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TEACHERS' REASONS FOR AND AGAINST ICT INTEGRATION INTO TEACHING AND LEARNING: A MIXED METHODS APPROACH

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A research report submitted to the Wits School of Education, Faculty of Humanities
Universtity of the Witwatersrand in fulfillment of the requirments
for the Masters' Degree

Johannesburg

2017

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Master of Education at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



_____

Victor Ngobeni,

Date: 8th day of September in the year 2017

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Chapter 1 Background and introduction

1.1 Research Aims

The aim of this research was to use a combination of quantitative and qualitative approaches (also called mixed method approach) to examine reasons for and against integrating Information Communications Technology (ICT) by teachers from schools in Gauteng Province who have attended Microsoft courses. In accordance with the aims of the research, five research questions were proposed:

1) How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?
2) What are the levels of ICT integration for teachers who have attended Microsoft courses?
3) What are the factors which could have a bearing on the integration of ICTs?
4) What reasons do teachers who have attended Microsoft courses provide for or against integrating ICT into teaching and learning?
5) In what way does the qualitative data about teachers' reasons help to explain the quantitative data about their integration levels?

1.2 Rationale

This research was motivated by my personal experience of initially being a teacher who was trained on the Microsoft teacher programme, and then later becoming a master trainer who went on to train hundreds of teachers in Sub-Saharan Africa, on the same programme, for almost 10 years. The Microsoft teacher programme is a global, multi-billion dollar programme, which came into being in 2005, under the brand name Partners in Learning (PIL). The programme comprises a collection of courseware mainly aimed at assisting teachers to integrate technology meaningfully into teaching and learning.

Since inception the programme has trained over 50 000 teachers across South Africa on a number of courses related to ICT integration, as part of the schools' software licensing and support agreement. Annually, the programme targets up to 1 000 teachers at a cost of several hundreds of thousands of rands. To address scale, very few training sessions are scheduled on a school to school basis. Most sessions are scheduled in a centrally located computer-enabled resource, which could be a school, a District teachers' centre or community centre. Guided by the course level, number of training resources (e.g. computers), and transport considerations, a selected number of teachers from schools in the vicinity would attend the sessions. The course is offered at no cost to teachers, and the average number of participants in a training session is 30.

The Microsoft teacher courses range from beginner level, intermediate, up to the advanced level. Courses at the beginner level (also called basic level) normally focus on how teachers can use Microsoft productivity programmes (Word, PowerPoint and Excel), for normal, day-to-day administration (e.g. typing class tests, presenting lessons, recording and analyzing learners' grades, etc.). Courses at intermediate level aim at strengthening teachers' basic technology skills level while introducing them to ideas on how they can infuse these skills in their normal teaching practice.

On the other hand, advanced courses aim at equipping teachers with not only technology skills but the relevant methodology for integrating technology into the curriculum. In line with the growing trend on software development in education, the advanced training also exposes teachers to newly developed applications (commonly known as Apps for Education). For example, recent training sessions have focused on Microsoft Apps like: *Office Mix*, *OneNote*, *Sway*, and how these tools can be used to enhance teaching and learning. Most of the training sessions are conducted on a face-to-face basis, although in the last two years there has been more emphasis on online courses. Refer to Table 1 for a summary of the main Microsoft teacher courses, and their ICT competency levels.

Microsoft Course	Course Description	ICT Skill Level
Digital Literacy Curriculum (DLC)	The DLC is for anyone with basic reading skills who want to learn the fundamentals of computer technology	Basic
ICT Skills for Teachers	This course aims to improve teachers' ICT skills (e.g. Microsoft productivity software i.e. Word, Excel, PowerPoint) in relation to their everyday professional practice	Basic - Intermediate
Microsoft Tools/Apps for Learning	This course demonstrates how Microsoft tools and technologies (e.g. Office Mix, Sway, One Note etc.) positively impact modern teaching and learning, focused on improving student outcomes	Intermediate
Teaching with Technology	This is an online course aimed at helping teachers explore how ICT integration can enhance teaching and learning	Intermediate - Advanced
21st Century Learning Design	In this course teachers learn how to transform their regular lesson plans to build and assess students' 21st century skills using relevant rubrics.	Advanced

Table 1 Microsoft teacher courses and skill level

As a best practice incentive, Microsoft annually awards teachers who have demonstrated the innovative use of their products through what is called the Microsoft Innovative Expert Educator (MIE) programme. This award programme has been part of the Partners in Learning (PIL) programme, since its inception, although the nomination criteria change slightly each year. To be eligible for the awards, participating teachers are required to implement what they consider to be an innovative technology-enhanced lesson or project in the classroom and submit an electronic portfolio of evidence. The teachers' entries would be judged on their innovativeness by a panel of educational technology experts of mostly former winners. The

entrants stand a chance to win a variety of sponsored prizes, including laptops, smart phones, tablets and other similar gadgets.

However, the ultimate prize is a national "Microsoft Innovative Expert (MIE) award", which more than being a recognition award, goes with a sponsored international trip to meet and compete with other similar teachers in what is termed the "Global Forum". Microsoft usually calls this event the "World Cup for Teachers". Despite these incentives which includes an all-expenses paid trip (often to a historically acclaimed location), what has been puzzling is the low levels of participation amongst teachers. Current statistics indicate that out of hundreds of teachers trained every year, only about 5% of the population (judging by the number of entrants), is willing to participate in this awards programme. This could be an indication that teachers are struggling to implement ideas from the training programmes, and therefore research that investigates the reasons why teachers integrate technology (or not) is important.

The lack of interest from teachers to participate in communities of practices and incentive programmes related to ICT integration seems to concur with the body of literature which demonstrates that despite large investments in technology equipment, resources and teacher training with the aim of improving the teaching and learning, the integration of ICT in many countries (including South Africa) has been limited (Pelgrum and Law, 2003). Several authors, including Mumtaz (2000), attribute factors such as poor accessibility to ICT resources, theft of the ICT resources, as well as inadequate training as possible reasons for low levels of integration.

Meanwhile, other authors, including Fullan (2001) argue that the teacher is central to the process of change in implementation curriculum innovation, which includes the use of technology. According to this perspective, the point of departure in uncovering reasons for limited ICT integration lies in understanding the role and perceptions of the teacher with regards to ICT. Amongst other approaches, this would typically involve an assessment of the current ICT integration levels of teachers, as well as an overall understanding of the factors

that both enable and restrict them from integrating technology into teaching and learning. The solution to this problem would hopefully go a long way into helping governments and interested stakeholders in designing and implementing successful ICT-based programmes.

1.3 The promise of technology

It is not surprising that South Africa, like most other developing nations, is making huge investments on the promise of technology to transform the face of education with the hope that this can ultimately solve some of the most pressing problems plaguing the country including poverty, unemployment, HIV/AIDs, energy shortage and many other socio-economic problems (Kozma, 2008). However, considering the Apartheid legacy of educational inequalities, that the country emerged from, investments on technology often compete with more pressing fundamental needs including lack of classrooms, furniture, and in some cases, textbooks (Kistan, 2014). Efforts to prioritize technology investments over physical infrastructure are often justified by the potential role of technology "in enabling learner-centred, inquiry-based and higher order skills learning", as stipulated in the White Paper on e-Education (DoE, 2004, p. 17).

The South African Public Education System (Grade R-12) is governed by the National Department of Basic Education (DBE) which governs national policy, strategy and curriculum. However, budgets, including technology deployments, are currently devolved to the provincial level across the nine provinces. The result is that the nine provinces are all at different levels of technology deployments, with some provinces, e.g. Gauteng, involved in more advanced programmes than others.

1.4 Provincial technology deployments

Notably, only two provinces out of nine have a history of large scale technology deployments in education, and these are: Gauteng and the Western Cape Provinces, although their deployment strategies differ slightly. Whilst the Western Cape has concentrated on getting infrastructure and teacher professional development in place before large scale device

deployments, Gauteng seems to have a penchant to deploy in large numbers upfront. To demonstrate this case, two examples are relevant: in 2001, the Gauteng Department of Education (GDE), in partnership with the Department of Finance, launched the Gauteng Online School Project (GOSP). This was a multiyear project which ultimately cost billions of rands in implementation and maintenance. The main objective of the Gauteng Online project was to build a province wide school computer network comprising over 2000 schools, through a 25-seat computer lab with internet and email capabilities to enhance curriculum delivery.

In the same period, the Western Cape launched a similar initiative called the Khanya project, although it involved a less number of schools (about 1500) and a slightly different approach. *Khanya* is derived from a Xhosa word "Ukukhanya" meaning *enlightenment*. The Khanya project had a number of bold aspirations inducing: "to transform the Western Cape Education Department into a world leader in sustainable curriculum delivery through ICT; to increase educator capacity and effectiveness by means of technology; enhance the quality of the learning experience in the classroom providing an opportunity for learners to benefit from a variety of learning styles; assist differently abled learners to maximise learning" (Khanya, 2008). However, all these technology investments would have meant nothing if teachers were not being trained and supported to be able to use them. Research abounds to support the view that without proper appropriation, the potential of ICT to enhance teaching and learning cannot be realized (Chigona, Chigona, Kayongo and Kausa, 2010).

More than 15 years ago, the national Department of Basic Education (DBE) adopted and supported the Intel Teach to the Future as one of the soundest teacher professional development programmes on ICT integration. The Intel Teach to the Future was an international ICT training project, launched in 2000 by Intel Corporation. The programme was aimed at helping teachers integrate technology into the classroom through project-based learning approaches. Exactly 5 years after the programme was launched, Wilson-Strydom, Thomson, and Hodgkinson-Williams (2005) evaluated the adoption of the programme by teachers in South Africa. One of the most remarkable findings from this research is that a reasonable percentage of teachers (i.e. 48%) credited the course for "implementing a

technology-integrated lesson more than once a month" (Wilson-Strydom et al., 2005, p. 76). However, the significance of this finding lies in the range of reasons for lack of implementation, for the remaining 52%. At that time, it did not come as a surprise that 75% of the non-implementers cited lack of ICT resources as the main reason for failing to integrate technology into their practice.

It is over 10 years since the results of the Intel Teach to the Future research have been shared and in that period the Department of Basic Education (DBE), along with the private sector, have made substantial strides in addressing the issue of lack of ICT resources in schools. As pointed out earlier, the Western Cape and the Gauteng Province are leading the way in terms of provincial multibillion rand technology deployment in schools. The big question is: how much impact have these investments had on transforming teacher pedagogy and enabling students to fulfil one of the mandates of the White Paper on e-Education which is: "the ability to use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community" (DoE, 2003, p. 17). And also, what reasons do teachers advance for integrating ICT, or not?

Chapter 2 Literature review

2.1 Introduction

This chapter will explore the literature related to the field of technology in education, especially in connection with reasons influencing the use (or non-use) of technology by teachers. More than being a purely descriptive exercise of stating who said what concerning the field, this is rather a critical assessment of the literature. The chapter will offer contrasting views of key authors, which will include an evaluation of prevailing theories (and models), as well as stating where the weaknesses and gaps in the literature exist. As a point of departure, a definition of the central term of this research: i.e. "ICT" will be offered. This will be followed by a discussion about the differences between two related concepts: "ICT competence" and "ICT integration". Thereafter a brief overview of a framework related to ICT integration called Technological, Pedagogical and Content Knowledge (commonly known as TPACK), will be offered. The discussion will conclude with a graphical conceptual framework which will illuminate the main key factors, concepts and variables related to reasons for and against ICT integration, and the relationship among them.

2.1.1 What is ICT?

This research centred on the use (or non-use) of Information Communications Technology (ICT) by teachers, and therefore a clear definition of ICT, in the context of teaching and learning, is required. But ICT is such a vast term with multiple meanings, and so: where does one start? In terms of the history of technology in education, there are two distinct eras: 1) the 'pre-digital era' of the textbook and pen; and 2) the 'digital era' of what is "diversely referred to as 'information and communications technology' or otherwise abbreviated as ICT, 'computerized technology' and several other variations on the 'information technology' label" (Selwyn, 2001). While it is commonly accepted that there is no standard definition of ICT, Selwyn (2001), prefers the umbrella term "digital technology" to refer to a range of different aspects of contemporary technology that can be used to produce, manipulate, store, communicate, and/or disseminate information, including, but not limited to:

- Computing hardware, systems and devices (such as desktop PCs, laptop computers, tablet computers, interactive whiteboards, simulation system and immersive environment),
- Personal computing devices (such as mobile phones, 'smart phones', personal digital assistants, mp3 players);
- Audio-visual devices (such as digital radio, digital television, digital photography, digital video);
- Games consoles and hand-held games machines;
- 'Content-free' computer packages (such as word processors, spreadsheets);
- 'Content-related' computer software packages (such as simulation programmes, tutorial packages);
- Worldwide web content, services and applications (not least web-pages and web-based services);
- Other internet applications such as email and 'voice over internet protocol' (such as Skype and other related-web-based telephone services."

To further demonstrate the difference between pre-digital and modern "ICT's", Koehler, Mishra and Cain (2013, p. 13) stated that "on an academic level, it is easy to argue that a pencil and a software simulation are both technologies…however digital technologies—such as computers, handheld devices, and software applications—by contrast, are protean (usable in many ways), unstable (rapidly changing), and opaque (the inner workings are hidden from users." In educational terms, one can argue that perhaps the most prominent technologies in the last 20 years, are the internet-based technologies, with the worldwide web leading the charge in this regard. A lot has already been written about how the "worldwide web applications are now a major element of contemporary digital technology use – not least in the form of search engines such as *Google,* hypertext-linked web pages and online tools and services such as 'e-tailing', social networking, content sharing applications, and so on" (Selwyn, 2011).

The evolving capabilities and complexities of web-based technologies, especially in the last 20 years, has enabled the technology to progress from the 'instrumental' (i.e. being used primary for information seeking and gathering) to the 'expressive' (i.e. being used as a tool to perform and realize social interactions, through what is commonly called 'social media') (Selwyn, 2011). The use of ICT for social media is just one potential function, or as J.J Gibson would refer to it as "affordance" of ICT in education. Bearing in mind that this research investigated reasons for integrating ICT (or not) into teaching and learning by South African teachers, and therefore a thorough definition of "ICT integration", in terms of the South African policies on e-Education, is required.

2.1.2 ICT integration

For South African teachers, the White Paper on e-Education (DoE, 2004) is the blueprint for technology-enhanced education. This policy defines e-Education as a process that revolves around the use of ICTs to accelerate the achievement of national education goals. The policy defines ICT integration as more than acquiring computer literacy skills necessary to operate various types of information and communication technologies (ICT), but rather as the use of ICT to enable learners to acquire high-order thinking skills, including, amongst others: the ability to access, analyse, evaluate, integrate, present and communicate information; problem solving, and collaboration with others (DoE, 2004).

As stated earlier, one of the opportunities offered by ICT is the abundance of resources (information, pictures, videos, simulations) that are readily available on the internet through the World Wide Web. However, ICT integration means more than accessing these resources, and it is rather about the "appropriate selection, use, mix, fusion of and integration of many sets of competencies amongst teachers and students" (DoE, 2004, 14). It can be argued that this view on the role of technology in education leans towards the constructivist theory of learning whereby students learn by doing and are engaged, rather than the show-and-tell and the "teaching machines" approach, often associated with behaviourist theories of learning. In most instances, due to their ever-improving capabilities, the process of integrating and

implementing ICT involves teachers having to re-evaluate their role as mediators and facilitators of learning rather than as gate-keepers of learning or centres of delivery of learning. As stated in the Guidelines for Teacher Training and Professional Development in ICT (DoE, 2007, p. 4), ICT integration requires "creativity and imagination from both teachers and learners, and teachers should believe that learners can contribute to the learning experience."

Before one examines the origin of ICT integration models, and how they have evolved with time, it is necessary to tease out the interrelationship between the ability to use ICT (also called ICT competence) and the ability to infuse technology within teaching and learning (i.e. ICT integration). This is an important area to be addressed as most ICT integration models assume that the ability to infuse or integrate ICT into teaching and learning will not take place unless teachers have the "right interest, skills, attitude and ability to appropriately use ICT tools and technical equipment" (Lawrence and Veena, 2001, p. 1), and that is to say: ICT competence is a prerequisite for ICT integration.

This means that ICT competence is one of the many reasons why teachers use technology or not. As much as the definition for ICT integration has been offered, it makes sense to also do the same with "ICT competence" since the two concepts are somehow intertwined. A good grasp of the concept of "ICT competence" is pertinent to both the quantitative and the qualitative part of this research. In the quantitative phase of the research, "ICT competence" is one of the concepts indirectly related to the first three questions of the research: i.e. how teachers use ICT? What are their levels of use? And, what are the possible factors that might influence ICT integration? In terms of the qualitative part of the research, "ICT competence" came out as a possible reason for enabling or preventing ICT integration.

2.1.3 What is ICT competence?

The United Nations Educational, Scientific and Cultural Organization (UNESCO) (2016, p. 4) defines competency as "an element or combination of knowledge, skills and attitudes that

an individual should be able to use to perform at work, school or other environments". In terms of teachers and their profession, it is widely accepted that they are expected to "apply broad, deep, and integrated sets of knowledge and skills as they plan for, implement, and revise instruction" (Lawrence and Veena, 2011, p. 2), and proficiency in using technology is but one of the expected competencies. Out of the need for schools to have a clearer vision of the role that teachers can play in harnessing the power of technology for teaching and learning, UNESCO, in partnership with industry leaders and global subject experts, developed the ICT Competency Framework for Teachers (commonly shortened to: UNESCO ICT CFT).

2.1.4 The UNESCO ICT Competency Framework

The UNESCO ICT CFT is regarded by many organizations as the international benchmark which set out the competencies required to teach effectively with ICT. As earlier indicated, the integration of ICT depends on several factors, including the subject being taught, the learning objectives, available resources and the nature of the students. However, the UNESCO ICT CFT has more of a general purpose which is to "inform educational policy makers, teacher-educators, providers of professional learning and working teachers on the role of ICT in educational reform" (UNESCO, 2011, p. 3). It is, thus, not subject or content specific and this makes it well suited to be used as a lens to understand ICT competency levels amongst teachers who teach different grades and subjects, and this is what this research involved.

The UNESCO ICT CFT was used to provide insight into how schools typically integrate ICT, from the most basic to the most advanced level. In a way, the framework was partly applied in determining teacher ICT use levels, which directly speaks to the second research question: *What are the levels of ICT integration for teachers who have attended Microsoft courses?* Secondly, from a conceptual point of view, the UNESCO ICT CFT was compared with the South African White Paper on e-Education with regards how the two documents guide teachers on the "potential role of technology". In its introduction, the Framework

stresses the point that "it is not enough for teachers to have ICT competencies and be able to teach them to their students. Teachers need to be able to help students become collaborative, problem-solving, creative learners using ICT so they will be effective citizens and members of the workforce" (UNESCO, 2011, p. 3).

Similarly, the principal role of ICT as stipulated in the South African White Paper on e-Education (DoE, 2004, p. 14), reads thus: "ICTs, when successfully integrated into teaching and learning, can ensure the meaningful interaction of learners with information. ICTs can advance higher order thinking skills such as comprehension, reasoning, problem-solving and creative thinking and enhanced productivity". This is one example of how South African education policies, at least on paper, can be easily compared to international trends. The big question remains whether teachers in the classroom can translate the policy objectives into reality, hence the need for research.

Further to this, the UNESCO ICT CFT identifies three broad approaches or levels of ICT integration, and these are:

- Technology literacy – enabling students to use ICT to learn more efficiently.
- Knowledge deepening – enabling students to acquire in-depth knowledge of their school subjects and apply it in complex, real-world problems, and
- Knowledge creation – enabling students, citizens and the workforce they become, to create new knowledge required for more harmonize, fulfilling and prosperous societies. (UNESCO, 2011).

Each of these three approaches can be interpreted against a set of competencies which addresses six aspects of a teacher's role, namely: Understanding ICT in Education, Curriculum and Assessment, Pedagogy, ICT, Organization and administration, Teacher Professional development. The UNESCO ICT CFT provides generalized ICT competency standards, but when it comes to providing more specific competencies on ICT, the International Society for Technology Education (ISTE) is one of the most commonly used frameworks.

2.1.5 ISTE teacher ICT standards

The International Society for Technology in Education (ISTE) defines ICT competency as a set of technology standards that describe proficiency in using computer technology in the classroom, and these standards are grouped into four main domains: Basic Technology Operation, Personal and Professional Use of Technology Tools, Social, Ethical, and Human Issues, and Application of Technology in Instruction (ISTE, 2008).

In collaboration with the National Educational Technology Standards (NETS), these standards were further organized into five general aspects or competencies that just about every teacher needs, no matter the subject or grade, namely: productivity, communication, research, media and presentation. Here follows a list of the ICT competencies as summarised by Lawrence and Veena (2011, pp. 3-5):

1) **Productivity**
    - The ability to ***produce and manage learning documents***, including composing standard educational publication e.g. newsletters, hand-outs, etc.
    - ***Analyse quantitative data*** which includes putting student scores into a spreadsheet and analyzing them
    - ***Organize information graphically*** which includes using general tools like word processors, or presentation programmes
2) **Research**
    - ***Use effective online search strategies*** – the ability to choose the most appropriate research tools and databases, and applies the most effective search techniques, to produce useful and safe online resources in the classroom.
3) **Communication**
    - ***Communicate using digital tools.*** These include email, instant messaging, mobile colleagues, and knowing how to organize and manage these tools in the classroom.

- ***Collaborate online for learning.*** Takes advantage of the tools listed above plus blogs, wikis, chats, audio and videoconferencing to bring outside resources into the classroom and to encourage academic collaboration among students.
- ***Publish learning resources online.*** From a simple teacher's web site to a complex curriculum wiki to the online posting of student projects, to podcasting, the teacher has mastered an array of tools and techniques for publishing learning materials online.

4) Media

- ***Capture and edit images, audio, and video.*** The teacher can use digital still and video cameras, edit their output on a computer, and produce learning materials that range from simple slide shows to the archiving of student presentations and performances.

5) Presentation

- ***Create effective digital presentations.*** Using common tools for preparing slide shows, videos, and podcasts, the teacher can create presentations that follow the principles of communication, and can apply these design principles to the evaluation of students' digital work.
- ***Deliver digital multimedia presentations.*** Using common devices such as computers, projectors, and screens, the teacher can set up classroom presentations and arrange for students to do the same.

These competencies describe diverse teacher uses of technology, and for this reason they form the basis of this research in terms of answering the first question, i.e. *How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?*

But as many authors have indicated (Ertmer, 1999; Mumtaz, 2000; Becta, 2004; Hew & Brush, 2006), technical competence alone is not enough to help teachers integrate ICT. Teachers also require other set of skills, including the knowledge about the relevant methods to use with different technologies (i.e. technological pedagogical skills), as well as a good

understanding of the content to be taught. A teacher who possesses a combination of the appropriate technical skills (i.e. technological knowledge) and they can apply relevant methods and strategies (i.e. pedagogical knowledge) in specific subject content (i.e. content knowledge), with the aim of furthering curriculum goals, that teacher is said to possess what is commonly known as Technological Pedagogical Content Knowledge model, also abbreviated as: TPACK (Koehler et al., 2013). Similarly, to ISTE teachers' standards, TPACK framework is relevant in terms of determining teacher ICT integration levels, in relation to the first question of the research: *How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning*? A brief overview of TPACK will demonstrate how.

2.1.6 What is TPACK, and why is it relevant for this research?

The Technological Pedagogical Content Knowledge framework, also called TPACK was first introduced by Mishra and Koehler in 2006, and builds on Lee Shulman's (1986, 1987) construct of pedagogical content knowledge (PCK) to include technology knowledge (Koehler et al., 2013). The main proponents of the model, Mishra and Koehler, contend that TPACK framework identifies the knowledge teachers need to teach effectively with technology and it is no surprise that the framework has since grown into a movement that "spans a multitude of content areas and engages a broad spectrum of researchers and education professionals who are working to understand its theoretical and practical implications" (Koehler et al., 2013, p. 13). TPACK framework identifies three main areas of knowledge (i.e. content, pedagogy and technology) involved in teaching that integrates technology, as shown in the Venn diagram in Fig. 1.

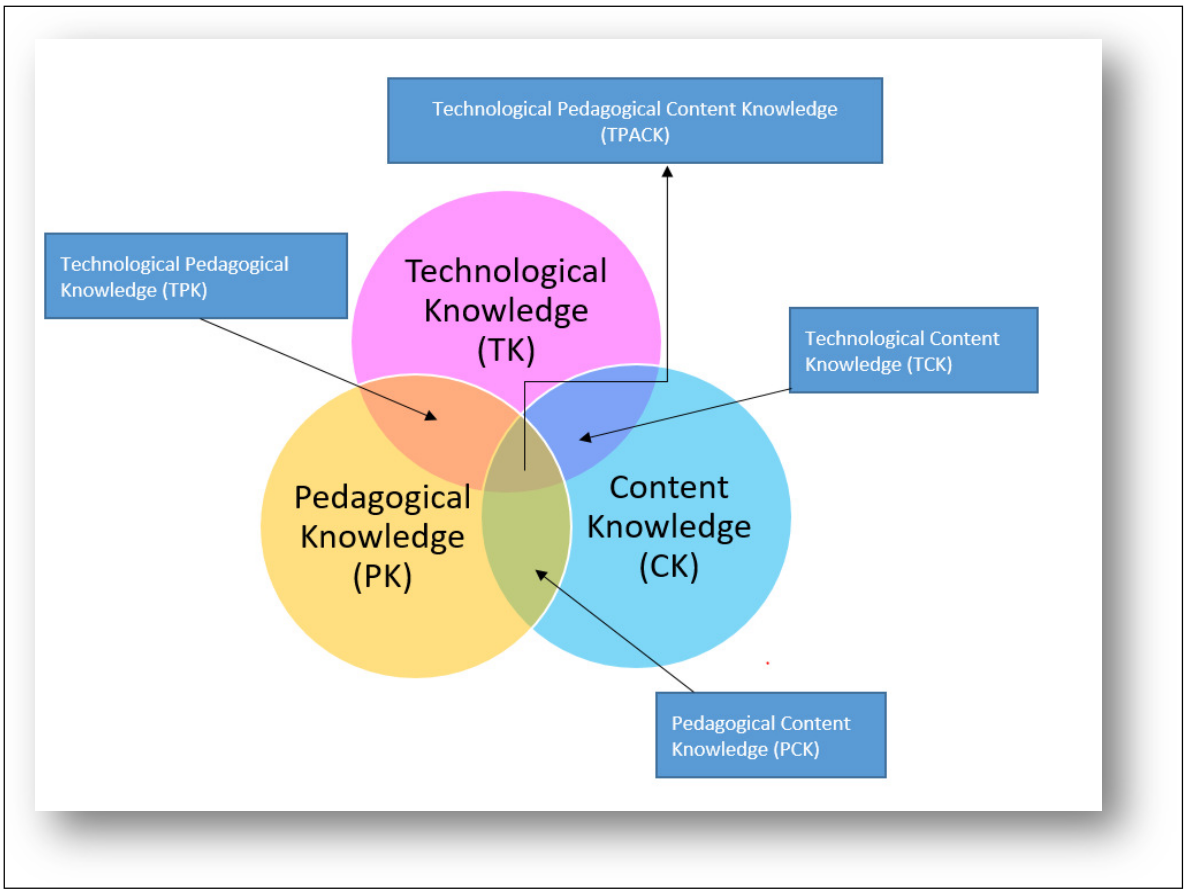


Figure 1 TPACK Framework (Mishra and Koehler, 2006)

However, equally important to the model "are the interactions between and among these bodies of knowledge, represented as PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge), and TPACK (technology, pedagogy, and content knowledge)" (Koehler et al., 2013, p. 14).The dark blue area of overlapping circles in the diagram (Technology Knowledge and Content Knowledge overlap) refers to knowledge on how technology helps the teacher to access and present the subject content (TCK). The pink area, which represents the overlap between the Technological and Pedagogical Knowledge circles, refers to knowledge on how technology can influence the way one teaches (TPK). What the model aims to communicate is that teachers should plan lessons holistically, taking all three areas of knowledge into account, so the knowledge the teacher implements in planning and implementing the lesson represents the middle, brown area where all three circles overlap. But TPACK is more than the sum of individual parts. As summarized by Koehler et al. (2013, p. 16):

> "TPACK is different from knowledge of all three concepts individually...instead, TPACK is the basis of effective teaching with technology, requiring 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 to develop new epistemologies or strengthen old ones."

The main assumption of the TPACK framework is that teachers will struggle to achieve the holistic understanding of how technology, pedagogy and content interact if they have a knowledge deficiency in one or more of the three knowledge areas. Considering that this research investigated the many ways in which teachers integrate ICT (or not) in their everyday practice, one could safely say an indirect aim of the research was to test whether teachers have the TPACK, since without TPACK, teachers cannot be expected to successfully integrate ICT.

However, it is commonly accepted that education is a complex phenomenon, and what more if one throws technology into the equation? This explains the need for educational research as a tool that combines experience and reasoning to discover, describe and explain human behaviour (Cohen, Manion and Morrison, 2007). On a general level, one of the aims of conducting research is to collect and analyze data in order to increase our understanding of the phenomena about which we are concerned or interested. In this regard, the use of models can help in "discovery or creation of knowledge, or theory building; testing, confirmation, revision, refutation of knowledge and theory; and/or investigation of problem for local decision making" (Hernon, 1991).

Within the technology in education field, theories or models can be used to help us understand, amongst others, issues and factors involved in teachers' integration of ICT. As will be discussed later in Chapter 3, models can also help researchers in selecting a suitable research method, depending on whether one wants to base their research on an earlier theoretical model or not. Specific to this research, theories or models of ICT integration (especially the Hooper and Rieber model) were used to explain and understand teacher

change, including why and how teachers use technology as they move towards ICT integration. A brief overview of models of ICT integration can draw attention to critical facets of each model, and will allow more considered selections to be made about their relevance and use.

2.2 Models of ICT integration

As affirmed by Trinidad, Newhouse and Clarkson (2004) many models have been developed over the last three decades to explain the processes involved in the integration of ICT in education. Although each model has different objectives depending on its target group (e.g. individuals, groups, schools or educational organizations etc.), however most share one or more of the following objectives, which includes: "to describe quality pedagogy in the use of ICT to effectively support student learning in schools; to assist teachers in planning to integrate ICT into learning environments; to describe progress by teachers as they move towards the integration of ICT in quality pedagogy; to assist teachers in the development of their own practice in the use of ICT to support student learning; and to provide a tool for teacher dialogue for ICT integration with good pedagogy and provide topics or questions that describe concerns teachers may have" Trinidad et al. (2004, p. 1).

But, just like most other phenomena, models respond to the times: which means that as exciting trends in educational technology and teacher development continue to emerge and evolve, so do models on technology integration into teaching and learning. In recent years there has been a general shift towards models that "encapsulate the complexity of issues involved in teacher competencies in ICT usage and uptake" (Trinidad et al., 2004, p. 10), as opposed to traditional and developmental models which view the process of change as linear and assume that teacher change will come about as a result of in-service training, and thus overlook the role of individual motivation or external influences that may also contribute to teachers' professional development (Ertmer, 2015). Indeed, as noted by Ertmer (2015, p. 6):

> "The general idea behind these developmental models was that teachers' uses evolved as they gained experience. Furthermore, the consensus was that it took five or six years for teachers to accumulate enough experience to use technology in ways

described by the top levels in these models—that is, to *transform* teaching and learning".

An example of such developmental models is the Apple Classrooms of Tomorrow model (also called ACOT). The ACOT model was originally conceived as a programme "to study what happens when "tomorrow's" resources are routinely available, ACOT provided students and teachers an Apple computer both at school and at home" (Baker, Gearhart and Herman, 1993, p. 1).

2.2.1 The ACOT Model

Amongst the various ICT integration models, the Apple Classrooms of Tomorrow (ACOT) model remains one of the most commonly referred to by policy makers and educators alike. This is the same model recommended by the South African White Paper on e-Education (DoE, 2004), as a guide to teacher professional development. As noted by one of the first teams to evaluate the programme, the main assumption of the model is that "text-based curriculum delivered in a lecture-recitation-seatwork mode is first strengthened through the use of technology and then gradually replaced by far more dynamic learning experiences for students" (Dwyer, Ringstaff, Haymore and Sandholtz, 1990, p. 1). In the process teachers typically progress through five successive stages as they gradually replace their traditional beliefs and practices with new ones. These stages are: entry, adoption, adaptation, appropriation and innovation (see Fig. 2). The model is usually represented by a pyramid to show hierarchical relationships of the stages, with the entry stage on the bottom typically having the largest number of the population, and the innovation having the least number. Here follows a brief description of the ACOT model, as summarized from research done by: Dwyer et al. (1990).

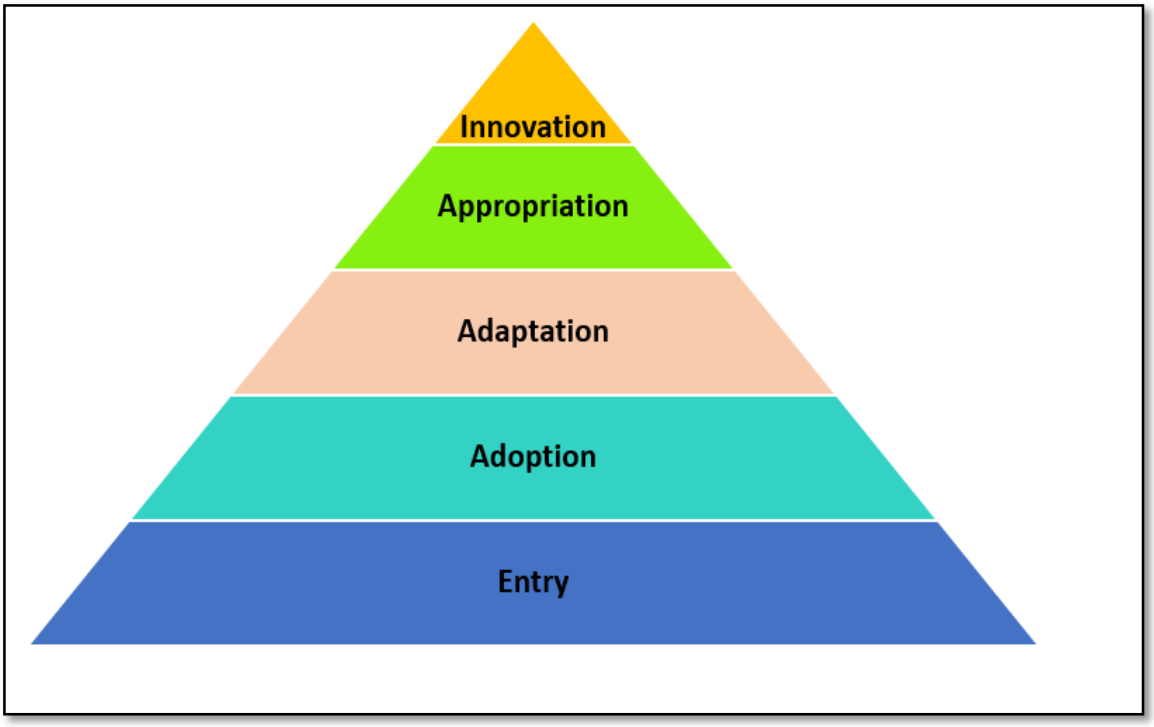


Figure 2 ACOT stage model of ICT integration (DOE, 2007)

The entry stage is the stage that replaced the so called "traditional classroom" which was "text-based and the common tools were blackboards, textbooks, workbooks, ditto sheets, and overhead projectors. These tools were used in combination to support lecture, recitation, and seatwork" Dwyer et al., 1990, p. 4). In this beginner stage the teacher is newly introduced to a computer and he or she can use it at a basic level, but faces many frustrations and insecurities which negatively affects her confidence. Dwyer et al. (1990, p. 5), described a teacher at the entry level as one who has had "little or no experience with computer technology and is in various stages of trepidation and excitement."

In the adoption stage teachers' struggles to accommodate the new technology seemed to have abated, even though computer-based issues were far from over. Although the teachers' adoption of the technology had improved from the entry level, the computer was mainly used to support text-based drill-and-practice instruction. The dominant teaching styles at this stage were focused on whole-class teaching and individualised work (Dwyer et al., 1990). The teacher can use computers mainly for administration purposes, and in some cases, may be

able to teach students aspects of computer literacy. Dwyer et al. (1990, p. 5) aptly summed up this staged when they said, “although much had changed physically in the classrooms, more remained the same.”

In the adaptation stage, (Dwyer et al., 1990) found that the teachers had become more comfortable with the use of the computer to support everyday classroom activities, but whole class teaching and individualized work remained the dominant practice. Productivity was the major theme of the stage—students produced faster and this freed up some time for the teachers to engage students in higher-order learning objectives, problem solving and productivity-related activities which included the use of “word processing, databases, some graphic programs and many computer-assisted instruction (CAI) packages” (Valenzuela, 2006, p. 98).

In the appropriation stage, the use of technology was becoming more natural for the teachers. The teachers showed signs that they understand technology and used it effortlessly as a tool to accomplish real work. This is the stage where the teachers’ roles started to “shift more noticeably and new instructional patterns emerged. Team teaching, interdisciplinary project-based instruction, and individually-paced instruction became more and more common” (Dwyer et al., 1990, p. 7). Teachers were now becoming facilitators rather than “dispensers” of knowledge.

Dwyer et al. (1990) found that the innovation stage (sometimes called the invention stage) was reached by very few teachers. However, according to the researchers, this is the stage whereby teachers have become more disposed to view learning as an active, creative, and socially interactive process than they were when they entered the programme. Teachers operating in this stage can create entirely new learning environments that use technology as a reflective tool, so that learning becomes collaborative and interactive. Such teachers “are ready to invent interdisciplinary learning activities that engage students in gathering information, analyzing and synthesizing it, and ultimately building new knowledge on top of what they already know” (Dwyer et al., 1990, p. 9).

As indicated earlier, the ACOT model was a typical first-world project funded by Apple Corporation, and it focused on those schools that were provided with constant access to state-of-the-art resources and had higher levels of ICT literacy for teachers and students, as compared to the developing countries. For this reason, "the processes involved in this type of project cannot be regarded as typical of situations found in normal schools" (Valenzuela, 2006, p. 98). This is the main criticism of the model, especially in the developing countries, like South Africa, where technology access and support is often irregular, and therefore, ICT integration cannot be taken for granted.

Another shortcoming of the ACOT Project is that the model did not "provide evidence about individual differences in terms of teachers' background, experience, age, motivations, attitudes, purposes for using computers, etc. that is, factors that could help explain how teachers move from one stage to another" (Valenzuela, 2006, p. 99). For these shortcomings, this model is inadequate for explaining reasons as well as levels of integration by teachers in South Africa. For a developing country like South Africa where most the teachers are still battling with ICT literacy, let alone ICT integration, a desirable model is one which leans more towards explaining the process that happens from a moment teachers are introduced to new technology, up to a level when ICT is part of their everyday practice such that it helps them to continuously reflect and improve on their practice. An example of such a model is the instructional transformational model, as proposed by Hooper and Rieber (1995).

2.2.2 The instructional transformational model (Hooper and Rieber)

As proposed earlier, the instructional transformational model (Hooper and Rieber, 1995) offers a better lens to understand teachers' behaviour with regards to ICT integration and use, although it too, has some limitations. Unlike the ACOT model which views technology simply as mechanical tools, the Hooper and Rieber model takes a different approach by identifying two main types of technology in education: "product technologies" and "idea technologies". Product technologies include hardware, or machine-oriented, etc., and idea

technologies refer to non-tangible forms of technologies including, software, books, even instructional style. This definition clearly exceeds narrow conceptions of technology that equate it exclusively to normal hardware, software and machines.

While "product technologies" seems straightforward to understand, it is "idea technologies" that need further clarification. Idea technologies give a new meaning to educational technology as a process that "involves applying ideas from various sources to create the best learning environment possible for students" (Hooper and Rieber, 1995, p. 154). This includes how a classroom might change or adapt when a computer is integrated into the curriculum. Therefore, based on this definition, instructional style (i.e. pedagogy) can be considered the "soft" part of technology (Hooper and Rieber, 1995).

This, rather idiosyncratic notion of comparing pedagogy to technology can be traced back from the most basic definition of technological innovation as "a system of practical knowledge not necessarily reflected in things or hardware" (Saettler, 2004). Following from this definition, pedagogy—which is a way of teaching, qualifies to be a technological innovation because "it combines a set of procedures and processes intended to bring about transformation" (Dron, 2009, p. 2121). To expand on this relationship, Dron (2009, p. 2121) further argues that "pedagogies are technologies that can be used well or badly, to create great learning or to produce piles of scholarly rubble." The Instructional Transformational model (also called the Hooper and Rieber model) is based on the assumption that sees technology and pedagogy as comparable. Fig. 3 summarizes the Hooper and Rieber model and it demonstrates how the contemporary perspective of educational technology (which encompasses the role of learners in knowledge construction) goes beyond the traditional perspective that focuses only on technology and instruction.

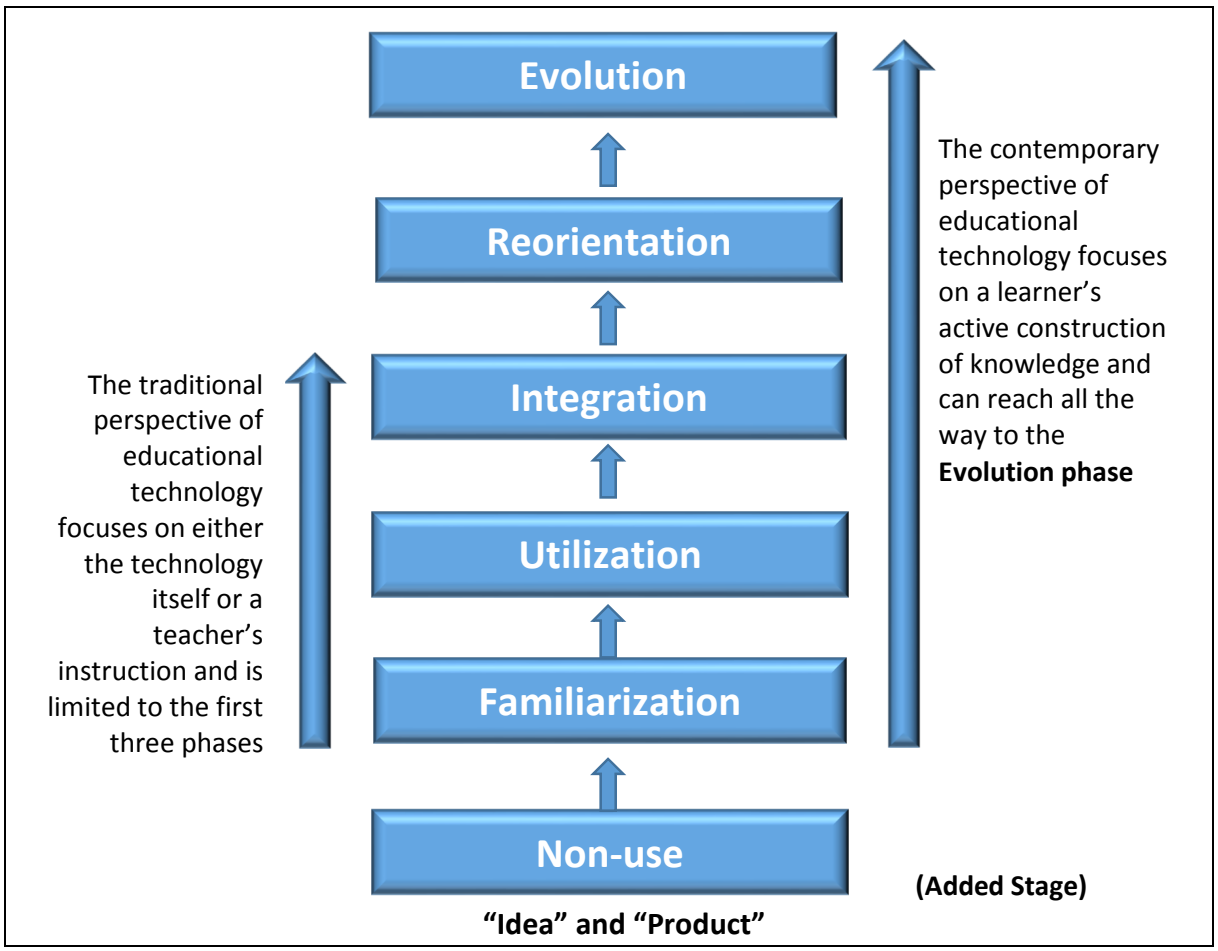


Figure 3 Adapted Hooper and Rieber model (Hooper and Rieber, 1995)

In summary, the original Hooper and Rieber model identifies five stages or phases of technology integration and these are: Familiarization, Utilization, Integration, Reorientation, and Evolutions. However, like many other similar stage models, this model assumes availability of ICT resources, and thus, it lacks the "non-use" stage. Research has consistently shown that availability and quality of hardware are major conditions for integration ICT in education. For the purposes of this research, an extra level, called the "non-use" stage, was added (see Fig. 3), and this is how the added stage affected the model:

i) **Non-Use** – teachers in this level do not use ICT either because they do not have access to it or they do not know how ICTs can be used for teaching and learning, or have no interest whatsoever in ICTs.

ii) **Familiarization** – this is the base-line exposure to technology, whereby teachers try a computer programme in-service training/workshop or conference event. If the teacher does not see immediate relevance and usefulness of the product and technology, all the ideas associated with it are discarded. This is where ideas from training programmes start and end (Hooper and Rieber, 1995, p. 156).

iii) **Utilization** – teachers in this phase use the technology in the classroom but would abandon it should the technology malfunction (Rodgers, 1999, p. 156). This is often the highest level that most teachers reach with computer-based technologies, and at this stage the technology has not been integrated into the curriculum.

iv) **Integration** – this is the break through phase. This is the beginning stage of appropriate use of technology in delivering instruction. The technology has now become part of the teacher's every day practice such that if it is taken away then the teacher would have a hard time reworking their lessons (Rogers, 1999, p. 156). Often technology adoption stops here.

v) **Reorientation** – in this phase teachers reconsider and re-conceptualize the purpose and function of the classroom (Hooper and Rieber, 1995, p. 157). The teacher focuses on how the technology enables student construction of knowledge. The students become the centre (subject) of learning rather than the object of education. The teacher is willing to learn the technology with the students. In enabling constructivist learning environment, the Hooper and Rieber model "emphasizes the changing role of the teacher from being the centre of delivery of instruction to being like a manager or facilitator" (Valenzuela, 2006, p. 110).

vi) **Evolution** – teacher understand that the educational system, including the classroom learning environment, must continue to evolve and adapt to remain effective (Hooper and Rieber, 1995).

Hooper and Rieber (1995, p. 155) argue that, "the traditional role of technology in education is necessarily limited to the first three phases, whereas contemporary views hold the promise

to reach the evolution phase." However, understanding where teachers are in terms of their level of technology integration is the first step in understanding the factors influencing technology integration (Rogers, 1999, p. 8).

This was not the first instance that the Hooper and Rieber model was used to evaluate teachers' integration levels in a quantitative study with the aim of influencing teacher professional development. In 2011 Wright and Wilson used the Hooper and Rieber model to evaluate the impact of technology integration training as an element of the University of Alabama Teacher Education Program. Wright and Wilson (2011) tracked technology integration by ten teachers who were in their Teacher Education programme, ten years after they had left the programme. The findings helped the researchers to come up with recommendations for improving teacher education.

As the literature on ICT integration constantly shows, one can have the best courses and intentions to help teachers improve their knowledge on technology in education, but if teachers are not interested or motivated towards their own professional development, not much can be achieved. Personal interest and attitude play a huge role in the adoption and use of ICT. As Ertmer (2005, p. 27) argued: "ultimately, the decision regarding *whether* and *how* to use technology for instruction rests on the shoulders of classroom teachers." Having said this, one cannot underestimate the role that environmental factors (e.g. access to resources, training and support) play in determining the levels of ICT integration.

In summary, literature points to two groups of factors responsible for teacher integration of ICT: i.e. the internal factors (related to personal characteristics, e.g. attitude, interest and beliefs) and external factors (related to the environment, e.g. access to resources etc.). These factors influence the teachers' decision making process whether to integrate technology or not. In other words, internal or external factors influence teachers' motivation to integrate technology or not. These factors often work interdependently. For example, a teacher who teaches in a school that has limited access to technology is most likely to point to lack of access as their reason for not integration technology, whereas another teacher from the same

school might point to lack of interest as their main reason for not integrating technology. The environment remains the same but the teachers' motivation (i.e. that which gives purpose and direction or reason for behaviour) are different. This means that whether teachers will integrate technology or not is mostly dependent on their motivation to do so. But the question is: what motivates people?

2.3 Motivation

Motivation can be defined as nothing but a theoretical construct that explains behaviour, and it can help us understand people's reasons, desires, and needs. Keller (1979, p. 27) defined motivation as "that which accounts for the arousal, direction, and sustenance of behaviour." Meanwhile Kanfer (1990, p. 78) expatiated on the subject by stating that motivation is not something that is observable, but what is observable are behaviours and products of those behaviour, which can either be physical or mental. Keller (1979, p. 27) concurs with the idea, and he developed further ideas on the subject when he said: "given that effort is an indication of motivation, the challenge is to understand the components of motivation itself." These definitions prove how complex this seemingly straight-forward phenomenon can be to explain. However, most authors agree on at least one thing, which is that: the study of motivation is generally concerned with why people think and behave as they do.

Historically, there have been many theories based on motivation, but the one that is relevant for this research is the theory that links motivation with attribution, as proposed by Weiner (1972). Applied in this research, the *theory of attribution* provided an important method for examining and understanding the teachers' motivation and reasons for and against integrating technology. A brief discussion of the attribution theory is in order.

2.4 What is attribution?

By their nature, humans are always looking to assign causes in order to understand their behaviour and that of others. Attribution theory describes the process by which people

explain the causes of behaviour and events (McLeod, 2012, p. 8). The theory was spearheaded by Fritz Heider and developed by other psychologists, mainly Weiner. The main assumption of this theory is that "people want to understand their environments and, therefore, strive to understand why certain events happen" (Anderman and Anderman, 2009, p. 2). Literature on the subject typically identifies four attributions: i.e. attributions to luck, task difficulty, ability, and effort.

The following simple educational example, as suggested by Anderman and Anderman (2009, p. 2), explains the theory: "when students fail a test, they will probably attribute that failure to a specific cause, such as (1) lack of ability, (2) lack of effort, or (3) poor instruction". Similar reasons, albeit contextually different, can be provided by teachers in their explanation for why they are not integrating technology, e.g. lack of ICT skill, lack of interest or inadequate/lack of training.

In short, attribution theory suggests that people are affected by two factors: 1) environmental factors (also called external attributions, e.g. characteristics of the students' home or school) and by 2) personal factors (also called internal attributions, e.g., prior experiences and prior knowledge). These background variables affect the types of attributions that individuals are likely to make (see Fig. 4).

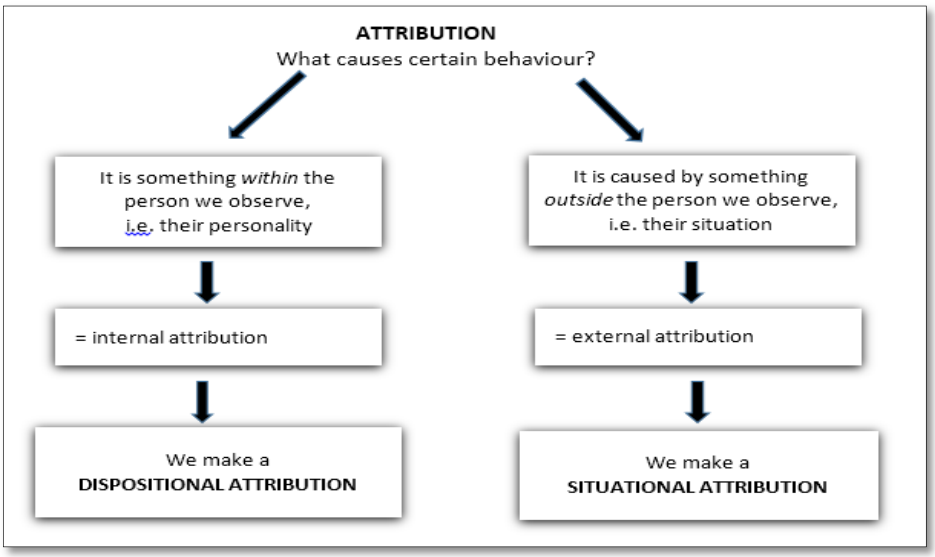


Figure 4 What causes certain behaviour? (Adapted from Rice, 2016)

Here follows a brief definition of the two attributions:

i) **Internal attribution** – refers to "the process of assigning the cause of the behaviours to some internal characteristic, rather than outside forces" McLeod (2012, p. 8). This could include personality traits, motives or beliefs. Internal attributions are sometimes referred to as dispositional attributions.

ii) **External attribution** – also called situational attribution, is the opposite of internal attribution. This refers to interpreting someone's behaviour as being caused by the situation or event that the individual is in. In this case the cause of the behaviour is outside the person's control.

Typically, teachers' reasons for integrating technology (or not) would be influenced by either an internal or external attribution. For example, amongst the internal reasons enabling teachers to integrate technology could include personal drive or ambition whereas external enabling reasons could include the availability of resources or appropriate teacher training. On the other hand, some of the internal reasons preventing teachers from integrating technology (also called barriers to ICT integration) could be fear of the technology or lack of skill whereas poor access could then be one of the external barriers. This theory will become more important in trying to answer the fourth question of the research: *What reasons do teachers who have attended Microsoft courses provide for integrating ICT (or not) into teaching and learning?* But teachers' reasons emanate from factors influencing integration, and therefore it is important to discuss some of the possible factors, based on the literature.

2.5 ICT integration factors

Mumtaz (2000) identifies three interlocking factors that affect teachers' integration of ICT, and these are: teacher, resources and institution. An overview of the factors is in order:

a) Teacher personal factors

Teacher personal factors are related to their internal attributes including: e.g. age, gender, teaching experience, teacher's pedagogical knowledge as well as teachers' attitude to change, whereas the resources and institution factors are related to their external attributes.

Literature cannot agree on the interrelatedness amongst these factors. For example, some authors, including Mumtaz (2000) argue that teacher personal factors far outweigh institutional or school factors in terms of influencing ICT integration. Similarly, in his review of Roger's Diffusion of Innovation theory, Orr (2003), remarked that "each individual's innovation-decision is largely framed by personal characteristics", which seems to suggest that environmental issues come second. This is consistent with recent studies that have shown that teachers' characteristics (e.g. individual's educational level, age, gender, educational experience and experience with the computer for educational purposes) can influence the adoption of technology (Afshari, Bakar, Luan, Samah and Fooi, 2009, p. 80). Amongst personal characteristics include: teacher age, gender, technology skill (competency) level, and their attitude to change, are some of the most commonly cited factors by most researchers as determinants of ICT integration.

While other studies have found that there is "no correlation between *age* and ICT use by teachers" (Becta, 2004, p. 29), later research indicate that "as the age of the teachers decreased, their attitudes towards ICT increased" (Afshari et al., 2009, p. 81). The reason for this is that "the probability that teachers would use ICT in the classroom was limited by the reality that teachers who were educated 20 years ago were trained by people who themselves were trained before the arrival of computers in schools" (Afshari et al., 2009, 81).

Gender differences as a determiner of ICT integration is the next variable associated with personal characteristics. According to Becta (2004, p. 29) there is a small amount of evidence found that points to the correlation between teachers' gender and their usage levels of ICT, with males reported to be having higher usage and lower anxiety levels than females. This

issue becomes more relevant to particularly in primary schools where the ratio of females to male is usually higher.

Much of the literature on education transformation suggests *teachers' beliefs and attitude to change* as one of the main factors to ICT integration (Becta, 2004; Fullan, 2000; Ertmer 1999; Mumtaz, 2000). Attitudes are specific feelings that indicate whether a person likes or dislikes something and in the context of ICT integration this may be conceptualized as teachers' liking or disliking the use of technology (Hew and Brush, 2006, p. 229). On the other hand, beliefs are premises or suppositions about something that are felt to be true and this includes their beliefs about teaching and learning and the role of technology in the process (Hew and Brush, 2006, p. 229).

A factor directly related to teacher attitude and confidence levels is *technology skill level* (also called ICT competency) (Becta, 2004). If teachers are not sufficiently prepared (or skilled enough) to use technology then their confidence suffers, which may affect their beliefs and attitude to technology integration. The situation can also work the other way round. And, in fact, this can be a much bigger problem because as Hew and Brush (2006, p. 228) have noted, "in addition to lack of technology knowledge and skills, some teachers are unfamiliar with the pedagogy of using technology". This is where the importance of TPACK (i.e. the knowledge to integrate technology, pedagogy with relevant content), as discussed earlier, comes into the picture.

b) Resources factors

Resources factors are concerned with access to ICT resources both hardware and software. Consistent research has shown that teachers who integrated technology often came from schools where "hardware and access to resources were twice the average, were comfortable with technology and used computers for many purposes" (Mumtaz, 2000, p. 324).

But the resources factor is not a straightforward issue because "because even in cases where technology is abundant, there is no guarantee that teachers have easy access to resources" (Hew and Brush, 2006, p. 226). Research has shown that most schools prioritise the best technology resources to technology classes (e.g. computer science) over other classes. Also, for schools that have their computers housed in laboratories, scheduling can become an issue as teachers "might not have easy access to them if they needed to compete with other teachers for laboratory time" (Hew and Brush, 2006, p. 227).

c) Institution factors

Institution factors look at how organizational aspects like leadership, school type, grade level taught technical support, school time tabling structure, and opportunities for training enable or hinder ICT integration. One of the most cited factor amongst these is teacher training. According to Becta (2004) one of the common downfalls of teacher training is training that only focus at equipping teachers with technology skills overlooking pedagogical skills. The following statement from the report summarizes the complexity: "the issue of training teachers in how to use ICT to effectively manage children's learning both during the lesson and also in preparation of lesson beforehand (pedagogical training), rather than simply training them in the skills of using ICT equipment is an important one" Becta (2004, p. 10).

However, as pointed out by Mumtaz (2000) and Ertmer (1999), schools can only do so much to encourage ICT integration, the rest depends on the teachers' willingness, experience, attitude and beliefs of the potential of ICT in general. Teacher motivation and commitment to their students' learning and to their own development is more crucial than resources available because even if teachers are provided with up-to-date technology and supportive networks, unless they have the right attitude, motivation and pedagogical know-how, they may not be enthusiastic enough to use it in the classroom (Mumtaz, 2000).

Owing to the vastness of factors affecting ICT integration, most researchers prefer a binary approach to differentiate between factors that enable or favour the integration of ICT (also

called enablers) and those that prevent or hinder the integration on ICT (also called barriers). This distinction is particularly useful for this research in terms of answering the third question: *What are the factors which could have a bearing on the integration of ICTs?* The next sections discuss the literature related to both groups of factors, i.e. i) factors favouring ICT integration, and then, ii) factors hindering ICT integration.

2.5.1 Factors favouring ICT integration (also called "enablers")

An enabler is simply a person or thing that makes something possible. Writing for and on behalf of the British Educational Communications Technology Agency (Becta), Scrimshaw (2004), classifies the enabling factors that support integration of ICT at the "individual" and "school level." Based on the Becta (2004) online survey, the following are some of the "individual" factors cited by most survey participants: access to own laptop, availability of high quality resources, unlimited access to hardware and software, high level of technical support, availability of good quality training. On the other hand, in terms of "school level" factors, enablers emphasized include on-site technical support, staff ICT teacher professional development, support of ICT vision from senior management and whole school ICT policies on using ICT across the curriculum,

Scrimshaw (2004) pointed out that the skills that most influenced their uses of computers are those related to the teachers' competence in managing classroom activities; to their pedagogical skills; and, less importantly, to their computer-handling technical skills. This means that if the software matches the teacher's pedagogy there is a good chance that the teacher will use it. Put simply, "the extent to which individual teachers are committed to integrating ICT, and how this commitment relates to that of the school as a whole, can have a significant impact on the degree to which ICT can be integrated by those teachers" (Becta, 2004, p. 6). As much as there are factors enabling ICT integration, there are also hindering factors.

2.5.2 Factors hindering ICT integration (also called "barriers")

When one considers all the technology investments that are being thrown into schools in the form of ICT resources, including computers, interactive whiteboards, and the cost of training (and sometimes incentives for best practice), the key question that everyone is asking is: what is stopping teachers from integrating technology into teaching and learning when this innovation has been around for more than twenty years? Thus, the same question asked differently goes: what barriers do teachers face in their attempt to integrate technology? A barrier, as opposite to an enabler, is anything which makes it difficult for someone to do something.

The Becta report (2004) cites four broad reasons why teachers often struggle with ICT integration, and these include the fact that: i) ICT is seen as incompatible with some teachers' wider educational beliefs, ii) there may be immovable social obstacles to greater levels of take-up, iii) there may be powerful but removable obstacles in schools to expansion of use, or finally iv) the obstacles may be to do with the personal characteristics of some teachers.

On the other hand, authors belonging to the institutional change school of thought, including Ertmer (1999), align their thinking to the attribution theory by dividing teachers' barriers on ICT integration into two groups: i) The external, also called first order barriers, and ii) The internal, also called second order barriers. According to this perspective, the external factors, also called first order barriers, are extrinsic to teachers (i.e. they are almost beyond their control), and these would include: ICT equipment, time and training.

Meanwhile, second order (internal) barriers e.g. teachers' beliefs, are regarded to be fundamental to change and they usually surface when first order barriers have been eliminated. The second order barriers are intrinsic to teachers and include underlying beliefs to teaching and learning and may not be immediately apparent to the teachers themselves. See Table 2 for a summary of the two types of barriers.

Order	Barrier
First order (external)	• Lack of resources • Institution • Subject culture • Assessment
Second order (internal)	• Attitude and beliefs • Knowledge and skills

Table 2 First and second order barriers (adapted from Ertmer, 1999)

While also emphasizing the idea of "first and second order" barriers, as popularized by Ertmer (1999), the Becta report (2004), provides a more comprehensive report drawn from a range of sources to present the most significant barriers which prevent teachers from making full use of ICT in teaching and learning. In addition, the Becta report stresses the complex inter-relationship between the two forms of barriers and explains how a single barrier e.g. teacher's lack of confidence in ICT usage (internal barrier), can affect and be affected by other barriers e.g. lack of personal access (external barrier), technical problems (external barrier), lack of teacher competence (internal barrier), etc.

Having said that, the opposite is also applicable: i.e. an external barrier (e.g. lack of resources) can easily become an internal reason in a way teachers perceive and cognize the barriers. In line with Mumtaz (2000), the Becta report also differentiates between school level barriers and teacher level barriers and it demonstrates how teacher level barriers are "more difficult for policy makers to tackle, as it is the teachers themselves who need to bring about the required changes in their own attitude and approach to ICT" (Becta, 2004, p. 20). The fact that barriers often influence each other means that there is a need to understand their interrelatedness in detail, and where knowledge gaps exist.

2.5.3 The relationship between barriers, and the knowledge gaps

The relationship between first and second order factors and how they influence teachers' reasons for using technology (or not) was a crucial part of this research, and this explains the decision for combining the quantitative with the qualitative strands, to get a more balanced view. In fact, factor relationship on ICT integration is one of the knowledge gaps that has been existing in the literature for some time, and this research aimed to address exactly that. As Hew and Brush (2006, p. 241) once asked: "How much do we exactly know about how first and second barriers interact and influence each other in hindering integration of technology for instructional purposes?"

The second knowledge gap, that this research addressed, is related to how the barriers operate within the staged models, especially the Hooper and Rieber. One of the assumptions that this research investigated, as noted by Hew and Brush (2006, p. 245), is that certain barriers are more prevalent in certain stages, for example, that "first order barriers such as availability and accessibility of technology were more likely to be encountered by teachers at the beginning stages (e.g. familiarization and utilization)."

Chapter 3: Research methodology and design

3.1 Introduction

This chapter focuses on the why (i.e. methodology) and how (i.e. the methods/ research design) the data for this research was gathered. First, a summary of the method used in the research will be given. This will be followed by a discussion on the strengths and limitations of the different methods, before a justification of the chosen method is made. The method will focus on the following aspects:

- **Participants**: who were the participants of the research (both quantitative and qualitative strands)? What was the sample size and its parameters?
- **Data collection process**: how data was collected, (including the instruments used),
- **Data analysis and discussion**: how the data was analysed (including the instruments used)? and how this analyses approach assisted in answering the research questions?

3.2 The summary of the method

The purpose of this two-phased approach, mixed method study was to use surveys and interviews to determine levels, factors, as well as reasons for and against ICT integration amongst teachers who have attended Microsoft courses, in the last 24 months since the start of the research. The data for the teachers and their schools exists in the Microsoft teacher training database. The study itself took about 6 months, including the administering of surveys, which was followed by the interviewing process.

The first phase of the research involved the gathering of quantitative data from teachers, using paper-based surveys. This phase had the two main objectives:

1) To obtain information about the current state of ICT use, including:
    - the number of ICT resources in their schools,
    - how extensively and frequently teachers were using ICT?
    - for what purpose they are using ICT? and

- which Microsoft training they had received?

2) To categorize and describe the levels of technology integration as per the Hooper and Rieber (1995) model, as discussed earlier.

The surveys were followed by semi-structured interviews with a few individuals to probe or describe reasons for integration levels in depth. In summary, the qualitative phase of the research also had the two main objectives:

1) To describe and explore reasons for the levels of integration of ICT by teachers, as well as the extent of use they make of ICT for teaching (i.e. why teachers are integrating at the levels identified in the first phase?);

2) To determine how factors enabling and hindering the process of ICT integration have become reasons?

Refer to Fig. 6 for the research phase process, including data collection and analysis methods as employed in the research.

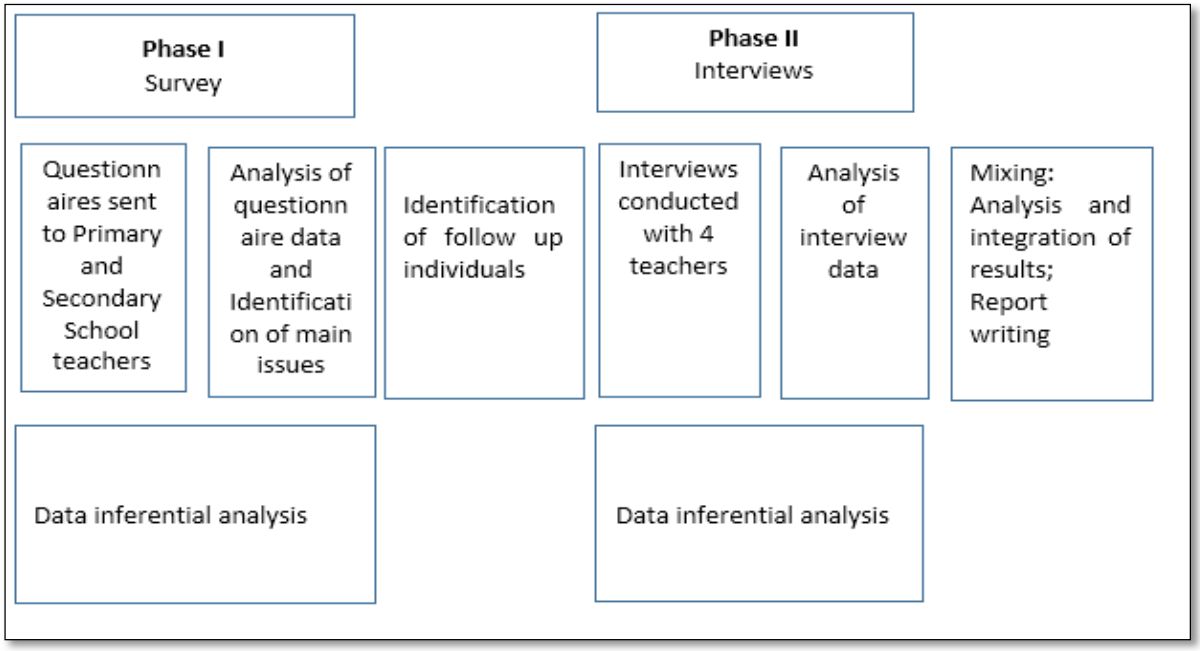


Figure 5 Summary of research phases

3.3 What is mixed method research?

Qualitative and quantitative research are traditionally the two most common research methods. However, in the last twenty years or so, out of the need to have a richer and more balanced perspective, a new method which combines the two forms came into being. This is called the mixed method research. Creswell and Clark (2011, p. 8) define mixed method as a "research type whereby a researcher combines elements of quantitative and qualitative research approaches, for the purposes of breath and depth of understanding and corroboration."

While mixed method research has been referred to by different names including: multi-method, integrated, hybrid, combined, and a few others, there is consensus that employing this method expands the scope or breadth of research, and it makes "an account to be rich, robust, comprehensive and well developed" (Cohen and Crabtree, 2006, p. 1). The process of using multiple data sources in an investigation to produce a deeper understanding is called "mixing", and according to Cohen et al. (2007), this is preferred because a single method can never shed enough light on a complex phenomenon.

3.4 Why mixed method research?

According to Hew and Brush (2006), one of the limitations of the quality of past research studies on technology integration is that most of them appeared to be descriptive: i.e. they focused mainly at describing conditions as they existed in a particular setting (e.g., the number of teachers at different grade levels who use computer-based instruction). Granted, in a descriptive study, the researcher may use qualitative data sources (field notes from observations, interviews), quantitative sources (descriptive statistics), or both but the emphasis is more on "what is" type of questions, and less on the "how and why" (Hew and Brush, 2006).

However, the problem with descriptive studies is that one usually ends up with an incomplete picture of the phenomenon. For example, in a one dimensional, descriptive study on ICT integration, it is difficult to demonstrate how variables relate to one another (e.g. how lack

of resources affect teachers' beliefs and attitudes towards ICT integration). A possible solution to this problem is to have mixed methods approach whereby the researcher collects, analyzes and mixes both quantitative and qualitative data in a single study, with the aim of providing a better understanding of the research problem (Creswell & Clark, 2011).

As attested by the literature review in Chapter 2, the topic on ICT in education is multifaceted and it involves many variables, so that a researcher would need a combination of statistics (quantitative) as well as interpretive (qualitative) accounts to understand the reasons for levels of ICT integration. This is exactly what happened in this research. Using the mixed methods approach, the survey results helped illuminate certain trends and ambiguities that were expatiated through interviews.

The fact that interviews were used as a follow up to surveys gave the participants the opportunity to express a myriad of reasons why they integrate ICT (or not), and the factors influencing their reasons. This is something that the survey or interviews alone would not have sufficiently addressed. In summary: the rationale for using mixed methods to study this situation is that the quantitative analysis addressed the levels of integration (i.e. what? and how?), but to understand why they do it (or not), a qualitative content analysis to discover the deeper reasons for the levels of integration (i.e. the why?), needed to be conducted.

The use of a combination of quantitative and data qualitative collection methods enhanced the credibility of this study in many ways. For example, while the survey inferences provided a pattern or trend on levels and factors influencing ICT integration, on the other hand, the use of interviews provided an in-depth account of the reasons and the extent of integration. The two methods were used complementarily and this created an opportunity for elaboration, illustration, and clarification of the results from one method to other method (Creswell & Clark, 2011). The purpose of the research meant that there was a need to gather data on ICT integration levels, from a wider population, before one ascertains the reasons for the levels of integration through in-depth measures, i.e. interviews. The explanatory sequential, as one of the mixed research designs, was well suited for this approach. But, what exactly is it?

3.5 The explanatory sequential design

Before offering an explanation on why the explanatory sequential design was preferred for this research, here follows an overview of the other designs related to mixed method approach, and a brief explanation to demonstrate why they were not preferred for this research. In principle, there are six major mixed methods designs, and each design has its aims and purposes (Creswell & Clark, 2011). This list somehow demonstrates the level of complexity and sophistication from one design to the next:

a) **Convergent parallel design** – researcher uses qualitative and quantitative methods concurrently, prioritizing the methods equally;
b) **Explanatory sequential design** – researcher starts with collection and analysis of quantitative data which is followed by collection and analysis of qualitative data;
c) **Exploratory sequential design** – this design starts with and prioritizes the collection and analysis of qualitative data which is followed by quantitative phase to test or generalize the initial findings;
d) **Embedded design** – researcher collects and analyzes both quantitative and qualitative data within a traditional quantitative or qualitative design;
e) **Transformative design** – researcher uses a transformative framework e.g. feminism to quantitatively uncover and then qualitatively illuminate underlying issues;
f) **Multiple phase design –** combines both sequential and concurrent strands over a period of time that the researcher implements within a program of study addressing an overall programme objective (Creswell & Clark, 2011, pp. 69-72).

As demonstrated in the summary above, the explanatory sequential design is a method that involves an iterative process whereby the data collected in one phase contribute to the data collected in the next. In this design, data from the quantitative phase is collected and analysed, and this is followed by the collection and analysis of qualitative data. The following

shorthand notation is often used to describe the explanatory sequential design: QUAN → qual = explain findings. This notation (as represented in Fig. 7), means that the researcher implements two phases in a sequence, with the quantitative methods occurring first, and having greater emphasis in addressing the study's purpose, followed by the qualitative method to explain the quantitative results (Creswell and Clark, 2011).

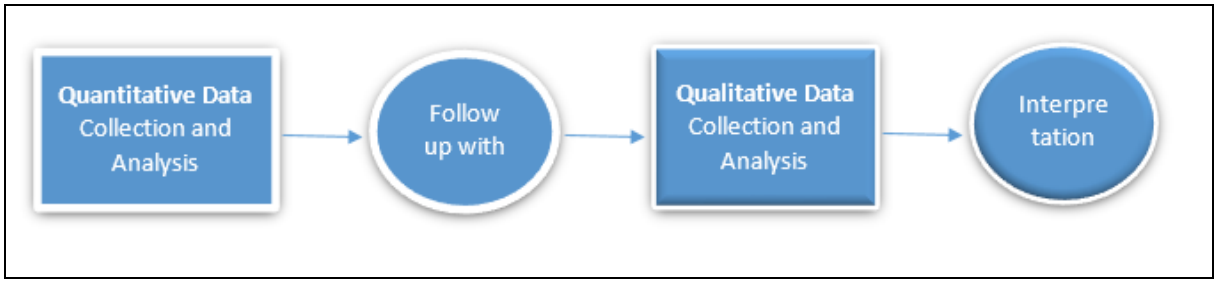


Figure 6 The explanatory sequential design (adapted from Creswell & Clark, 2011)

The choice of the explanatory sequential design over other mixed research designs was influenced by the research topic: "*Teachers' reasons for and against ICT integration into teaching and learning*". As it stands, this research question is very broad and there could be a wide range of reasons why teachers integrate ICT (or not). To have a rich, balanced account there is a need to gather data regarding how ICTs are being integrated and at what levels, from a wider population, before one ascertains the reasons for the levels of integration through in-depth measures like interviews. The research used responses from surveys to determine patterns on the levels of integration first, and then drilled deeper to understand reasons for these patterns through interviews.

More weight was placed on the quantitative surveys to gather as much data about integration levels as possible, and thereafter interviews were used to probe the reasons for the levels. It therefore would not have made sense to opt for a design that places equal weight on qualitative and quantitative data (e.g. convergent parallel design) or a design that prioritizes qualitative data (e.g. exploratory sequential design). However, it must be said that one of the challenges of using this design is that it requires more time to implement the two phases, with the qualitative phase often taking more time than the quantitative (Creswell & Clark, 2011). That is the reason that led to the qualitative phase focusing on fewer participants.

The research process started with the collection and subsequent analysis of quantitative data on levels and factors of ICT integration amongst teachers who have attended Microsoft courses. Paper-based surveys were used to collect relevant data from 122 teachers, out of total 420 teachers that were contacted. The first phase was followed by the collection and analysis of qualitative data on reasons why teachers integrate ICT (or not) at the levels determined in the first phase. The inferences from the quantitative phase helped in the design of the qualitative phase in terms of two factors, which are: 1) which participants to follow up with? and 2) what results need to be explained? In the qualitative phase data was generated from 4 teachers through interviews. After the data from quantitative and the qualitative phases were collected and analysed, the two approaches were merged in the interpretation stage, in a process called "mixing". Refer to Fig. 8 for a diagrammatic representation of how the explanatory sequential design method was applied in this research.

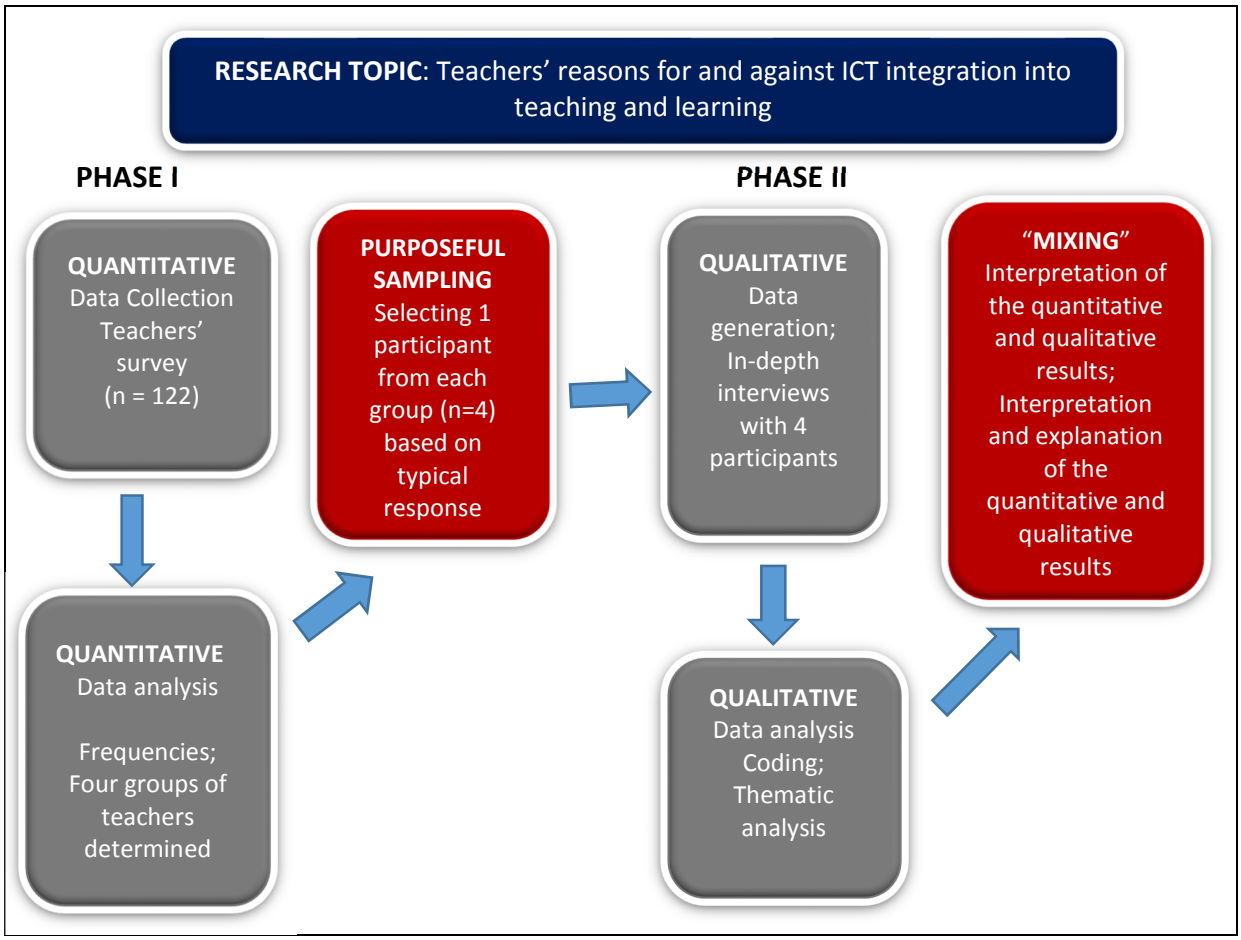


Figure 7 Application of the explanatory sequential design (Creswell & Clark, 2011)

3.6 Data collection process

As pointed out by Creswell and Clark (2011), mixed method design should not be seen as a short-cut or easy way out to research design, but rather a process that emphasizes complete qualitative and quantitative research methods, which includes the process of collecting data in both forms. It therefore requires "certain skills, time and resources for extensive data collection and analysis" (Creswell & Clark, 2011, p. 13).

Following the recommended data collection procedure in the explanatory sequential design process, surveys were used to collect quantitative data on the levels of ICT integration by teachers who have attended Microsoft courses. Thereafter the data was analyzed and the results from this process were used to inform the follow-up qualitative phase about the reasons for and against ICT integration process. Interviews (for selected teachers) were used to generate data in the qualitative phase. The survey questions were entirely close-ended, and the response categories were developed with the help of literature on teacher change and models of ICT integration, as described in the literature review section (Chapter 2). The subsequent in-depth, semi-structured interview instrument consisted of individualized questions intended to explore particularly interesting or ambiguous survey responses as well as focusing on determining reasons for integrating ICT (or not).

Data sampling occurred at two points in this design: in the quantitative phase, and in the qualitative phase and covered areas like: who should the population be? What is the sample size? What data to be collected from whom and how? As well as how permission would be obtained? See Table 3 for the summary of the data collection procedure in both quantitative and qualitative phases, in 3 steps, as conceived from Creswell and Clark's (2011) framework:

- Sampling procedures,
- Obtaining permissions,
  Collecting/Generating data,

Quantitative Data Collection Procedures	Procedures in data Collection/ Generation	Qualitative Data Generation Procedures
Population size • Research was conducted with teachers from 13 public schools in Gauteng • In total about 420 surveys were administered. • 172 surveys were returned. • A sample of 122 teachers drawn **Purposeful and convenience Sampling** • Surveys were administered to teachers from schools that have received Microsoft training in the last 24 months. • These schools were drawn from the Microsoft Teacher Professional Development database	**Sampling procedures**	**Population size** • Research was conducted with 4 teachers from schools that were part of Phase 1 (survey) **Purposeful sampling** • Interviews were conducted with **4 teachers** from Gauteng Schools, who were part of the first phase. • Teachers were drawn from four categories: 1) Teachers who do not know how computers can be used for teaching and learning; 2) Teachers who have only used ICT during training; 3) Teachers who are integrating technology with minimum training;

Population Composition • The survey involved teachers from Gauteng schools who have received Microsoft training in the last 24 months.		4) Teachers who are integrating at an advanced level. **Population Composition** • Four teacher were selected for the qualitative phase to reflect different views and rich picture about reasons for integrating ICT, or not.
Ethics clearance • The Wits University Ethical clearance procedure was followed to gain permission from the Gauteng Department of Education (GDE) to conduct research in public schools.	**Obtaining Permissions**	**Ethics Clearance** • The Wits University Ethical clearance procedure was followed to gain permission from the Gauteng Department of Education (GDE) to conduct research in public schools.
Data collection instrument • The Computers in Education (CEQ) survey was used to collect data about teachers' use of ICT **(see Appendix A).** **Data collected** • Highly structured, closed questions were used since	**Data Collection/ Generation**	**Data generation instrument** • An interview protocol, which includes questions to be asked during an interview and space for recording information gathered, was developed. **Data generated** • The purpose of the interviews was to probe

they are easier to compare and analyze. • The purpose of the surveys was to probe deeper into factors that could influence teachers' frequency of ICT use as well as the level of ICT use and the extent of integration as per the Rieber and Hooper model • The instrument collected four types of info: **i) Personal info** - Age, sex, teaching experience, grade taught etc. **ii) School ICT resources** - Number of ICT for teaching and learning in school, teacher and student access to ICT in school, etc. **iii) Teacher personal Access to ICT** - Access to ICT at home and school and purposes for using ICT		deeper into reasons and factors that could influence teachers' integration levels. • Interview covered the following areas: **i) Personal info** - Teachers' attitude towards computers in general and their use in subject teaching, - Teachers' beliefs about the role of ICT in subject teaching; **ii) Organizational** - Teachers' views about the existence and quality of supporting structures at the school, - Teachers' views about possible constraints and barriers, etc. **iii) Professional** - Teachers' views about their competence and confidence in using ICT for teaching, - Teachers' views about their perceived ICT knowledge

iv) Microsoft in-service training attended - Which Microsoft training teachers received? **v) Pedagogical use of ICT** - How computers (or ICTs) are being used and integrated into teaching and learning - If teachers used ICT in school; if not what are the reasons, frequency of use, etc.		and skills for specific ICT types, etc. - Reasons for integrating (using) ICTs the way they do

Table 3 Data collection process (adapted from Creswell & Clark, 2011)

3.6.1 Data collection instruments

Teacher surveys

As indicated earlier, face-to-face surveys were used to collect data in the first phase of the research, i.e. the quantitative phase. The surveys were handed in personally by the researcher to each individual teacher for completion. Each survey included a letter (see Appendix B) which explained the purpose of the research, and it also assured confidentiality and privacy of the participants.

The objectives of the survey

According to Cohen et al. (2007, p. 206), in general, the main advantage of using a survey is that it can be "used to scan a wide field of issues, populations, programmes, etc. in order to measure or describe any generalized features". Other advantages of using surveys are that :

"they gather data on a one-shot basis and they are economical and efficient; they generate numerical data; they manipulate key factors and variables to derive frequencies; they ascertain correlations (e.g. to find out if there is any relationship between access to resources and the level of ICT integration); they gather standardized information using the same instruments and questions for all participants; they gather data which can be processed statistically (Cohen et al., 2007).

As will be demonstrated later, most of the survey functions stated above are relevant to this research. However, before one looks at the specific benefits of using surveys, it is important to restate the research questions. As explained in Chapter 1, the main research questions proposed for this study were the following:

1) How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?
2) What are the levels of ICT integration for teachers who have attended Microsoft courses?
3) What are the factors which could have a bearing on the integration of ICTs?
4) What reasons do teachers who have attended Microsoft courses provide for and against integrating ICT into teaching and learning?
5) In what way does the qualitative data about teachers' reasons for and against integrating ICT help to explain the quantitative data about their integration levels?

On a general level, the aim of the survey was to explore and investigate the implementation and use of ICT by teachers in primary and secondary schools in the Gauteng Province. In particular, the survey collected information related to the first three questions of the research: i.e. how extensively and frequently teachers were using ICT? On which levels were the teachers using technology? What possible factors which could have a bearing on ICT integration?

The decision to use surveys to collect data in the first phase of the research was influenced by the overall aim of the research as encapsulated in the research questions. Most of the information in these questions (e.g. levels of integration, possible factors) are descriptive, and can be expressed quantitatively. As pointed out by Valenzuela (2006, p. 130), surveys are well suited for "collecting and explaining descriptive data such as number of computer resources, time or frequency of use, types of use, etc. and can also be used to investigate more complex issues by means of statistical techniques from which inferences can be made."

The structure of the surveys

Basically, there are two types of surveys: the ***exploratory***, in which no assumptions or models are postulated (in which relationships and patterns are explored), and the ***confirmatory***, in which a model, causal relationship or hypothesis is tested (Cohen et al., 2007; Routio, 2007). Researchers use the exploratory approach when hardly anything is known about the matter at the outset of the project, whereas in a confirmatory study "the researcher tries to see whether the collected material conforms to the model or must he correct the model or look for a more suitable one" (Routio, 2007).

In this research, the design of the survey was influenced by concepts and variables derived from the literature on factors influencing ICT integration, as well as related theories and models (mainly the Hooper and Rieber model). This means that this was a confirmatory survey. Ideas for the survey structure were borrowed from the Computers in Education (CEQ) survey, as used in the research conducted by Valenzuela (2006) on ICT implementation by Chilean teachers. The survey was divided into five sections (see Table 4), each one aimed at eliciting responses relevant to the main objectives of the study. (See full survey in Appendix A).

Section	Title of section	Type of information requested	Number of items
1	Personal information	Age, gender, school details, teaching experience, grade and subject(s) taught	7
2	Computers in school	Number of computers at school, Access to computers by teachers and students, Frequency of using computer resources	8
3	Personal use of computers	Home and school access to PC, Computer experience, Computer uses	3
4	Microsoft training	Courses that teachers have attended	1
5	Pedagogical use of computers	Frequency of ICT-based lessons, Reasons for integrating ICT or not	4

Table 4 Main sections of the teachers' survey

Implementation of the survey

A total of 450 face-to-face surveys were administered to teachers in 13 schools in Gauteng, with a composition of 3 primary schools, 9 secondary schools, and 1 combined school. "Face-to-face" means that the survey had to be completed by the respondents in a controlled environment, in the presence of the researcher. This system was preferred over other means (e.g. mail, internet, etc.) to increase the response rate and the credibility of the data.

However, face-to-face surveys was a time-consuming exercise as prior arrangement to meet with the teachers had to be made with the school principal through school visits and telephonic follow up. The survey completion required some sacrificing from the teachers as this had to be done after school, to ensure the normal running of the school as required by GDE. A brief covering letter that explains the research clearly and introduces the researcher was included in the survey. The contents of the letter were also discussed briefly before the start of the survey completion process.

Teacher interviews

Considering that the aim of this method was to explain quantitative inferences, this therefore meant that the interview questions would mainly be determined by the responses in the survey. After the analysis of the teacher survey, four main patterns/categories worth exploring emerged. For each category, a teacher was selected from the sample, for further probing. In total, 4 teachers were selected, and arrangements for interviews were made.

The objectives of interviews

In general terms, an interview is a flexible tool for data gathering, and it enables multi-sensory channels to be used, i.e. verbal, non-verbal, spoken and heard. According to Cohen et al. (2007), interviews serve one or more of three purposes:

- To gather information having direct bearing on the research objectives; or
- To test hypotheses or to suggest new ones; or
- To be used in conjunction with other methods in a research undertaking for the purposes of following up unexpected results, or to validate other methods or to go deeper into the motivations of respondents and their reasons for responding as they do.

The use of interviews in this research was more in line with the latter function, i.e. to follow up to the surveys, to probe deeper into the factors and reasons that could influence teachers' levels of ICT use and extent of integration. The interview schedule was based on the literature review (see Chapter 2) and the levels of ICT adoption as per the instructional transformational model, proposed by Hooper and Rieber (1995). The interviews were semi-structured and provided teachers with the opportunity to elaborate their replies given in the surveys in more detail.

The structure of the interview

As indicated, the interviews were semi-structured and they were mainly guided by the teacher's responses in the surveys. A key feature of the semi-structured interview is in the partial pre-planning of the questions. Semi-structured interviews still allow for replication of the interview with others, but are less controlled.

The following are common features in the type of questions that were asked to the 4 teachers, as indicated in Table 5 (See full interview schedule in Appendix B).

Section	Dimensions	Type of information asked
1	Personal	• Teachers' experiences with computers • Teachers' attitudes towards computers in general and their use in subject teaching. • Teachers' beliefs about the role of ICT in subject teaching. • Teachers' experience with computers and its effects on current ICT use.
2	Institutional	• Teachers' views about the existence and quality of supporting structures including Principal's attitudes, time to practise and learn ICT skills, • Impact of the Microsoft in-service training.
3	Resources	• Teachers' views about possible constraints or barriers. • The availability of software and access to computers in school, supporting structures.
	Reasons for integrating ICT (or not)	• **If they are using technology**: their motivation or reasons for using technology, software they used, why they used such software, etc.

4		• **If they are not using technology**: their motivation or reasons for not using technology, software they would have liked to use if they had access to computers, etc.

Table 5 Areas of information covered in the teacher interview schedule

3.7 Research ethics

It must be noted that the entire data collection plan, as described above, depended on the ethics clearance for data collection from the both the Wits University and the Gauteng Department of Education (who are the employer of the teachers who were the subjects of the research). Without this, the research would not have been carried out. Since the research involved both quantitative (i.e. survey) and qualitative (interviews) data collection instruments, ethics for both phases had to be sought. This means that several ethical precautions were taken into consideration during the design and implementation of both instruments. Failure to meet these responsibilities would have been perceived as undermining the whole scientific process and had the potential for legal and financial penalties and liabilities for the researcher and the institution concerned (Cohen et al., 2007). Following is a discussion of the main ethic responsibilities for surveys:

3.7.1 Ethical issues related to surveys

Bearing in mind that questionnaires are, according to Cohen et al. (2007, p. 318), "always an intrusion into the life of the respondents, be it in terms of time taken to complete the instrument, the level of threat or sensitivity of the questions, or possible invasion of privacy", several ethical issues had to considered in the design and implementation of both the survey and interviews.

First, it is important to remember that in no way can the respondents be coerced into either completing a questionnaire or participating in an interview (Cohen et al., 2007). The issue of participants' informed consent and their rights to decline to participate was made very clear

to them, starting from the covering letter of the questionnaire, as contained in Appendix B. After all the permissions were acquired from the principals who were part of the research sample, participating teachers were gathered in a room and the teacher letter was given to each participant and then had its contents discussed with them before the start of the survey completion process.

The following are the main ethical issues that were discussed with teachers, prior to the completion of the surveys. These issues are clearly articulated in the teacher covering letter (Refer to Appendix B):

- The participants' informed consent – the participants were made aware that they were under no obligation to participant in the research,
- The purpose of the research – it was made clear to the participants that the research was part of researcher's masters' degree,
- The participants' rights to withdraw at any stage – participants were made aware about their right to withdraw from the research at any stage,
- Participants' rights to decline to participate – the participants were under no obligation to participate,
- Issues of confidentiality and anonymity were discussed with the participants,
- The participants were made aware that data from the research would be disposed between 3-5 years after the completion of the project,
- Who participants can contact with questions – the details of the research owner were clearly communicated with the participants, verbally and in written form on the teacher letters.

3.7.2 Ethical issues related to interviews

There are three main ethical issues related to interviews, namely: informed consent, confidentiality, and the consequences of the interviews (Cohen et al. (2007), and these were duly complied with during the research; from the interview arrangement stage up to the data capturing stage.

After identifying the participants to be probed on reasons for integrating ICT, a telephonic request to conduct interviews was made directly to them. This was done with the permission from their respective principals. In the arrangement process, the participants were informed of the nature and purpose of the interview (i.e. what will happen and how, and the structure and organization of the interview). As per Cohen et al. (2007), ethical issues, including informed consent, guarantees of confidentiality, beneficence and maleficence (i.e. the interview may be to the advantage of the respondent and will not harm him or her) were discussed before the interview took place.

The interviews were conducted in an environment which was "clear, polite, non-threatening, friendly and personable, to the point, but without being too assertive" (Cohen et al., 2007, p. 362). The interviews were recorded on a computer sound recorder software for later analysis. At the end of the interviews, the participants were thanked and informed that the information provided in the interview would be transcribed and sent back to them via email for verification, and this was done within 5 days after the interview. The participants were also assured that the information shared would remain confidential for the period of the research and up to 3-5 years thereafter.

3.8 Data analysis process

The explanatory sequential design data analysis consists of analytical techniques which are applied to both the quantitative and qualitative data as well as to the mixing of the two forms of data sequentially in a single project. During the mixing process both quantitative and qualitative findings were merged and tested to provide an explanation. The mixing took place in the data interpretation stage, i.e. after both sets of data have been collected and analyzed. In summary, the data analysis occurred in three phases:

i) The analysis of the initial quantitative data,
ii) The analysis of the follow-up qualitative data and,

iii) The analysis of the mixed methods questions as to how the qualitative findings help to explain the quantitative findings. Inferences and conclusions will be drawn.

See Table 6, for the summary of the data analysis procedure for the both methods.

Quantitative Data Analysis Procedure	**General procedure in Data Analysis**	**Qualitative Data Analysis Procedure**
• Organize the data by assigning numeric values • Prepare the data for analysis with Microsoft Excel. • Clean the database for errors	Preparing the data for analysis	• Organize documents and visual data • Transcribe text • Prepare the data for analysis
• Visually inspect data • Conduct descriptive analysis • Check for trends and distributions	Exploring the data	• Read through data • Develop qualitative codebook/typology
• Analyze the data to answer the first three research questions	Analyzing the data	• Code the data • Assign labels to codes • Interrelate themes (categories) or abstracts
• Establish validity and reliability of current data • Assess the internal and external validity of results	Validating the data and results	• Use validation strategies, e.g. member checking, triangulation, disconfirming evidence, and external reviewers • Check for accuracy of account with interviewees

• Represent results in statements of results • Provide results in tables and figures	Representing the data findings	• Represent findings in discussion of themes and categories
• Explain how the results address the research questions • Compare the results with past literature, or prior explanation on barriers/factors on ICT integration	Representing the inferences	• Assess how the research questions were answered • Compare findings with the literature on barriers/factors on ICT integration

Table 6 Summary of data analysis process for the quantitative and qualitative strands

3.8.1 Quantitative data analysis (teacher surveys)

The Hooper and Rieber model provided a basis for analyzing teachers' responses in the quantitative phase in terms of addressing three questions, namely: 1) *How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?* 2) *What are the levels of ICT integration for teachers who have attended Microsoft courses?* And 3) *What are the factors which could have a bearing on the integration of ICTs?*

The methodology

Here follows a section by section description of the survey items and how they helped in answering the research questions. As indicated in Table 5 in the previous section, the teachers' survey had five sections:

Section 1 of the teacher survey gathered teacher *personal information* as a possible factor to ICT integration. The aim of this section was to combine data on participants' background

and relevant personal details with other variables (e.g. level of ICT integration against age of participants).

Section 2 collected data about the "*institution factors*" that might have a bearing on ICT integration, like how organizational aspects like school type, grade level taught and learner access to resources enable or hinder ICT integration.

Section 3 is related to Section 1 in the sense that it also collected teacher personal information. However, this section focused on how teachers were using the computers at their disposal for teaching and learning, and also how much experience they have on computers. The manner in which teachers were integrating computers into their practice is one of the significant parts of this research, as contained in the first of the five research questions, which reads thus: *How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?*

The teacher computer uses were mapped against the Hooper and Rieber model to determine the teachers' integration levels (see Table 7). For example, one can see from the table that teachers who are trying to learn how to use computers operate within the familiarization level, whereas teachers that participate in online conferences and/or can publish or share their ideas with others can be said to using ICT at the evolution level. The reason for this is that by participating in online conferences, such teachers use technology to share ideas with others, and in so doing, they have an opportunity to continuously reflect on their teaching practice. This in turn, enables them to continuously evolve and adapt to remain effective in their practice.

Hooper and Rieber levels	Level description	Teacher computer uses
Evolution	The teacher understands that the educational system, including the classroom learning environment, must continue to evolve and adapt to remain effective	• To publish teaching materials on the internet • To participate in online conferences
Reorientation	The teacher focuses on how the technology enables student construction of knowledge	• To discuss teaching ideas with colleagues
Integration	The technology has now become part of the teacher's every day practice	• To evaluate software
Utilization	Teachers in this phase use the technology in the classroom but would abandon it should the technology malfunctions	• To plan lessons • To keep students' records • To communicate with colleagues
Familiarization	This is the base-line exposure to technology, whereby teachers try a computer programme in-service training/workshop or conference event	• To learn how to use software/hardware • To find out information in the CD ROM • To find out information on the internet

Table 7 Teacher ICT uses mapped to the Hooper and Rieber model

Section 4 required the teachers to state which Microsoft course they had been trained on. The teachers' responses to this question provided a basis for their expected level of ICT integration. This involved mapping the Microsoft courses to the Hooper and Rieber model, as indicate in Fig. 9. Referring to this figure, one can see, that the basic literacy course (also called Digital Literacy Curriculum, or simply DLC) falls under the "familiarization" stage.

This course is about base-line exposure to technology. In the Digital Literacy Curriculum course teachers are exposed to the core functions of productivity programmes like Microsoft PowerPoint, Microsoft Word and Microsoft Excel.

On the other hand, one can see that the course called 21st Century Learning Design is categorized under the evolution stage of the Rieber and Hooper model. The 21st Century Learning Design is a course whereby teachers learn how to transform their regular lesson plans to build and assess students' 21st century skills (including the use of technology), using relevant rubrics. Teachers do this in a reflective and collaborative approach whereby they work in small teams and review each other's lessons or projects and give constructive feedback. The process requires teachers to learn from each other, and hopefully continue to evolve and adapt their practice.

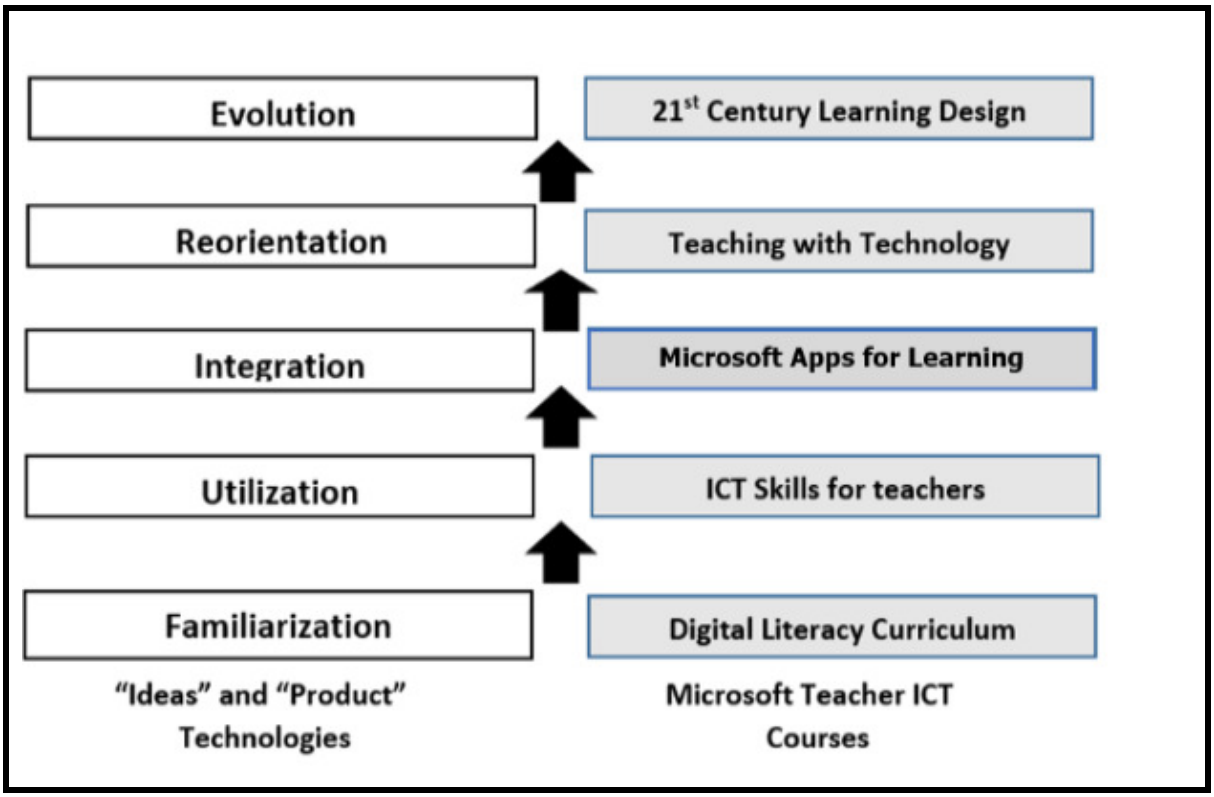


Figure 8 Microsoft teacher courses mapped to the Hooper and Rieber model

Section 5 gathered information related to the second question of the research, which reads thus: *What are the levels of ICT integration for teachers who have attended Microsoft courses?* This section required the teachers to give reasons why they are integrating technology (or not) in their everyday practice. Amongst the reasons for not integrating technology were the following options: a) I have not implemented a technology-based lesson because I do not know how computers can be used for teaching and learning, b) I have not implemented a technology based lesson because there are no computers at my school, c) The only time I have tried using computers was during training, but I have not considered trying it in my classroom, d) I have used technology in the classroom, but I stopped using it due to software/hardware failure.

Amongst the reasons for implementing technology were the following options: a) I use technology regularly in my teaching such that if it is suddenly removed or is unavailable, I cannot proceed with the instruction as planned, b) I use technology in the classroom in activities that enable student knowledge construction, creativity, innovation and collaboration, c) I use technology in the classroom in a manner that enables me to question my own practice and continuously attempt to improve my methods. Both sets of reasons (i.e. for and against ICT integration) were mapped to the Hooper and Rieber model to determine teacher levels of integration, as indicated in Table 8.

Hooper and Rieber levels	**Teacher ICT integration levels**
Non-use	I don't know how computers can be used for teaching and learning
Non-use	I have no interest in computers
Non-use	No computers at my school
Familiarization	I only used computers at training
Utilization	I stopped using computers due to hardware failure
Integration	Integrate ICT regularly
Reorientation	Use ICT for 21st Century Skills
Evolution	Integrate to transformation learning

Table 8 Teacher levels of ICT use mapped to the Hooper and Rieber model

3.8.2 Qualitative data analysis (the interviews)

As indicated earlier, the aim of the qualitative section was to deal with the last two questions of the research: i.e. question 4) what reasons do teachers who have attended Microsoft courses provide for integrating ICT (or not) into teaching and learning? And question 5) in what way does the qualitative data about teachers' reasons for integrating ICT (or not) help to explain the quantitative data about their integration levels? The latter question is actually a mixed question whereby the reasons provided by the interviewed teachers were used to explain possible ICT integration factors, as well as how and why teachers integrate as answered by the first three questions in the quantitative section.

The methodology

Once the data from interviews was collected, the next stage involved analysing them, by some form of coding or scoring process (Cohen et al., 2007). It is important to note that while data analysis in mixed methods follows the same process as in any single method strand, in terms of analyzing data from interviews, there are several "generalized" stages involved, (and these were followed in this research):

- generating natural units of meaning,
- classifying, categorizing and ordering these units of meaning,
- structuring narratives to describe the interview contents and
- interpreting the interview data (Cohen et al., 2007, p. 368).

The process described above is also called coding (other writers call it indexing). In short, coding in a qualitative study is "the translation of question responses and respondent information to specific categories for the purpose of analysis" (Cohen et al., 2007, p. 368). This process typically involves reading and making a judgement on the content from the interviews, and this is also called content analysis. Code words were assigned to the text segments in the left margin and broader themes in the right margins. Thereafter the codes were grouped into broader themes or categories, and the themes (or interrelated themes) are

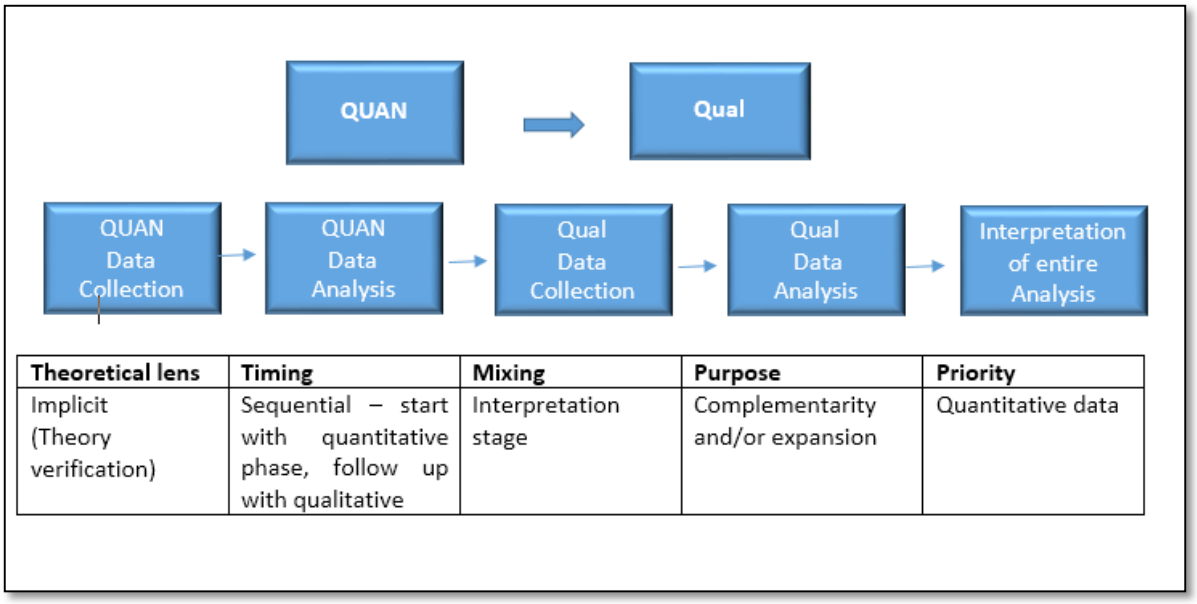
the findings, or results that provide answers to the qualitative research (Creswell & Clark, 2011). As guided by Miles and Huberman (1994, p. 56), "…it is not the words themselves but their *meaning* that matter." The data from the interviews was merged with the data from the surveys in what is called the mixing process.

3.9 The data mixing process

Creswell and Clark (2011, p. 66) define mixing as "the explicit interrelating of the study's quantitative and qualitative strands". Two concepts are useful to understanding when and how mixing occurs: point of interface (point where mixing occurs – e.g. mixing can take place at four different points: interpretation, data analysis, data collection, and design) and the mixing strategy. Four possible mixing strategies are identified: 1) merging the two data sets, 2) connecting from the analysis of one set of data to the collection of a second data, 3) embedding of one form of data within a larger design or procedure, and 4) using a framework (theoretical programme) to bind together the data sets (Creswell & Clark (2011).

The mixing strategy that was used in the research involved merging the two sets of data, and this took place during the data interpretation stage. Mixing during interpretation means that the quantitative and qualitative phases were mixed during the final step of the research process after both sets of data were collected and analysed (Creswell & Clark, 2011). In this process, inferences from the qualitative phase (i.e. the description of the reasons) were used to explain the inferences from the quantitative phase (i.e. the manner and levels of integration).

Refer to Fig. 10 for the summary of the research, indicating data collection process all the way to the mixing stage. This figure shows that the aim of the research was to verify or expand the model (i.e. Hooper and Rieber model), and it involves the collection and analysis of quantitative and qualitative data in a sequence (with priority on quantitative data), with the integration or merging of the data taking place during interpretation stage.



Theoretical lens	Timing	Mixing	Purpose	Priority
Implicit (Theory verification)	Sequential – start with quantitative phase, follow up with qualitative	Interpretation stage	Complementarity and/or expansion	Quantitative data

Figure 9 Summary of the research

As depicted in Figure 9, the purpose of a theoretical lens, commonly known as theoretical framework, is to provide a broader rationale for the research. However, in a research that involves a number of concepts and variables which interact with each other, a conceptual framework serves as the best tool for the researcher to develop and refine his or her ideas. A conceptual framework lies within a theoretical framework and one of its main function is to justify the research problem. Due to its often visual nature, a conceptual framework helps the researcher identify more easily the relevant concepts and methods of investigation.

But, what exactly is a "conceptual framework", and how did its formulation in this particular research contribute in the assessment and refinement of the research goals, and the selection of appropriate methods?

3.10 Conceptual framework

While there are different opinions about the inter-relationship between a conceptual framework and a theoretical framework, however, most authors agree that whether written down or not, a conceptual framework is usually a less well developed explanation for events,

and it effectively encompasses a combination of actual ideas as well as beliefs and assumptions that the researcher has about the phenomenon that is being studied (Maxwell, 2004). The most important function of a conceptual framework, therefore, is to help the researcher develop some kind of a *tentative theory* of the phenomenon that they are investigating. As Miles and Huberman (119, p. 18) put it, "a conceptual framework explains, either graphically or in narrative form, the main things to be studied—the key factors, constructs or variables—and the presumed relationships among them. Frameworks can be rudimentary or elaborate, theory driven or commonsensical, descriptive or casual."

One of the most effective tools of developing and clarifying theory is through a concept map (Maxwell, 2004). A concept map of a theory is a continually developing visual display of that theory—a picture of what the theory says is going on with the phenomenon that the researcher is studying, and it consists of two things: concepts and the relationships among them (Maxwell, 2004). Concept maps are mainly used for two main reasons: 1) to pull together, and make visible the researcher's implicit theory, or to clarify an existing theory, or 2) to help the researcher develop theory, by exposing unexpected connections, contradictions and limitations in the theory.

Concept maps use a combination of boxes (or circles) to represent concepts and lines or arrows to show relationships between them (Maxwell, 2004), and they can take any of the following forms, including: 1) an abstract framework mapping the relationship among concepts, 2) a "flow-chart"-like account of events and these are connected, 3) a casual network of variables or influences, 3) a tree like diagram of the meanings of words, 3) a Venn diagram, representing concepts as overlapping circles (Maxwell, 2004).

The next section demonstrates how a simple computer programme called *Lucid chart*, was used to develop a concept map (in a Venn diagram format), that maps the relationship among the variables and factors involved in the theory on *reasons for and against ICT integration*. Two main sources of knowledge were used in developing this concept map:

i) Experiential knowledge – i.e. the researcher's personal background and identity with regards to ICT integration theory; and,

ii) Existing theory – these includes other researchers' theories and empirical research which was covered in the earlier sections of this chapter, as part of the literature review.

3.10.1 Concept map: Teachers reasons for and against ICT integration

Figure 10 is a concept map that visually shows the main variables and factors related to teachers' reasons for integration ICT (or not), as identified from the literature and experiential knowledge of the researcher. The three main variables are: 1) teacher level, 2) resources and 3) institution level. The main concepts connected with these variables including "ICT", "ICT integration", "ICT competence", "ICT models and frameworks" etc., were defined and operationalized in Chapter 2. However, the aim of the concept map is to demonstrate how the interrelatedness of the variables and the factors informed the conception of the object of study, in terms of formulating the research questions and the relevant methods of investigation.

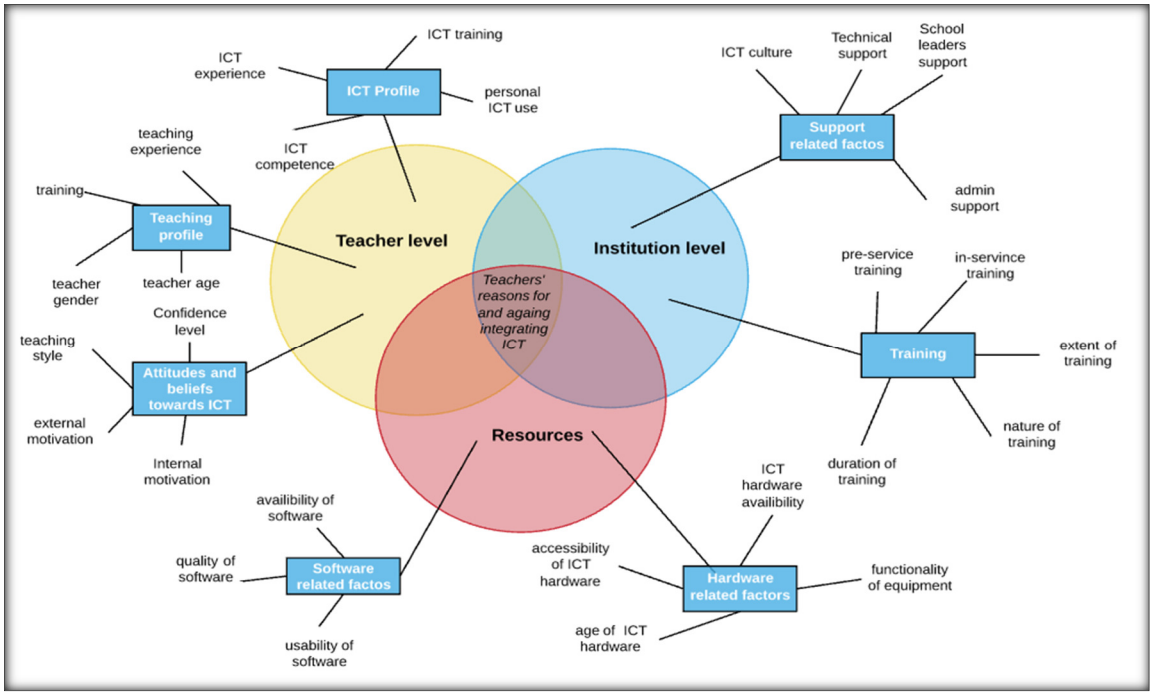


Figure 10 Concept map on reasons for and against integrating ICT

To start with, the vastness of the field of ICT integration (as demonstrated by the interconnectedness of the variables and factors in the concept map) necessitated the use of mixed methods investigative approach, whereby interviews were used to corroborate teachers' responses from surveys in order to get a rich, more balanced account of the reasons for and against ICT integration. This explains the reason why this research focused on answering a number of questions, i.e. five in total—a combination of both quantitative and qualitative questions, instead of one or two as is usually the norm in a single phase study.

As indicated earlier, concept mapping is not an end in itself, but it is an iterative process. As Maxwell (2004, p. 54) puts it: "a concept map is not something that you do once and you are finished with; you should go back and rework your concept map as your understanding of the phenomenon you are studying develops." For example, the original map on teachers' reasons for and against ICT integration did not have as many factors and concepts as indicated in the final version of Fig. 10. While most of the original factors were drawn from the literature on ICT integration (Chapter 2), some factors (e.g. teacher innovativeness, external/internal motivation, school leaders' support), were only added after review of the quantitative phase, in preparation for the teachers' interviews.

Also, the fact that the three main variables (i.e. teacher level, institution level and resources) are represented in a form of a Venn diagram symbolizes their interrelatedness. In order words, if one wants to explain the reasons why teachers integrate technology (or not), one needs to understand that the variables influence each other. Therefore, it will not help to treat the variables in isolation. The whole point about concept maps is to show the relationship among variables.

Furthermore, the literature on "barriers" and "enablers" of ICT integration in Chapter 2, indicated that sometimes the variables and factors not only influence each other in a two-way process, but are cyclical (Becta, 2004; Fullan, 2000; Ertmer 1999; Mumtaz 2000). Take an example of a resources factor like poor quality of software in a school ICT environment, which might result in poor training (institution factor). In return, this might affect the

teacher's competence and confidence level of integrating technology (teacher level factor). Depending on their influence on other teachers, a small group of teachers with low ICT competence and confidence might bring a low morale (ICT culture) to the entire school (institution factor). In the end, a school might find itself being caught up in a vicious cycle of poor curriculum implementation and delivery, due to a "cancerous issue" that started with what seems to be as "minor" an issue as quality of software. Hew and Brush (2006, p. 231) summed the interrelationship between variables aptly when they said:

> "teachers' attitudes and beliefs towards technology are also thought to be affected by their knowledge and skills, and vice versa. In addition, the institution appears to directly affect the adequacy of resources provided for technology integration, the adequacy of teachers' knowledge and skills (via provision of professional development), and teachers' attitudes towards using technology."

Chapter 4: Research results

4.1 Introduction

The data for the initial study (i.e. quantitative - surveys) was collected between July and September 2016, while the follow up study data (i.e. qualitative - interviews) was generated between September and November 2016. The data from surveys about factors and levels of ICT integration was transcribed and analysed using Microsoft Excel software, while data from interviews about teachers' reasons for integration (or not) were coded into categories related to ICT integration internal and external factors, including Ertmer's (1999) first and second order barriers to ICT integration.

The results are shared in the order in which they were collected, i.e.: firstly, the quantitative phase (survey) section, and then the qualitative phase (teacher interview) section. Both sections start with a representation and discussion of the main findings of each research phase, and this is concluded with a discussion on how the findings from each phase answered the research questions.

4.2 Survey results and discussion

A total number of 450 surveys were administered in 13 schools in Gauteng Province (9 secondary and, 3 primary schools and 1 combined school), from which 172 teachers replied to the surveys. This is a response rate of 71, 7%. Out of the 172 surveys returned, 50 were eliminated due to errors and/or lack of sufficient detail. In the end, a sample of 122 surveys, were drawn. This comprised 57 primary school, 51 secondary school and 14 combined school teachers.

However, not all teachers answered all the questions in the survey; therefore, "n_a" was often used to represent the number of teachers who answered a question. The results have been

structured under three headings; each one representing the main variables associated with the integration of ICT by teachers, as identified in the literature review, in Chapter 2:

- Teacher,
- Resources, and
- Institution.

4.2.1 The teacher (personal/biographical information)

This section shares the results of teachers' biographical information as a potential factor of ICT integration. As indicated in Chapter 2, *Teacher personal factors* are related to their internal attributes including: e.g. age, gender, teaching experience, teacher's pedagogical knowledge as well as teachers' attitude to change.

a) Teachers age and integration levels (n=115)

Table 9 shows the age distribution of the sample. Out of 122 teachers surveyed, 115 were willing to provide their ages. The table shows teachers aged 40 – 49 years made up the most percentage of the population (38,3%), while the least percentage (17,4%) represented teachers aged 30-39yrs. Teachers aged 50 and above made up the third largest group.

Age group	Number	%
20-29yrs	27	23,5
30-39yrs	20	17,4
40-49yrs	44	38,3
50 above	24	20,9
Total	115	100,0

Table 9 Teachers' age distribution

However, Fig. 11 shows integration level per age group. In the first two age brackets (20-29yrs and 30-39yrs), there are more teachers who integrate technology in teaching and learning than those who do not. Whereas, the last two age brackets (40-49yrs and 50yrs and above) shows the opposite: i.e. there are more teachers who do not integrate technology than those who do.

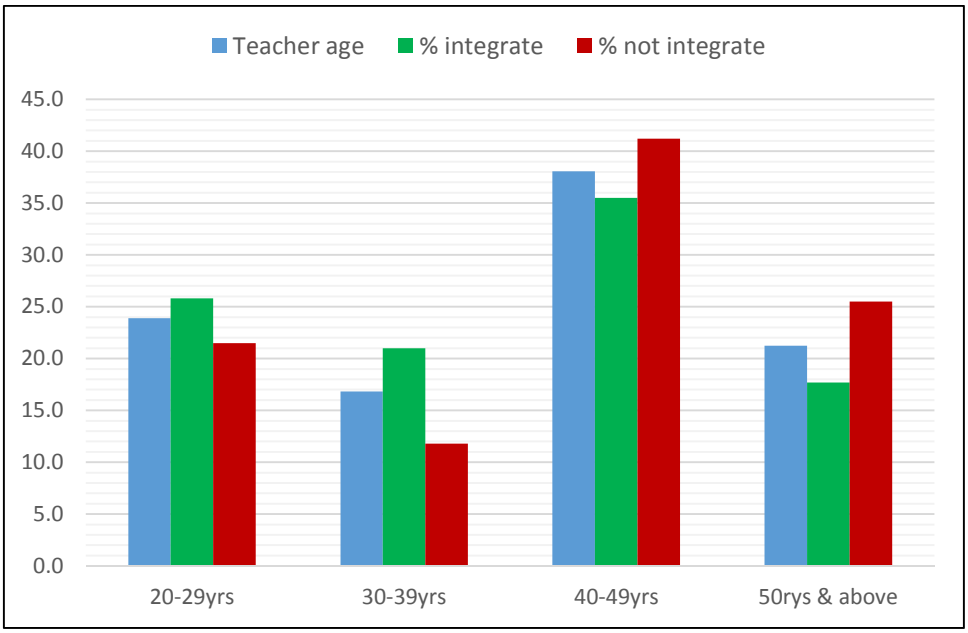


Figure 11 ICT integration level by teacher age (n = 115)

b) ICT integration based on teaching experience (n = 121)

At the time of the research 67% of the sample had less than 10 years' experience teaching at the same school. Only 15, 8% of the sample had 20 years' or more of teaching experience at the same school. Fig. 12 shows the participants' teaching experience (at the same school) and their level of ICT integration based on the Hooper and Rieber levels. It is clear from this graph that highest number of teachers who integrate are those within 0 – 5 years of their teaching experience.

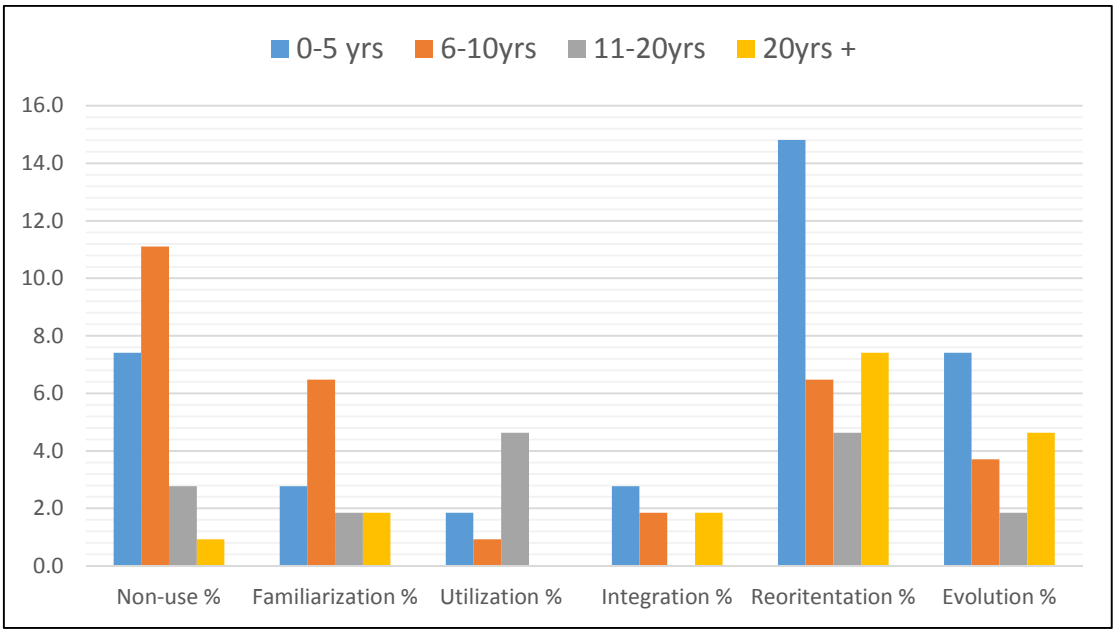


Figure 12 Teaching experience and level of integration (n = 108)

c) ICT integration by gender

The issue of gender differences as a potential determiner of ICT integration was discussed in Chapter 2. From the sample, 35 males and 74 females shared their current ICT integration levels. Fig. 13 shows that the males are slightly ahead of the females in the higher levels of integration as per the Hooper and Rieber model, i.e. integration, reorientation and evolution levels. On the other hand, the females have higher percentages in the lower levels of integration, i.e. non-use, familiarization and utilization levels.

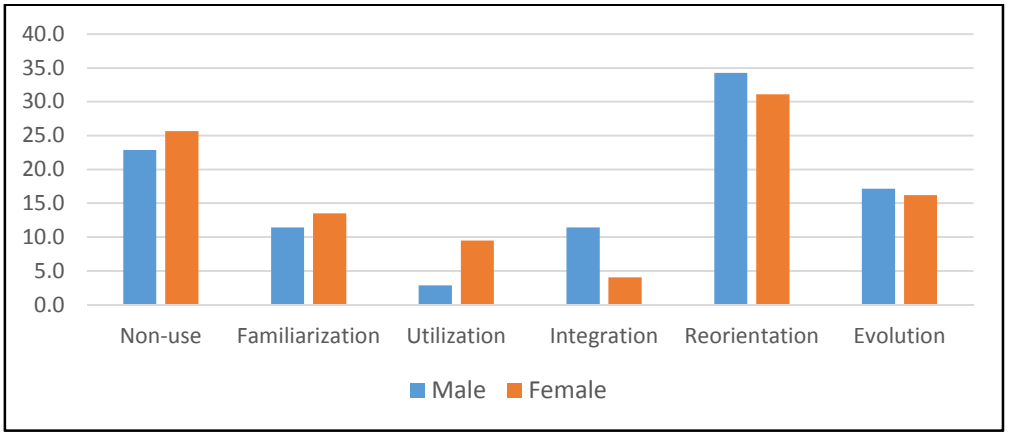


Figure 13 ICT integration by gender

d) Teacher computers uses (n = 122)

Teacher computer use is based on their level of competency. In Chapter 2, three frameworks were introduced in order to give more clarity about what ICT competency means and these are: ISTE and UNESCO and TPACK. Fig. 14 shows that the top three top teacher computer uses are: 1) to find out information on the internet, 2) to keep students records, and 3) to plan lessons. The last three uses are: 1) to participate in online conferences, 2) To publish teaching materials on the internet, and 3) to discuss teaching ideas with colleagues.

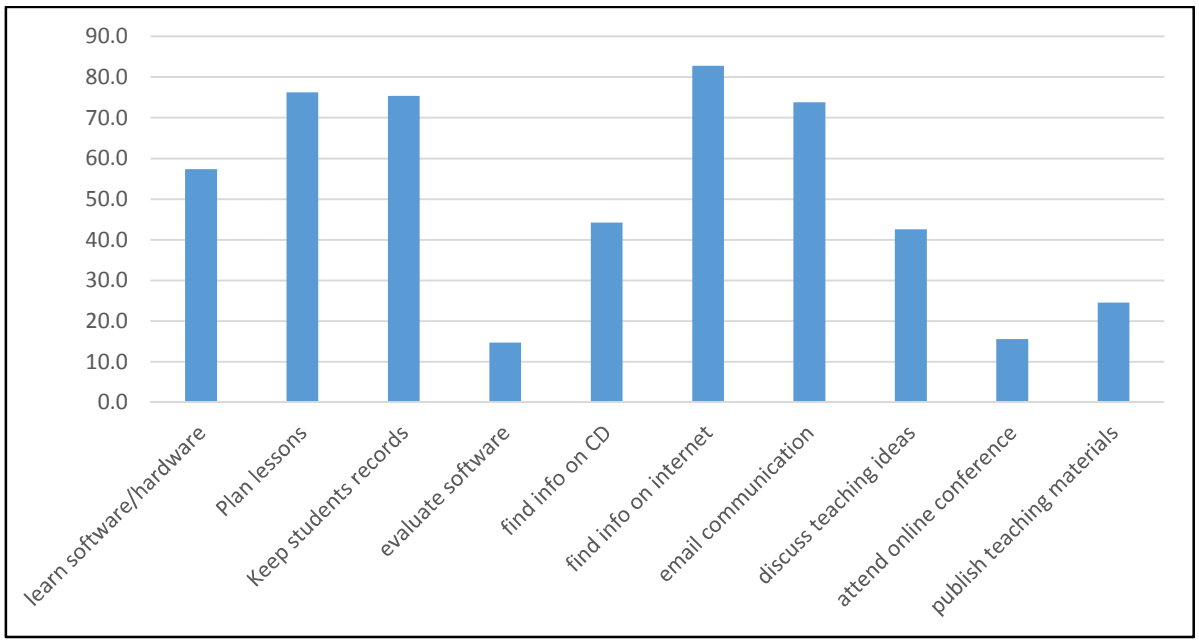


Figure 14 Teacher computer uses

e) Reasons for not integrating computers

As indicated in Chapter 2, reasons for not using technology may be related to factors inside and/or outside the teachers' control. From the sample, 110 teachers shared their reasons for integrating technology or not, and out of this number 49 teachers (44, 5%) indicated their various reasons for not integrating technology. Fig. 15 has mapped teachers' reasons to the Hooper and Rieber model, and one can see that the main reason for teachers not to integrate ICT into teaching and learning is lack of access to resources. This is followed by teachers

who indicated that they are learning how to use technology but the only other time they have tried using it was during training, i.e. familiarization level. About 16% of the teachers indicated that they have stopped using technology due to malfunction (i.e. utilization level).

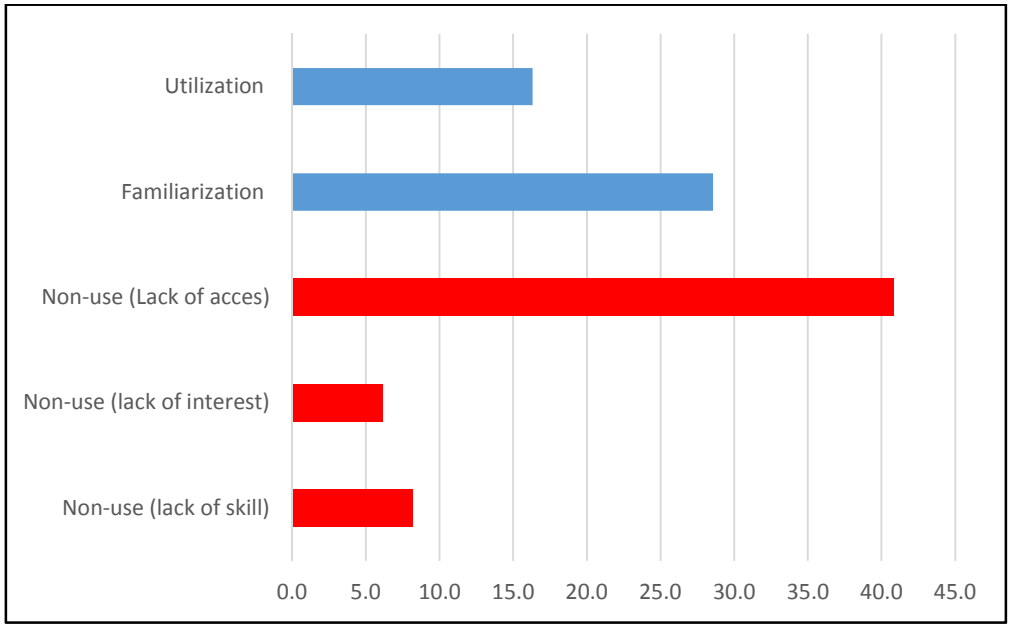


Figure 15 Teachers' reasons for not integrating ICT (n = 49)

f) Levels of ICT integration (n = 61)

Out of 110 teachers, 61 (55, 5%) indicated that they were actively integrating ICT into teaching and learning. Fig. 16 summarises the teacher integration levels based on the Hooper and Rieber model, it is clear that the majority of the teachers (59%) were using technology to promote 21st Century skills including creativity, collaboration, and knowledge creation (i.e. reorientation level). However, only 29% of the teachers used technology in a manner that allows them to reflect and continuously improve their teaching practice (i.e. evolution level).

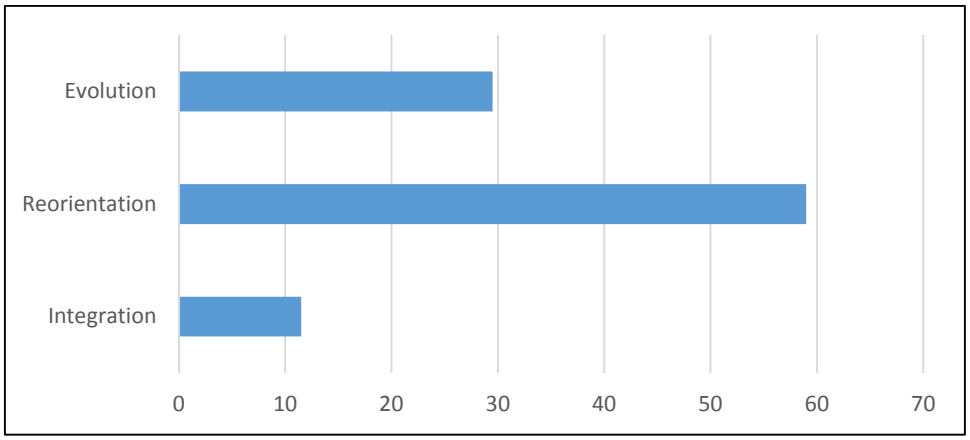


Figure 16 Levels of ICT integration mapped to the Hooper and Rieber model

4.2.2 Resources

The "*resources factors*" are concerned with access to ICT resources both hardware and software. This sub-section shares information about the sampled teachers' school ICT resources, in terms of quantity, students'access to the ICT resources, and whether the ICTs are internet enabled.

a) Integration based on number of computers (n = 99)

Out of 108 teachers who responded to the question on ICT access, 99 (i.e. 87, 9 %) indicated that their schools have some form of computers that are dedicated to teaching and learning. Fig. 17 shows integration levels (as per Hooper and Rieber), based on the number of school computers in a school. One can see from this graph that higher levels of integration (were achieved by schools with between 11 to 40 or more computers).

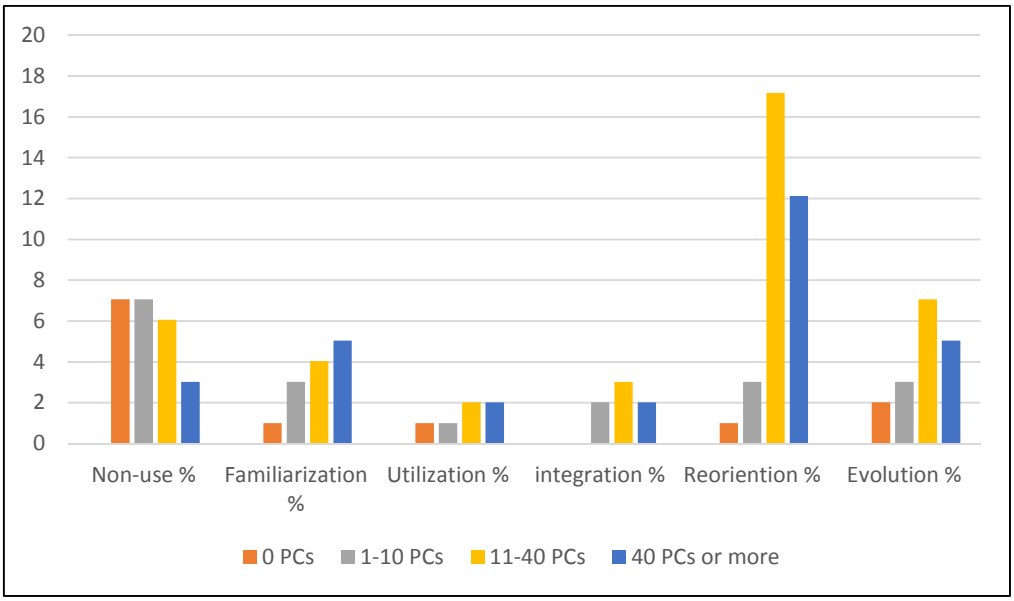


Figure 17 Integration levels based on school number of computers (n=99)

4.2.3 The institution

Chapter 2 discussed, at length, the "*institution factors*" including aspects like school type, grade level taught and, technical support and opportunities for training as potential factors that can enable or hinder ICT integration. This sub-section looks at the results of the survey, in relation to some of these factors:

a) School type

Some authors claim that school type is a factor to ICT integration, and this is based on the gender ICT use research by the European Commission (EC) in 2003 which stated that 77% of male teachers use computers offline, compared to 66% female and this becomes much more of an issue in primary schools where the ratio of female to male is much greater (Becta, 2004). From the sample of 122 teachers, 47, 1% taught at primary schools (also called GET – General Education and Training band), and 41, 8% taught at the secondary schools (also called FET – Further Education and Training). The last group (11, 5 %) taught at a combined school.

Figure 18, shows that there are no major differences in the integration levels between primary and secondary schools. However, the combined school shows a marked difference between the first two school types, especially with regards to non-integration levels.

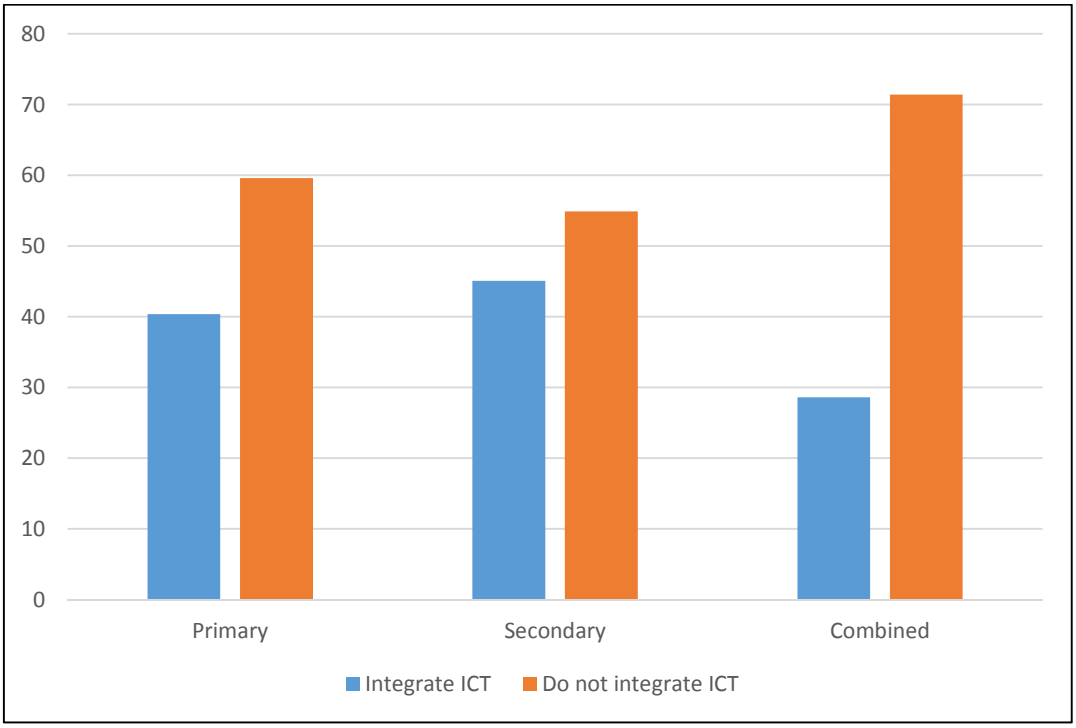


Figure 18 Integration by school type

b) Training

As indicated in Chapter 2, training is one of the main predictors of ICT integration. Fig. 19 indicates the Microsoft training that the teachers from the sample received, and this is mapped to the Hooper and Rieber model. This figure shows that more teachers, from the sample, attended the ICT Skills for Teachers course than any other Microsoft course, at 41, 3%. 21st Century Learning Design is the course attended by the lowest number of teachers at 8, 1%.

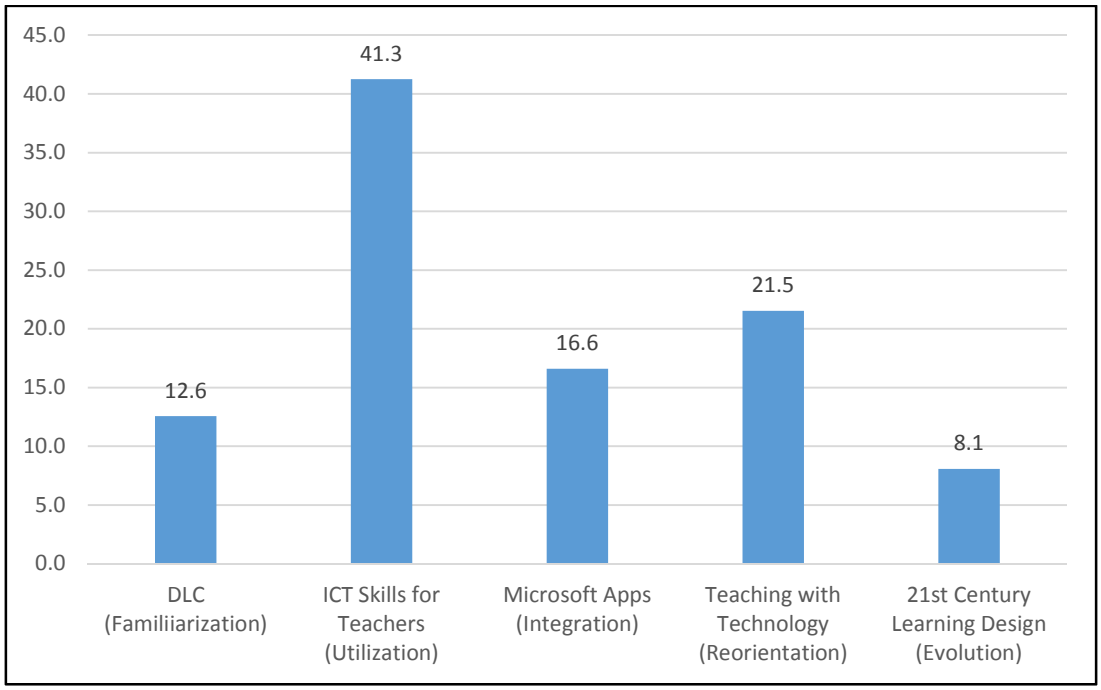


Figure 19 Microsoft courses offered to teachers mapped to the Hooper and Rieber model

4.2.4 Summary of the inferences from the quantitative phase (surveys)

The results of the surveys, as described in the previous subsections, presented a picture of how ICT was integrated in South African schools in the year 2015. Working with a sample of 122 teachers, (which is by no means representative of the entire teacher population in South Africa) a number of issues which needed follow up were revealed. The following are some of the main findings of the survey, under three headings: teacher, resources, and institution.

a) The teacher

Based on the research results, it appears that the following personal factors have a bearing on ICT integration: teacher age, teaching experience, gender differences and teacher ICT skill level. This is in line with literature on the subject (Becta, 2004; Hew & Brush, 2006; Afshari et al., 2009).

The research finding about *age* as a possible variable of ICT integration, is summarised by Fig. 10. This graph shows that younger teachers were more likely to integrate technology than the older teachers. This finding confirm research cited by Afshari et al. (2009) which showed an increase of teacher attitude towards ICT the younger the teachers become.

In chapter 2, *gender difference* is one of the teacher personal characteristics cited as a potential influencer of ICT integration. This research found that there is a difference between male and female teachers in their level of integrating technology. In fact, male teachers appear to be ahead of female teachers, especially in the advanced levels of integration (i.e. reorientation and evolution levels).

Teacher ICT skill (ICT competence) is another possible ICT integration variable that was discussed, at length, in Chapter 2. The research found that most teachers use technology for their own knowledge enrichment (internet searching) and work administration (to keep student records) than to help learners achieve their learning goals or help teachers participate in forums aimed at improving their teaching methods.

b) Resources

As indicated in Chapter 2, research is consistent on the importance of access to resources as a predictor of ICT integration. This research has found that schools with more ICT resources (schools with between 11 – 40 or more computers) also display higher levels of integration that schools with fewer resources. This is confirmed by Mumtaz (2000) who pointed out that good practice in ICT integration is usually found in schools with high quality of ICT resources.

c) The institution

The two main *institution-related factors* that were investigated by the research include training and barriers to ICT integration. In terms of training, the research found that the majority of the teachers (41%) received Microsoft training rated at the utilization level of the Hooper and Rieber model. Very few teachers (8.1%) received training on how to design learning resources that transform (revolutionized) teaching and learning.

In terms of barriers to ICT integration, the research identified lack of access as the main hindrance to ICT integration. This may be one of the reasons to explain low levels of ICT amongst many teachers in the sample, as Becta (2004, p. 29) noted: "one of the factors which contribute to the degree of a teacher's confidence in using ICT in school is the amount of personal access to ICT that the teacher has."

4.2.5 How the quantitative phase of the research answered the research questions

The first question that the quantitative phase of the research answered was: *How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?* Fig. 20 shows the distribution of teacher ICT uses mapped to the Hooper and Rieber model. One can see that the majority of the teachers surveyed in this research used technology in the familiarization (e.g. to learn how to use software/hardware) and utilization levels (e.g. to keep students' records, to find out information on the internet, or to communicate with colleagues) of the Hooper and Rieber model.

The three most common uses of ICT were: to find information on the internet (83, 6% of the teachers), to keep students records (79, 5 of the teachers), and to plan lessons (75, 4 of the teachers). The least number of teacher ICT uses were in the evolution and reorientation levels: to evaluate software (14, 8% of the teachers), to participate in online conferences (17, 2% of the teachers), and to publish materials on the internet (25, 4% of the teachers).

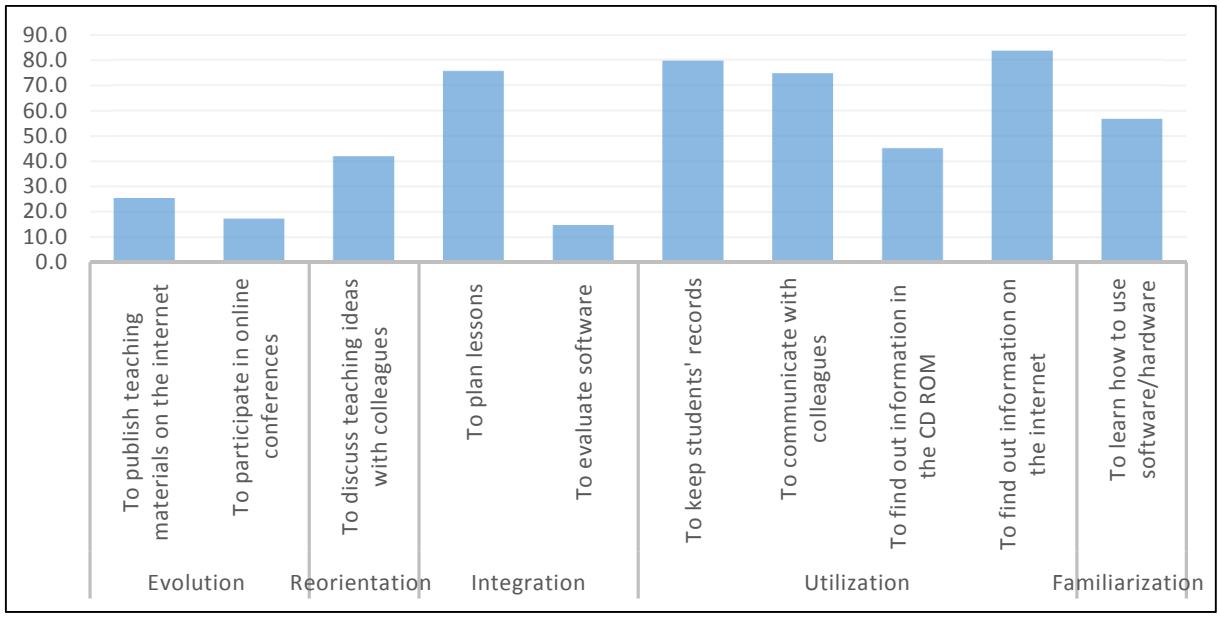


Figure 20 Teacher ICT uses mapped against the Hooper and Rieber model (n = 122)

The quantitative phase also addressed the second question, which reads thus: W*hat are the levels of ICT integration for teachers who have attended Microsoft courses?* Fig. 21 indicates that almost a quarter of the teachers surveyed (i.e. 24, 5%) are not using ICT due to lack of either resources, interest or skills. These teachers belong to the non-use group that was added to the Hooper and Rieber model (Refer to Fig. 3, Chapter 2). The most number of teachers (32, 7%) indicated that their purpose of integrating ICT is to improve leaners' 21st Century skills. These teachers belong to the "reorientation level" according to the Hooper and Rieber model. The least number of teachers are those that have tried using ICT but have stopped due to hardware/software failure, and these make up 7, 3 % of the sample.

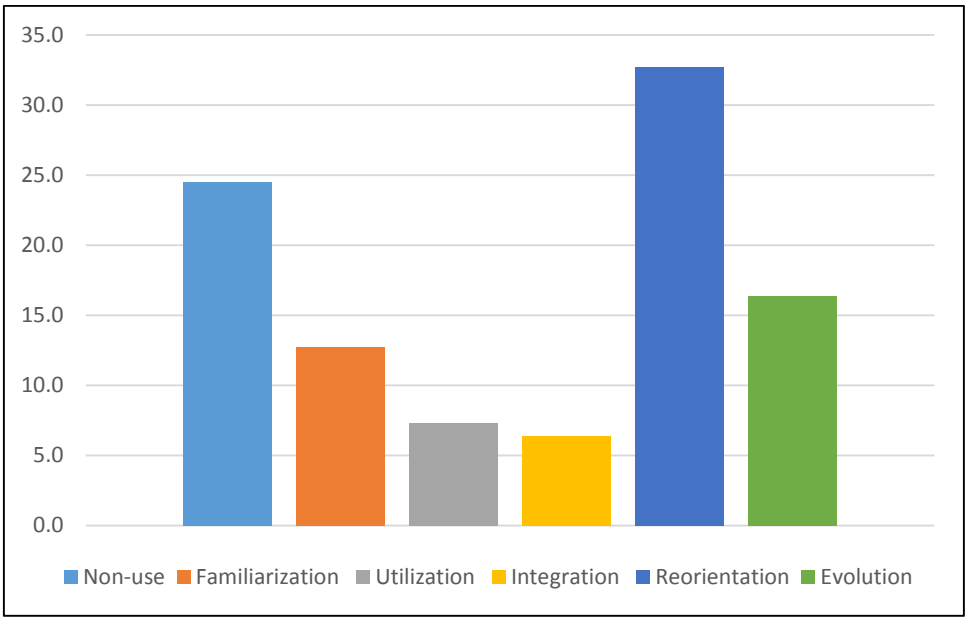


Figure 21 Teacher ICT integration levels mapped to the Hooper and Rieber model (n = 110)

The third and last research question which was addressed by the quantitative phase is: *What are the factors which could have a bearing on the integration of ICTs?* The teacher responses to the survey brought into focus several factors that could either encourage or discourage teachers from integrating ICT. Amongst the internal factors that seemed to have an impact on ICT integration include: age, gender, resources, skill level and personal interest. The main factors external to the teachers that came out include: resources and training. These findings are in line with the literature on factors hindering and favouring ICT integration respectively, as discussed in the literature review in Chapter 2.

However, what became clear at the end of this phase is that some of the inferences required more elaboration. For example, how is it possible for a teacher who has been trained on ICT integration to say that they do not know how this is done? Could it be because of their personal skill level? Or maybe the training did not match their skill level, or are there any other reasons? This necessitated the research to move into the qualitative phase, starting with the identification of individuals to be followed up with.

4.3 Selection of sample for qualitative phase (i.e. interview)

Close analysis of the quantitative data generated from teacher surveys illuminated patterns, trends and anomalies which required further explanation by means of interviews. See Table 10 which shows the four main patterns that emerged, and the reasons for probing such patterns. To aid the analysis process, the main patterns have been mapped to the Hooper and Rieber model.

Patterns/trends	**Reasons for probing**	**Hooper and Rieber levels**
Teachers who had indicated that they do not know how computers can be used for teaching and learning	What possible barriers/reasons are stopping the teacher from integrating ICT?	Non-use
Teachers who were not integrating technology; but have only used it during training	What possible barriers/reasons are stopping the teacher from integrating ICT?	Utilization
Teachers who were integrating ICT, but having done fewer Microsoft courses	Besides training, are there any other enabling factors/reasons of ICT integration?	Integration
Teachers who had done more Microsoft courses and are integrating ICT at an advanced level.	Besides training, are there any other enabling factors/reasons of ICT integration?	Evolution

Table 10 Main trends that emerged from the quantitative phase

For each category, a teacher was selected from the sample, for further probing. In total, 4 teachers were selected, and arrangements for interviews were made.

4.3.1 Interview analysis

The data from the teacher interviews was recorded on a computer sound software, and later transcribed into text. Coding process was used to analyse the text. Coding is an analysis procedure that involves the process of reviewing field notes, transcribed or synthesized, and dissecting them meaningfully, while keeping the relations between the parts intact (Miles & Huberman, 1994). The aim of coding is to generate codes or tags or labels based on the units of meaning (attached to words, phrases, sentences, etc.) compiled during a study, and these can be translated into themes.

In this research, code creation was an iterative process. For example, the main codes (e.g. the master code INT – for "technology integration", INT-NO – for "integrate technology", INT-NO – for "do not integrate technology", REA-INT – for "internal reason", REA-EXT – for "external reason") were created prior to the collection of the data, based on the literature review and conceptual framework as covered in Chapter 2. Other codes developed progressively during the collection process, onwards through to data analysis. The themes generated from the interviews were changed into variables related to reasons for and against ICT integration.

However, as Miles & Huberman (1994, p. 240) have noted: "words are fatter than numbers and usually have multiple meanings", and this makes them harder to move around and work with. It is for this reason that a matrix (Table 11) was developed, to summarise and partition the interview data in a systematic way.

Coding category / theme	Definition and meaning of coding category	Indicator of coding category (A criterion indicating the state or level of the coding category, i.e. how do you know the category is present in the data?)	Example of quote taken from interviewees exemplifying this category
INT	Technology integration	Computers in school	"Computers have a big role to play in education"
INT-YES	Teachers who integrate technology	Use ICT…	"I use ICT daily, and it changes my role from being a leader in the classroom to being a mediator"
INT-NO	Teachers who do not integrate technology	I am not using computers…	"I am not using technology for my students in the classroom"
INT-TOOLS	Tools teachers use for integration	PowerPoint, internet, Excel, YouTube	"I do not take my learners to the lab, I use the lab for myself, to enrich myself using the internet"
REA-INT-YES	Internal reasons for integrating technology	My aim; my goal	"I am an innovative teacher"
REA-EXT-YES	External reasons for integrating technology	Our school, My school, my principal, the system	"The principal encourages us to use

			technology to promote 21st century skills"
REA-INT-NO	External reasons for not integrating technology	I am not able, I do not know how	"I do not how to do it (*integration*) (sic), I am still learning"
REA-EXT-NO	External reasons for not integrating technology	Our school, My school, my principal, the system	"There are not enough computers at our school"
TH-TRANING	Pattern developing about the importance of training	Training	"I enjoyed the Microsoft training"

Table 11 Interview coding matrix

4.3.2 Interview results and discussion

In the next two sub-sections, the results of the interviews of the four teachers will be shared. To protect the participants' right to privacy as required by the ethics committees of both the university and the Gauteng Department of Education, the identity of the participants including their personal and school names schools will remain anonymous throughout the report. As advised by Cohen et al. (2007, p. 64), "the principal means of ensuring anonymity, then, is not using the names of the participants or any other personal means of identification." Therefore, pseudonyms were used.

The teachers' interview results are a product of the interview analysis, which served two purposes: 1) to identify teachers' reasons for being at the level of integration that they were on, and 2) to find out if any of their reasons can be aligned with the ICT integration factors as identified in the literature, as well as in the quantitative phase.

The results of the teacher interviews are presented in a form of a discussion of the evidence for the themes that came out of the analysis of interview data, in relation to the two purposes

mentioned above. Teachers' results have been divided into two groups, based on their reasons for and against integrating technology. Each teacher's reasons and level of use have been mapped to the Hooper and Rieber model (1995).

Teachers not integrating technology

Amongst the four teachers who were interviewed, two teachers indicated that they were not integrating technology, and consequent to this, they were probed on reasons that motivated their non-use. The first teacher is Dolly (not her real name) who teaches Life Skills, Maths and English to Grade 3 learners in a township school of about 800 learners, with access to about 40 computers. Although, other teachers at her school have access to the computer lab, Dolly does not have such access, and she also does not own any form of a computer or laptop for work. Dolly first had access to a computer in 2003, and the only other time she has tried using a computer is during one of her latest Microsoft training. In this training, she was impressed by one of the latest Microsoft's online presentation tool called Sway, even though she had not had a chance to try it out since the training. According to the Hooper and Rieber model (1995), Dolly falls under the "familiarization level", which is the stage whereby teachers have had a base-line exposure to technology, and have only tried a computer programme in-service training/workshop or conference event.

Jackson (not his real name) belongs to a small group of teachers in this research who did not integrate ICT due integration skills. At the time of the interview Jackson was 49 years old and had been teaching for 16 years. Jackson taught Life Skills to Grade 5 and 6 learners in a township school. Even though he was not using computers in his lessons, Jackson believes that computers have an important role to play in education by making learning interesting and easy. Having said this, he still believes in two things: 1) that computers should not replace teachers, and 2) age is not a factor in learning how to use computers. In his own words, he said, "…*but computers will never replace teachers because computers are programmed by people. Age is not an issue, whether you are young or old, if you are trained properly on how to use computers, you will always find them useful."* Jackson indicated that he was currently doing an end user computing (Basic Literacy) course on Microsoft productivity programmes

(i.e. PowerPoint, Word, and Excel) with a local teacher professional development service provider. Based on the Hooper and Rieber model (1995), Jackson falls under the "non-use level". The matrix in Table 12, summarises the two teachers' interview results.

Teacher name	**Hooper and Rieber level**	**Microsoft courses that the teacher has attended**	**Teachers' reasons/factors against ICT integrating**	**Teacher quotation exemplifying his/her level of integration**
Jackson	Non-use	Digital Literacy Curriculum; ICT Skills for Teachers	**Factors:** • Lack of skills • Lack of ICT resources. • No professional support	"I do not know how to do it (*integration)* (sic), I am still learning."
Dolly	Familiarization	Digital Literacy Curriculum, ICT Skills for Teachers, Microsoft Apps for Learning	**Factors:** • Poor computer lab scheduling for students; • Training that is not continuous (i.e. one off training); and • Insufficient and old computers.	"I only use computer to enrich myself, using the internet."

Table 12 Summary of factors and reasons for teachers who were not integrating technology

Teachers integrating technology

Two teachers amongst the four interviewed were integrating technology into their lessons for completely different reasons. Sizwe (not his real name) is a relatively young Grade 7 Maths and Science teacher who has only been teaching for two years. Sizwe teaches in a township school where teachers own laptops, which were organized and owned by the school. Sizwe's students have access to a computer laboratory, even though some of the computers are old, and often malfunction. Sizwe dropped out of a Computer Science Degree in 2009, due to personal reasons, and as an alternative he chose to pursue a teaching career. Due to his background, Sizwe has very good ICT skills, although he has not done many courses on ICT integration. The only ICT integration course he has done is the *Microsoft Apps for Learning*. However, Sizwe is a regular user of technology both for his work administration and teaching and learning purposes. He normally uses Microsoft PowerPoint to deliver his lessons, and he regularly uses Microsoft Excel for his learner administration purposes, including saving and processing learner records. Based on the Hooper and Rieber level of use, Sizwe fall under the "integration Level".

On the other hand, Thandi (not her real name) is a teacher who teachers a Grade 4 class in a school that has a computer lab that is accessible to learners on arrangement. Her school is situated in peri-urban area (commonly known as township) where poverty and unemployment is rife. About two years ago, Thandi was introduced to courses on how to integrate technology into teaching and learning, and this has spurred her to become an innovative user of technology to transform her teaching. Thandi belongs in the flagship programme called the Microsoft Innovate Educators (MIE) programme, and based on her level of ICT use she is in the "evolution Level" of the Hooper and Rieber model (1995). A teacher in the evolution level understands that the educational system, including the classroom learning environment, must continue to evolve and adapt to remain effective. The matrix below (Table 13), summarises the two teachers' interview results.

Teacher name	**Hooper and Rieber level**	**Microsoft courses that the teacher has attended**	**Teachers' reasons/factors for ICT integrating**	**Teacher quotation exemplifying his/her level of integration**
Sizwe	Integration	ICT Skills for Teachers, Microsoft Apps for Learning	**Reasons:** • To make learning interesting **Factors:** • Teacher professional development • Personal interest • Skill level • Principal's leadership	"*I am a regular user of computers both for my personal administration, and for teaching and learning. I use computers for presenting in the classroom, with PowerPoint. I use Excel to capture learners' marks...etc. I use computers for communication, email, etc. as well for entertainment, playing music and watching movies."*
Thandi	Evolution	Digital Literacy Curriculum, ICT Skills for Teachers, Microsoft Apps for Learning,	**Reasons** • To improve learner performance; • To enable her students to acquire 21st century skills	*"I consider myself an innovative educator because I bring in new and advanced methods of teaching and learning through ICT."*

		Teaching with Technology	including how to work independently; • To enable her learners to be creative, in her own word, "to think outside the box"; and • To create a fun, student centred learning environment	

Table 13 Summary of reasons and factors for teachers integrating

4.4 Summary of the inferences from the qualitative phase (interviews)

In closing the qualitative phase, the main question to address is: *What reasons/factors for what levels (of the Hooper and Rieber Model) can be inferred from the analysis of the qualitative data?*

The interviews were conducted with teachers representing four levels of the Hooper and Rieber model, i.e. non-use (which is the added level); familiarization, integration and evolution. Each of the teachers provided different reasons for why they were operating at the levels that they were.

The teacher at the non-use level cited lack of technology knowledge and skill as the main reason why they were not integrating technology. Lack of technology-supported-pedagogical knowledge and skills is one of the most common reasons cited by teachers for not integrating technology (Hew and Brush, 2006; Ertmer, 1999; Becta 2004). According to Ertmer (1999), lack of skill is a second order barrier which may be brought about by first order barriers, including lack of resources and/or training.

The teacher in the familiarization level indicated that she used technology (the internet) to improve her content knowledge. However, she was not integrating technology with her students, not necessarily because there are not enough computers in her class, but mainly due to poor scheduling. As indicated in the Becta report (2004, p. 11), the issue of lack of resources is complex because "in some cases, teachers at schools with sufficient quantities of good quality resources were still experiencing problems as a result of the organization of those resources."

Amongst the two teachers who were integrating technology, one of them indicated that he had high technical experience with ICT (having done Computer Science). It became clear in his explanation that technology was integral to his instructional process; and without it he would have difficulty conducting teaching. However, based on how he described his integration strategies, one could see that he is at the medium level of the Hooper and Rieber model (i.e. the integration level). Despite his high level technical skills, this teacher was not doing much more than using technology (e.g. Microsoft PowerPoint) to support his lessons, and not engaging his students in his lessons (reorientation), or transforming his teaching practice (evolution).

The last teacher indicated that she was using technology to transform her classroom, and she credited much of her success to training that she had received during her pre-service and her in-service time. As noted by Becta (2004, p. 8), "in order to achieve high levels of teacher competence in ICT, there is a need to provide training."

Chapter 5: The mixing phase – interpretation of data and discussion

5.1 Introduction

This section answered the fifth question of the research, which reads thus: *In what way does the qualitative data about teachers' reasons for and against integrating ICT help to explain the quantitative data about possible factors and their integration levels?* To answer this question, the findings of the teachers' surveys were mixed or linked with the interviews to explain possible ICT integration factors as well as reasons for and against integration. These issues were dealt with in the teachers' surveys, in the following questions:

- How do teachers who have attended Microsoft courses integrate ICT (or not) into teaching and learning?
- What are the levels of ICT integration for teachers who have attended Microsoft courses?
- What are the factors which could have a bearing on the integration of ICTs?

As indicated earlier, the main reason for the linking of the two phases taking place at the interpretation level is to use qualitative findings to validate, interpret, clarify, and illustrate quantitative findings (Miles and Huberman, 1994). According to Miles and Huberman (1994), there are three levels at which the linkage can be done: 1) the "quantizing" level where qualitative information can be either counted directly or converted into ranks or scales, 2) linkage between distinct data types; or 3) linkage of overall study design. This research adopted the second approach, whereby qualitative information, text rich data from teacher interviews about reasons for ICT integration was compared to numerical data from questionnaires about factors and levels of integration.

Three main areas in which the findings from qualitative data helped to clarify quantitative data were identified, and each one will be discussed separately: 1) What are the reasons for the manner in which teachers who have attended Microsoft courses integrate ICT, 2) What are the reasons for the levels of integration for teachers that have attended Microsoft course,

and 3) What reasons do teachers cite about the possible factors which could have a bearing on ICT integration? Answering these questions involves using the teacher interview inferences (i.e. the teachers' reasons) to explain their survey responses (about factors and levels), and this where the data mixing process starts.

Refer to Fig. 22 for the summary of the mixing process that was applied in the research. This figure shows that the research used literature on ICT integration, and mainly the Hooper and Rieber model, to determine data to be collected and analysed in quantitative and qualitative sequence (with priority on quantitative data), with the integration or merging of the data taking place during interpretation stage. The final product is a discussion on reasons why teachers integrate ICT (or not), including implication for the research and suggestions for future investigations.

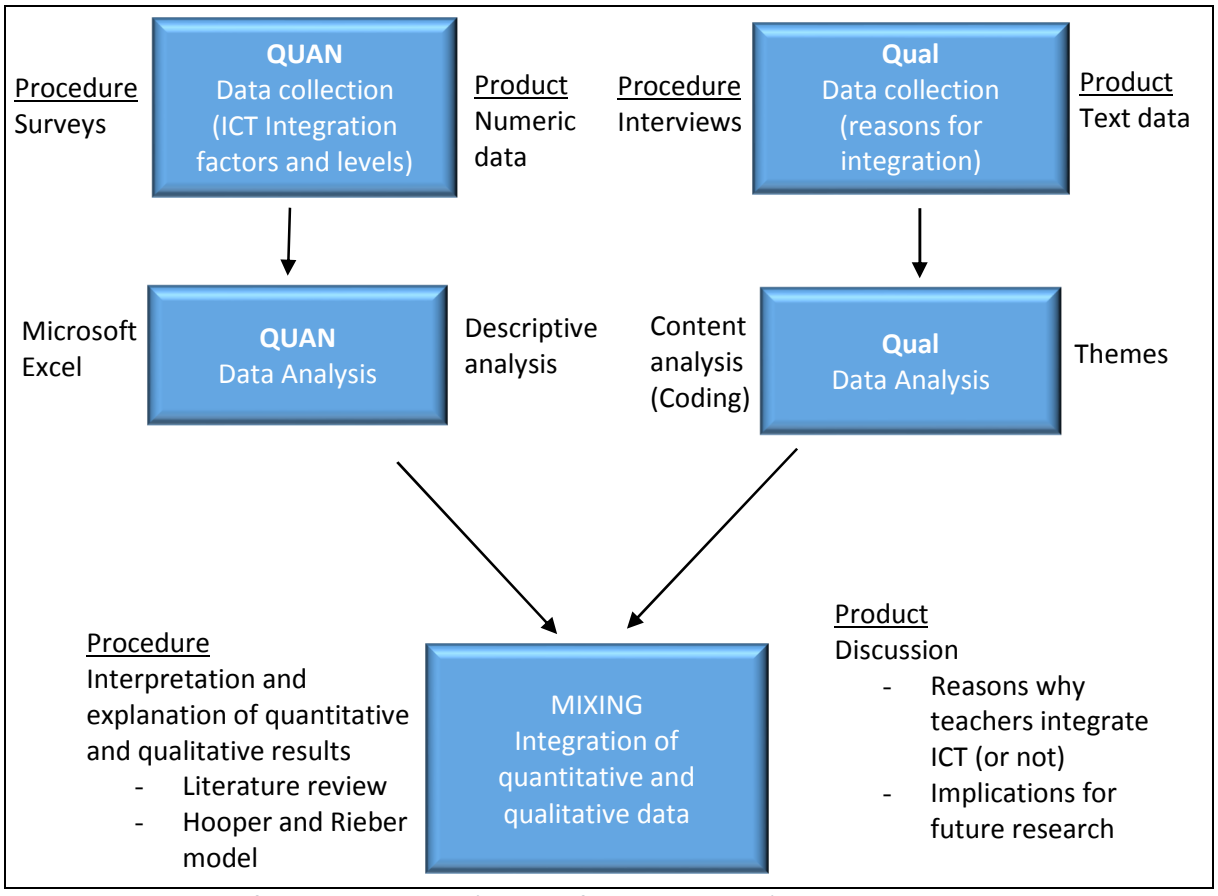


Figure 22 Summary of the mixing process (adapted from Open Access)

5.2 What are the teachers' reasons for their levels of ICT use?

Fig. 23 is a repeat of the summary of teacher uses of ICT as shown in Chapter 4, but this time the graph highlighted the reasons for using ICT for the interviewed teachers in orange. Of the four teachers interviewed, two teachers indicated that they were integrating technology, to achieve different outcomes: one of the teachers indicated that he was using technology to do learner administration and for teaching (mainly Microsoft PowerPoint). This teacher represents 75, 4% of the sample who indicated that they also use technology to plan lessons, and this is a technology associated with "integration level". It appears that the main reasons why he was able to use technology in this manner is due to exposure to training and his technical background.

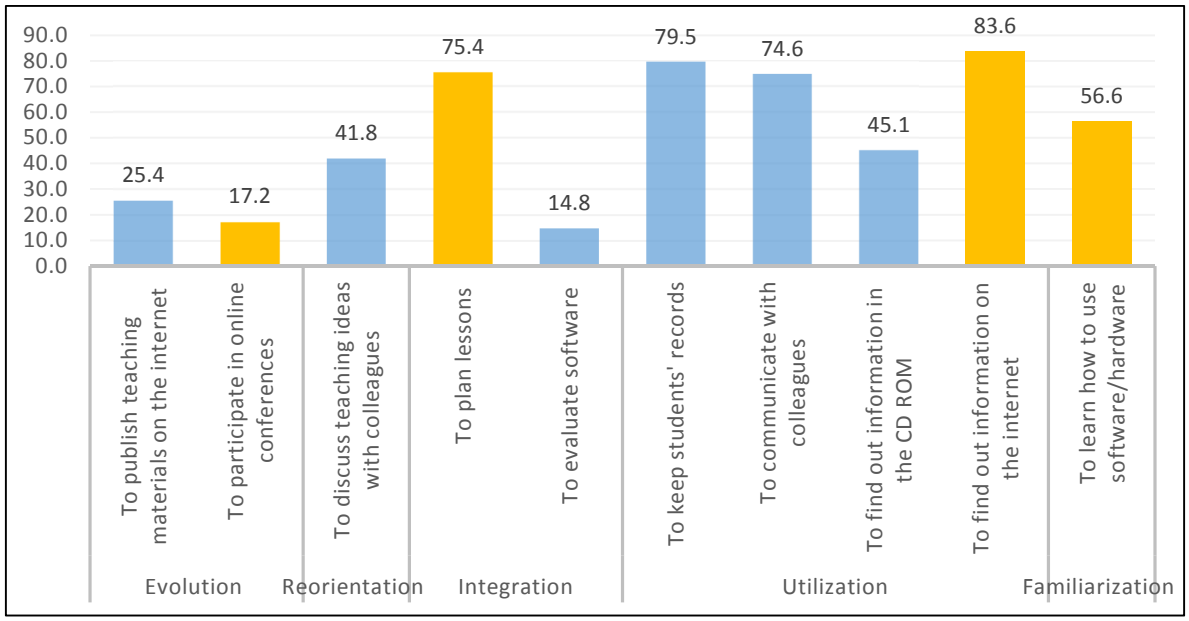


Figure 23 Teacher uses of ICT mapped to the Hooper and Rieber model

The other teacher who was also using technology indicated that she used it regularly in her classes to do lessons and projects that incorporate 21st Century skills. She also indicated that she used technology to connect with other teachers, and also to do online courses as part of the Microsoft Innovative Educator (MIE) programme. As one can see on Fig. 23, she is part of the second lowest users at 17, 7%. She is one of the few teachers operating in the

"evolution" level of the Hooper and Rieber model. As suggested by Hooper and Rieber, (1995, p. 158), teachers in the evolution phase understand the classroom learning environment should constantly change to meet the challenge and potential provided by new understanding of how people learn."

Similarly, the ICT uses for two other teachers who were not using technology can be mapped to the Hooper and Rieber model, in the "familiarization" and "non-use" levels respectively (coded in orange). The one teacher who indicated that she had used technology at training, but the circumstances at her school (i.e. lack of access) prevented her from using it, is clearly operating in the "familiarization level". In describing the training that she had once attended, she said, "*The Microsoft training was exciting…it introduced us to new tools",* however she could not explain how she had incorporated the ideas from the training into her every day practice. This confirms the characteristics of teachers at "familiarization" level, as summarized by Hooper and Rieber (1995, p. 156), "the teacher may discuss the experience and ideas represented in the experience, even with some degree of authority, but no further action takes place". The other teacher, was not using technology due to lack of skills, and he would fall under the added "non-use "level.

5.3 What are the teachers' reasons for their levels of ICT integration?

Table 14 shows the results of the teacher survey with regards to levels of integration. The levels of the four teachers that were interviewed are shaded in blue.

Hooper and Rieber model	Description	No.	%
Non-use	No computers at my school	27	24.5
Familiarization	I only used computers at training	14	12.7
Utilization	I stopped using computers due to hardware failure	8	7.3
Integration	Integrate ICT regularly	7	6.4
Reorientation	Use ICT for 21st Century Skills	36	32.7
Evolution	Integrate to transformation learning	18	16.4
Total		**110**	**100**

Table 14 Teacher ICT levels mapped to the Hooper and Rieber model

The findings of the interviews gave a glimpse of the reasons for the levels of integration. The "non-use" teacher indicated the main reasons why he had not been using technology was that he did not have the right skills to do so. This could very well be the same reason for about 24, 5% of the other teachers in this category. The other teacher in the familiarization level (12, 7 % of the sample) indicated that the last time she had used technology was during the last training she had attended. She also indicated that the main reasons why she did not use technology with her learners is that she did not have access to the lab due to scheduling issues at her school. As indicated in Chapter 2, this is a common problem in most schools.

The third teacher interviewed represented teachers in the "integration level", which represents 6, 4% of the sample. This teacher had high technical skills but used technology mainly for administrative purposes and basic level of integration. This confirms the statement made by several researchers (Mumtaz, 2000; Ertmer, 1999; Becta, 2004; Hew & Brush, 2006), in Chapter 2 that ICT integration for teachers is more than acquiring ICT skills—it is how teachers combine the knowledge of how to use the technology, how to teach through the technology using the relevant content (TPACK). The last teacher interviewed indicated that she was using technology to transform her teaching practice (evolution level), and this represents 16, 4 % of the sample. It appears that over and above her school's supportive structure (in terms of resources and training), she was also intrinsically motivated to be a teacher who integrated technology.

5.4 What are the factors and that influence teachers' ICT integration?

The qualitative findings of the research, (i.e. the results of the interviews) point to four main factors that could have a bearing on ICT integration, and these are: access to ICT resources, teachers' age, and teacher professional development. A brief discussion of each of the potential factors follows:

5.4.1 Access to ICT resources

As indicated in Chapter 2, several research studies continue to cite access to resources as one of the most common factors that can either enable or prevent teachers from integrating new technologies into education (Becta, 2004; Mumtaz, 2000; Bingimlas, 2009). Dolly, (one of the teachers interviewed) indicated how, despite her willingness and reasonable ICT skills, she had not been able to integrate technology in her lessons, mainly due to the unavailability of the school laboratory. On the other hand, in addition to his good ICT skills, Sizwe indicated that one of the reasons why he was able to integrate technology in his lessons was because he and his students, had access to the school ICT resources, especially the computer lab.

Table 15 shows integration levels by number of computers by the teachers in the sample, and it is clear from this table that there is a casual link between number of computers in a school and the teachers' level of integration—the more computers in a school, the higher the level of integration (and vice versa). This is rather contrary to the view held by some authors, including Mumtaz (2000) and Ertmer (1999), who argued that internal factors e.g. skills, attitude, beliefs are more influential to ICT integration than the external factors.

No. computers	Non-use %	Familiarization %	Utilization %	integration %	Reorientation %	Evolution %	**Hooper and Rieber levels of ICT use**
0 PCs	7.1	1.0	1.0	0.0	1.0	2.0	12.1
1-10 PCs	7.1	3.0	1.0	2.0	3.0	3.0	19.1
11-40 PCs	6.1	4.0	2.0	3.0	17.2	7.1	39.4
40 PCs or more	3.0	5.1	2.0	2.0	12.1	5.1	29.3
TOTAL							**100**

Table 15 ICT Integration by number of school computers

5.4.2 Teacher age

Teacher age as a factor and reason for the various levels of ICT integration is one of the findings of the teacher interviews. Between the two teachers who were not integrating ICT, one of the teachers fell in the 40-49yrs age bracket, as compared to the other pair of "integrators" who both fell in the 20 -29yrs age bracket. When asked whether his "advanced age" was a factor responsible for his inability to integrate, Jackson was quick to point out that this was not the case. Rather, Jackson ascribed his lack of ICT integration mainly to lack of training and resources. In his own words he said*: "Age is not an issue, whether you are young or old, if you are trained properly on how to use computers, you will always find them useful."*

However, as we have seen with Fig. 10 in Chapter 4, it does seem as if age is a predictor of ICT integration as the level of integration decreased with increased age. Teacher professional development, in the form of training, was the last common factor and reason identified by all the four teachers, as having influence on ICT integration.

5.4.3 Training

For all the four teachers who were interviewed, training was a recurrent theme as a factor and reason enabling or hindering ICT integration. This is consistent with the literature on ICT integration factors, as discussed in Chapter 2. But the issue here is not just training in the skills of using ICT equipment but, as Becta (2004, p. 10) indicated, "the issue of training teachers in how to use ICT to effectively manage children's learning, both during the lesson and also in preparation of lessons beforehand (pedagogical training) …is an important one."

As already pointed out, although training is the external factor, but "competence" is the equivalent internal factor or reason why teachers use technology or not. Figure 24 shows a comparison between teacher integration levels and the courses that they were trained on. It is clear from this graph that there is a haphazard relationship between the two variables. For

example, 41% of the teachers in the sample, have been trained on a Microsoft course at utilization level (i.e. ICT Skills for teachers), but the integration level for utilization sits at 9, 6 %.

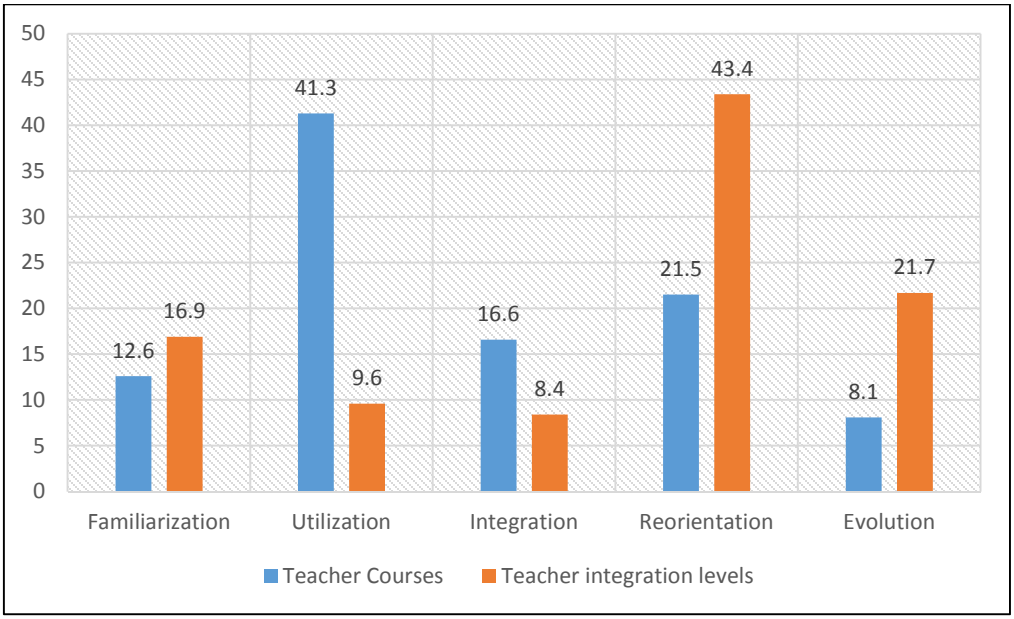


Figure 24 Integration levels based on teacher courses (mapped to Hooper & Rieber model)

The haphazard relationship between training level and integration level proves the fact that training is not the sole predictor of ICT integration. As one of the interviewed teachers, namely Dolly, has demonstrated: one can receive training targeted at a particular skill level only to face a lack of access barrier at school (in her case, she was unable to use her school's computer lab due to scheduling issues).

5.5 Reasons and factors for or against integrating ICT

The four interviewed teachers cited a number of reasons and factors for and against integrating ICT. For example, amongst reasons for integrating ICT, the following were mentioned: "*to improve learner performance*; "*to improve learners' 21st Century skills"*, "*to make learning authentic"*. Whereas some of the factors which were discovered through the coding process of the interview transcript included: *training*, *access to resources*, *leadership support*, *skill level*, and *personal motivation*.

The two "non-integrating" teachers cited issues including: *lack of access*, *lack of training*, *old and malfunctioning computers* as some of their main reasons for their struggles. The underlying factors included *poor resource management*, *skill level*, and *training*. These reasons and factors (for and against ICT integration) are consistent with the findings of the quantitative study and the literature on "enablers" and "barriers" to ICT integration (Mumtaz, 2000; Ertmer, 1999; Becta, 2004; Hew and Brush, 2006), as discussed in Chapter 2.

For operationalization purposes, the teachers' reasons and factors, from the interview findings, have been summarized in Table 16, based on the Hooper and Rieber levels of use and the attribution theory. Both theories were introduced in the literature review in Chapter 2. The Hooper and Rieber model has been used throughout the research as a de facto lens for describing teacher ICT use and levels, whereas the attribution theory is more relevant in terms of understanding how teachers assign factors and reasons for ICT integration. The theory points to two types of attributions: external and internal.

In the context of teacher use of technology, external attributions are attributions or reasons driven by factors beyond the teacher control, e.g. lack of access, while internal attributions are reasons related to the teacher's internal characterises e.g. skill level or attitude. One can see by analysing the type and the number of reasons offered that the teachers were more willing to ascribe motives for and against ICT integration to factors or reasons external to them e.g. lack of access, poor scheduling, curriculum goals etc. This is less surprising as one of the primary assumptions of attribution theory is that people were more likely to interpret their environment in such a way as to maintain a positive self-image. Fritz summed up this assumption nicely when he said: `

> "No one wants to be the bad guy, and assigning attribution is one of the ways that people seek to see themselves in a more positive light. By blaming other people and avoiding personal recrimination, individuals strive to keep a positive self-image. If people believe they are responsible for bad outcomes, they are less motivated to repeat their behaviors. By shifting blame, people avoid accountability and therefore feel able to repeat the same behaviors."

Reasons/factors for integrating ICT	**Internal reasons/factors**	**Hooper & Rieber Level**
	Personal admin	Utilization
	Recognition as innovative teacher	Evolution
	Efficiency	Utilization
	External reasons/factors	
	Improve learner performance (curriculum goals)	Utilization
	Make learning interesting	Integration
	Achieve 21st Century Skills	Reorientation
	Principal's motivation	Familiarization
Reasons/factors against integrating ICT	**Internal reasons/factors**	
	Lack of skill	Non-use
	External factors	
	Lack of access	Non-use
	Poor scheduling	Non-use
	Lack of training	Familiarization
	Old computers	Utilization

Table 16 Teachers' reasons and factors for or against ICT integration

Predictably, all the fours teachers, including the "non-integrators", projected a "positive-image" when it came to attitude and beliefs about the role of ICT. Jackson, one of the non-integrators, is a case in point, and on the subject, he said: "*Although I am still learning how to use computers for teaching and learning, I believe that \computers play a big role in education, they make learning interesting…computers save time."*

Chapter 6 Research limitations, conclusion and recommendations

Limitations of the research

The main limitation of this study (and this is a general limitation with studies that are based on surveys and/or interviews) is that its findings are based solely on the participants' self-reported data. As noted by Hew and Brush (2006), self-reported data from interviews and surveys are not always a reliable means to understand how teachers integrate technology because beliefs, intentions and perceptions do not always translate into reality. And as we have seen with the attribution theory, people normally have a bias towards projecting a positive image about themselves.

The second limitation is on the selection of the sample for both phases of the research. This research was confined to teachers who had done Microsoft courses. It is important to bear in mind that teachers are always exposed to many other technology-integration related courses besides Microsoft, and it is possible that had such teachers been included in the research, the results would possibly have been different.

Conclusion

A number of conclusion can be drawn from the findings, but the main one relates to the use of the Hooper and Rieber model as a tool that helped in selecting the logical structure of the entire research project, including planning it. The research proved that with minor adjustments, including adding the "non-use" stage, the Hooper and Rieber model can be used as a lens to understand how teachers integrate ICT (or not) in their everyday practice. By integrating the model with the attribution theory one can have a better understanding of the teachers' reasons for and against teachers integrating technology.

There were also number of themes that emerged from the research, including:

1. Technology use for most teachers is confined to using the basic common tools, mainly for personal use (e.g. searching for information on the internet) and learner record keeping (using spreadsheet software). Very few teachers use technology to advance the goals of the White Paper on e-Education, which is to support 21st skills amongst the students. However, for the few educators who do so, they seem to have supportive structures, e.g. available resources as well as the support from the school principal.
2. Teachers face many barriers in an effort to integrate technology, and the most common one is access to resources. In some cases, access to resources is not necessarily caused by the unavailability of resources, but by the apparent inability by the school to use available resources equitably and sensibly.
3. Integration factors affect teacher perception in different ways: for example, lack of resources (which is an external barrier) can affect teachers' confidence to integrate technology (which is an internal reason).
4. Training cannot be taken for granted that it will translate into action. For example, a number of teachers received training rated at higher levels (e.g. reorientation and evolution), but their integration levels were far below the course levels.
5. Teachers are more likely to attribute their integration or non-integration reasons to forces external to them.

Recommendations for future study

As indicated earlier, one of the limitations of this research is that it was based on self-reported data from surveys and interviews, and this brings into question the accuracy of how technology is being integrated (or not). Over and above using surveys and interviews in combination, future research could add the use of observations to get a more accurate picture of how teachers are actually integrating technology, and what issues they come across in the process, rather than solely relying on their perceptions. By using more objective tools to gather data about teacher practice means that the research would take a longer period than what this research took. However, with opportunities to observe how teachers react to

technology over a period of time, one should end up with findings that are thicker, richer and more accurate.

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APPENDIX A: Teacher survey

Confidential

Computers in Education Questionnaire

The main objective of this questionnaire is to know the current state of computer use in schools for teachers who have attended Microsoft courses in the last 12 months. The term computer will be used throughout the questionnaire to cover a wide range of use of Information Communication Technology (ICT) including, personal computers (PC), tablet PC, smart phones, software applications, the use of internet, e-mail, and other forms of communication technologies.

Please answer all the questions below by crossing (☒) the appropriate answer or filling in the gaps

1. **Personal information**.

1.1. What is your name? (**N.B. You have a right to remain anonymous or to use a pseudonym**)

……

1.2. Are you Male or Female?

Male ☐ Female ☐

1.3. How old are you?

20-29 ☐ 30- 39 ☐ 40-49 ☐ 50 and above ☐

1.4. What is the name of your school?

……..

1.5. Please specify the type of area in which your school is situated.

Rural Area ☐ Urban area ☐ Township/Peri-urban area ☐

1.6. How long have you been teaching at this school?

0- 5yrs ☐ 6-10yrs ☐ 11 – 20yrs ☐ 20yrs and above ☐

1.7. Are you GET or FET educator?

GET ☐ FET ☐

1.8. Which learning area(s)/subjects do you teach?

……

……

……

2. **Computers at your school**

This refers to the computers at your school for administration, teaching and learning

2.1. Number of computers in my school for teaching and learning is:
☐ 0 computers ☐ 1-10 computers ☐ 11 – 40 computers ☐41 or more

2.2. Do your students have access to tablet PCs
☐ Yes ☐ No

2.3. Are students from your school allowed to bring their own computers (including tablet PCs)
☐ Yes ☐ No

2.4. In my classroom (the room in which I teach, NOT the computer lab) I have:
☐ 0 computers ☐ 1 computer ☐ 2- 4 computers ☐ More than 5 computers

2.5. Do the computers in your classroom have internet access?
☐ Yes, all of them ☐ Yes, some of them do ☐ No, none of them do ☐ Not applicable

2.6. In your school, do you have access to computer lab(s)/computer room(s)?
☐ Yes (answer 2.7, skip 2.8) ☐ No (answer 2.8, skip 2.7)

2.7. If yes, how often do you bring your students to the computer lab?
☐ Not at all ☐ Daily ☐ Weekly ☐ Monthly

2.8. If no, do you think such a resource would benefit teaching and learning, if it existed?
☐ Yes ☐ No

3. Personal use of computers

This refers to the use of computers for carrying out diverse tasks of personal interest such as finding out information, recreational purposes, etc.

3.1. Please indicate whether you have had access to a computer for your personal use in the last 12 months

a) at home? Yes ☐ No ☐
b) at school? Yes ☐ No ☐

If you do not have access to a computer for your personal use, please go to Section 4.

3.2. How long have you been using a computer for your personal use?
0- 5yrs ☐ 6-10yrs ☐ 11 – 20yrs ☐ 20yrs and above ☐

3.3. Please indicate for what purpose you used the computer which you had access to (**If you have not used computers, skip this question**):

a) To learn how to use software/hardware		g) To communicate with colleagues via email	
b) To plan lessons		h) To discuss teaching ideas with colleagues via discussion groups	
c) To keep students records		i) To participate in online conferences (via internet)	
d) To evaluate software		j) To publish teaching materials in the internet	
e) To find out information in CD ROM		k) Other purposes (please specify)	
f) To find out information in the internet			

4. Microsoft Training

This section is about the Microsoft training that you have received in the last 12 months. Course short description has been provided to refresh your memory about the contents of the course.

4.1. Indicate which of the following Microsoft courses you have attended in the last 12 months and what kind of course it was by putting a cross ☒ on the relevant type.

Microsoft Course	**Short Description**	**Duration (days/ hours)**
Digital Literacy Curriculum (DLC)	The DLC is for anyone with basic reading skills who wants to learn the fundamentals of computer technology	
ICT Skills for Teachers	This is Microsoft End User course that aims to improve teachers' ICT skills (e.g. Microsoft productivity software i.e. Word, Excel, PowerPoint) in relation to their everyday professional practice.	
Microsoft Tools/Apps for 21st Century Learning	Microsoft tools for 21st Century teaching and learning include the use of Office Mix, Sway, and OneNote. This training involves how to access these tools in the Microsoft Educator Community.	
Teaching with Technology	This is an online course aimed at helping teachers explore how ICT integration can enhance teaching and learning	
21st Century Learning Design	In this course teachers learn how to transform their regular lesson plans to build and assess students' 21st century skills using relevant rubrics.	
Other, please specify:		

5. Pedagogical use of computers

The pedagogical use of computers refers to the use of computers technology to support the teaching and learning of the different subjects in primary or secondary school.

5.1. Since completing your Microsoft training, how often do you have your learners use computer technology to engage in lessons, research or activities in ways they did not before you participated in the training?

☐ More than once a month

☐ About once per month

☐ I have not used computers with my learners

5.2. The following statements describe possible reasons why you **HAVE or HAVE NOT** implemented a technology-based lesson **since your training**.

Choose **ONE** statement by putting a cross ☒ along the statement that best describes your reason for implementing or not implementing a technology based lesson

(**NOTE**: If you **HAVE NOT** implemented a technology based lesson answer 5.2.1. and skip 5.2.2 or the other way round – **you cannot answer both sections**.)

5.2.1. **Reasons for <u>NOT</u> implementing technology based lesson(s)**	**(Choose ONLY one option)**
a) I have not implemented a technology based lesson because I do not know how computers can be used for teaching and learning.	
b) I have not implemented a technology based lesson because I do not have interest in ICTs.	
c) I have not implemented a technology based lesson because there are no computers at my school.	
d) The only time I have tried using computers was during training, but I have not considered trying it in my classroom.	
e) I have used technology in the classroom, but I stopped using it due to software/hardware failure.	
5.2.2. **Reasons for implementing technology based lesson(s)**	**(Choose ONLY one option)**
a) I use technology regularly in my teaching such that if it is suddenly removed or is unavailable, I cannot proceed with the instruction as planned.	
b) I use technology in the classroom in activities that enable student knowledge construction, creativity, innovation and collaboration.	
c) I use technology in the classroom in a manner that enables me to question my own practice and continuously attempt to improve my methods.	

To discuss in more depth, the issues covered in this questionnaire, please indicate your willingness and availability to participate in a short interview (of about an hour)

……

…….

If you are willing to be contacted, please provide your mobile number: ……

Thank you for your help!

APPENDIX B: Teachers' information sheet

DATE: …../…../2016

Dear ……..

My name is Victor Ngobeni and I am a Masters' in the School of Education at the University of the Witwatersrand.

I am doing a mixed-approach research on reasons for the levels of ICT integration into teaching and learning by Gauteng Provincial teachers who have attended Microsoft courses.

The reason why I have chosen your school is because you have recently received Microsoft training and your experiences present a range of scenarios on how ICT is being used for administration, as well as teaching and learning.

I was wondering whether you would mind if I collected information about your experiences and attitudes towards ICT integration.

Your name and identity will be kept confidential at all times and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

You will not be advantaged or disadvantaged in any way. Your participation is voluntary, so you can withdraw your permission at any time during this project without any penalty. There are no foreseeable risks in participating and you will not be paid for this study.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,



Victor Ngobeni
19 Pandora Road
Kensington
victorn@live.co.za
082437 0964

APPENDIX C: Teacher's Consent Form:

Please fill in and return the reply slip below indicating your willingness to be a participant in my voluntary research project called: **Reasons for the levels of ICT integration into teaching and learning by Gauteng Provincial teachers who have attended Microsoft courses.**

I, _____ give my consent for the following:

Permission to review/collect documents/artifacts	**Circle one**
I agree that (SPECIFY DOCUMENT) can be used for this study only.	YES/NO
Permission to observe you in class	
I agree to be observed in class.	YES/NO
Permission to be audiotaped	
I agree to be audiotaped during the interview or observation lesson	YES/NO
I know that the audiotapes will be used for this project only	YES/NO
Permission to be interviewed	
I would like to be interviewed for this study.	YES/NO
I know that I can stop the interview at any time and don't have to answer all the questions asked.	YES/NO
Permission to be photographed	
I agree to be photographed during the study.	YES/NO
I know that I can stop this permission at any time.	YES/NO
I know that the photos will be used for this project only.	YES/NO
Permission for questionnaire/test	
I agree to fill in a question and answer sheet or write a test for this study.	YES/NO
Permission to be videotaped	
I agree to be videotaped in class.	YES/NO
I know that the videotapes will be used for this project only.	YES/NO

Informed Consent

I understand that:

- My name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- I do not have to answer every question and can withdraw from the study at any time.
- I can ask not to be audiotaped, photographed and/or videotape
- All the data collected during this study will be destroyed within 3-5 years after completion of my project.

Sign_____ Date_____