the internet (TK), for appropriate photographs that connect to their fable; and		

<table>
<tr><td></td><td colspan="2">• The teacher and technical assistant support the learners in the computer laboratory.</td></tr>
<tr><td>During-lesson Questions to ask</td><td colspan="2">1. What are the characteristics of fables?
2. Identify characteristics of fable in the videos they watch.
3. Do fables have moral lessons?
4. What moral lessons do they like their fables to have?</td></tr>
<tr><td>Point for Conclusion of Lesson (Drawing it all together and taking it forward)</td><td colspan="2">• Groups are selected to read their stories to the entire class (PK).
• 14 stories are posted on the school blog, showing the learners names as authors (TPACK)</td></tr>
<tr><td>Assessment: Informal/Formal</td><td>Informal assessment: randomly ask questions in class in relation to fable.</td><td>How will you mark this process?
The learners' fables will be marked according to the characteristics of fables and whether their moral lesson is clearly stated.
They will be marked online.</td></tr>
<tr><td>Performance expectancy (UTAUT2)
What are the pedagogical benefits, to both teachers and learners, of this lesson on fables</td><td colspan="2">Benefits for the learners
1. The learners understand the concept of fables and reading stories with moral lessons;
2. The learners work together on a project – they work collaboratively, where the weaker and stronger learners work together – focussing on their strengths. This improves their self-esteem and self-confidence;
3. The learners acquire 21st century literacy skills;
4. This learning is exciting: the learners' final fables are posted on the schools blog.

Benefits for the teachers (UTAUT2 – performance expectancy)
1) The teacher presents and demonstrates; using PowerPoint which saves time compared to the chalkboard.
2) The teacher facilitates, rather than being solely in charge of learners' learning.
3) The marking of learners' completed tasks is faster and easier, as the stories are marked online.
4) The learners receive immediate feedback.</td></tr>
<tr><td colspan="3">REFLECTION</td></tr>
<tr><td colspan="3">What worked well in this lesson?</td></tr>
<tr><td colspan="3">What did you do to make this happen?</td></tr>
<tr><td colspan="3">What could you improve if you were to teach this lesson again?</td></tr>
<tr><td colspan="3">How have you used your resources effectively?</td></tr>
<tr><td colspan="3">What have you learnt about your learners during this lesson?</td></tr>
</table>

Having identified an exemplary lesson where TPACK was evident, to conclude this chapter the new 'Acquisition and Integration of TPACK' model, guided by the findings of Research Questions One and Two, are presented and discussed. When developing this model, the researcher was mindful that Teachers 6, 8, 9, and 10 had pedagogical content knowledge (PCK), yet lacked the ability to blend TK, TCK, TPK and TPACK in their lessons (Section 6.4). The researcher therefore focused on developing a model that instructors (technology trainers) can use to address this knowledge deficit, so that teachers can acquire the abilities to adopt and teach effectively and confidently with technology once provided with appropriate resources. The ideal situation would be for TEIs to ensure that all pre-service teachers acquire 'TPACK' skills before graduating from the university. Figure 6.1 shows the acquisition and integration of TPACK.

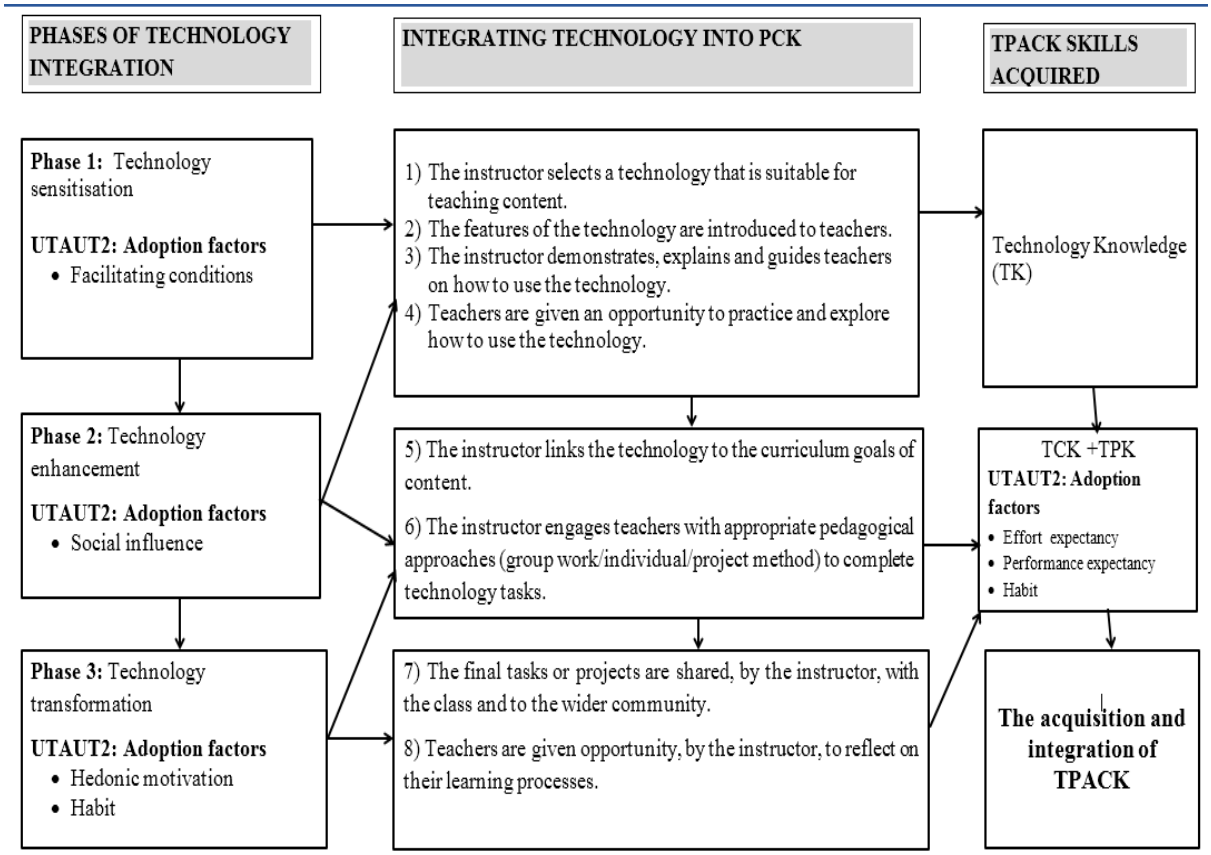

Figure 6.1: The acquisition and integration of TPACK Model

This proposed model shows three phases through which teachers can progress to acquire TK, TCK, TPK and TPACK skills. In relation to the UTAUT2 model, in each phase the researcher shows factors that may motivate adoption and integration of technology for curriculum

delivery. It further describes three 'phases' for instructors to follow in showing teachers how to integrate TK into their PCK.

Phase 1: Technology sensitisation

The aim of this phase is for instructors to familiarise teachers with the functions of technological hardware and software programs so they can integrate them into their lessons. It is hoped that teachers acquire technological knowledge and skills to operate a wide range of technology, which they can adopt, adapt and use to suit their teaching and learning outcomes. For this to happen, 'facilitating conditions' such as smart board, computers, should be put in place.

During professional development training, an instructor selects a technology that is suitable for teaching a specific content. The features of this technology are introduced and demonstrated to the teachers with explanations on how to use the technology. The teachers are given an opportunity to practise and explore how to use the technology, so that they will become competent and proficient users of this particular technology. They will develop TK in order to move to Phase 2.

Phase 2: Technology enhancement

The technology skills learnt in Phase 1 are important for progression to Phase 2, as indicated by the arrows in Figure 6.1. The aim of this phase, therefore, is for instructors to guide teachers to enable them to select and use appropriate technology when teaching particular content, and make suitable pedagogical decisions. Teachers need to be able to analyse and apply appropriate content-specific applications (TCK) that assist in achieving the curriculum goals.

In this phase, the instructor links the technology to the curriculum goals informing the content (TCK) and engages teachers with appropriate pedagogical approaches (group work/individual/project method) to complete the technology tasks (TPK). From the findings in Chapter Five, when teachers collaborate with each other, they learn better and improve their social relationships. They became more confident in asking for technical assistance. In relation to Venketesh et al. (2012) the concept of 'social influence' may influence the uptake and use of technology.

In relation to the TPACK constructs, the skills acquired in this phase are TCK and TPK. In relation to the findings in Chapter Five, teachers who had acquired these two skills (TCK and TPK) used technology with less effort (effort expectancy); because it was beneficial

(performance expectancy); and using technology became automatic (habit) as they used it to blend their teaching and learning with technology.

Phase 3: Technology transformation

The aim of Phase 3 is for the instructor to publish the final tasks or completed projects developed by the teachers in Phase 2, to a wider audience, and share them with the class. This means that 'technology transformation' begins in Phase 2 (as shown in the arrows in Figure 6.1): teachers create their own technology tasks. Teachers are also given the opportunity to reflect on their learning processes.

The focus in this phase is on the end product of a technological project. The end product is the acquisition of the TPACK skill. In Chapter Five, teachers who had TPACK skills were intrinsically (hedonic) motivated and they automatically (habit) blended technology during their curriculum delivery.

It is hoped that if this model is used during professional development training, and the factors that influenced adoption of technology are considered in each phase, teachers in this study will be able to adopt, adapt and effectively blend technology into their teaching and learning.

This newly proposed TPACK Acquisition Model needs to be tested and validated, but it has the potential to bring about real and lasting change in teachers' pedagogical practices.

6.4 SUMMARY OF CHAPTER SIX

All six NQTs observed used technology for a variety of purposes, according to their pedagogical objectives for a particular lesson. Teachers from fee-paying schools had a TPACK mind-set when they taught with technology; they could blend technology, pedagogy and content knowledge. These teachers used technology in a constructivist manner in their classrooms as they gave their learners activities that required them to take responsibility for their own learning by creating new projects. Teachers from no-fee-paying schools used technology in a traditional manner with little or no interaction with their learners. An interesting finding is that these teachers, during the interviews (as described in Chapter Five, Section 5.2.1), revealed that they regarded themselves as competent in the use of technology – when in reality they did not have the ability to effectively blend technological, pedagogical and content knowledge.

Based on the findings in this study, the researcher has proposed a new model to be used by instructors to assist NQTs to acquire the TK, TCK, TPK and TPACK skills that they lack. By developing this model, the researcher has contributed to the field of technology integration. She hopes the model will motivate NQTs to adopt and acquire the requisite skills to teach effectively with technology.

In Chapter Seven, conclusions will be drawn, and recommendations will be made.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

This chapter discusses the correspondences and disparities between the research aims of this thesis as initially formulated and the actual outcomes after the data had been collected, analysed and categorised. Recommendations are made for policy, practice and future research.

The study aimed to discover *why* technology in schools in the Western Cape is often underutilised by teachers. Some teachers use technology for administrative purposes, while others do not use it effectively in their teaching. Although some schools in the Western Cape have been provided with various forms of technology for teachers to use in their teaching and learning, much more needs to be done to encourage NQTs to adopt, adapt and use technology effectively in the classroom. Investing in technological equipment does not automatically translate into the effective use of it in the classroom. Currently, the WCED is involved in many technology initiatives, such as making free high-speed broadband available to schools, so would presumably like to know the reasons for teachers' resistance to the deployment of this technology.

7.2 SUMMARY OF THE FINDINGS IN RELATION TO THE RESEARCH QUESTIONS

7.2.1 What factors influenced NQTs' ability to integrate technology into their pedagogical practice?

In order to explore the factors that influenced NQTs' ability to integrate technology into their pedagogical practice, concepts from the TPACK and UTAUT2 models, which formed the conceptual framework, were invoked to help organise, interpret and analyse the data. The TPACK model was found to be limited because it did not include social factors that could influence a teacher's use of technology. The researcher adopted the UTAUT2 model instead. By using both education (TPACK) and consumer (UTAUT2) study models to frame the collection and analysis of the data, the researcher gained a comprehensive insight into factors that influenced the use of technology in the classroom.

The factors that affected the ability of NQTs to integrate technology can be classified into two broad themes, *enabling* and *disabling* factors.

Enabling Factors

The enabling factors that influenced NQTs' ability to integrate technology included family, learner and colleague support; the availability and accessibility of technology; past experiences of deploying technology; the value of technology for teaching and learning, and the CAPS document.

Although it is yet to be reported in the national or international literature, the issue of family support as an enabling factor emerged in this study. One older teacher at a no-fee-paying school was assisted by her son, who encouraged his mother to use their family laptop at school because the school had limited resources. Since the son was being trained as a teacher, he could assist his mother to develop technology materials for her teaching. The teacher felt empowered to use technology because she had support from home that helped build up her confidence.

Learners supported their teachers in setting up technological equipment in the classroom, which saved instructional time. More proficient learners assisted in developing their peers' technological skills, which relieved some of the burden shouldered by the teachers. Teachers often worked collaboratively with colleagues and shared technological course materials, and this served to facilitate and encourage the imaginative, confident deployment of technology.

The availability and accessibility of technology, particularly in fee-paying schools, are important enabling factors identified in this study. These factors created an environment in which two of the teachers observed were able to blend technology, pedagogy and content knowledge in the way required for effective teaching with technology. During their lessons, these teachers used a social-constructivist approach, setting technology-based projects which encouraged their learners to work in groups and construct new knowledge. The teachers and learners had no time restrictions on their use of technology in the laboratories. Such activities required learners to take responsibility for their own learning. This finding confirms that some NQTs involved in this study are in fact making innovative use of technology for teaching and learning. This occurred in schools where teachers had an abundance of technological resources to support their teaching and learning. In schools where teachers had limited access to technology, they used their own personal equipment, which became an enabling factor.

Having stress-free access to a variety of technological equipment, including computer software and hardware, is a vital factor enabling teachers' effective, innovative and creative deployment of technology in the classroom. When technology was freely available in schools NQTs frequently made use of it. Two of the six teachers observed, who taught in fee-paying schools, had considerable support of this kind from their schools. The schools' management provided 'facilitating conditions' by making resources available. Teachers had access to their own laptops bought by the school, which they could take home to prepare lessons. Easy access to computer laboratories, with all the technology set up, and reliable technical support to maintain the computers, facilitated, and increased, teachers' use of technology in the classroom. Regular hands-on professional development training allowed these teachers to explore the use of different pedagogies.

Past experience of using technology constituted another enabling factor. Many of the teachers mentioned that their past experience, in the form of workshops during their pre-service training at university, helped them become more confident and competent in the use of technology. Projects that required them to use technology, working with their mentor teachers during their Teaching Practice, and their experience in previous jobs all made it easier for teachers to integrate new and more advanced forms of technology into their professional practice. Some of these teachers were not pressured by the schools but used technology because of its benefits and as a result of previous experience of using it.

The nature of a particular subject area was a significant factor encouraging NQTs to use technology in their teaching. Most of the lessons observed by the researcher were EFAL lessons (the majority of teachers taught learners whose first language was either Afrikaans or isiXhosa). Using video clips in English lessons enhanced learners' understanding of difficult concepts. Technology in this instance comprised an enabling factor because it added value to the teaching.

Another enabling factor in the use of technology was that teachers could employ technology to prepare PowerPoint lessons at home: instructional time was saved and teachers had more time to engage with learners during their lessons. Teachers saved their PowerPoint lessons on flash drives or computers, which made it easier for them to re-use the materials when teaching the same lesson to other grades. Teachers could update their notes and increase the font size to accommodate visually impaired learners. Technology in this instance proved invaluable when used in the classroom.

A significant factor identified in this study was the age of teachers. The six teachers observed in this study comprised both 'digital immigrants' and 'digital natives' due to their ages, yet they all used technology in their lessons; with varying degrees of effectiveness. The easier the technology, the more teachers will use it.

Some of the software programs installed on the computers in laboratories were aligned with the CAPS document and the subject areas. This encouraged the teachers to use the technology as it was perceived to be of direct benefit to learners' understanding of the curriculum. In addition, some school manuals provided information about the CAPS curriculum and how teachers could incorporate technology in teaching particular content, saving them time to search for appropriate technology course materials.

Disabling factors

Most of the disabling factors were experienced by NQTs who taught at no-fee paying schools. These factors included learners who lacked a basic knowledge of technology; lack of funds; the challenge of having to buy and use their own laptops in the classroom; the apathy of principals; the challenges of a booking system; the time it took to find appropriate technology; their experiences during their pre-service training, and a lack of awareness of the e-Education policy.

At no-fee-paying schools teachers commented that learners could not complete simple activities on the computer such as logging on or clicking on a page. This inability to master basic computer skills discouraged several teachers. Time that could have been used in the classroom to convey content knowledge of the subject was wasted on instructing pupils in the elementary points of computer literacy.

Other factors which discouraged teachers from using technology in the classroom included a lack of funds, as manifest in limited updating and upgrading of the technological equipment; the computers developing viruses which affected teachers' personal documents stored on their own flash drives; limited or unreliable access to the Internet; computers that did not function well; limited technological support; access to the Internet restricted to administrators and principals. In two of the no-fee-paying schools, a disabling factor was that the computer laboratories were overcrowded, computers were obsolete or frequently froze, and electrical points were faulty. As a result of the lack of funds in the no-fee-paying schools, technology equipment was limited and had to be shared according to unsatisfactory timetables. This

discouraged teachers, who could not use the technology when they required it and felt that the time allocated to them was in any case too short.

In no-fee-paying schools, teachers spent large amounts of their own money purchasing technological equipment for use in their classrooms. NQTs are thus using technology for teaching and learning despite a lack of resources. Transporting personal equipment to school and back every day in crime-infested communities was a real challenge for these teachers. A further disabling factor was the lack of safety at school for storing this personal technological equipment. The fact that NQTs purchased their own equipment proves how committed teachers were to technologically driven tuition.

The teachers' personal laptop screens were too small in a class of 40 or more learners, and this became a disabling factor. Learners had difficulty seeing, reading and hearing when a small projector was connected to a laptop. This resulted in disruptive behaviour during classes and the teachers had to spend instructional time managing learners' behaviour.

Another disabling factor affecting teachers' use of technology in the classroom was the apathy of principals regarding technology for teaching and learning. Many of the principals in schools were 'digital immigrants' and not interested in supporting their teachers' use of technology. These principals had not received training to use technology and were indifferent about technical assistance, either to maintain the limited equipment or to assist teachers in their use of technology. In one school there was a technical assistant, but he was unreliable. He was a volunteer worker in the school and did not respond promptly to teachers' requests for help. At another school, the principal gave the FP teachers preferential access to the limited technology because he believed that younger learners needed to be more visually stimulated. The IP teachers who were the participants in this study were discouraged from borrowing technological equipment. At another school the Science teachers were given preference to use the computer laboratory.

When teachers had to book to use the limited technology facilities available, they were discouraged from doing so. Although the arrangement gave all teachers an equal opportunity to use the technology, it did mean that teachers had to plan well in advance, and no spontaneous teaching using technology could be undertaken. When teachers did use the equipment, they were nervous that it might break and they would be held responsible for breaking it. This disconcerting consideration curtailed one particular teacher's use of technology in her

teaching. The finding could be interpreted to mean that the appropriate 'facilitating conditions' were not in place at no-fee-paying schools; instead, teachers were required to expend considerable effort to use technology, which unsurprisingly discouraged them from doing so.

Most teachers agreed that a lack of time to develop technology-related activities was a predominant factor in their reluctance to deploy technology. Due to their school work and the curriculum overload, many teachers resorted to downloading video clips from YouTube in their lessons. They reported that searching for appropriate technology materials online and integrating it into their teaching took time and was laborious. These teachers viewed technology integration as an 'add-on' to their normal teaching responsibilities.

A further disabling factor mentioned by many teachers in this study was that during their pre-service training, the focus was merely on content acquisition. They stated that the time allocated for technology courses was too little: they had had only six workshops during their four years of undergraduate training. One teacher mentioned that he was sent to a no-fee-paying school for his Teaching Practice which lacked a variety of technological resources to support his teaching. Although there were some technology facilities, student-teachers were not allowed to use them. Such negative experiences during Teaching Practice did not assist in preparing these teachers to teach effectively with technology.

During the data generation process, the researcher became aware that the teachers were not aware of the e-Education policy embodying the ICT vision for the country. One school had its own policy that obliged teachers to use technology in their teaching.

In conclusion, various enabling and disabling factors were identified, which either encouraged or discouraged NQTs to use technology in their teaching. Frequency of use appeared to be linked to the issue of school funding. At no-fee schools in the lower quintiles the use of technology was curtailed by logistical factors. At affluent schools the use of technology was widespread and largely effective. If teachers at no-fee-paying schools received pedagogical support there is every likelihood that more teachers would adopt and effectively integrate technology into their teaching and learning. If the teachers are self-motivated, they will overcome physical challenges such as the lack of school resources by purchasing their own equipment and using it for curriculum delivery.

7.2.2 Why are NQTs integrating technology into their pedagogical practice?

To answer Research Question Two, two key themes emerging from the findings are discussed: the pedagogical benefits for learners when technology is used for teaching and learning, and the pedagogical benefits for teachers. These findings are linked to the TPACK model and to the constructs of 'performance expectancy' and 'hedonic motivations' in the UTAUT2 model.

As far as pedagogical benefits for learners are concerned, NQTs used technology to gain learners' attention, to make lessons exciting and fun, and to improve their understanding of difficult concepts; to involve learners in collaborative learning, using creative strategies to increase learners' self-confidence; and to teach learners how to search for credible and authentic information using the Internet. These findings correspond to the construct of 'performance expectancy' in the UTAUT2 model, since NQTs used technology because of the value it added to their lessons. All these themes will be discussed in the following section.

The teachers all used video clips in their classrooms to gain their learners' attention. Four of the six teachers in this study taught in gang-ridden areas and indicated that their learners' attention was not always on the lessons being taught. With technology, these learners became more focussed on the lesson, even excited about it, and engaged more in class activities. The technology was also pedagogically beneficial: videos increased the learners' ability to understand difficult, abstract concepts, complemented the teachers' explanations, and catered for the diverse learning needs of the learners.

Two of the teachers involved their learners in collaborative, authentic activities when they taught with technology. This active-learning pedagogy was clearly beneficial: it created an environment where learners sought assistance from their techno-savvy peers in the performance of creative tasks that required group members to search for information on the Internet, and type their tasks on Microsoft Word. Teachers uploaded tasks onto online platforms. The learners working in their groups enjoyed this pedagogical approach and apparently felt motivated to learn in the flexible and non-threatening environment. This style of teaching develops the social and technological skills needed for the 21st-century workplace.

The reason *why* these NQTs used technology in their teaching was to develop learners' self-confidence through involving them in innovative technological projects. For example, learners completed technology-based projects that were posted on an online platform (a blog). Learners' projects were thus published and shared with the school community. The teachers concerned

found that this boosted leaners self-esteem, and had a ripple effect. Learners became more motivated, participated more in class and communicated better. Even the most timid learners began to take part in class activities.

With so much information on the Internet, teachers taught their learners how to search for reliable information and use trustworthy sites when completing their assignments. This information is vital for IP learners to know, as they are exposed to a wide variety of both authentic and fake or untrustworthy information on the Internet.

As far as teachers are concerned, a major benefit accruing from integrating technology into their teaching and learning was that, by using collaborative and project-based strategies, they had more time to interact and engage with all their learners. The individual needs of learners were better attended to, and extra attention was paid to groups who struggled to complete technology tasks.

Through the use of technology project-based activities, learners could upload their assessment tasks online, which made marking easier: teachers could mark at any place or time if they were connected to the Internet. Another benefit to teachers was that, when they assessed learners using formative online activities, feedback was immediate. By assessing learners in this way, teachers could at once identify the learners who were struggling to understand the concepts being taught, and provide remedial action.

To conclude the answer to the second research question, the NQTs used technology because of its benefits for both teachers and learners. Yet despite their use of technology, which engaged the interest of learners and enhanced their understanding of the curriculum, some teachers, particularly in the no-fee-paying schools, lacked the ability to integrate technology, pedagogy and content knowledge. The researcher's acquisition and integration of TPACK Model could be used when training teachers to enable them to teach effectively with technology.

7.3 RECOMMENDATIONS

Based on the findings reported above, the researcher presents the following recommendations for policy, practice and future research.

7.3.1 Policy

It is recommended that provincial departments and TEIs drive the vision of the NDoHE e-Education and MRTEQ policies. Having technology policies in place is not enough; teachers need to be acquainted with all ICT policies to inform and amplify the integration of technology into their teaching and learning. The majority of teachers were not aware of ICT policies that could guide and foster their use technology.

As we move further into the 21st century, it is recommended that the WCED, in its quest to support and uplift schools by enabling blended learning, needs to respect the basic terms of restorative justice by making it obligatory to provide technology, training and security to both fee and no-fee-paying schools in this study.

7.3.2 Practice

In this section, recommendations are made for principals, professional development training workshops and TEIs.

7.3.2.1 Recommendations for principals

Both principals and teachers, in no-fee-paying schools in this study, should attend professional development training on technology. This recommendation is important as principals in these schools did not assist or encourage their teachers to use technology. In one school, the principal gave priority to FP teachers to use technology equipment, while at another school, internet access was only for the principal and the administrator, since it was so costly.

Teachers from no-fee-paying schools did not have the privilege of access to a computer connected to a projector, a smart board in every classroom nor technological resources which made it difficult for them to teach innovatively with technology. The researcher recommends that these schools bridge the digital gap by prioritising, in their planning schedules, to have one furnished computer laboratory capable of accommodating an entire class with the necessary security systems in place. The computer room should have other technological resources such as smart boards and projectors.

At no-fee-paying schools where there was a lack of technological resources, teachers made an effort to use their personal technological equipment. These teachers transported their own equipment from home to their schools. It is recommended that principals, in these schools,

should reward their teachers in some way, at the very least with a certificate acknowledging their efforts.

Due to the importance of personally owning technology equipment, it is recommended that, no-fee paying schools make provision for teachers to become technology owners. This could be done through partnership with companies, to arrange affordable payment options for teachers. School principals in these schools could apply for grants to assist in purchasing personal technological equipment for teachers.

It is recommended that principals, employ technical assistants with skills in ICT and knowledge of the curriculum. These technical assistants would be able to make informed decisions about purchasing relevant software programs that are in line with the CAPS curriculum. The majority of teachers complained that the software programs installed on the school's computers did not align with the CAPS curriculum. This discouraged them from using the programs, given the pressure they are under to complete the curriculum.

It is recommended that teachers be trained to fix minor technological problems rather than rely upon technical assistants, which wastes instructional time. It was observed that a teacher wasted instructional time while waiting for the technical assistant to fix a minor technical problem. At no-fee paying schools, in this study, which lack the funds to hire a technical assistant, teachers who are skilled in the use of technology should be assigned by their principals to assist other teachers in case of technical problems, and regularly to update software applications to minimise breakdown. In most of the no-fee-paying schools, it was observed that software programs were not regularly updated, something which, again, discouraged teachers from using them.

From the findings, it is recommended that principals, involve learners in technology training so that they will be better equipped to deal with technological tasks in the classroom. Training learners to use technology means that they will require less support from teachers during technology tasks; teachers may be encouraged by this saving. A teacher in no-fee-paying school repeatedly mentioned during interviews that learners lacked basic technology skills and relied on her when she gave them technological tasks; wasting her instructional time.

7.3.2.2 Recommendations for professional development training:

It is recommended that professional development training, should focus upon developing teachers' TPACK skills, in order to enable them to teach effectively with technology. The TPACK skills could be acquired when teachers are exposed to technology project-based tasks, such as the 'digital storytelling project' that required them to take active responsibility for their own learning by combining many skills. It is recommended that during professional development training, teachers are given individual or group technology tasks/activities to complete with follow-up and reflection sessions. The majority of teachers did not teach effectively with technology because they could not blend technology, pedagogy and content knowledge.

Teachers in this study who were not skilled in the use of technology for teaching and learning, could learn during professional development training. Professional development training on technology should be regular, and teachers should be monitored after training in order that challenges they may have encountered while teaching with technology might be addressed. This recommendation is supported by the fact that some teachers complained that after training, some of their colleagues had been put off by technical problems and only used technology for administrative purposes.

7.3.2.3 Recommendations for TEIs:

Lecturers at TEIs should place equal emphasis on technological, pedagogical and content knowledge when teaching subject matter: a blend of these three fields of knowledge is required for effective teaching with technology. All the teachers in this study reported that the TEI where they had studied focused mainly on content and pedagogical knowledge, with limited attention to technological knowledge.

Since some teachers complained that during their pre-service training they were sent to schools which had no technological resources, it is recommended that teaching practice co-ordinators should expose teachers to schools in both lower and higher socio-economic brackets. Their experience in schools with substantial resources will better prepare teachers to teach with technology.

7.3.3 Recommendations for future research

The majority of NQTs did not teach effectively with technology because they lacked TK, TCK, TPK and TPACK. The researcher developed a model entitled 'the acquisition and integration of TPACK' to address this lack. Further research is needed to test and validate this new model.

The majority of the teachers in this study taught with technology in a traditional manner and they attributed this to their pre-service training, which did not adequately prepare them to teach with technology. It is recommended that future studies conduct research into how pre-service teachers are prepared to teach with technology. Teacher Education Training is an important starting point for teachers to be trained to teach effectively with technology.

From these findings, it appears that school stakeholders (teachers' colleagues, learners, family members and some principals) play an important role in encouraging teachers to use technology. Future studies could interview these school stakeholders to ascertain in-depth their perceptions of factors that may influence teachers' use of technology.

The sample for this study was relatively small: 74 teachers responded to an online survey, ten of whom were interviewed and six observed in the classroom. Chapter Five comprehensively discussed factors that influenced NQT's ability to integrate technology, while Chapter Six discussed *why* NQTs integrate technology into their pedagogical practice. The findings reported in these chapters cannot reliably be generalised because of the small sample size and limited context: different contexts may yield different results. This study should perhaps be replicated in a high school context to ascertain whether similar results would be obtained.

7.4 SUMMARY OF CHAPTER SEVEN

This chapter provides an overview of this study. It draws conclusions from the findings presented in Chapters Five and Six, which respond to the two research questions. The findings provided insight into the unequal nature of schools in the Western Cape. While fee-paying schools had an abundance of resources, no-fee-paying schools had limited or no resources. The findings provide evidence that technology resources are still a problem in some schools in the Western Cape, despite the e-Education (2004) policy's insistence on equal and quality education. In addition, the findings highlight that there is a need for teachers to be trained to blend technology, pedagogy and content knowledge, which is required for effective teaching

with technology. The ‘acquisition and integration of TPACK’ model developed by the researcher can be used to address this need.

From the findings, recommendations were made pertaining to policy, practice and future research.

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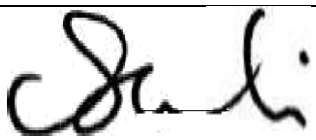
APPENDIX A:
CPUT APPROVAL LETTER

Signatures:

Researcher/Applicant:	Chantyclaire A. Tiba 	Supervisor or Senior investigator (if applicable):	A/P Janet Condy 
Date:	11.04.2014	Date:	14.04.2014

Please note that in signing this form, supervisors are indicating that they are satisfied that the ethical issues raised by this work have been adequately identified and that the proposal includes appropriate plans for their effective management.

Education Faculty Ethics Committee comments:

EFEC unconditionally grants ethical clearance for the study titled **"Factors influencing novice teachers' use of digital technologies as a pedagogical tool"**. The certificate is valid for 5 years from the date				
Of issue:				
Approved			 Chairperson: Cina P Mosito	Date: 27 April 2014
Approval Certificate/Reference: EFEC 24-4/2014				

APPENDIX B:
WCED APPROVAL LETTER (1)

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20140806-34192
ENQUIRIES: Dr A T Wyngaard

Ms Chantyclaire Tiba
25 Lawrence Road
Maitland
7405

Dear Ms Chantyclaire Tiba

RESEARCH PROPOSAL: FACTORS INFLUENCING NOVICE TEACHERS' USE OF DIGITAL TECHNOLOGIES AS A PEDAGOGICAL TOOL

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **08 August 2014 till 30 March 2015**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 07 August 2014

APPENDIX C:
WCED APPROVAL LETTER (2)

Western Cape Government
Education

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20140806-34192
ENQUIRIES: Dr A T Wyngaard

Ms Chantyclaire Tiba
25 Lawrence Road
Maitland
7405

Dear Ms Chantyclaire Tiba

RESEARCH PROPOSAL: FACTORS INFLUENCING NOVICE TEACHERS' USE OF DIGITAL TECHNOLOGIES AS A PEDAGOGICAL TOOL

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **13 April 2015 till 30 September 2015**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 18 March 2015

APPENDIX D:
A LETTER REQUESTING TEACHERS' FOR PARTICIPATION IN THIS STUDY

Cape Peninsula University of Technology

Chantyclaire A. Tiba
Faculty of Education and Social Sciences
Cape Peninsula University of Technology
Highbury Road, Mowbray
P.O. Box 652.

Dear Sir/Madam,

A REQUEST FOR TEACHERS' PARTICIPATION IN THIS STUDY

I am currently a full-time doctoral student at the above-mentioned institution. My thesis is titled: Factors influencing Newly Qualified Teachers' use of technology as a pedagogical tool.

I am interested in teachers' experiences, and how and why they are integrating technology in their classrooms. The Western Cape Government has provided technological equipment to public schools and trained teachers in their use. Teachers are expected to teach with technology. However, anecdotal evidence shows that teachers are reluctant to use technology in their teaching and learning. Hence, this research will be beneficial as the researcher intends to highlight enabling factors and barriers to teachers' use of technology, so that WCED can formulate programmes to encourage more teachers to use technology in their teaching. My research is framed around the backdrop that it is important to teach today's learners who are digital natives with technology. Data for this study will be collected through online survey, one-on-one interviews and classroom observations.

Measures will be taken to protect anonymity of the participants and the schools by omitting the use of real names during reporting of the findings. This letter serves to inform you that all the information gathered will be used solely for research purposes. Your participation is strictly voluntary and you are under no obligation to participate in this study. I have attached the approval letter from the University Ethics Committee and WCED allowing me to conduct research.

If you want more information on this research project, please feel free to contact me on my email: chantylee2006@yahoo.com or alternatively my supervisor's email: condyj@cput.ac.za. I would be grateful if you would assist me in this research.

Yours sincerely

Chantyclaire Tiba

Signed at [redacted] on the 28 day of Aug 2014
Signature

APPENDIX E:
CONSENT FORM FOR TEACHERS

Cape Peninsula University of Technology

CONSENT FORMS FOR TEACHERS

I [redacted] (Name and Surname) have been made aware of the following by the researcher:

a) That an audio recorder will be used during interviews to capture accurate data.
b) I have a right to withdraw from the study at any time without providing reasons.
c) That my name will not be mentioned when reporting findings or in any output of the research.
d) That there are no foreseen risks involved in this study. However, safeguard has been taken to reduce both known and unknown risks.
e) The transcribed interview data will be sent back to me for feedback and confirmation of information.

I am satisfied as all my questions regarding this research has been answered and I am aware of the nature and purpose of this study. I consent to serve as a research participant for this research project titled **"Factors influencing Newly Qualified Teachers' use of technology as a pedagogical tool".**

[redacted]
Name and surname of participants

[redacted]
Signature

Chantyclaire Tiba
Name and surname of researcher

.....
Signature

APPENDIX F:
A REQUEST TO PRINCIPALS' FOR PERMISSION TO CONDUCT RESEARCH

Cape Peninsula University of Technology

Chantyclaire A. Tiba
Faculty of Education and Social Sciences
Cape Peninsula University of Technology
Highbury Road, Mowbray
P.O. Box 652.

Dear Sir/Madam,

A REQUEST TO PRINCIPALS FOR PERMISSION TO CONDUCT RESEARCH

I am currently a full-time doctoral student at the above-mentioned institution. I am requesting permission to interview and observe Mr/Mrs/Ms [redacted] (name withheld) in her classroom while she teach with technology.

My thesis is titled: Factors influencing Newly Qualified Teachers' use of technology as a pedagogical tool. I am interested in exploring teachers' experiences, and how and why they teach with technology in their classrooms. The Western Cape Government has provided technological equipment to some schools and trained teachers in their use. Anecdotal evidence shows that teachers are reluctant to use technology in their teaching and learning. Hence, this research will be beneficial as the researcher intends to highlight enabling factors and barriers to teachers' use of technology, so that WCED can formulate technology programmes to encourage more teachers to effectively use technology in their teaching. My research is framed around the backdrop that it is important to teach today's learners, who are digital natives, with technology.

Teachers who have accepted to be part of this study will chose a date and time which is convenient for them to be interviewed and observed in their classrooms while they teach with technology (no research will be conducted in the fourth term).

Measures will be taken to protect anonymity of the participants and the schools by using pseudonyms when reporting findings. All information gathered will be used solely for research purposes.

Participation of the teacher is strictly voluntary and the teachers are under no obligation to participate in this study. Should you agree, you hereby asked to sign this form.

Find attached the University Ethics Committee and WCED approval letter allowing the researcher to conduct research.

Signed at Maitenberg on the 12 day of May 2014

Signature [redacted]

APPENDIX G:
SAMPLE OF ONLINE QUESTIONNAIRE SURVEY

Name: Chantyclaire A. Tiba
DEd student, Cape Peninsula University of Technology
Mowbray, Education.
P.O. Box 652.

Email: 3063369@gmail.com

Dear teacher,
I am currently a full-time student pursuing a doctoral degree at the above-mentioned university. The purpose of my study is to explore factors that influenced Newly Qualified Teachers' to use technology as a pedagogical tool. The Western Cape Government has provided technological equipment to public schools and teachers are trained in their use. Teachers are expected to use technology for teaching and learning. However, anecdotal evidence shows that teachers are reluctant to use technology in their classrooms. This research project will be beneficial, as the researcher intends to highlight enabling factors and barriers to teachers' use of technology, so that the WCED can formulate programmes to encourage more teachers to effectively use technology. My research is framed around the backdrop that it is important for teachers to teach today's learners who are digital natives with technology. You have been approached for this project because you were trained during pre-service training on how to teach with technology, thus you may provide valuable insight into the topic understudy.

The results obtained from this study will only be used for research purposes. All information will be confidential and will be reported using pseudonyms. Please complete questionnaire to the best of your knowledge and you have the right not to participate or to withdraw at any time without providing any reasons. Do not write your name on any part of the questionnaire, except your email for those who wish to be further contacted. By completing the questionnaire, you are consenting for the researcher to use the information you have provided.

Thank you for your time and co-operation. If you need any assistance, contact me using my email address above.

Yours faithfully
Chantyclaire Tiba (Researcher)

Note: Please can you respond to this survey by the 31st August 2014.

Please answer all questions by 'clicking' appropriate box(es) and/or write your response(s) in spaces provided. You may click more than one option, where applicable. - Copy

Part 1: Demographic Data

1. Age

○ 21 – 30 ○ 31 - 40 ○ 41 - 50 ○ Over 50

2. Gender

○ Male

○ Female

3. Which phase are you currently teaching?

○ Foundation phase

○ Intermediate phase

○ FET

4. Type of school

○ Fee-paying school ○ No fee-paying school

Part 11: Technology use and frequency (The term 'technology' refer to all educational hardware and software programmes teachers use in their classrooms.)

5. I use technology?

○ Often ○ Seldom ○ Never

6. The ICT tools that are available in the school (Click all options which apply):

☐ Audio recorders ☐ Video recorders ☐ Computer / laptops ☐ Internet

☐ Interactive white boards ☐ Educational software ☐ Satellite TVs ☐ Projectors

☐ CD ROMS ☐ Emails ☐ Websites

☐ Other:

Part 111: Enabling factors and barriers to teachers' use of technology

7. Factors motivating me to use ICT (Click all the options which apply):

☐ Competence in the use of technology

☐ Availability of technology hardware

☐ Availability of software programmes

☐ Availability of technical support

☐ Ownership of technological equipment

☐ Professional development training

☐ Benefit of using technology

☐ Technology is easy to use

☐ Support from principal

☐ Pre-service training

☐ Other:

8. The challenges I faced integrating technology into my teaching are ... (Click all the option which apply)

- [ ] Lack of technological hardware
- [ ] Lack of technological software
- [ ] Lack of support from principal
- [ ] Technology difficult to use
- [ ] Lack of support from colleagues
- [ ] Lack of technical support
- [ ] Lack of professional development
- [ ] Lack of pedagogical knowledge
- [ ] Other:

Part 1V: Teachers' experiences

9. How are you using technology for teaching and learning? Explain

10. Give an example of a lesson which you used technology? Please include the following details: content taught, technology and strategies used while using technology.

Part V: Recommendations

11. What will you recommend, to school stakeholders, in order for them to be encourage more to use technology in their teaching?

12. If you will like to be further contacted for this research project, type your email address below.

Please check if you have completed all questions. Thank you for your time in completing survey.

Click to Submit Questionnaire

APPENDIX H:
INTERVIEW SCHEDULE

Date of interview:

Place of interview

Duration of interview:

Peculiarities of the interview:

INTERVIEW QUESTIONS

1. Tell me your name, grades, and subjects that you teach?

2. The 21st century is said to be a digital age. Do you use technology in your classroom? If yes-go to Q3, if no go to Q2.1.

Example: technology in this context refer to educational technology that teachers use for teaching and learning.

2.1 If no, why don't you use technology in your classroom?

2.2 If you were given the opportunity to use technology, would you have used it in your classroom? If yes, explain why?

2.3 What do you think the advantages will be to use technology for teaching and learning?

2.4 What do you think the disadvantages will be to use technology for teaching and learning?

3. If yes, what kind of technology do you use in your classroom?

3.1 How will you rate your competence in the use of technology, from 1-5, 1- being very poor, 2- poor, 3- average, 4- good, and 5- excellent?

3.2 Which technology are you competent using?

3.3 How often do you use technology for teaching and learning? occasionally every day Explain.

4. Why are you using technology for teaching and learning? Explain

5. In your opinion, what factors influenced you to use technology in your classroom? Explain

6. In your opinion, what challenges did you experienced integrating technology in your classroom? Explain.

7. How do you think these challenges can be addressed? Explain

8. Given an opportunity to talk to WCED on the use of technology for teaching and learning, what would you say to them?

9. What kind of changes regarding technology would you like to see in your school?

10. Are there any other issues that you would like to add to the discussion?

APPENDIX I:
SAMPLE OF OBSERVATION SCHEDULE

Description of school

Teachers' name	
School observed	
Location/Address	
Grade observed	
Date of observation	
Time of observation	
Lesson observed	
Physical features of the class	
Class size (Learners)	
Class size (Space)	
Physical description of the school Layout of the classroom	
Technology used in the lesson	

RESEARCH QUESTIONS	PRE-DETERMINED THEMES	NOTES ON PRE-DETERMINED THEMES
Research question one: what factors influenced NQTs ability to integrate technology as a pedagogical tool? (The focus here is on factors motivating	**<u>Consider the following</u>** Support from principals	
	Support from colleagues	
	Availability of technological hardware	
	Availability of software programs	

RESEARCH QUESTIONS	PRE-DETERMINED THEMES	NOTES ON PRE-DETERMINED THEMES
teachers to use technology in their classrooms)	Availability of technical support	
	Competence in the use of technology	
	Ownership of technological equipment	
	Support from colleagues	
	Self-confident to use technology	
Why are NQTs using technology as a pedagogical tool? (the focus here is on what technology teachers used, reasons for using technology and strategies teachers used in their classrooms while using technology)	Get learners attention	
	To teach abstract concepts	
	To teach difficult subject matter	
	Involve learners in collaborative learning	
	Enhance learners communication skills	
	Involve learners in creative learning	
	How teachers integrate the TPACK and UTAUT2 concepts in their teaching	
	Different methodologies/techniques use to enhance learners understanding of content.	
Challenges teachers faced in their classrooms while teaching with technology?	Lack of technological hardware	
	Lack of technological software	
	Lack of technical support	

RESEARCH QUESTIONS	PRE-DETERMINED THEMES	NOTES ON PRE-DETERMINED THEMES
	Lack of technological skills	
Additional information (New information)		

APPENDIX J:
SCHEDULE FOR INTERVIEWS

Date	**Participants**	**Venue**	**Duration**
16th September, 2014	Teacher 1	School (principal's office)	1hr 5 minutes
17th September, 2014	Teacher 2	School (Teachers' classroom)	1hr 30 minutes
10th October, 2014	Teacher 3	University (staffroom)	15 minutes
10th October, 2014	Teacher 4	University (staffroom)	2hrs 10minutes
9th September, 2014	Teacher 5	University (staffroom)	2hrs 00 minutes
19th September, 2014	Teacher 6	Restaurant	51:14minutes
22th September, 2014	Teacher 7	School (Teachers' classroom)	15 minutes
24th September, 2014	Teacher 8	School (staffroom)	1: 30 minutes
25th September, 2014	Teacher 9	School (staffroom)	1: 30 minutes
26th September, 2014	Teacher 10	School (Computer laboratory)	49:00 minutes

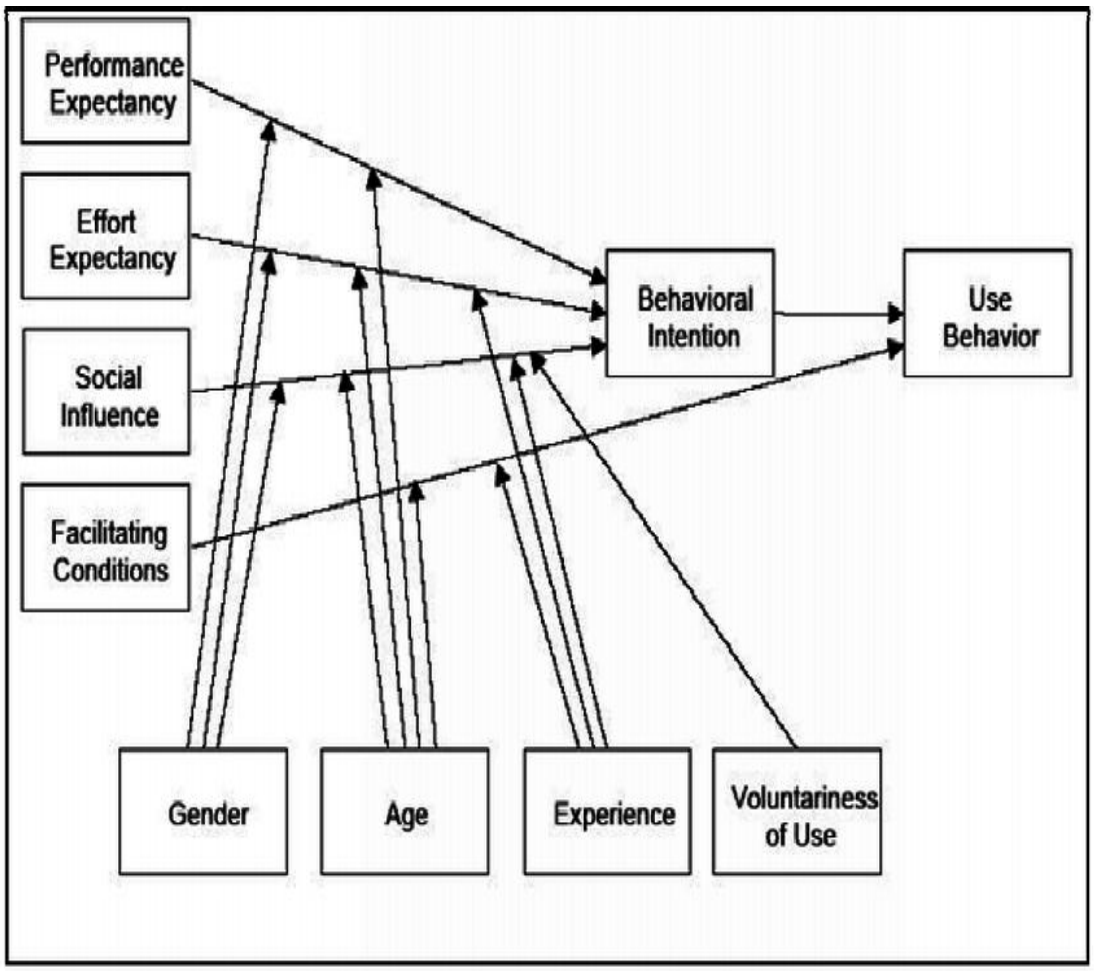
APPENDIX K:
SCHEDULE FOR CLASSROOM OBSERVATIONS

Dates observed	**Participants**	**Number of lessons observed**	**Subjects observed**
June 3rd and 2nd, 3rd, 10th, 11th, 15th, 16th September, 2015	Teacher 4	Seven	English First Additional Language (3), Natural Sciences (1), Mathematics (1), Life skills (2)
April 2nd, July 22nd, 23rd, and August 5th, 24th, 25th, 26th, 2015	Teacher 5	Seven	Mathematic (2), Afrikaans First Additional Language (1), Natural Science (1), Social Sciences (1) and English First Additional Language (2)
April 2st and 22nd 2015, June 9th, 10th and 11th, 2015	Teacher 6	Five	English First Additional Language (2), Mathematics (1), Natural Sciences (2)
May 5th 6th, 19 and 21st, 2015	Teacher 8	Four	English First Additional languages (2), Life Skills (2)
April 29th, 13th May, 29th May and 16th July 2015	Teacher 9	Four	Mathematics (1), Natural Sciences (1) and Life Skills (2)
March 3rd, 4th and 5th August 10th, 12th, 14th and September 30th, 2015	Teacher 10	Seven	Two English First Additional Language (2), IsiXhosa First Language (1), Natural Sciences (1), Mathematics (1) and Life Skills (2)

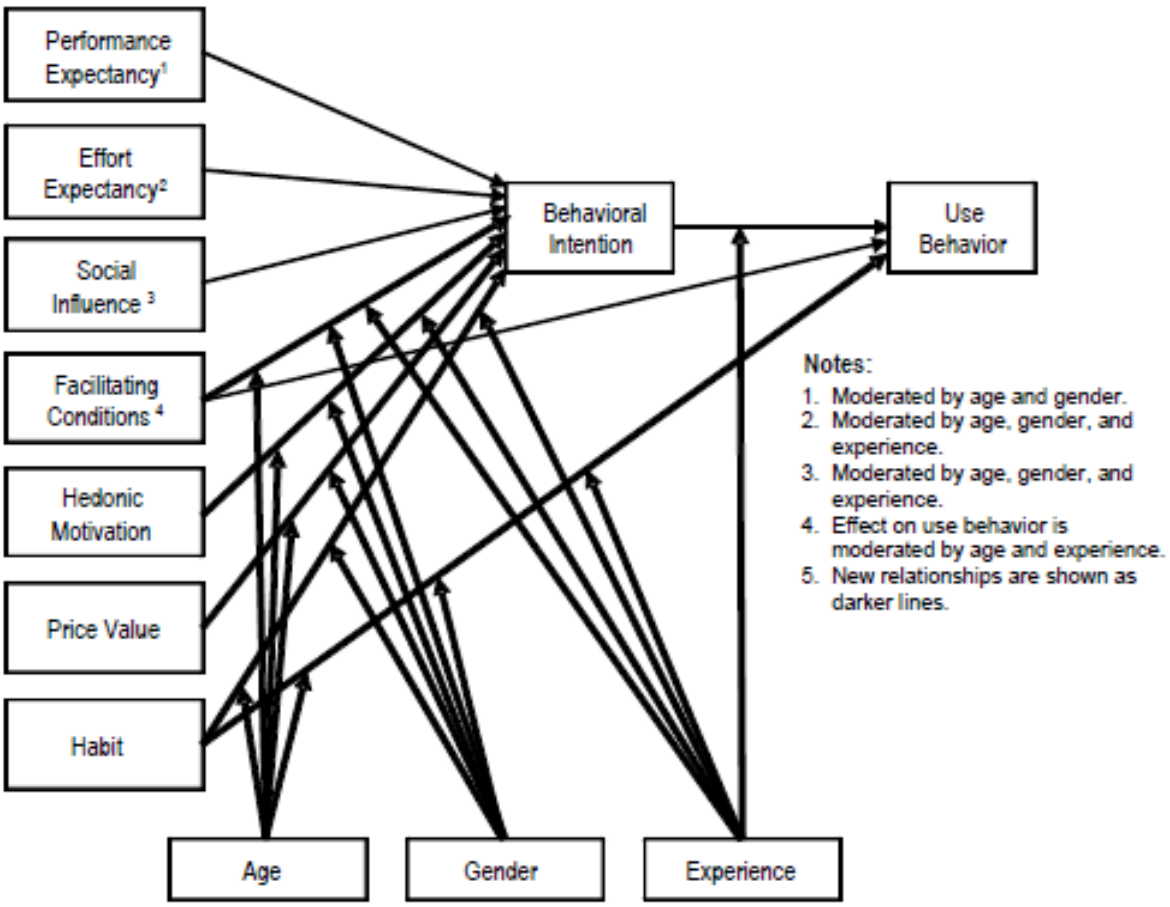
Total subjects observed (34)

a. English First Additional Language (11 lessons)
b. Natural Sciences = Six
c. Life Skills= Eight
d. Mathematics = Six
e. Afrikaans First Additional Language= One
f. Social Sciences = One
g. IsiXhosa First Language = One

APPENDIX L:
THE UTAUT MODEL



APPENDIX M:
THE UTAUT2 MODEL



APPENDIX N:
JOURNAL ARTICLE

Digital storytelling as a tool for teaching: Perceptions of pre-service teachers[1]

C TIBA,[2] J CONDY,[3] A CHIGONA,[4] AND N TUNJERA[5]

Abstract

It has been shown that teachers are reluctant to use technology despite the South African (SA) government's huge expenditure on technological equipment. This might be the result of teachers being unable to select appropriate technology that will yield positive learning outcomes as well as being ill-equipped to integrate technology into their pedagogy. To this end, pre-service teachers at a University were trained on how to integrate digital storytelling (DST) effectively into their teaching. The aim of this study is to gain insight into the potential benefits of DST for teaching and learning and to determine factors that may prevent pre-service teachers' uptake of DST during in-service practice. This is a qualitative study in which fifty pre-service teachers were divided into five groups for focus group interviews. Data were analysed, and the results show that pre-service teachers perceived DST to be beneficial in the classroom as it has the potential to (i) motivate and engage learners, (ii) promote voice/self-expression, and (iii) promote collaborative learning and acquisition of multiple skills. Pre-service teachers are of the opinion that a lack of resources, self-confidence and time owing to restrictive curricula may prevent uptake of DST during in-service teaching. It was recommended that school stakeholders create a balance between intrinsic and extrinsic factors that will promote the adoption and integration of DST into teaching. Also, the education institution concerned strives to balance all three strands of knowledge: technology, pedagogy and content.

Keywords: Technology, digital storytelling, technology integration, multimedia, pedagogy, digital native, pre-service teachers

Introduction

Digital technology has become commonplace as many children are using technology on a daily basis. These children spend most of their time with technological tools such as computers, videogames, digital music players, cell phones and other tools of the digital age (Prensky, 2001: 1). The growth in the use of technology by children has forced school

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1. Acknowledgement: The authors are grateful to the Intermediate Senior Phase students of 2013 for their insightful comments and to the staff at CPUT who facilitated the focus group

2. Chantyclaire A. Tiba (corresponding author: 30633669@gmail.com) is a doctoral student at Cape Peninsula University of Technology, South Africa.

3. Prof. Janet Condy is an Associate Professor at Cape Peninsula University of Technology, South Africa.

4. Dr Agnes Chigona is a Research Fellow in the Faculty of Education at Cape Peninsula University of Technology, South Africa.

5. Nyasai Tunjera is doctoral student at the Cape Peninsula University of Technology, South Africa.

TD The Journal for Transdisciplinary Research in Southern Africa, 11(1) July 2015, pp. 82-97.