

https://dspace.org/

Pedagogical integration of ICTs by teachers: a case study at five South African public schools

Nhlapo, Mandla

2022

https://hdl.handle.net/10539/34006

Downloaded from a DSpace repository. https://dspace.org/

Pedagogical Integration of ICTs by Teachers: A case study at five South African public schools

By

Mandla Nhlapo

A research report submitted in accordance with the requirements for the degree of

Master's in Education

School of Education



Supervisor: Dr Ian Charles Moll

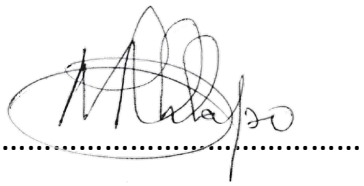
February 2022

DECLARATION

I declare that

Pedagogical Integration of ICTs by Teachers: A case study at five South African public schools

I produced the research report, and all the materials I used or quoted are listed and recognized in the paper's reference section. The research report has also never been submitted to another university.



……

M.B. Nhlapo

February 2022

ACKNOWLEDGEMENTS

I would like to thank:

- Dr. Ian Moll, my supervisor, for his encouragement.
- Family and friends for their inspiration and support.
- Gugulethu, for teaching me how to use modern writing tools.
- the Creator for endowing me with the motivation and tenacity to complete this study.

ABSTRACT

This study investigates how teachers in South African public schools are incorporating information and communication technology (ICTs) into teaching. It is influenced by observations of leading educationists that while technology permeates most dimensions of society its impact on education has had mixed reviews.

The research endeavours to answer the question: *What is the pedagogical value of integrating ICT into teaching practices at South African public schools*? It focuses on two research objectives: how teachers are using ICT in their day-to-day teaching practices and whether enacted practices reflect espoused practices; to understand teachers concerns with ICT and identify areas which require the attention of all stakeholders in the education system.

The research commences with a literature review of how ICT supports theories of learning; epistemological issues for teaching with technology; teacher beliefs as enablers/inhibitors of ICT adoption in education; a change management approach for successful educational reform; and a review of the pedagogical value of ICT.

A mixed-method research methodology is applied in a multi-case study of five ICT using teachers from five public schools. The use of ICT in education is analysed by observing teaching lessons, applying Laurillard (2002) Conversational Framework to classroom interaction, and observing what media forms are used by the teacher to mediate learning. The Concerns Based Adoption Model (CBAM) survey is administered to elicit teacher views and concerns about the introduction of ICT in teaching practices including areas for improvement.

Findings indicate that teacher experience and beliefs, influence the use of ICT in teaching. Adoption concerns are also correlated to teachers' experience and beliefs.

Key Words: ICT Pedagogical Integration, the pedagogical value of ICT, Conversational Framework, media forms, ICT, CBAM, pedagogical tool.

Table of Contents

DECLARATION 3

ACKNOWLEDGEMENTS 4

ABSTRACT 5

List of Tables 9

List of Figures 10

List of Acronyms 11

Definition of Key Terms 13

Chapter 1 15

1. **Background** 17
2. **Problem Statement** 19
3. **Purpose Statement** 20
4. **Research Questions** 20
   - 4.1. Question 20
   - 4.2. Sub-questions 21
5. **Research Assumptions** 21
6. **Outline of the Report** 22

Chapter 2 23

1. **Conceptual Framework** 23
2. **Literature Review** 25
   - 2.1. Theoretical considerations of teaching and learning with ICT 25
   - 2.2. Epistemological issues for teaching with technology 32
   - 2.3. Beliefs and Change Management 48
   - 2.4. Pedagogical Value of ICT 60

Chapter 3 69

1. **Research Philosophy** 71
2. **Research Approach** 72
3. **Methodological Choice – Mixed Methods** 72
4. **Research Strategy** 73

4.1. Overview 73
4.2. Qualitative Case Study Design 74
4.3. Sampling Approach 75
4.2.1. Selection of Schools 75
4.2.2. Selection of Teachers 77
4.2.3. Selection of Grade 79
4.2.4. Selection of Observation Lesson Subjects 79
4.4. Quantitative Survey Design 80
5. Time Horizon 80
6. Data Analysis Techniques and Procedures 81
6.1. Overview 81
6.2. Tools and Analysis Techniques Description 83
6.2.1. Lesson observation approach 83
6.2.2. Semi-structured Interviews 88
6.2.3. Concerns Based Adoption Model – Analytical Tools 88
7. Validity, Reliability and Ethical Considerations 91
7.1. Validity 91
7.2. Reliability 92
7.3. Ethics 93
Chapter 4 96
4.1. ICT Learning Support Tools 96
4.2. Lesson Analysis 102
4.2.1. Teacher T1 - Espoused ICT Integration Practice 102
4.2.2. Teacher T1 - Enacted ICT Integration Practice 103
4.2.3. Teacher T1 - Change Management Issues 107
4.2.4. Teacher T2 - Espoused ICT Integration Practice 109
4.2.5. Teacher T2 - Enacted ICT Integration Practice 109
4.2.6. Teacher T2 - Change Management Issues 115
4.2.7. Teacher T3 - Espoused ICT Integration Practice 116
4.2.8. Teacher T3 - Enacted ICT Integration Practice 116
4.2.9. Teacher T3 - Change Management Issues 119
4.2.10. Teacher T4 - Espoused ICT Integration Practice 120

4.2.11. Teacher T4 - Enacted ICT Integration Practice 120
4.2.12. Teacher T4 - Change Management Issues 125
4.2.13. Teacher T5 - Espoused ICT Integration Practice 126
4.2.14. Teacher 5 - Enacted ICT Integration Practice 127
4.2.15. Teacher T5 - Change Management Issues 131
4.3. Conclusion 132
Chapter 5 133
References 143
Appendix A 153
Appendix C 159
Part A 159
Part B 162
Part C 164
Exhibit 1 167
Exhibit 2 170
Exhibit 3 172

List of Tables

Table 2.1 –Media forms, learning experiences, and delivery methods

Table 2.2 Effective integration of ICT in education

Table 3.1 Observation guide

Table 3.2 ICT engagement form

Table 3.3 SoCQ statements

Table 4.1 Enacted ICT practice of T1

Table 4.2 Enacted ICT practice of T2

Table 4.3 Enacted ICT practice of T3

Table 4.4 Enacted ICT practice of T4

Table 4.5 Enacted ICT practice of T5

Table 5.1 Learning pathway for T1 and T3's lessons

Table 5.2 Learning pathway for T2, T4 and T5's lessons

List of Figures

Figure 2.1 Conceptual Framework

Figure 2.2 Conversational Framework for learning (adapted from Laurillard 2000)

Figure 2.3 Framework for pedagogical practices using ICT

Figure 2.4 Technology mapping model

Figure 2.5 Conversational Framework

Figure 2.6 Conversational Framework for learning (adapted from Laurillard 2000)

Figure 2.7 Educational practice: A conceptual framework

Figure 2.8 PERLS generic pedagogical framework

Figure 2.9 New Pedagogies for deep learning

Figure 3.1 Research process onion

Figure 3.2 Consequence concerns profile

Figure 4.1 Classroom with a smartboard and an interactive whiteboard

Figure 4.2 GDE digital content platform

Figure 4.3 MySDLR menu screen

Figure 4.4 IQ interactive educational platform

Figure 4.5 MyCore Caps Curriculum

Figure 4.6 CBAM profile of T1

Figure 4.7 CBAM profile of T2

Figure 4.8 CBAM profile of T3

Figure 4.9 CBAM profile of T4

Figure 4.10 CBAM profile of T5

Figure 5.1 Summarised Teacher profiles

Figure 5.2 Inexperienced ICT using teacher's profiles

Figure 5.3 Experienced ICT using teacher's profiles

Figure 5.4 Change Frame for developing competence in digital integration in teaching and learning

List of Acronyms

Acronym	Description
AISI	African Information Society Initiative
CAPS	Curriculum Assessment Policy Statement
CD	Compact Disc
CBAM	Concern Based Adoption Model
CDROM	Compact Disc, Read Only Memory
COL	Commonwealth of Learning
CF	Conversational Framework
DVD	Digital Video Desk
DBE	Department of Basic Education
GDE	Gauteng Department of Education
ICT4D	Information and Communication for Development
ICTs	Information and Communications Technologies
ISAD	Information Society and Development
NCS	National Curriculum Statement
NECT	National Education Collaboration Trust
OECD	Organisation for Economic Cooperation and Development
PCK	Pedagogical Content Knowledge
PTD	Professional Teacher Development
PRA	Pedagogical Reasoning and Action
TM	Technology Mapping
TCK	Technological Content Knowledge
TPK	Technological Pedagogical Knowledge
TPCK	Technological Pedagogical Content Knowledge
TPACK	Technological Pedagogical and Content Knowledge
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNESCO ICT-CFT	UNESCO – Information and Communication Technology Competency Framework for Teachers
SoCQ	Stages of Concern Questionnaire
Wi-Fi	Local area wireless computer networking

Definition of Key Terms

Key Term	Description
Asynchronous social media communication	Communication between two people where there is a time lag between responses.
Change Management	Ways in which an organisation defines and implements change within its processes.
Cognitive tools	Cognitive tools are educational technologies that assist students in learning by allowing them to think more deeply about a topic or perform better than they would otherwise.
COVID-19	SARS-CoV-2 is an infectious disease caused by the SARS virus.
Espoused practice	Intentions, beliefs, and attitudes of teachers
Enacted practice	Actual instructional approach of the teacher
Hypermedia	A non-linear medium of information access via hyperlinks.
Hyperlink	A hypertext document link that is activated by clicking on a highlighted word or image.
ICT affordances	Perceived and real capabilities of ICT
ICT pedagogical integration	The utilisation of ICT in teaching and learning
Interactive whiteboard	A digital gadget that lets users project files onto a board's surface and manipulate them.
Intelligent Tutoring System	Computer software that provides immediate instruction or feedback to learners
Media	Tools used to present content
Media forms	Categorisation of media by Laurillard (2002)
National Development Plan	A long-term government economic plan, aimed at unlocking a country's potential in all sectors of the

	economy for a sustainable, holistic, and inclusive national development.
Teleconference	A meeting with participants in different locations linked by telecommunication devices.
Video Conference	A conference technology in which the audience in different locations can communicate with each other in sound and vision.
Web 2.0 ICT tools	The second stage of the internet, marked by the transition from static to dynamic web sites and the advent of social media.

Chapter 1

Introduction

The basic education curriculum in South Africa has been altered multiple times since the country's democratic transition. Chisholm (2005) describes the first revision as the “cleansing” of the curriculum in the aftermath of the first democratic elections in 1994. In 1997 Curriculum 2005 was introduced as the second revision to the curriculum. The third revision was the creation of the Revised National Curriculum Statement. The fourth review saw the introduction of the National Curriculum and Assessment Policy Statement.

Given the plethora of changes to the curricula, it is not surprising that basic education is said to be in crisis (Taylor & Vinjevold, 1999; Jansen, 1997; Jansen & Blank, 2014; Christie, 2008; Wright, 2012; van der Berg et al., 2011; Spaull, 2013). Why has education in South Africa not produced the desired outcomes? did policymakers prioritise the wrong areas of education reform? According to Kozma (2008) for a country to advance its education through what he calls the “knowledge ladder”, it must undertake a detailed review of the levers of development in the areas of education policy, curriculum, ICT, pedagogy, school organisation and the professional development of teachers. Each one of these areas requires a co-ordinated and incremental approach to reform. There is no doubt that a break with the past required a comprehensive transformation of the pre-1994 education system. Guiding principles for post-1994 policy changes can be summarised as:

> “set out a vision of what an ideal education system might look like in South Africa, based on two main sets of principles: equality and human rights on the one hand, and human resource development on the other” (Christie, 2008, pg. 132).

Further research into the effects of the post-1994 education system overhaul indicates that:

> “The policies could not be implemented as envisaged. They were formulated in terms of what would be ideal, rather than in terms of changing what existed. They emphasised structural design, without giving sufficient attention to implementation and the support that might be required in different contexts” (Christie, 2008, pg. 133).

It was a case of putting too much focus on form rather than substance. Besides changes in policy in post-apartheid South Africa, at the turn of the 20th century, South Africa had to contend with Globalisation and the Information Age. The world experienced what Held et al. (1999) describe as a "global shift moulded by economic and technological forces, into a shared economic and political arena". Societies began to reorganise themselves into what Castells (1999) calls "networked societies", where links were created according to dominant values and interests while disconnecting with everything that is not valuable. This "shift" was also experienced in education albeit of a different kind. Schools in OECD[1] countries had to deal with the first generation of what Prensky (2001) calls "digital natives". According to Prensky (2001) teachers are now faced with the challenge of coming up with instructional practices that appeal to parallel processing, random-accessing, fantasy-focused, and connected group of learners. South Africa could not be oblivious to the global transformation of society and risk being left out of the "network". According to Isaacs (2007), Mr Thabo Mbeki, the then deputy president of South Africa, sponsored the Information Society and Development (ISAD) conference. It gave rise to the African Information Society Initiative (AISI and was later sponsored by the United Nations Economic Commission for Africa (UNECA). This marked the beginning of the focus on ICT by the government in its national strategy for development. In education, the Department of Education released an e-Education White Paper in 2004[2] which set a target for basic education learners to be ICT literate by 2013.

This research seeks to reflect on the status quo, lessons learnt and the strategic direction we ought to follow if we are to achieve targets for ICT as defined in the e-Education White Paper of 2004.

[1] a unique platform where the governments of 34 democracies collaborate with each other and over 70 non-member economies to achieve economic growth and long-term development.

[2] Department of Education, (2004). *White Paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs).* Government Gazette. No. 26734, South Africa

1. Background

In education, ICT is seen as a tool to promote the shift from instructor-centred to learner-centred pedagogical approaches (Koh & Lee, 2008). Sanders and George (2017) observe three justifications for ICT in education. First, is the vocational justification, where schools are expected to prepare learners for the workplace. The president of South Africa, President Cyril Ramaphosa, confirmed this belief when he announced that:

> "in line with our Framework for Skills for a Changing World, we are expanding the training of both educators and learners to respond to emerging technologies, including the internet of things, robotics and artificial intelligence"[3].

Second, is the societal justification founded on the belief that education should be provided through schools which prepare learners for social independence in the 21st-century world "often characterised by the acronym VUCA – volatile, uncertain, complex and ambiguous"[4]. To affirm this belief, the Minister of Basic Education in an address where she released the 2018 Grade 12 results made this remark:

> "the Brookings Institute in Washington DC, one of the leading think-tanks in the world, found that embedded in the CAPS curriculum, are skills and competencies for a changing world. Such skills and competencies include but are not limited to critical thinking and problem solving, creativity and innovation, collaboration and teamwork, communication and information literacy, as well as social justice and human rights[5]."

Third, is the pedagogical justification associated with affordances of technology (Conole & Dyke, 2004), the belief that ICT will lead to engaged and motivated learners, and that learning would be revolutionised.

[3] The State of the Nation Address of February 2019 https://www.gov.za/speeches/president-cyril-ramaphosa-2019-state-nation-address-7-feb-2019-0000

[4] An extract from an article titled "Industry 4.0. is being taken seriously" an article which appeared in the Mail & Guardian of January 18 to 24 2019 on pg.31 written by Professor Sarah Gravett, executive dean of the University of Johannesburg's faculty of education.

[5] Keynote Address by the Minister of Basic Education, Mrs Angie Motshekga, MP, delivered at the Release of 2018 NSC Examination Results. https://www.education.gov.za/Newsroom/Speeches/tabid/950/ctl/Details/mid/8127/ItemID/5972/Default.aspx

The envisaged benefits of ICT have yet to be realised and have resulted in what Sanders and George (2017) refer to as the "rhetoric-reality" gap. This gap is the result of barriers such as ineffective usage of ICT in education (Padayachee, 2017; Pelgrum, 2001; Hew & Brush, 2006; Snoeyink & Ertmer, 2001; BECTA, 2004; Hennessy et al, 2010), fear of technology and rejection by teachers (Bitner & Bitner, 2002; Cuban, 1986, 1996), teacher's beliefs (Ertmer, 1999, 2005; Windschitl & Sahl, 2002) and incorrect conceptualisation of computers as a resource for teaching (Crook, 1994). Sanders and George (2017) observe that the rhetoric-reality gap problem persists despite the profusion of research-based and opinion-based literature on ICT in education.

The DBE (2015) acknowledges challenges with the adoption of ICT in schools when it indicates that:

> "This is an inherently difficult area……. The area is a difficult one because the evidence is not very clear on, for instance, what information and communications technology (ICT) investments are best for improving learning and teaching" (Department of Basic Education, 2015, pg. 16).

In other words: *what is the pedagogical value of ICT in education?* This is the key question of this research. According to the research findings, for teachers to see the value in incorporating ICT into their classroom practices, they must understand that technology is a medium that can alter how learning occurs rather than alter learning itself (Saljö, 2010, cited in Sanders & George, 2017). Therefore, pedagogy and the role of teachers remain a critical success factor for teaching and learning with ICT. The "pedagogical value" issue raises questions on whether there is a need for a "new pedagogy" emanating from the introduction of ICT, a position held by several researchers in the field of education (Fullan & Langworthy, 2014; Somekh, 2007) or whether teaching and learning remain a fundamentally "rhetorical activity, seeking to persuade students to change the way they experience the world through an understanding of the insights of others" (Laurillard, 2002, pg. 23).

This research supports both views. It recognises the potential for modern technology to support the traditional role of teachers as facilitators of knowledge acquisition as well as the emerging role of teachers as activators (or change agents) of knowledge where learners oversee their learning enabled by Web 2.0 ICT tools under the active guidance of teachers (Fullan & Donnelly, 2013).

The research also recognises that for benefits of ICT to be realised, adoption should be facilitated through a system-wide change implementation approach. Such an initiative represents a change to established teaching practices and it is likely to threaten teachers' comfort zone with the status quo that has been

passed on from previous generations of teachers. A natural response to a threat is to act in a manner that protects self-interest and create barriers to change. Hence the study proposes that key stakeholders in education (education departments, district offices, principals, subject leaders, etc) should adopt a comprehensive Change Management approach to reduce teachers' resistance to change.

2. Problem Statement

South African studies on ICT in education have looked at adoption issues (both access and usage), policy alignment and implementation issues, and teacher training issues. Ndlovu (2015) observed that research on ICT integration in South Africa and globally, does not give a clear account about how teachers employ ICT in their teaching. Objectives of this study are the same as those in Ndlovu (2015) which investigated the teaching practices of seven secondary school teachers in Soweto. Through a multi-case study account of how teachers utilize ICT in teaching practices, the study aims to investigate the pedagogical value in teachers' use of ICTs.

The study recognises that the benefits and challenges of ICT integration should be viewed from the teacher's perspective hence it uses the Stages of Concerns Questionnaire of the Concern Based Adoption Model (CBAM) framework to highlight teacher's adoption issues.

An understanding of current classroom practices should assist the DBE in structuring interventions to address ICT integration issues.

3. Purpose Statement

This multi-case study research will observe classroom interactions of teachers at five public schools who claim that they have been able to change their teaching practices to include teaching with ICT. The study seeks to understand ***how*** ICT is used in the classroom and ***what*** do the teachers deem as the pedagogical value of using ICT in their lessons and **what** concerns do they have with the use of ICT in classroom practices. Alignment between teachers espoused and enacted ICT practices is analysed to understand barriers to effective ICT integration. The study uses Laurillard (2002) Conversational Framework as an instrument for accessing teacher and learner classroom interactions.

Learnings from this research could be used to further enrich the body of knowledge of how ICT is used by teachers in under-resourced public schools. Outcomes of the study could also be used to identify areas for further improvement in teacher professional development to maximise the benefits of teaching with ICT.

Feedback obtained from teacher interviews using the CBAM Stages of Concern framework could be used as a justification for a longitudinal study on teachers' concerns about the use of ICT in schools.

4. Research Questions

The research problem that the researcher is addressing through this study is the need to know more about how teachers from under-resourced public schools use ICT in their classroom practices. Research questions are intended to unpack the research problem as well as the purpose statements. They are also used to provide coherence and structure to the research report.

4.1. Question

What is of pedagogical value in the use of ICT in the classroom practices of teachers at five South African public schools?

4.2. Sub-questions

a) What is deemed by teachers to be of pedagogical value in the use of ICT in the classroom and what concerns do they have with the use of ICT in classroom practices?
b) To what extent are teachers' espoused practices reflected in their enacted practices?

5. Research Assumptions

The research is conducted with teachers from five public schools in the Tshwane districts of the Gauteng Department of Education in South Africa. These schools are “exposed sites”:

> “In these schools, there are high concentrations of learners who struggle with the curriculum. It is not a cultural advantage that is pooled at these sites, but multiple disadvantages - poor language skills, fragmented family lives, poverty, low levels of parental education, lack of facilities, leisure that is distracting rather than supportive of the school. These are indeed "exposed sites" in which effective learning depends largely on the capacity of teachers to make up for the gap between what the academic curriculum assumes about students and who students really are”
> (Teese & Polesel, 2003, pg. 123).

The National Planning Commission (2011) published a National Development Plan, a 2030 vision for a transformed South Africa, which acknowledges that even though positive changes have been achieved in the education sector since 1994, low-quality education in historically disadvantaged schools persists. It attributes the current situation to weak capacity throughout the civil service. Other challenges such as school infrastructure, curriculum changes, low enrolment levels and poor performance in international studies that measure learners' numeracy and literacy skills at basic education levels, have also been cited. However, strengthening the human capital (administrative and teaching) at the school level will go a long way towards addressing quality issues. Hence the study is focusing on teachers' understanding and appreciation of the pedagogical value of ICT in classroom practices.

6. Outline of the Report

This section covers an outline of research topics covered in the report.

Chapter 1: Introduction

This chapter presents the rationale for introducing educational technology in South Africa. It provides context by looking at progress to date concerning ICT integration in classroom practices of teachers.

Chapter 2: Literature Review and Theoretical Perspectives

This chapter reviews key concepts used in the research, which are framed through a Conceptual Framework.

Chapter 3: Methodology and Research Approach

The research approach and methods for the study are presented. In this chapter, the rationale for the research design is explained in detail.

Chapter 4: Data Collection and Analysis

Data from teachers' pedagogical practices are analysed using the analytic framework for the study. The objective of analysing the data is to understand how teachers are using ICT in their classroom practices and to understand the pedagogical value of using ICT.

Chapter 5: Research Findings and Conclusion

Findings of what was observed in the multi-case study are interpreted using the induction analysis technique. Conclusions are drawn and the knowledge contribution that this study makes to theory and concepts relating to ICT in education is presented.

Chapter 2

Literature Review and Theoretical Perspectives

This chapter is organised into two parts. In part one, a high-level description of the conceptual framework as depicted in Figure 2.1 is presented. The conceptual framework is intended to show key concepts and theories used in the study, and identify relationships between the concepts (Badenhorst, 2007). Part two focuses on the literature review of key concepts and theories that constitute the conceptual framework. The literature review in this report serves the purpose of generativity as defined by Shulman (cited in Ravith & Riggan, 2017) that generativity is a way in which researchers make meaning of prior research to situate their work in a pre-existing milieu.

1. Conceptual Framework

In answering the research question on *What is of pedagogical value in the use of ICT in the classroom practices of teachers at five South African public schools* the research study considers four concepts: a pedagogy framework of how to make learning with ICT possible; a change management framework to alleviate resistance to change whilst facilitating the adoption of ICT in classroom practices; the "knowing-doing problem" to explain the relationship between espoused and enacted ICT practices of teachers; and a conceptual overview of the pedagogical value of ICT in education.

The pedagogical framework considers two teaching and learning concepts. First, is the Conversational Framework, a framework of pedagogy that informs teaching strategies, teacher and learner interaction, teacher judgments and decisions, and how to use ICT in learning. Second, the concept of mediated learning as proposed by Vygotsky and Feuerstein, is considered to emphasise the importance of a teacher's mediation role in teaching and the use of ICT as a mediating tool for learning.

Fullan's principles for successful system-wide education reform and the CBAM model, are used as frameworks for analysing educational reform and the impact of change on the individual. Theories of teacher beliefs and conceptual change are analysed to understand the espoused and enacted ICT practices of teachers.

To comprehend the pedagogical usefulness of ICT, the idea of affordances proposed by Conole and Dyke, as well as the impact of ICT on educational practices proposed by Alexandra, are examined.

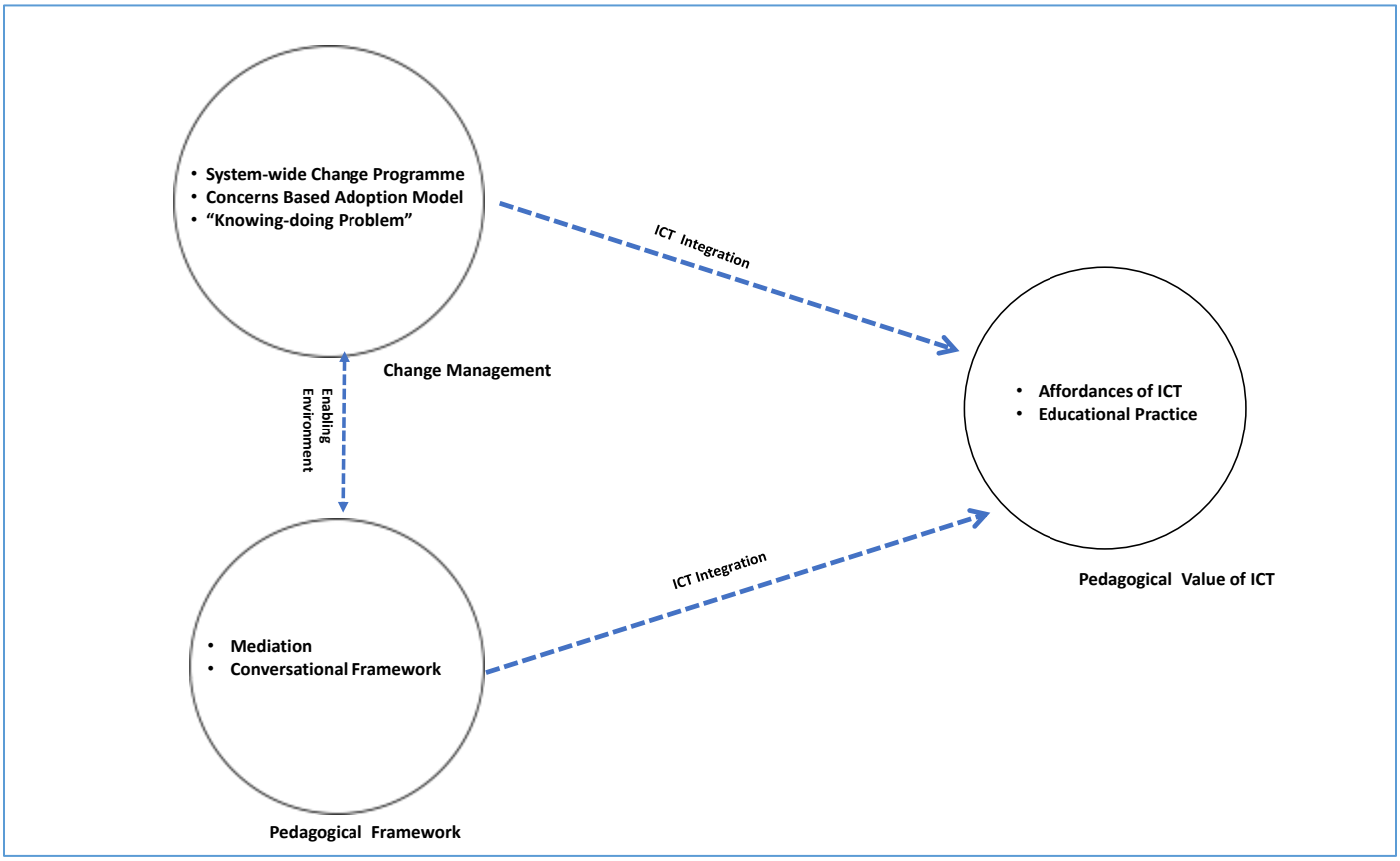


Figure 2.1: Conceptual framework

2. Literature Review

An in-depth review of literature on educational ICT is presented in four sections:

- a review of how ICT supports theories of learning. The objective is to identify a learning theory that provides the best justification for using ICT in education.
- a review of epistemological issues for teaching with technology.
- a review of teacher beliefs, how they affect ICT uptake in education, as well as the change management approach for successful education reform.
- a review of affordances of ICT and the impact of ICT on pedagogy.

2.1. Theoretical considerations of teaching and learning with ICT

2.1.1. ICT and theories of cognition and learning

Crook (1994) observes that the deployment of ICT in education does not seem to have been influenced by specific theories of cognition and learning. He argues that this could be influenced by the multi-faceted nature of information technology (learners can use computers for numerical calculations, playing games, word processing, programming, communication, simulation, etc). Crook (1994) argues for an overarching theoretical perspective to justify the role of technology in education.

The use of machines in education was first proposed by Skinner in support of the behaviourist learning theory when he suggested that in instances where a series of contingencies is necessary to take the organism to the final desired behaviour, it may be necessary to use mechanical and electrical devices (Skinner, 1954). These machines should break down the process of becoming competent in any field into manageable phases, with reinforcement based on each step's completion. Skinner's proposal resulted in the adoption of programmed instruction (auto-instruction) as a model for ICT usage in education. However, several researchers raised concerns about the application of auto-instruction in education. Cooper (1993) argues that programmed instruction is constructed as a behavioural objective with test that are referenced on criteria as a means of assessing performance, which leads to a concentration on the required performance whilst eliminating knowledge acquisition. The fact that a learner remembers a concept that is referenced in the programmed instruction does not imply that they understand it, hence the argument that programmed instruction does not guarantee knowledge acquisition. Unfortunately,

referenced tests are required to ensure that the programmed instruction is "error-free" and will achieve the behavioural objectives on 90% of learners that are exposed to it, whilst sacrificing deep subject matter insights. Programmed instruction is seen as an automated learning tool that perpetuates traditional rote learning approaches often associated with the behaviourist learning theory.

Following Chomsky's critique of Skinner's behaviourist theory, interest shifted to psychology's advances in cognitive psychology. Chomsky's key criticisms of the behaviourist theory are that it does not provide evidence that behaviour is a function of environmental factors or genetic conditions. It proposes a "black box" approach where behaviour is a function of a stimulus and a corresponding response (Chomsky, 1959,1971). As cognitive psychology became popular and applied in education, it had to encompass the need to recognise the individual differences of learners, rather than treating them as a homogeneous group which had to be taken through sequenced instructions. Programmed instruction evolved into intelligent tutoring systems (ITS) and included functions such as a storage of correct responses with which learner answers are compared; a learner module which represents errors or misconceptions that occur when a learner is presented with new content; and a pedagogy module, which evaluates what is known about the learner and his/her responses and makes decisions about how information is to be presented to the learner. According to Copper (1993), intelligent tutoring systems are a complex attempt at recognising individual learner differences however they have not been successfully applied in education. ITS relies on the individualisation of the curriculum to a learner's needs, which can only be achieved using complex algorithms that can diagnose a pupil's particular errors and needs (Crook, 1994), thus making the provisioning of such applications unaffordable for an average school.

Education has not only been influenced by cognitive psychology but also development psychology through the work of Piaget. Cognitive development for Piaget is captured in the term "constructivism" where children are actively "constructing" their understanding of the world (Crook, 1994). According to Cooper (1993), the constructivist view of the mind is that of a creator of symbols required to represent the knower's reality. Therefore, to constructivists, reality is personally constructed, and personal experience determines reality. By extension, learning is problem-solving based on personal discovery. Jonassen (1991) notes that instructional goals in computers that support a constructivist approach to learning require negotiated rather than set instructional goals, with no one best way of sequencing instruction. According to Jonassen (1991) the goal of instructional systems would then concern itself with developing "mental construction toolkits" inside learning environments that facilitate knowledge construction. The

development of this "mental construction toolkit" is a challenge for instructional designers of computer-mediated lessons. According to Karagiorgi and Symeou (2005), the major issue is the pre-specification of knowledge. Entry-level skills, efficiency and certifying learner competency levels are not a concern for constructivist. Evaluation in instructional design is another challenging area associated with constructivism. Setting standards to evaluate learning outcomes that are individually developed is difficult. According to Wilson et al. (cited in Karagiorgi & Symeou, 2005) the fact that constructivism is an underlying philosophy of knowing rather than a learning approach causes problems in instructional design.

According to Karagiorgi and Symeou (2005), there are generally two loosely associated groups of constructivists: the radical constructivists and the social constructivists. For social constructivists, knowledge is feasible not only personally, but also in social contexts. Social constructivism is influenced by Vygotsky's work which gained prominence in the 1990s and was spurred on by the discovery of the internet. The internet led to a swell in educational software and online learning became the focus of schools, supposedly in line with the constructivist doctrine (Romeo, 2008). Crook (1994) claims that socio-cultural thinking frames learning as a social experience and supports the evaluation of all new educational materials in terms of their potential to increase interpersonal learning situations. This is because education is a social system whose goal is to transfer knowledge and skills, as well as to socialise children and adolescents into the perspectives, values, and attributes they need to function effectively in society. It also aims to facilitate each learner's cognitive, social, and physical development (Johnson,1981). Crook (1994) places a lot of hope on the socio-cultural theory as a theoretical framework for assessing computers in all spheres of education. Its grounding in culture supports human action comprising of objects, societies and rituals that have acquired their current nature during a long history of development means that cognitive activity captures and expresses the "thinker's" interaction with culture (Crook,1994). Hence it offers a good theoretical framework for assessing computers as a new mediating tool in education and its impact on cognitive activity.

2.1.2. Mediation – A central concept of sociocultural theory

The concept of mediation is central to socio-cultural psychology. The teaching profession and approaches to learner instruction and pedagogy have been profoundly influenced by Vygotsky's theories of mediated activity and Feuerstein's concept of mediated learning experience (Kozulin & Presseisen, 1992). Higher mental processes might be thought of as functions of mediated activity, according to Vygotsky (cited in

Kozulin & Presseisen, 1992). Three types of mediators were presented by Vygotsky. First, physical tools that have an indirect impact on psychological processes in humans. Human cognition is influenced by the use and evolution of tool-mediated activity from a primitive to a more advanced form. Second, psychological tools are non-physical symbolic mediators such as language and cultural symbolic systems from various periods and countries that humans utilise to mediate psychological activities like remembering, counting, and problem-solving. Third, mediation through another individual in a form of inter-psychological interaction and intra-psychological interaction. The question to ask at this point is: *what is the impact of the socio-cultural theory on cognitive development and education, in a world that is dominated by new mediational tools such as computers?* Before answering this question, Feuerstein theory of mediated learning experience requires consideration. According to Feuerstein (cited in Kozulin & Presseisen, 1992), a mediated learning experience is an interaction between human beings and the socio-cultural environment which influence an individual's "propensity to learn". Feuerstein is trying to answer the question on "the cause of differential cognitive development". His theory is influenced by his observation that given the same stimulus, different learners can show considerable variation in how they respond to instruction which led him to conclude that in every quality mediated learning experience there is modifiability and diversity which contribute to learner's cognitive plasticity and flexibility (Kozulin & Presseisen, 1992). Note that Feuerstein refers to the "quality" of mediated learning experience to emphasise that not all mediated interactions lead to learning. For learning to occur Feuerstein defined two sets of criteria, namely the universal criteria that should be present in every learning experience. These include intentionality and reciprocity mediation, transcendence mediation, and meaning mediation. He also proposed situationally determined criteria varying according to societal, environmental, and cultural factors e.g., mediation of the feeling of belonging, the search for novelty and complexity, etc.

For purposes of this multi-case study report, the focus is on the universal criteria for mediation. According to Kozulin and Presseisen (1992), intentionality turns an interaction from a random, incidental experience to one that is intentional. This multi-case study report adopts Laurillard (2002) Conversional Framework, depicted in figure 2.2 below, as the pedagogical framework for analysing teachers and learner interactions where ICT is used.

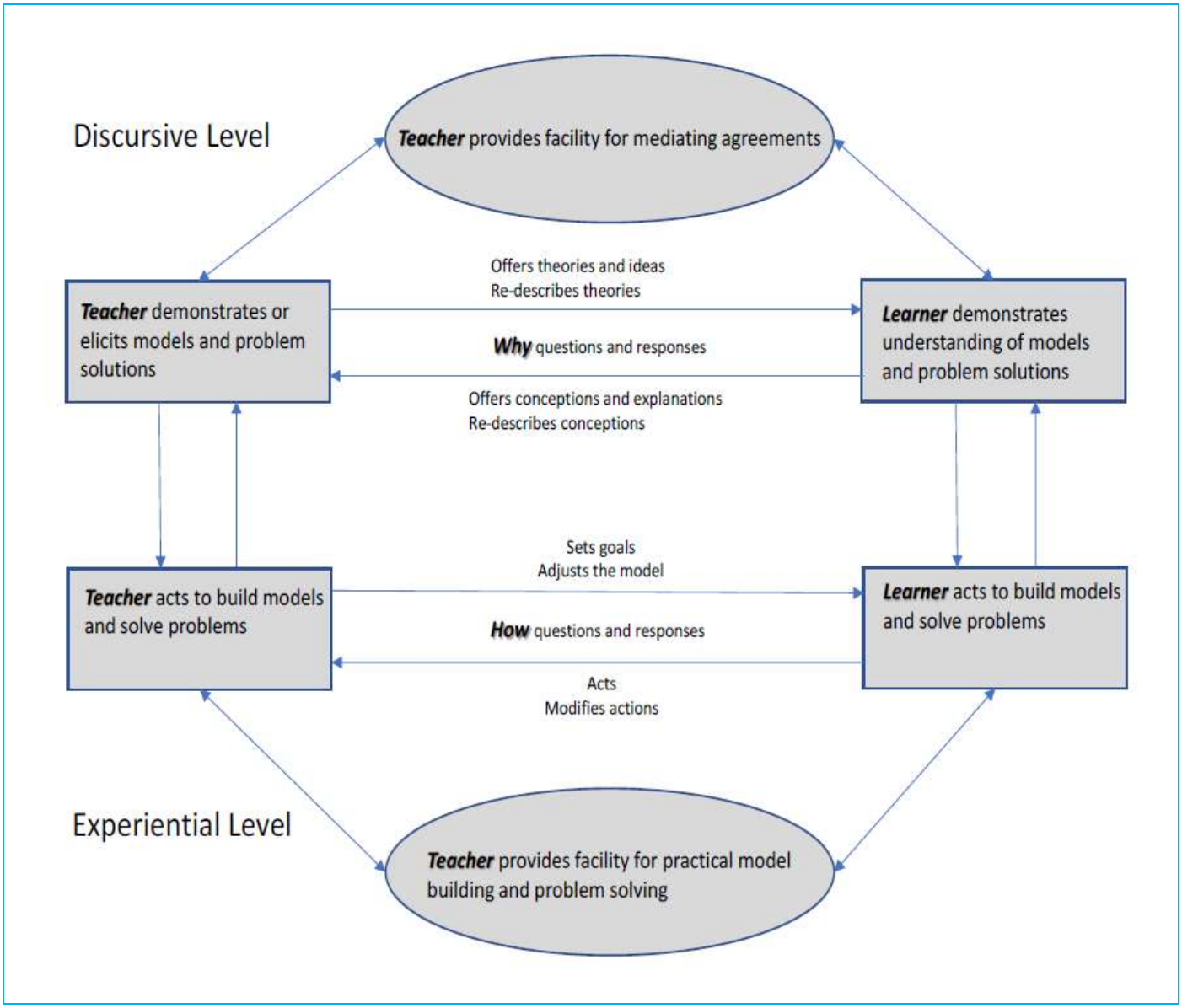


Figure 2.2 - Conversational Framework for Learning (adapted from Laurillard, 2002)

Source (Sharpes et al, 2007)

The framework's discursive level addresses the *Why* issues that arise during teacher-student interactions. The objective is to ensure that learners understand what the teacher aims to achieve in the lesson, thus aligning with Feuerstein concept of intentionality. For Feuerstein, reciprocity underlines the fact that the main target of mediation is the child's cognitive processes and not the mediation object (Kozulin & Presseisen, 1992). The adult/teacher demonstrates to the child that his/her answer is what matters by repeatedly concentrating on the learner's state of attention, learning tactics, and even mistakes that

he/she is making (Kozulin & Presseisen, 1992). As the reciprocity process progresses, mediated learning becomes a "two-way street," expressed as the convergence of understanding that a teacher would strive for at the Conversational Framework's discursive level.

Mediation of transcendence is about going beyond the goals of an interaction. Kozulin and Presseisen (1992) illustrate transcendence with an example of a child pointing to a fruit and asking what it is. Providing the label name of the fruit would be an unmediated response. A transcendent interaction would provide a broader definition, one that suggests category classification, such as the fruit having health advantages, a distinct taste and scent, and so on. Transcendence is an integral aspect of the experiential level of the Conversational Framework, where a teacher enhances a learner's understanding using authentic examples and sometimes mediated using tools such as the computer.

Mediation of meaning, according to Feurenstein (cited in Kozulin & Presseisen, 1992), is concerned with the "why," "what for," and other reasons for anything to happen or be done. The interaction between a child and a parent begins with a parent's excitement and encouragement expressed through gestures. The infant gradually internalises these linguistic exchanges and develops a "orientation" toward the search for meaning. Meaning mediation is most common at the discursive level of the Conversational Framework.

Feuerstein captured his ideas on the quality of mediated learning experience by designing the Instrumental Enrichment program, a tool for enhancing analytic capabilities in learners. As in Vygotsky's sociocultural theory, the use of tools is embedded in the scaffolding of learning, highlighting the importance of internalisation of ability through mediation (Kozulin & Presseisen, 1992). At this point, it is worth revisiting the earlier question on the impact of the socio-cultural theory on cognitive development and education in a world that is dominated by new mediational tools is such as computers, which should help answer the question on the pedagogical value in the use of ICT in the teaching and learning practices.

2.1.3. Implication for cognitive development and use of computers in education

To conceptualise the process underpinning the impact of computers on the individual cognition of learners, Crook (1994) uses Bruner's cognitive amplification to characterise the effect of contact with some mediational means when he comments:

> "Man is seen to grow by the process of internalising the ways of acting, imagining, and symbolising that exist in his culture, ways that amplify his powers" (Bruner, 1966, p. 320, cited in Crook, 1994).

Familiar technologies such as household utensils are said to enhance action and the symbolic equivalents internalised and then used to support cognitive development. Therefore, the amplifier model assumes that cultures extend their cognitive capabilities as the collection of mediational means grows to include resources such as computer-based resources. The amplification typically manifests in increased productivity, improved and better ways of accomplishing tasks and general growth of civilisation. According to Crook (1994), the amplifier metaphor focuses on “quantitative change” and has been advocated by many researchers starting with the work of Luria (cited in Crook, 1994) who reported an early justification of this metaphor. Working closely with Vygotsky, Luria studied the impact of literacy on traditional communities in Uzbekistan, after the revolution in Soviet society. Luria observed heightened cognitive impact because of access to literacy for people in Uzbekistan.

Cole and Griffin (cited in Crook, 1994) argue that there is more to cognitive development than progression which is amplified by a mere rich and varied supply of mediation technologies. They argue that the effect of adopting new mediational tools leads to the reorganisation of functional systems of cognitive activity. To illustrate their argument, they use the example of hunting. If one considers “killing” as a functional system of the activity of hunting, the “killing power” can be extended if a hunter uses a gun i.e., the products of the killing activity are increased when a gun is used. The amplification occurs when the gun is in the hunter’s hand and fired in a particular manner. As a result, the gun's effect is understood through its ability to reorganize the killing action, rather than in terms of extending a general-purpose killing power. There are many examples in everyday life where mediational means into an activity serves to reconfigure how it is carried out e.g., re-mediation of information storage using a computer. The issue of situatedness and localisation is often raised concerning the reorganisation of functional systems of cognitive activity. Cole and Scribner (cited in Crook, 1994) propose a concept of “literate practice”. They argue that the consequence of becoming literate in a practice is visible when reproducing a specific core activity that literate cultures in that practice would typically display. Their position is influenced by their study of the consequences of literacy amongst the people of Liberia. They discovered no evidence that their literacy exposure resulted in a cognitive benefit. Their conclusion differs with Luria’s account of the impact of literacy on the people of Uzbekistan. However, an analysis of specific literate practices that the people of Liberia were able to develop using their newly acquired literacy skills as a mediation tool would yield a different outcome.

It follows from this discussion that in the realm of problem-solving especially in subjects such as mathematics, computers can be used as "cognitive tools". Through computers, activities involved in problem-solving can be reorganised or remediated, leading to a situation where learners are learning "with" computers. However, re-mediation typically occurs in an environment that is conducive for learning and integrated with appropriate content and pedagogical approaches (Crook, 1994).

2.1.4. Conclusion

> *"Pupils should encounter computers as mediational resources incorporated within suitably rich settings of activity; that is, settings with authentic goals and purposes for those pupils, and settings that are explicitly integrated with other experiences of knowing and understanding as they get organised at other times*" (Crook, 1994, pg. 63)

Computers are multi-faceted and ubiquitous tools that are used in all aspects of human activity (personal uses, public and private sector organisational uses, industrial uses, etc). In education, the use of ICT does not seem to have a firm theoretical grounding, hence the ongoing tension about its impact on learner attainment. The sociocultural theory of learning also referred to as socio-cultural constructivism, provides the best theoretical basis for explaining the impact of ICT as a mediational resource on the cognitive development of learners, thus making it possible to learn "with" computers (Crook, 1994). However, the mere presence and use of the computers in a classroom practice will not necessarily result in a mediated learning experience unless technology, content, and pedagogy are properly integrated into an appropriate learning context and environment (Feurenstein, 1991, cited in Kozulin & Presseisen, 1992).

2.2. Epistemological issues for teaching with technology

This section is presented in four parts:

- a section that examines the information that teachers must have to embed ICT into their teaching. Concepts such as Pedagogical Content knowledge (PCK); Technological Pedagogical Content Knowledge (TPCK); ICT-TPCK and ideas on how to bridge the ICT skills gap are explored.
- a review of instructional planning and design as a manifestation of espoused practices. The Pedagogical Reasoning and Action (PRA) model is reviewed; modifications to the PRA to

accommodate 21st-century learning theories; affordances; and teacher beliefs, are also considered. An analysis of the Technology Mapping model as an example of a situated instructional planning and design approach which integrates ICT tool affordances, content, learner knowledge, teacher beliefs, and pedagogy is discussed.

- a review of the Conversational Framework as a framework for assessing enacted teacher practices where different digital media forms of ICT are used in classroom practices.
- concluding remarks.

2.2.1. Teaching with technology: what teachers ought to know

In his review of tests that were administered to assess teacher knowledge in 19th century North America, Shulman (1986) observed that focus was on content knowledge with pedagogical knowledge playing a secondary role. In the mid-20th century, there was a shift towards processes and procedures of lesson preparation, assessment, cultural awareness, management, understanding of student learning, and understanding of education policies i.e., the focus was on teachers' capacity to teach and pedagogy. The subject matter or content focus disappeared resulting in what Shulman calls the "missing paradigm" problem. In addressing the "missing paradigm" issue, Shulman (1986) proposes a framework for teacher knowledge which ensures that content and pedagogy are not seen as separate but integrated to answer questions such as:

> "What are the domains and categories of content knowledge in the minds of teachers? How, for example, are content knowledge and general pedagogical knowledge related? In which forms are the domains and categories of knowledge represented in the minds of teachers?" (Shulman, 1986, p. 9)

Pedagogical content knowledge, subject matter content knowledge, and curricular knowledge are the three categories of content knowledge proposed by Shulman's framework. PCK is defined by Shulman as a method of expressing and structuring a subject to make it understandable to others. It also includes the teacher's understanding of what makes learning specific topics simple or difficult for learners. It includes strategies to reorganise learners' understanding, in the case of misconceptions.

There is no universally accepted conceptualisation of PCK. Different scholars (Grossman, 1990; Morine-Dershimer & Kent, 1999; Carlsen, 1999; Driel, Verloop & Vos, 1998; Gudmundsdottir & Shulman, 1987; Tamir, 1988; Marks, 1990; Magnusson, Krajcik & Borko, 1999; Cochran, Derutier, & King, 1993; cited in

Karaman, 2012) have added additional components to the initial PCK model as proposed by Shulman (1986). All scholars agree that teachers' knowledge of representations of the subject matter, as well as knowledge of learner conceptions and content-related challenges, should be included in the construct of PCK. They also agree that PCK is distinct from common pedagogical knowledge. It is primarily concerned with the instruction of specific subjects. There is also consensus that PCK is profoundly anchored in classroom practices, i.e., it is situated in classroom practices and grows over time as new teaching experiences are gained (Angeli & Valanides, 2009; Putman & Borko, 2000).

In the 1980s the use of computers in North American classrooms was already widespread. It increased exponentially with the invention of server computers and the internet. Using Sachs (cited in Kozma, 2008) economic development ladder model, the United States of America's economy had become what Sachs refers to as the technology-based economy (often referred to as the information economy or knowledge society). According to Kozma (2008) in such an economy the use of ICT is much deeper than its everyday use as a learning support tool or information presentation tool. It is used for knowledge generation, critical thinking skill development, and promote interaction among knowledge communities that transcend time and space (2008, Kozma).

Even though Shulman (1986) proposed his framework during a period of heightened usage of ICT in North American schools, he did not recognise the role of ICT in his theoretical framework of teacher knowledge. It is this gap that Mishra and Koehler (2006) addressed when they conceptualised the TPCK framework, a teacher knowledge framework for technology integration in classroom practices. It builds on Shulman's pedagogical content knowledge framework to include information technology. It recognises challenges that teachers face in integrating ICT in classroom practices because:

> "By their very nature, newer digital technologies, which are protean, unstable, and opaque, present new challenges to teachers who are struggling to use more technology in their instruction" (Koehler et al, 2013, p. 13).

Other researchers such as (Angeli & Valanides, 2009; Angeli et al, 2016; Kimmons, 2015; Graham, 2011) have raised concerns with Mishra and Koehler (2006) conceptualisation of TPCK. They argue its precision should not be in doubt. Some of their concerns include:

- Clarification on whether TPCK is a different type of knowledge. Whether growth might refer to any of the constructs (i.e., PCK, TCK, TPK).
- The boundaries between components such as TCK and TPK are not clear.
- The role of ICT affordances in learning is not specifically addressed in TPCK.
- Teachers' epistemic beliefs and values about teaching and learning are not considered by the model.

It is with these concerns in mind that Angeli and Valanides (2009) conceptualised ICT-TPCK as a variation of TPCK.

> "ICT-TPCK can thus be defined as the ways knowledge about tools and their pedagogical affordances, pedagogy, content, learners, and context are synthesised into an understanding of how particular topics that are difficult to be understood by learners, or difficult to be represented by teachers, can be transformed and taught more effectively with ICT, in ways that signify the added value of technology" (Angeli & Valanides, 2009, p. 159).

ICT-TPCK addresses the issue of generality by focusing explicitly on ICT and its affordances. It emphasises TPCK, tools and their affordances, and learners. Angeli and Valanides (2009) argue that TPCK is a distinct body of knowledge (transformative view) rather than an integration of its constituent components (integrative view). This body of knowledge grows and improves as a teacher becomes comfortable with their classroom experience of using ICT hence it is situated in classroom practices.

Despite the integrative vs transformative argument, the central questions remain as to whether teachers can build TPCK knowledge. Koehler et al. (2013) classify three general approaches through which teachers can build knowledge of TPCK. First, the "PCK to TPACK" strategy draws on teachers' existing pedagogical content knowledge to create technological pedagogical content knowledge. Second, the "TPK to TPACK" approach is when a teacher has prior technical knowledge and uses it in the classroom by combining technological pedagogical knowledge with specialised content that is enhanced using technology. As mentioned in the previous section, the application of ICT-TPCK would be an example of a "TPK to TPACK" knowledge development approach. Third, is the simultaneous "PCK and TPACK" development approach which occurs when teachers work collaboratively with their peers with differing sets of expertise to design and practice on developing all aspects of TPACK interactively.

Given that South Africa embraced ICT as a driver of economic development in the early 1990s culminating in the adoption of the e-Education White Paper in 2004, it is reasonable to reflect on progress made in achieving ICT in education objectives as set out in the White Paper of 2004. In a report on ICT in education in South Africa, NECT[6] researchers conclude that "the capacity of the education system needs to be developed to integrate ICTs in support of education" (NECT, 2016, p. 23). Capacity typically points to issues of teacher training on how to incorporate ICT in lessons; ICT infrastructure; learner access to ICT resources; and many other enablers of effective ICT integration. On teacher professional development (TPD), the NECT researchers observe that a) there is a regulatory framework in place, but no evidence that it is being implemented; b) a national curriculum for TPD on ICT does not exist; and c) without any linkage to the existing TPD framework, multiple role players (educational institutions and solution providers) independently facilitate TPD in education. In a 2018 parliamentary debate on the analysis of ICT rollout in education[7], the Department of Basic Education reported that by 2016 only 26% (this is out of a population of just over 400 000 Department of Basic Education Teachers) of all teachers in the country possessed basic ICT skills, whereas just 7% had intermediate ICT skills for teaching and learning. The government recognises the slow pace in capacity building for effective ICT usage in South African schools, hence in 2014, it published the Operation Phakisa[8] concept document, an ICT provisioning model based on the Big Fast Results (BFR)[9] the methodology used to transform Malaysia's economy. The Framework for ICT implementation for the period 2016 – 2020 has also been developed. The framework is informed by recommendations of the Operation Phakisa ICT in education labs. Unfortunately, the government has chosen to focus on connectivity issues at the expense of teacher development. A national curriculum for TPD on ICT cannot be absent when there are sources such as the UNESCO ICT-CFT (2011)[10] a framework that outlines the various dimensions of ICT competencies that a teacher must develop to teach with technology. The Commonwealth of Learning (COL)[11] is a non-profit organisation established by Commonwealth leaders to promote the creation and sharing of open learning/distance education ideas, resources, and technologies, has populated the UNESCO ICT-CFT with content and is available to South

[6] Gent, P.R. & Meyer, I.A. (2016) *The Status of ICT in Education in South Africa and the way forward.* NECT Draft Report
[7] Parliament of The Republic of South Africa (2018). *Analysis of Basic Education Report on the ICT Rollout*. 26 February 2018
[8] DBE (2014) Operation Phakisa - Concept Document
[9] Big Fast Results methodology http://bfrinstitute.com/what-is-bfr/
[10] For full documentation on the policy framework and supporting documentation see http://iite.unesco.org/pics/publications/en/files/3214694.pdf

[11] http://thecommonwealth.org/commonwealth-learning

Africa. SchoolNet[12], a non-governmental organisation, has been at the forefront of ICT teacher professional development in South Africa and uses some of the COL training material for their teacher training programmes. To increase the percentage of teachers with the capability to integrate ICT into their classroom practices from the current 7% (as per the DBE own statistics), perhaps it would be prudent for the Department of Basic Education to adopt a parallel focus on connectivity and teacher professional development on TPACK. However, this cannot be done without strengthening the basic PCK of teachers that researchers have highlighted as a major issue for basic education in South Africa. Once a national curriculum for ICT integration is defined, a "train-the-trainer" knowledge dissemination approach could be used where expert instructors e.g., SchoolNet and other service providers, can be used to train a cohort of teachers within a province whose mandate should be training other teachers using a combination of in-service Teacher Training Centres and other District level initiatives. The New Zealand - ICT Professional Development Cluster[13] the approach which created communities of practice that received extensive government support to ensure that ICT integration was at an acceptable level at all the schools that were part of a phased ICT rollout, could also be employed to further entrench ICT integration in the classroom practices.

2.2.2. Instructional planning and design: a manifestation of espoused practices

Understanding TPCK or its strands is not enough. If teachers are to realise the pedagogical value of integrating ICTs in their classroom practices, they need to put their knowledge of TPCK into action. Shulman (1987) argues that "comprehension alone is not sufficient. The usefulness of such knowledge lies in its value for judgement and action" (Shulman, 1987, p. 14).

The pedagogical reasoning and action (PRA) model, proposed by Shulman (1987), is a framework for instructional design and implementation that includes the following stages:

- Comprehension**:** as the initial stage of pedagogical reasoning where teachers ensure that they understand what they intend to teach.

[12] https://www.schoolnet.org.za/
[13] New Zealand Ministry of Education (2003). *Digital Horizons: Learning through ICT.* Retrieved from www.minedu.govt.nz

- Transformation: a process of transforming comprehended ideas about the content to be taught into teachable content for learners to comprehend.
- Instruction**:** an act of teaching thorough organising and managing the classroom activities.
- Evaluation: involves checking students understanding during interactive teaching. Administering formative and summative assessments.
- Reflection**:** analysing the teaching and learning that has occurred, as well as accomplishments; and
- New comprehensions**:** a process of experiential learning where a teacher gains new insights on the curriculum.

Starkey (2010) argues that knowledge is evolving. Connectivism, a learning theory that considers knowledge creation in the digital society (Siemens, 2004), is an example of how learning has changed in the information age. Starkey proposes modifications to Shulman's PRA model for the digital age by substituting *transformation* with *enabling connections*. Access to information via the internet and the capacity to participate in knowledge growth via Web 2.0 technologies enable connections. *Teaching and learning* in Starkey's model combines *instruction and evaluation* in Shulman's model. The key difference is the role that ICT in facilitating formative evaluations during lesson instruction and summative evaluations at the end of a lesson.

Webb and Cox (2004) argue that ICT affordances and decisions about their use should be taken into account and added to Shulman's model. They further argue that research reveals that teachers' attitudes about the importance of ICT for learning, as well as the type of learning settings, have a role in their pedagogical reasoning. By extension, their critique of Shulman's model also applies to the TPCK model as conceived by Mishra and Koehler (2006), for not considering affordances of ICT and teacher beliefs and values. Webb and Cox (2004) research findings are summarised through the pedagogical practice's framework, depicted in Figure 2.3. The framework assumes that teachers' content knowledge, beliefs and values are key influencers of PRA. Teachers' classroom practices (teacher behaviour) are in turn influenced by their lesson plans and PRA. Learning activities are influenced by the affordances of ICT as well as the teacher and learner interactions.

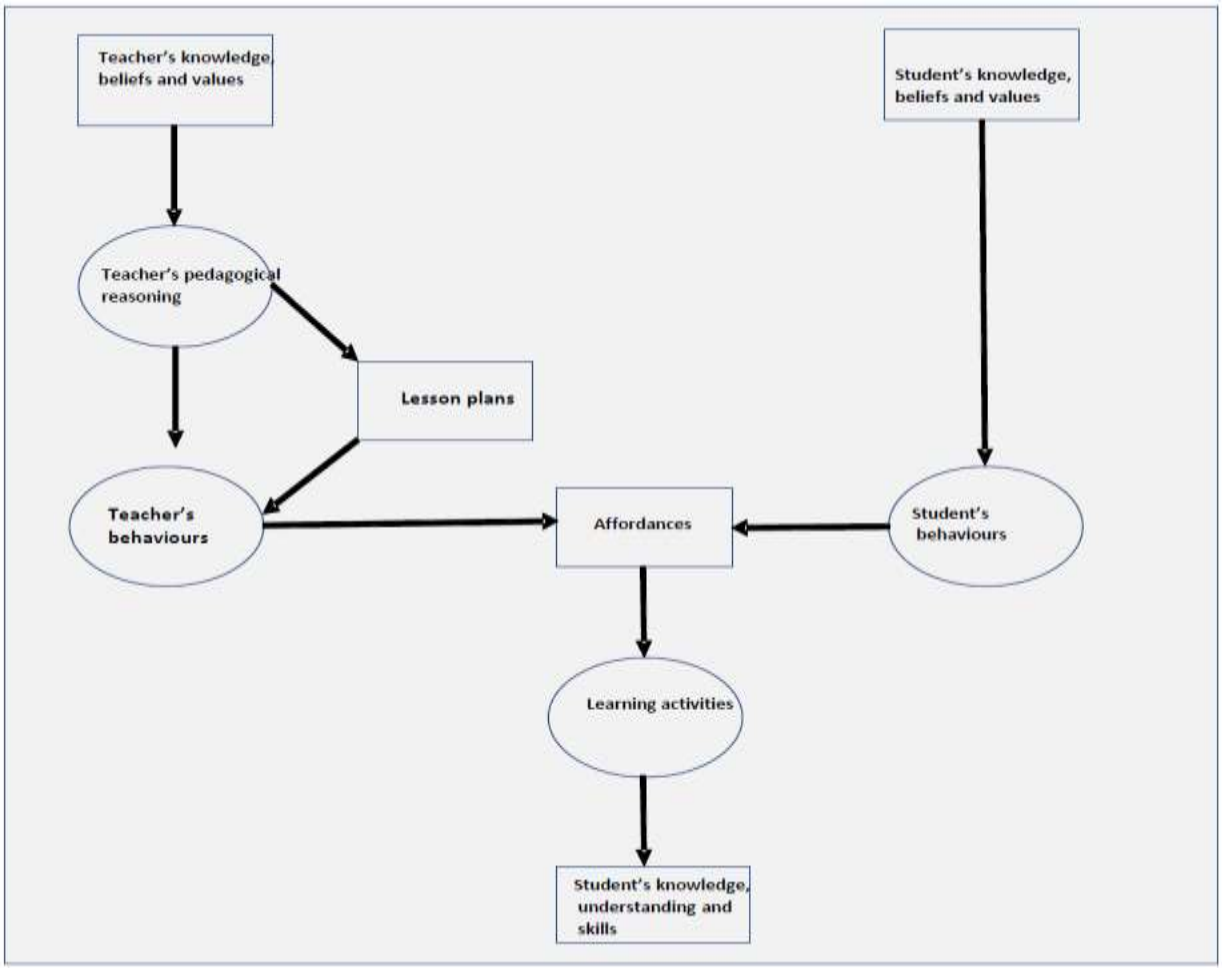


Figure 2.3 - Framework for pedagogical practices using ICT

Source: (Webb and Cox, 2004)

Webb and Cox (2004) acknowledge that the suggested framework places a high demand on teachers' knowledge of, and familiarity with, a variety of ICT technologies for integration into classroom practices while responding to learners' needs. The demand on the teacher is exacerbated by pedagogical methods that differ between subjects (Bromme, 1995, cited in Webb & Cox, 2004).

A reflection on instruction planning and design models (Shulman, 1987; Webb & Cox, 2004; Starkey, 2010) does not imply that this research report is advocating for "decontextualized, rules-governed and cognitive way of designing instruction conceptualised in instructional design model" (Moallem, 1998, p. 58). According to Moallem's (1998) research on instructional design, teachers' pedagogical approach is rooted in classroom practices. Proponents of the situated perspective to learning and knowledge (Greeno, 1997; Greeno, Collings, & Resnick, 1996), suggests that instructional planning for ICT should consider teachers' contextual and practical body of knowledge. Angeli and Valanides (2009) propose the Technology

Mapping (TM) model as a situated model towards instructional design by teachers. Traditional behaviourist and systems-oriented methods to instructional planning and design are not used in TM. It is a holistic and authentic approach in which context-specific aspects such as technological affordances, content, pedagogical practices, classroom setting, and learners are considered during the design and development of an iterative instructional design process. Figure 2.4 depicts the TM model as proposed by Angeli and Valanides (2009).

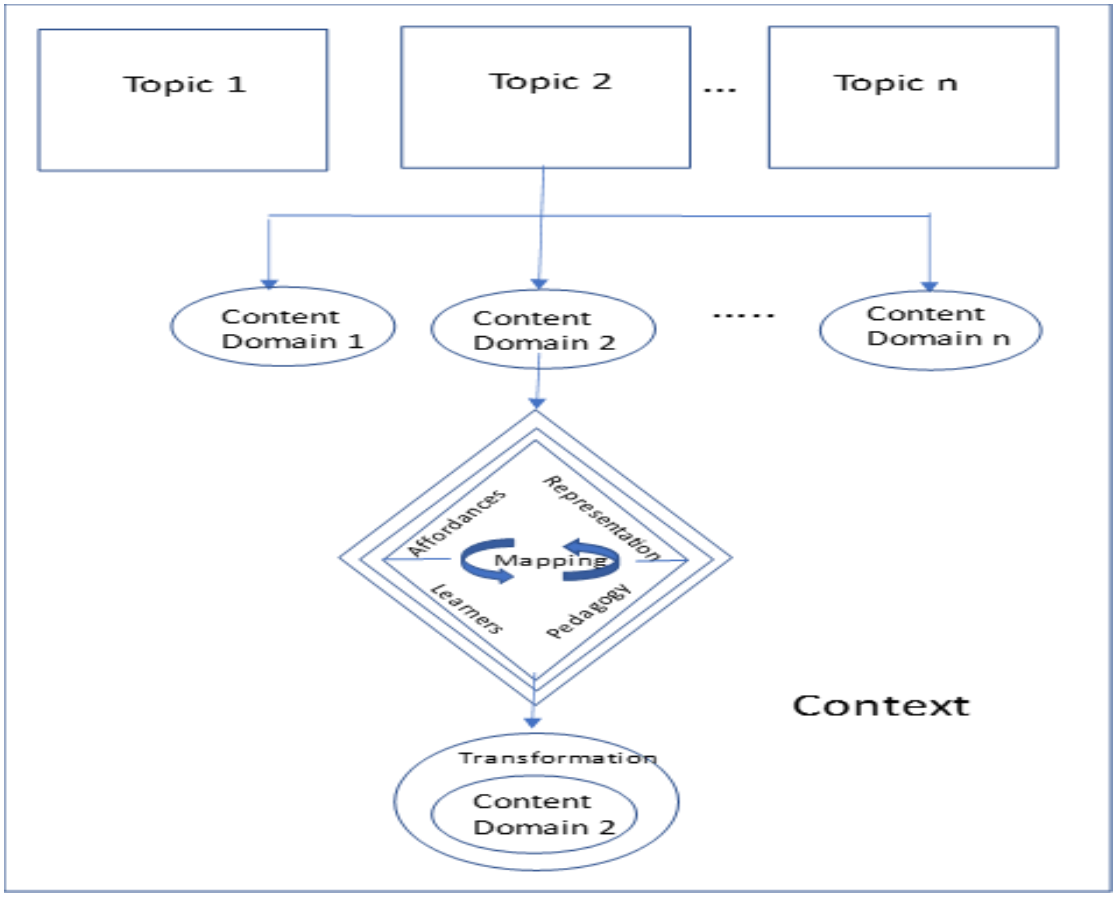


Figure 2.4 - Technology Mapping Model

Source: Angeli and Valanides (2009)

Using the TM methodology, a teacher must reflect on a specific content domain within a topic they intend to cover in a lesson, that is challenging to teach and learn. The layered design of the diamond in the TM model represents the iterative instructional design process that teachers engage in, to decide how to make content teachable to their learners. In doing so, a teacher needs to decide how tool affordances can be used to transform the content into representations. Representation is not limited to visual text representation only, it could include simulation, interactive dialogue, modelling, and playing an

educational game. Representations are tailored to the specific needs of learners and are used to employ various pedagogical strategies to support a teachers' classroom practice. Things may not necessarily pan out as the teacher intended. Hence Moallem (1998) refers to "reflection-in-action" where a teacher adopts an alternative teaching approach in response to a situation at hand.

This reflection-in-action is characterized by discursive dialogue, feedback and convergence between a teacher-and-learners and learner-to-learner in technology-infused lessons. It is this type of reflection-in-action that is of interest to this research study. Laurillard (2002) conceptualised these classroom interactions as the Conversational Framework.

The next section reviews the Conversational Framework and how the interaction between a teacher and learners can be facilitated using different types of digital media.

2.2.3. Classroom interactions: reflection-in-action towards convergence

Laurillard (2002) developed the Conversational Framework, a model for analysing classroom interaction. The model draws on Vygotsky (cited in Crain, 1992) social constructivist learning theory. The Conversational Framework is based on what Pask (1976) refers to as the "skeleton of a conversation" and modified for the education context of classroom interaction in which ICT and other learning support tools are infused to facilitate learning (Sharpes et al, 2007). Figure 2.5 depicts the Laurillard (2002) Conversational Framework.

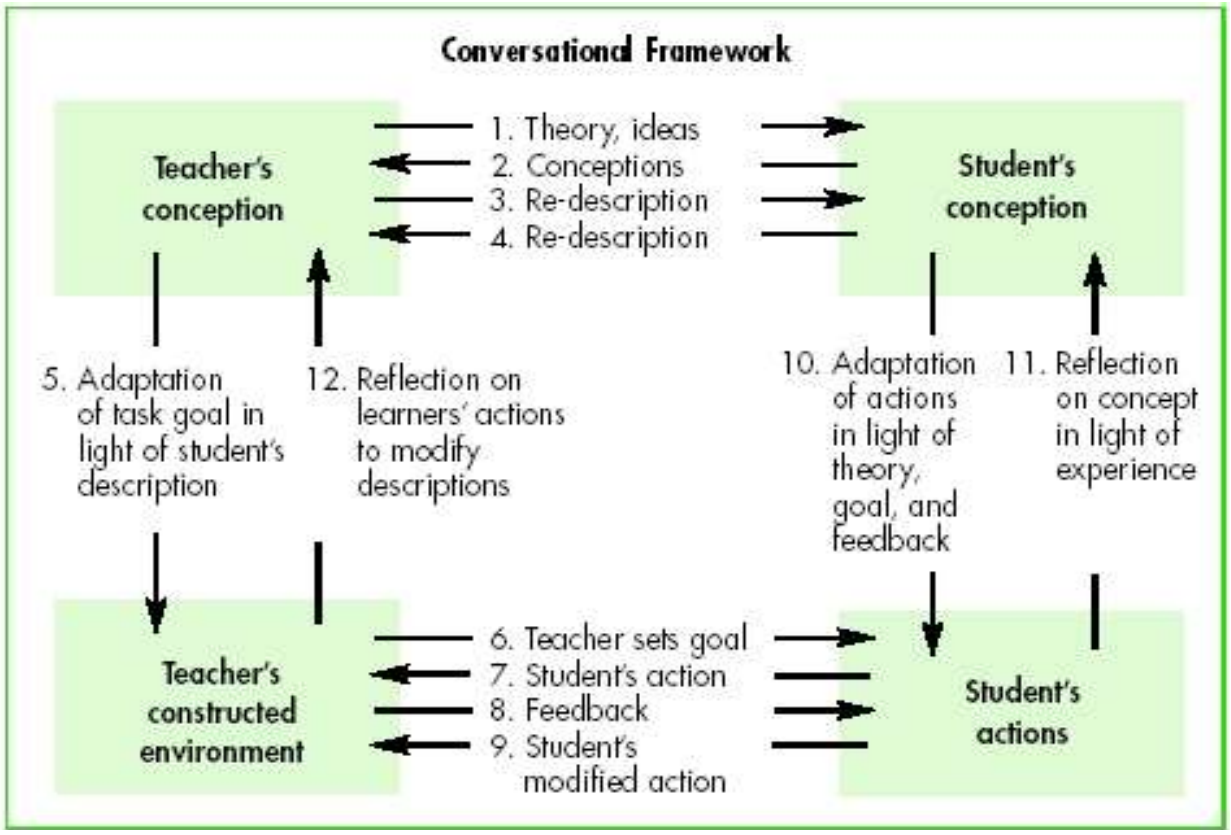


Figure 2.5 - Conversational Framework

Figure 2.5 depicts an effective dialogue which according to Laurillard (2002) must be discursive, adaptive, interactive, and reflective. The *discursive process* in Laurillard (2002) framework is a series of activities (activities 1–4 of the Conversational Framework) by which the teacher and the learner described and re-described their conception of the activity. Internal to both the teacher and the learner, is the *adaptive* process which consists of activities (5 and 10 of the Conversational Framework) in which each modifies their actions based on the discursive process. The *interactive* process is a series of activities between the teacher and the learner that include defining and trying to achieve the task objectives, offering and acting on feedback in view of the task goal (6 to 9 of the Conversational Framework). Internal to both teacher and learner, the *reflective* process consists of actions (11 and 12 of the Conversational Framework) to re-describe their conception of the task goal.

The Conversational Framework illuminates various levels of classroom dialogue, feedback and iteration presented through the *"what", "where*" and *"how"* questions, and convergence which occurs when the learner's understanding converges with the teacher's knowledge. These concepts are clearer in Sharpes et al. (2007) adaptation of Laurillard's conversational framework for learning in Figure 2.6.

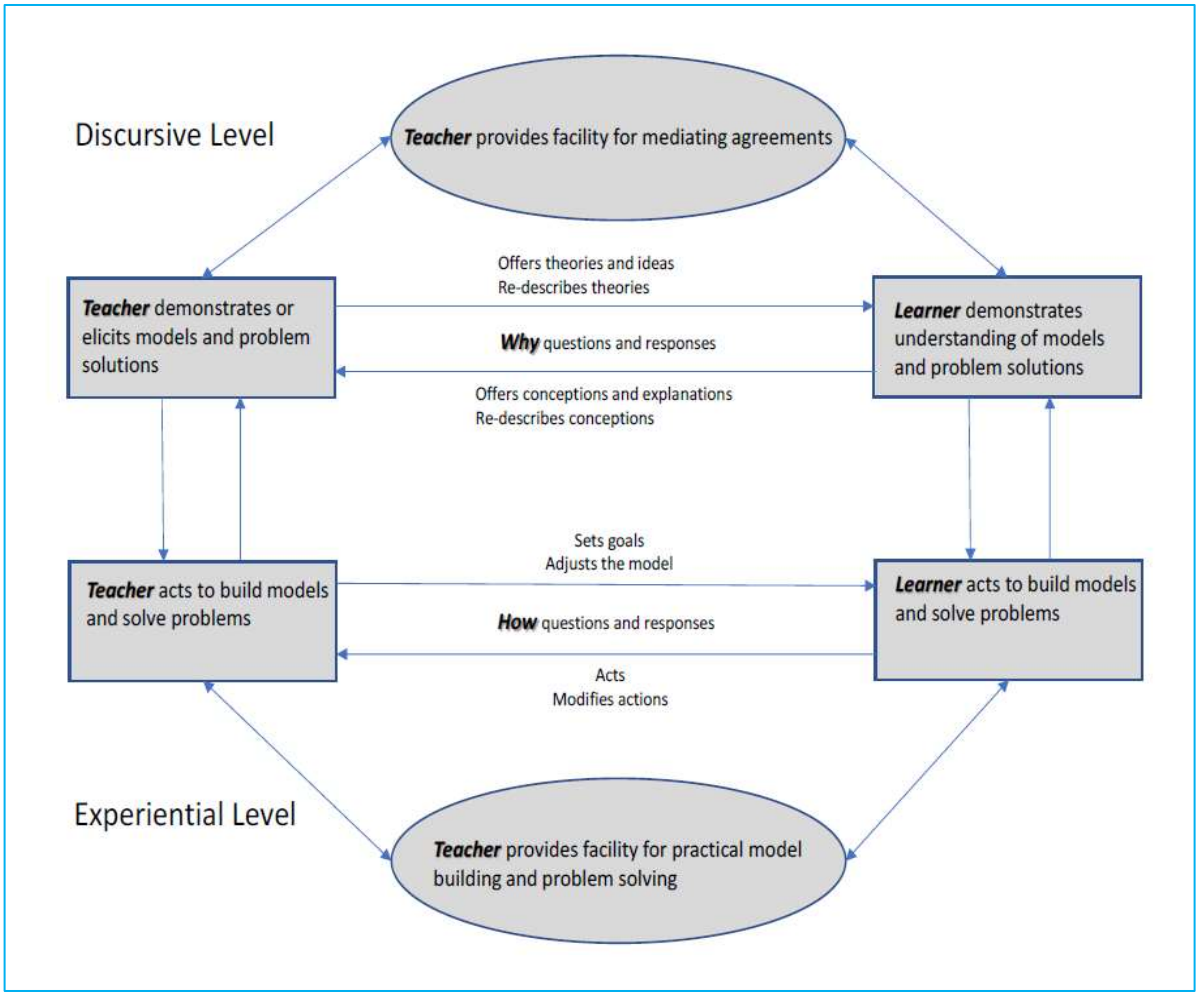


Figure 2.6 - A Conversational Framework for Learning (adapted from Laurillard, 2002)

Source (Sharpes et al, 2007)

The model suggests two levels of dialogue the "Level of Descriptions" and the "Level of Actions". The Level of Descriptions also referred to as the "Discursive Level" is where the teacher expresses ideas and concepts of the task at hand. Learners can raise questions and express their ideas. The discursive process continues with learners and the teacher engaging in an iterative process of challenging each other's views until learners reach a final understanding of the concepts. External representations, such as ICT, can help learners negotiate agreements by mediating conversations (Sharpes et al., 2007).

At the Level of Actions also referred to as the "Experiential Level", learners use conceptual understanding to adapt what was discussed. For the teacher, this level represents changes and adjustments of the content based on earlier discussions with learners.

The dialogue between the teacher and the learner(s) represents an interaction which according to Chai (2015) has traditionally been influenced by subject and object theories such as the traditional "teacher-centred teaching approaches" and more recently, the 'learner-centred' approaches.

The teacher-learner classroom interaction which features strongly in the Conversational Framework occurs through a process of iteration which is often defined as "a process for arriving at a decision or a desired result by repeating rounds of analysis or a cycle of operations". Iteration also features in other teaching approaches such as the mastery learning approach which uses iteration as one of its basic tenets (Block & Burns, 1976).

Feedback plays an important role in teacher-learner interaction. Feedback is critical if given in the right form and interpreted correctly to maximize the impact of interaction and identify alternative ways of examining learning material (Draper, 2009). It directs learners' attention to gaps in their knowledge and how to overcome them.

The outcome of iteration and feedback should lead to convergence about ideas and/or understanding of a certain topic.

Modern learning is also about the use of ICT to facilitate teacher-learner interaction. Laurillard refers to ICT in classroom practices as digital media and proposes five digital media forms that cover all the Conversational Framework's interaction activities, these are narrative media, interactive media, communicative media, adaptive media, and productive media. Table 2.1 is a summary of Laurillard (2002) description of media forms used for learning and teaching. According to Laurillard (2002), these media forms can be used to support a teaching strategy that is characterised by an iterative dialogue between a teacher and a learner as represented through the Conversational Framework. Laurillard (2002) further argues that there are four distinctive aspects of the dialogue progression between a teacher and a learner as captured through the Conversational Framework. These are discursive dialogue, where the teacher and the learner continuously make their conception of the topic goal accessible; adaptive dialogue, where the teacher use their own conception and that of the learner to determine the focus of the dialogue; interactive dialogue, where a teacher creates an environment where learners can act on, generate, and receive feedback on actions appropriate to the task goal; and reflective dialogue, where a teacher support learners link feedback on their actions to the topic goal.

The multi-case study analyses how teachers in public schools are using the digital media forms as defined by Laurillard to facilitate learning.

Table 2.1 – Media forms, learning experiences, and delivery methods

Media Form	Media Description	Learning Experience	Media Type
Narrative Media	• linear media • non-interactive • presentational media • broadcast media	• ***Apprehending****:* clarifies the structure of an argument; explains the nature of evidence. • ***Coherence:*** presentation of information to enable learner cognition. • ***Attending:*** capture learner attention to the narrative/topic. • ***Experiencing****:* offer vicarious experiences to learners through examples that are embedded in the narrative. • ***Discriminating****:* offer alternative forms of description, based on misconceptions and misrepresentations. • ***Relating experience to theory****:* is about referring learners to prior experiences of interacting with the world.	• Television • Video • PowerPoint slides presented through a slide projector • eBooks • Digital Audiobooks • Interactive Smartboard • Virtual Reality headsets
Interactive Media	• presentational linear media. • users can navigate and select content at will.	• ***Investigating and Analysing:*** offer learners the tools to select or negotiate their own task goal.	• Web resources • DVD • CD • Hypermedia • Web-TV

Communicative Media	Serves the discursive level of the conversational framework, by bringing together learners and teachers into a discussion.	• ***Articulating:*** encourage learner's articulation of conceptions and perspectives. • ***Challenging conceptions:*** enable learners to generate questions and exercises that will elicit misconceptions, or representational difficulties.	• Online conference • Video conference • Teleconference • Asynchronous social media communication
Adaptive Media	Computer-based adaptive media which accept input, transform it, and display the resulting output.	• ***Experimenting:*** define the goals against which learners can compare the intrinsic feedback to adjust their next action. • ***Clarifying internal relations:*** create an environment for actions with intrinsic feedback. • ***Relating theory to practice****:* develop goals and activities at the interactive level that require learners to use their knowledge of the theory.	• Simulation • Intelligent Tutoring System • Online instructional software
Productive Media	Provide an electronic environment in which learners can use tools like modelling environments, programming tools, and microworlds to create anything.	• ***Synthesising****:* learners consider the differences between their own and the teacher's conceptions, as well as the goal-action-feedback cycle. • ***Articulating:*** encourage learner's articulation of conceptions and perspectives. • ***Producing:*** use knowledge to produce a product experience	• Modelling • Software Development workbench

2.2.4. Conclusion

"those who can, do: those who understand, teach" (Shulman, 1986, pg. 14)

A discussion of epistemological issues for teaching with technology highlights that for teachers to benefit from affordances of ICT and exploit them in teaching and learning practices, they need to understand the ICT's role in education and how to employ it to achieve lesson/learning objectives. They also need to upskill themselves through ongoing TPD programmes and knowledge sharing with peers. It is only when they '*understand*' that they can teach. The starting point for understanding is the TPCK and its various strands. Nonetheless, its implementation is individualised because of the situatedness of classroom practices and teachers' belief systems about learning and teaching.

On the assumption that teachers value the contribution of ICT in their lesson practices, they need to plan its infusion in their instructional planning activities and appreciate that teaching is a conversation between learners–and-teacher and learner-and-learner towards convergence of knowledge. Therefore, teachers need to understand the role that can be played by different media forms to facilitate convergence.

It is the convergence of teacher-learner knowledge and learner-learner knowledge that should answer the question: *What is deemed by teachers to be of pedagogical value in the use of ICT in the classroom?* The convergence in this instance is mediated through ICT using socio-cultural theories of learning through mediation tools.

2.3. Beliefs and Change Management

This section reviews theoretical frameworks for managing reform in education and how to ensure that individual teacher concerns with the proposed reform are addressed. Research has shown that for any education reform programme to succeed, careful consideration of the psychology of how groups and individuals react to change is critical. Literature on how to

manage individual and system-wide change is reviewed to help answer the research sub-question: *What are the teacher concerns with the use of ICT in classroom practices?*

As indicated by the Gauteng Department of Education's ICT roll-out initiative, successful ICT integration appear to be falling into place in several of the provincial basic education departments. However, studies continue to show that ICT integration in learning and teaching is still minimal. To answer the research sub-question*: To what extent are teachers' espoused practices reflected in their enacted practices* in the use of ICT, this section of the report evaluates literature on teacher beliefs and the relationship between espoused and enacted practices in the use of ICT.

2.3.1. Enacted vs Espoused Practices

Pfeffer and Sutton (2000) define the "knowing-doing problem" as the challenge of translating knowledge about how to improve organizational performance into actions that are compatible with one's understanding. For this study, organisational performance refers to the extent to which teachers are not willing to use ICT into their lessons despite having knowledge about it and its benefits to teaching practices. In education research the “knowing-doing problem” is often referred to as the inconsistency of expressed beliefs and teacher practices (Chen, 2008; Sendurur, 2018). In a study conducted at Taiwan schools Chen (2008) found that most teachers understood constructivist learning principles promoted through government policies but opted to use ICT to cover only curriculum content. The misalignment of expressed beliefs and teacher practices in Chen (2008) study is attributed to what Ertmer (2005) refers to as 2nd order barriers that are often associated with teachers’ personal beliefs about curriculum and pedagogy. Calderhead (cited in Ertmer, 2005) makes the following distinction about knowledge and beliefs “Beliefs generally refer to suppositions, commitments, and ideologies, knowledge refers to factual propositions and understanding” (p. 715). Despite gaining knowledge about the ICT proposition for learning and teaching, research has shown that teachers are still free to accept the ICT proposition as either plausible or implausible and often influenced by their beliefs about the subject content, instruction and learning outcomes.

According to Zhao et al. (cited in Ertmer, 2005), the bigger the gap between a new instructional practice and an existing practice, the less likely it will be successfully implemented by teachers. Kagan (1992) review of empirical studies on teacher beliefs found that teacher views appear to be firm and resistant to change, and teacher beliefs are frequently connected with a consistent teaching style that can be seen across different classrooms and grade levels. However, these findings do not imply doom and gloom for reform efforts to increase the use of ICT in the schools that is aligned with constructivist learning approaches. Kagan (1992) points to research on conceptual change which suggests that personal beliefs serve as the filter and a basis of new knowledge. Some personal beliefs may aid learning because they are consistent with the new knowledge to be learned, while others may obstruct learning because they are incompatible with the new knowledge to be learned. A teacher who holds a constructivist view on learning is most likely to use ICT to enable a learner-centred approach, in line with his/her belief system. According to Kagan (1992), teaching a person something new entails causing a conceptual shift in his or her personal beliefs. In the case of learners, teachers promote conceptual change among learners by helping them to make their implicit beliefs explicit. This process is achieved in the Discursive Level of Laurillard's Conversation Framework. Once beliefs have been made explicit, a teacher would then confront a learner's inadequacies or inconsistency in their beliefs. The conceptual change is concluded when a teacher gives learners chances to integrate and differentiate the old and the new knowledge. This process takes place in the Experiential Level of Laurillard's Conversation Framework. The conceptual change process can also be used to change teachers' beliefs about ICT in the pre-service and in-service teacher training programmes. Transitioning to a new personal understanding of any notion, according to Kagan (1992), is particularly difficult since pre-existing views are tenacious, even in the face of contradictory evidence. According to Nespor (1987), beliefs change through a conversion process rather than argument or reason. Ertmer (2005) suggests three strategies for changing teacher beliefs about technology. These strategies draw on research on conceptual change and other research on beliefs. These are personal experiences, vicarious experiences, and socio-cultural influences. Personal experience comes from practice. Guskey (cited in Ertmer

2005) claims that beliefs change after, not before, practice, and that by assisting teachers in adopting effective and new practices, the accompanying beliefs are likely to change. As a result, technological tools should be introduced in stages, starting with those that support teachers' current teaching styles and progressing to those that support higher-level goals. It's also critical to offer teachers continuing technical and pedagogical support as they gain self-confidence and skill with ICT technologies, as well as the new instructional approaches needed to adopt a new set of pedagogical beliefs. Vicarious experiences are about observing similar others enact a specific classroom action e.g., in-service teachers observing how an expert teacher integrates ICT in a grade 8 mathematics lesson. According to Ertmer (2005), research has shown that vicarious experiences provide observers with confidence and motivation to accomplish the same performance as presented through the model lesson. Another way of exposing teachers to vicarious experiences is through communities of practice where teachers learn from peers in a “safe environment”. Socio-cultural influences play a noteworthy role in shaping teachers' practices and beliefs (Becker & Riel, 1999, cited in Ertmer 2005). These include values and opinions expressed by those around teachers e.g., school principal, and by the expectations of influential others e.g., school governing body, all of which are communicated through formal and informal norms and channels. Hence ongoing public conversations in the school environment explaining stakeholders' pedagogical beliefs (e.g., department, district, region, school principal, HOD etc) including explicit discussions about how technology can support those beliefs, are critical socio-cultural influences to help change educator’s beliefs about technology.

In a study conducted with a purposive sample of ICT using teachers, Ertmer et al. (2012) refer to the expressed beliefs and teacher practices as the espoused and enacted teacher practices. Ertmer et al. (2012) found that once 1st order barriers (associated with ICT infrastructure) were eliminated, espoused practices of ICT using teachers were aligned with their enacted practices. Teachers in Ertmer et al. (2012) study held student-centred beliefs that supported student-centred pedagogical practices. Internal factors such as a passion for technology, or

having a problem-solving mentality, also contributed to the alignment of espoused and enacted practices.

2.3.2. System-Wide Change Programme

In South Africa, if system-wide reform of the basic education had been achieved, learner in the basic education bands would be “ICT capable”. Most teachers would have been through professional development programmes to acquire the TPACK knowledge. Unfortunately, the e-Education White Paper of 2004 is not specific on how learners will become ICT capable, nor is there official progress reports on the status of the “ICT capability” of learners.

However, the White Paper refers to the development of an e-school environment where at an operational dimension, teachers and learners would acquire ICT skills using “approaches that employ an elaborate human network of support among teachers and learners and adopt a collective approach to knowledge and problem solving” (DBE, 2004, p.17). From this statement, one can assume that the White Paper’s silence on the ICT knowledge acquisition approach for learners is influenced by studies on “millennials”[14] born into a world where ICT is ubiquitous. In the education context millennials are often referred to as the New Learners (Levinsen & Sørensen, 2011) and exhibit competencies beyond basic device-operating skills. Several studies show that New Learners' use of ICT is complex and differentiated outside of schools than in schools (Livingstone & Bowill, 2001, cited in Levinsen & Sørensen, 2011). Assumptions about New Learner’s ICT knowledge cannot be made on the current cohort of teachers made up of “Digital Natives” and “Digital Immigrants” a term coined by Prensky (2001) to describe individuals born before and post the information-age. A 2016 status report on e-education[15], indicates that only 26% of teachers in South Africa have basic ICT skills and only 7% can effectively integrate ICT into their lessons. The status quo points to what Ertmer

[14] According to Wikipedia, the term "millennials is credited to authors William Strauss and Neil Howe who coined the term around 1987

[15] Parliament of The Republic of South Africa (2018). *Analysis of Basic Education Report on the ICT Rollout*. 26 February 2018

(2005) refers to as 1st and 2nd order change barriers. 1st order barriers are associated with inadequate ICT infrastructure, inadequate ICT training of teachers, budget constraints, and prioritisation of competing reform imperatives. According to Ertmer (2005), 1st order barriers are relatively easy to deal with because they are mainly influenced by socio-economic factors. However, dealing with 1st order barriers through the provisioning of resources is not the panacea for a successful reform programme in education. Fullan (2016) argues that:

> "Educational change stands or falls on whether educators, students, and other learners find personal meaning in what they are learning and how they are learning" (Fullan, 2016, p. 4).

In other words, the reform must lead to a change in practice and be meaningful and beneficial to all stakeholders including teachers and learners. Fullan (2016) posits that there are generally three types of change in education reform, namely:

- new or altered materials are introduced (e.g., instructional curriculum material and new technologies).
- adoption of new teaching approaches.
- shift of beliefs such as pedagogical assumptions and theories underlying new policies or programmes.

An education reform that covers all three dimensions is regarded as a large-scale change or a system-wide change programme (Fullan, 2016). A system-wide reform programme often leads to structural changes to education as evidenced by the introduction of ICT into teaching and learning which has implications for pedagogy, how a school is organised to provide ICT support to teachers and the teacher-learner relationship. The key question is: *how do we avoid the failure of such large and deep education reform programmes*? as evidenced by the current low incorporation of ICT into teaching and learning. Fullan (2016) proposes several principles for successful system-wide change. First, is the necessity to set closing the gap targets as the overall goal of the reform programme. Fullan argues that system-wide change cannot be achieved if it creates gaps in society. This principle has been successfully applied by the GDE when it set a target on closing the gap in matric results between township high schools and fee-paying schools (former Model C Schools) as a key performance indicator for the province's investment in ICT. The Gauteng MEC of Basic Education has been quoted as saying:

> "When we launched our ICT programme, this school was performing around 63%. Today, when we're releasing these results, this school is standing at a 94% matric pass rate. So, all our township schools have closed the gap."[16]

The second principle relates to the need to recognise that successful reform strategies are socially based and action-oriented. They develop collaborations where there were none before. Collaboration leads to trust and the strengthening of social capital and cohesion (Fullan, 2016). In school research, findings have shown that intra-school variations in learner achievement can be solved through teacher collaboration (Fullan, 2016). The third principle relates to capacity building, and the need to focus on it at the early stage of a change programme. Fullan argues that building capacity at the early stage of a reform programme by involving as many participants as possible is aligned with change management principles. People require fresh experiences that lead to various views to secure new beliefs and high aspirations for essential change. Capacity building and experiences develop skills, clarity, and motivation. This principle is also recognised in the e-Education White Paper when it refers to the use of human networks of support among teachers for knowledge development and problem-solving. The fourth principle is about continuity of good direction by leveraging leadership. Sustaining the success of a change programme in a school requires careful attention to be paid to developing the leadership of others in the interest of continuity. Leadership on a technology integration programme may be realised through various roles such as change champion, technological pedagogy expert/instructional design lead, and technical support expert. However, assigning leadership roles does not imply that the focus should be on rewarding performers and punishing underperformers. An international Mckinsey study of 20 strongly improving national education systems, authored by Barber et al. (2010) indicates that successful countries developed the "entire teaching profession" and raised the bar for all. Fullan also argues that studies have shown that it is collaborative group work that accelerates performance, a phenomenon that Fullan refers to as "social capital". The fifth principle is about building internal accountability linked to external accountability.

[16] Eye Witness News of 4th of January 2019 https://ewn.co.za/2019/01/04/lesufi-hails-township-schools-for-making-good-progress-in-pass-rate

Internal accountability in a school relates to the performance data of teachers. People embrace performance evaluations when they are in control, and when the feedback empowers them to succeed. On the other hand, rigorous external accountability across various levels is the norm in public education. Leading a change program with external accountability is not the best way to get accountability. Motivation and competency development should be the lead drivers. External accountability should be accompanied by internal accountability and the common objective should be to clarify goals and where each teacher is concerning achieving the reform programme's goals. Barber et al. (2010) in their study of improving national education systems found that in developing countries there was a 50/50 split between accountability and capacity building activities, in the good-to-great countries, interventions were 78% professional development and 22% accountability. The sixth principle is about establishing conditions for positive pressure. Fullan describes positive pressure as pressure that motivates. For instance, if a school is not performing due to challenging circumstances, the education department should be held responsible for capacity building. On the other hand, if a school receives more resources from the government, it should feel the pressure to perform. Fullan argues that the evolution of positive pressure means taking all excuses off the table. The Gauteng Department of Education is applying this principle together with its focus on closing the gap between non-fee and fee-paying schools. However, it is focusing on the matric pass rate and not necessarily on ICT integration as a lever for improved teaching and classroom practices.

2.3.3. Concerns Based Adoption Model

The preceding section dealt with the issue of 2nd order barriers as well as change navigation principles for successful reform of education. These are macro-level issues generally out of the control of teachers, except for 2nd order barriers which reflect teachers' belief systems. At a micro-level or at the core of any change initiative is the teacher (the “individual”) and the challenge of how to ensure that a teacher embraces change. There are several change management frameworks on how to manage “individual change”. The research report focuses on the Concerns Based Adoption Model (commonly known as CBAM) developed in the 1980s

as a specialised framework for managing teachers' concerns with education reform. The research report postulates that effective change management of education reform such as the introduction of ICT into education requires all stakeholders involved with the reform to manage both macro-level and micro-level change management issues.

Ideally, educational change initiatives should be managed through frameworks that are steeped in the research of educational reform principles. The CBAM is a widely used, applied framework and methodology for studying the process of implementing educational change. It focuses on teacher feelings and motivation towards change, as well as their actions as they assimilate the implications of change through their classroom experiences. The CBAM model has three diagnostic dimensions for conceptualising and measuring the change in teachers involved in a change initiative:

- The Stages of Concern (SoC).
- The Levels of Use (LoU) dimension.
- Innovation Configuration (IC).

Stages of Concern describes the feelings and motivations of teachers about the educational innovation e.g., use of computers in classrooms, at different points of the implementation. The framework proposes six stages of concern: Stage 0: Unconcerned where educators may not have in-depth knowledge about the change and demonstrate little interest in the innovation. Stage 1: Informational stage where an educator demonstrates interest in learning more about the change and its implications once implemented. Stage 2: Personal stage where information about the change creates anxiety about ability to implement the change, concerns about the appropriateness of the change and the personal cost of embracing the change. Stage 3: Management stage where an educator has had training on the innovation through formal education department led Teacher Professional Development initiatives or informal personal development. His/her understanding is supplemented by implementation experience after training. In this phase anxiety about a teacher's ability to successfully implement the change increases as the breadth and depth of the change unfolds with

experience. Stage 4: Consequence stage where concerns of teachers are mainly about learners and the implications of the change on learning outcomes. At this stage, some teachers would start to explore possibilities of modifying the innovation to maximise its effect on learning outcomes. Stage 5: Collaboration is about teachers continuing to have concerns about the benefits of the change implementation for learners. Through collaboration, they turn to their colleagues for knowledge sharing and insights on the implementation experiences. Stage 6: Refocusing is the stage of maturity. Teachers who achieve this stage of development exhibit comfort with the change/innovation and are beginning to consider major changes or even replacement of the innovation with something else. According to Anderson (1997), the six stages of teacher concern represent a developmental process and not necessarily a progression of concerns about the change. Studies on the use of computers in education indicate that most teachers progress to *Stage 4: Consequence stage* and seldom progress to *Collaboration* and *Refocusing.* This is because in the *Consequence Stage* teachers reflect on their beliefs about pedagogy and their attitude towards technology. If a teacher concludes that the implications of integrating ICT into lessons are not in line with their held views on how content should be taught, chances are that they would not embrace the change.

The Level of Use dimension of the CBAM focuses on teacher behaviour as they embrace the educational reform. Level 0: Nonuse a teacher at this level has a bit of knowledge about the change e.g., has heard about the educational technology and has seen other teachers using it. Level 1: Orientation is a phase where a teacher would typically seek information about the change. Would most probably enrol in TPD programme. At this stage, a teacher has still not decided to implement the change. Level 2: Preparation is where a teacher is preparing to put what they have learned through Orientation into practice. This may entail experimenting with lesson preparation using technology or practising how to use classroom technology such as the Interactive Whiteboard, PowerPoint etc. Level 3: Mechanical phase is where a teacher is implementing the change. Challenges in this phase include implementation logistics such as instructional lesson planning and classroom management. Level 4(A): Routine occurs when a teacher establishes a practice of regular usage of the innovation e.g., use of technology in

their lessons. Level 4(B): Refinement represents a shift from a teacher centric approach to a student centric approach. In this phase, the teacher actively assesses the impact of the innovation educational outcomes. A teacher may introduce changes to the innovation or its use to benefit learners. Level 5: Integration is about collaboration amongst educators to share experiences about the innovation and analyse areas for modification and improvement for the benefit of learners. This could include discussion groups of innovative ways of teaching specific subjects using computers as cognitive tools. Level 6: Renewal phase teachers are experienced users of the innovation. Their focus is the continuation of identifying areas for modification and improvement of the innovation. They may go as far as identifying alternative practices that are underpinned by the innovation. Anderson (1997) emphasizes that the level of use as teachers progress in implementing the innovation is dependent on the interaction between many factors such as teacher values, innovation attributes, implementation support, time, experience, and administrative pressure.

The Innovation Configuration dimension of the CBAM recognises the situated nature of classroom practices hence educators rarely implement the same innovation in the same way. The innovation configuration is used to describe variations in implementation for different teachers. These variations are captured in what is known as the Innovation Configuration Component Checklist. The checklist specifies key behavioural components of the change such as models of learning design (reproductive, interactive, generative, conversational, transformative), question techniques, use of ICT in education, teacher role, and evaluation techniques. It also includes possible ways in which educators implement the behaviours associated with each component e.g., the use of different ICTs to support different models of learning. Whilst recognising that there will always be variations, the Innovation Configuration Component Checklist may incorporate examples of best practices i.e., more desirable variations of how to implement the change. The checklist may also include components that are regarded as essential to the implementation of an innovation.

The CBAM framework has been used extensively in research concerned with the implementation of computers into classrooms. Newhouse (2001) cites several research efforts on the implementation of computers in education which employed the concern-based framework as the research methodology. Perhaps notable research projects which have their roots in the CBAM framework are the Apple Classrooms of Tomorrow (ACOT) project (which came up with the instructional transformation model). Large research projects typically develop their models and tend to substantially modify the original dimensions and instruments of the CBAM framework, an approach that is not condoned by the originators of the framework (Newhouse, 2001). The argument against modification is that these will require further validation in line with the original CBAM framework. Anderson (1997) shares the same view and suggests that researchers should focus on the theoretical critique and further development of the CBAM. Anderson (1997) sites several areas of further research to enhance the CBAM as a theory for managing educational change such as the interaction between the dimensions of the framework, factors behind the arousal and intensity of concerns, resolution of teacher concerns at different stages of the level of use, the role of the environment in shaping teacher concerns, innovation usage and change facilitator interventions, and the integration of CBAM with other developmental theories of learning.

2.4.2. Conclusion

> *"all change involves passing through the zones of uncertainty …….the situation of being at sea, of being lost, of confronting more information than you can handle"* (Schőn, 1971, pg. 12).

Knowing and understanding are not enough for teachers to realise the pedagogical value of ICT integration into classroom practices. All stakeholders involved in the education reform programme towards higher usage of ICT in schools should be aware of change navigation principles that affect how individuals and systems react to change. In as much as 1st order barriers should be eliminated. An equal amount of energy and focus should be invested in dealing with 2nd order barriers and hand-holding teachers as they move from a phase of mere

awareness and superficial use of ICT to a stage where they embrace ICT as a tool for facilitating effective learning when supported by an appropriate instructional pedagogy. The role of administrative support at all levels of the education system governance (department, province, region, district and school) is also critical. The introduction of ICT in education should be managed as a Change Management Journey with all the requisite support structures for managing a System-Wide change initiative e.g., programme office, budget, implementation plan, milestones, facilitators, change champions, teacher professional development programme, knowledge sharing forums and repositories etc, in place.

2.4. Pedagogical Value of ICT

Both sides of the debate on the pedagogical value in the use of ICT have been extensively covered in educational research. With proponents of ICT in education claiming benefits for learners such as assisting learners with easy access to information, support for learner centric and self-directed learning, promoting collaborative learning in a distance learning environment, and presenting learners with the prospect to develop higher-order thinking skills. Opportunities for teachers include improving the instructional quality and support for instruction by facilitating easy access to content (Fu, 2013).

Critics of ICT in education are disappointed by the extent to which teachers are embedding ICT into their lessons. Citing the use of technology that is confined to low-level teaching tasks such as access to information. The absence of a theoretical framework for the use of ICT in education has also been raised as an issue (Crook,1994). Teachers' attitudes and beliefs are also seen as a major barrier to the effective adoption and usage of ICT in education (Ertmer, 2005).

Harris (2016) observes that more personalised, curriculum-based and authentic-to-the-classroom methods are emerging and there is a growing awareness of TPACK as a highly contextualised construct. It is for these reasons that it is challenging to generalise the pedagogical value of ICT in teachers' pedagogical practices. Based on this context, the report analyses the pedagogical value of ICT by looking at its impact on pedagogy as well as the affordances of ICT.

2.4.2. Pedagogical Practice

The starting point in understanding the impact of ICT on pedagogy is to first understand *what pedagogy is*? In a report commissioned by the British Educational Communications and Technology Agency (Becta), Cox et al. (2003) argue that academics' conceptualisation of pedagogy has changed in line with recent developments in the views about cognition and meta-cognition (Watkins & Mortimore, 1999, cited in Cox et al., 2003). Other researchers have suggested that developments in ICT provide unique learning opportunities, hence there is a need to design a new "integrated pedagogy" (Cornu, 1995, cited in Cox et al., 2003). ICT is now changing the roles of teachers, and a compelling rationale for using ICT in education is its potential to act as a catalyst in changing the educational practices (Hawkridge, 1990, cited in Cox et al.,2003). Given the fluidity and debate amongst scholars on the definition of pedagogy, Cox et al. (2003) suggest that instead of trying to define pedagogy, it is better to focus on the educational practice conceptual framework in Figure 2.7 proposed by Alexander (cited in Cox et al., 2003) where pedagogy is one of the aspects of teaching and learning.

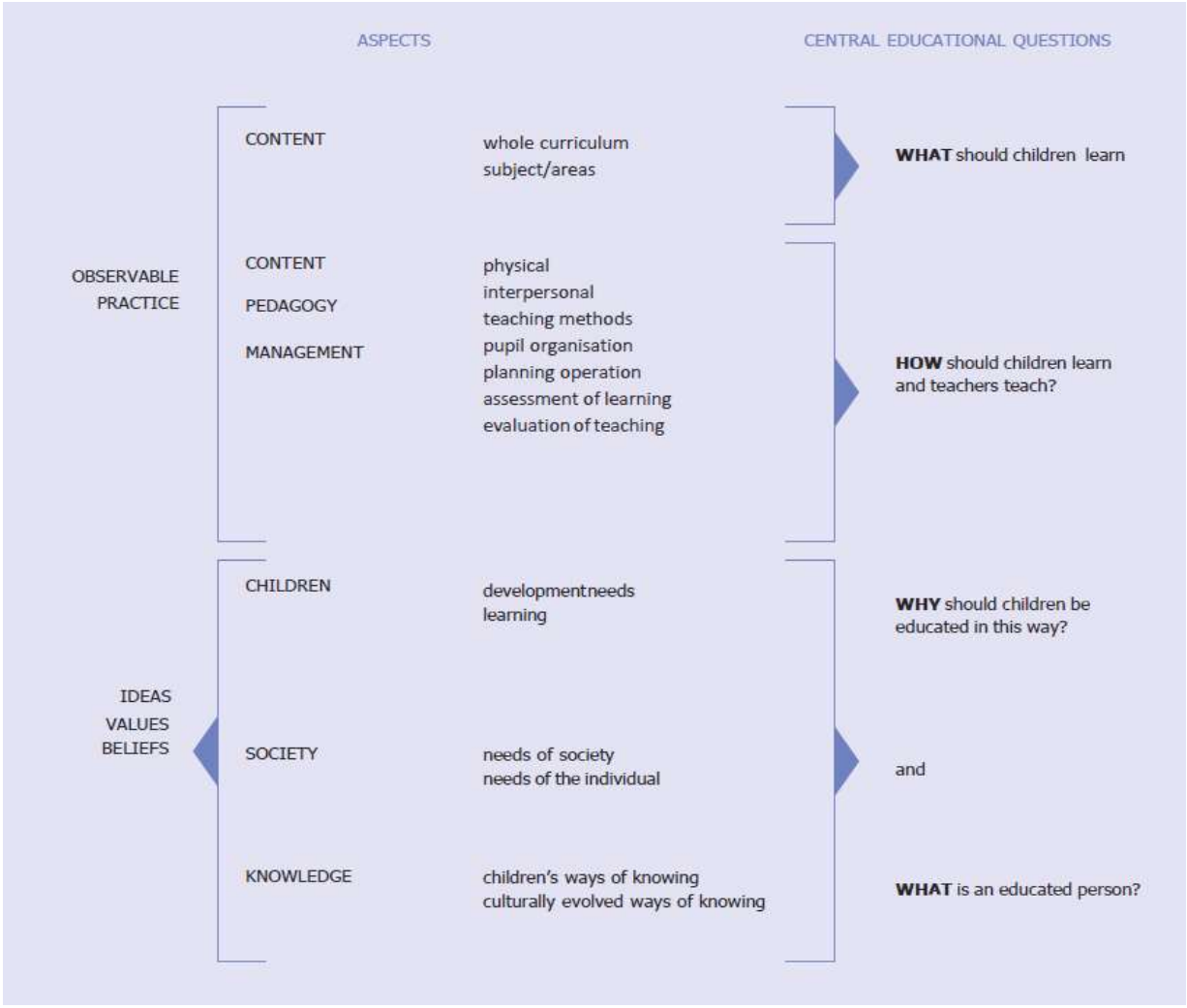


Figure 2.7 - Educational practice: A conceptual framework

Source: (Alexander, 1992, cited in Cox et al., 2003)

Alexander's conceptual framework suggests that pedagogy should be perceived within a broader framework of educational practice. He also argues that educational aspects in his conceptual framework should be treated as the minimum list. It should be possible to expand the list to accommodate the impact of ICT on education. Therefore, the pedagogical value of ICT can be viewed in relation to its impact on the educational practice. A practical example of how ICT has impacted educational practices and thus justifying its pedagogical value in education is illustrated by the Pedagogies for e-Learning Resources (PELRS) a BECTA project which explored ways of transforming teaching and learning through innovative uses of ICT.

Somekh (2007) describes PELRS as a project in which teachers, learners and university-based researchers focused on the question: *Could we organise teaching and learning in radically different ways now that we have the Internet, Internet-look-alike CD/DVD materials, digital imaging, video and other new technologies?* Its findings are summarised in Figure 2.8. Using the findings of the PELRLS project the conceptual framework of educational practice as proposed by Alexander (cited in Cox et al., 2003) can be expanded to include *'Use of ICT'* as an observable practice with implications on how children learn, and teachers teach. *'Location'* is another candidate for observable practice because when ICT is engaged, location can take the form of a school, home or be virtual. '*Pedagogic Strategies'* could be added as another aspect of pedagogy to accommodate an expanded list of new learning approaches such as a) online learning; b) pupils as teachers; and c) pupils as producers of knowledge. These possible changes to the educational practice conceptual framework are illustrations of how ICT is impacting pedagogy and the value it brings to teaching and learning.

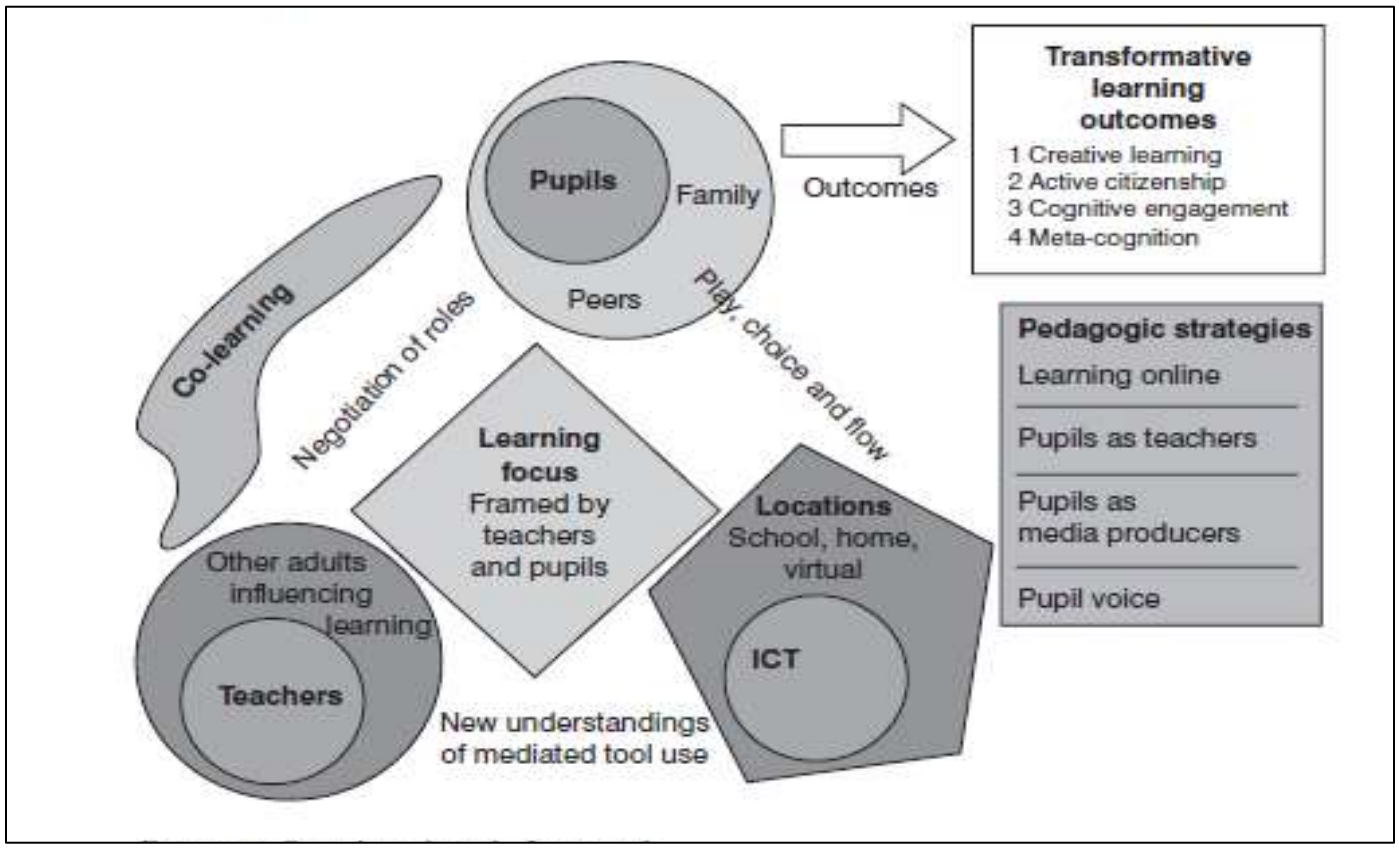


Figure 2.8 – PERLS generic pedagogical framework

Source: Somekh (2007)

Therefore, the proposition is that the pedagogical value of ICT should be measured based on its contribution to the educational practice. The PERLS project was able to demonstrate new pedagogies such as "*Pupils as teachers*", "*Pupils as producers*" and "*Learning Online"* that were the result of introducing ICT into educational practices.

2.4.2. Affordances of ICT

The pedagogical value of ICT has also been justified through its affordances. In the late 1970s, the concept of affordance was developed and introduced by a theorist called J.J Gibson. He regards affordance as a relationship between an organism and an object with the object perceived concerning the needs of the organism (Hammond, 2010). Norman (1988) also made a significant contribution to the body of knowledge on affordances. For Norman (1988), the term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. Norman's theory of affordance is more interested in the role of culture and context as compared to Gibson's theory, which is based on the direct perceptual pick up of an affordance (Hammond,2010). Conole and Dyke (2004) used Gibson's theory and developed a taxonomy of information and communication technologies affordances. The taxonomy of ICT affordance included:

- **Accessibility:** in education, accessibility means that teachers and learners have relatively easy access to vast amounts of information through interactive digital media (internet, hypermedia, CDs and DVDs). However, an increase in the amount of information accessed, has implications for information overload and the need for more critical evaluation of information sources. Hence learners should be taught information analyses skills.
- **Diversity:** is about access to a vast range of diverse experiences that can inform learning using ICT. These include access to information through websites, access to subject experts through communicative media, or the use of simulations to replicate complex concepts. Information technologies provide ways for learners to be exposed to experiences vastly different to their own and extend their experience beyond their communities.

- **Communication and collaboration**: affordance relates to new forms of dialogue and communication that have opened using ICT. ICT offers the potential for teachers to create online communities of learners for communicating and sharing information. Asynchronous communication through involvement in specialized discussion forums and chat rooms between learners and learners or learners and teachers are now possible. Mobile and video communication facilitate communication with any person at any anytime and everywhere. Collaborative ways of working through content sharing and version control mechanisms make it possible for learners to work collaboratively on school assignments. Excessive use of communication and collaboration affordances has led to the emergence of new anxiety often labelled as "FOMO" the fear of missing out (Fielding, 2014). Medical research and statistics also show an increase in incidences of IAD (Internet Addiction Disorder) hence it is incumbent upon teachers and parents to manage learners use and access to digital devices (Fielding, 2014).

- **Reflection and criticality:** are critical at both the Discursive and Experiential level of the Conversational Framework because it enables learners to re-describe their conceptions thus enabling the teacher to address learner misconceptions. However, the quick pace of information change mitigates against reflection. It eliminates time for reflection and deliberation, favouring a more pragmatic, reflexive rapid response to new information.
- **multimodal and non-linear:** Learners can use ICT to move beyond linear learning pathways, which are common in but not specific to behaviourist approaches, and adopt more customized tactics and pathways using a variety of media types and electronic devices. Web browsers, email, wikis, online discussion forums, social networks, YouTube, and any other tool that allows users to study and share information with others are examples of these technologies. New theories of learning such as Connectivism, a theory of learning proposed by Siemens (2004) that are associated with the multi-modal and non-linear characteristics of ICT, are also emerging.

- **speed and immediacy:** affordance of ICT makes it possible for information to be exchanged via the web instantaneously. It is now possible to have new models of teaching and learning such as online schools, online universities, and massive open online courses (MOOC). MOOC content is available to anybody who wishes to enrol and employ open technologies and methods to encourage learning and information sharing across the web.

2.4.3. Conclusion

"we must ensure that information and communication technologies (ICTs) unlock the door of education systems" Khofi Anan (former general secretary of the United Nations)

The pedagogical value of in the use of technology is best summarised by Fullan and Langworthy (2014) who suggest that a new pedagogy is emerging, and can be defined as:

> "the new model of learning partnerships between and among students and teachers, aiming towards deep learning goals and enabled by pervasive digital access" (Fullan & Langworthy, 2014, p. 2).

For Fullan and Langworthy (2014) the instructional elements of the new pedagogy are not 'new' teaching strategies, however what is new is the active learning partnership, made possible by technology. Figure 2.9 illustrates Fullan and Langworthy (2014) concept of new pedagogy. In the era of 'Old Pedagogies', the use of technology was one of three distinct capabilities that teachers employed to cover curriculum content. These capabilities are content knowledge, a teacher's pedagogical capacity and ability to use ICT. With the 'New Pedagogies', the foundation of teacher quality is their pedagogical capacity, a repertoire of teaching strategies, and their ability to form new learning partnership with students. This concept was vividly illustrated in the PERLS project where new learner centric pedagogical strategies emerged e.g., *'Pupil as a teacher'.* Technology has become ubiquitous, and it is used to discover and master content knowledge and to enable the deep learning goals of creating

and using new knowledge in the world. With new pedagogies the traditional role of teachers and textbooks as the only source of content is changed. By exploiting affordances of technology, learners are now able to access, create and use knowledge faster, thus engaging in deep learning tasks. Fulllan and Langworthy (2014) define deep learning tasks as:

> "tasks are energised by the notion of 'learning leadership', in which students are expected to become leaders of their own learning, able to define and pursue their own learning goals using the resources, tools, and connections that digital access enables" (Fullan & Langworthy, 2014, p. 21).

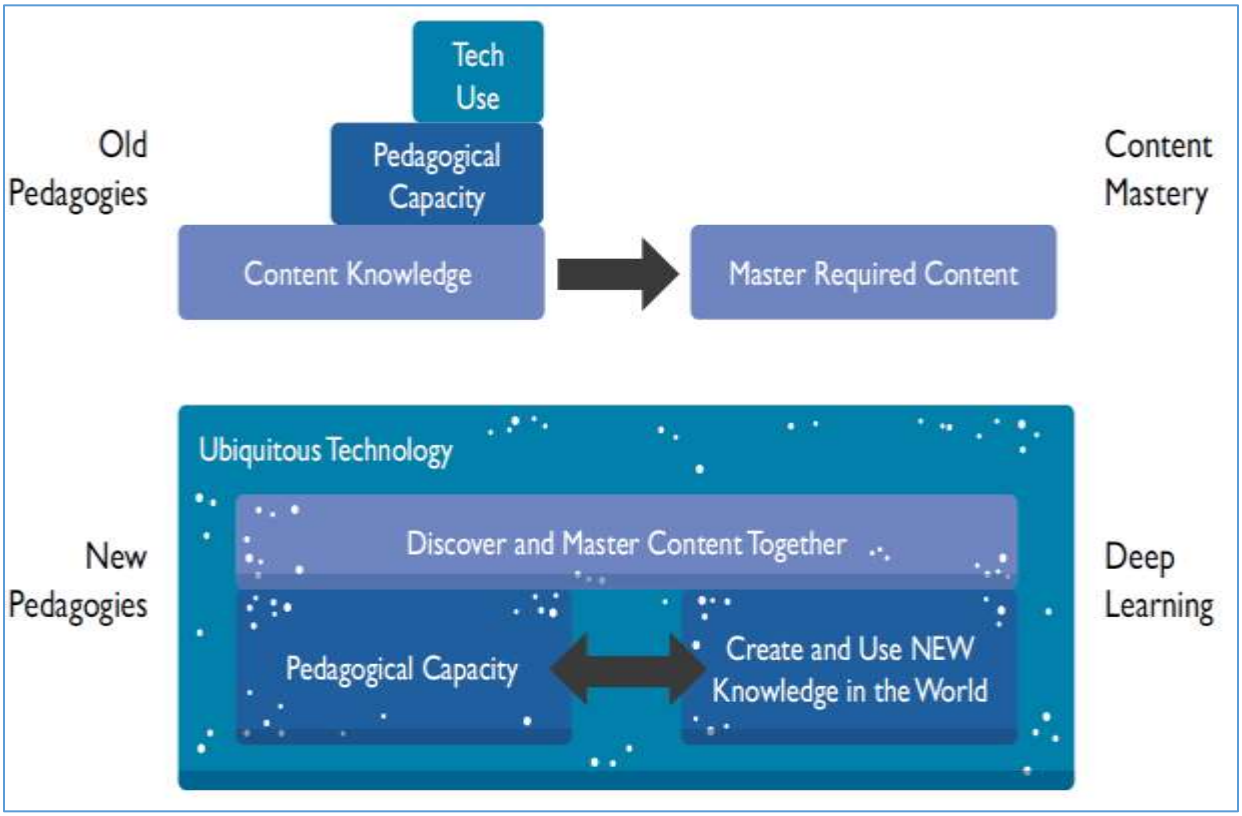


Figure 2.9 – New Pedagogies for Deep Learning

Source: (Fullan & Langworthy, 2014)

However new pedagogies represent the lived experiences of teachers and learners in OECD countries. Hence the call by the former secretary general of the United Nations that ICT must be used to unlock the doors of learning for all. This research report is trying to access the

extent to which the GDE has progressed in realising former secretary general Khofi Anan's vision by analysing how teachers and teaching has changed at GDE schools.

Chapter 3

Methodology and Research Approach

This chapter describes the design of the study. Topics for discussion are anchored on Saunders et al. (2012) "research process onion" framework, which illustrates stages that are considered when developing a research design. The chapter concludes with a discussion of validity, reliability, and ethical issues in research.

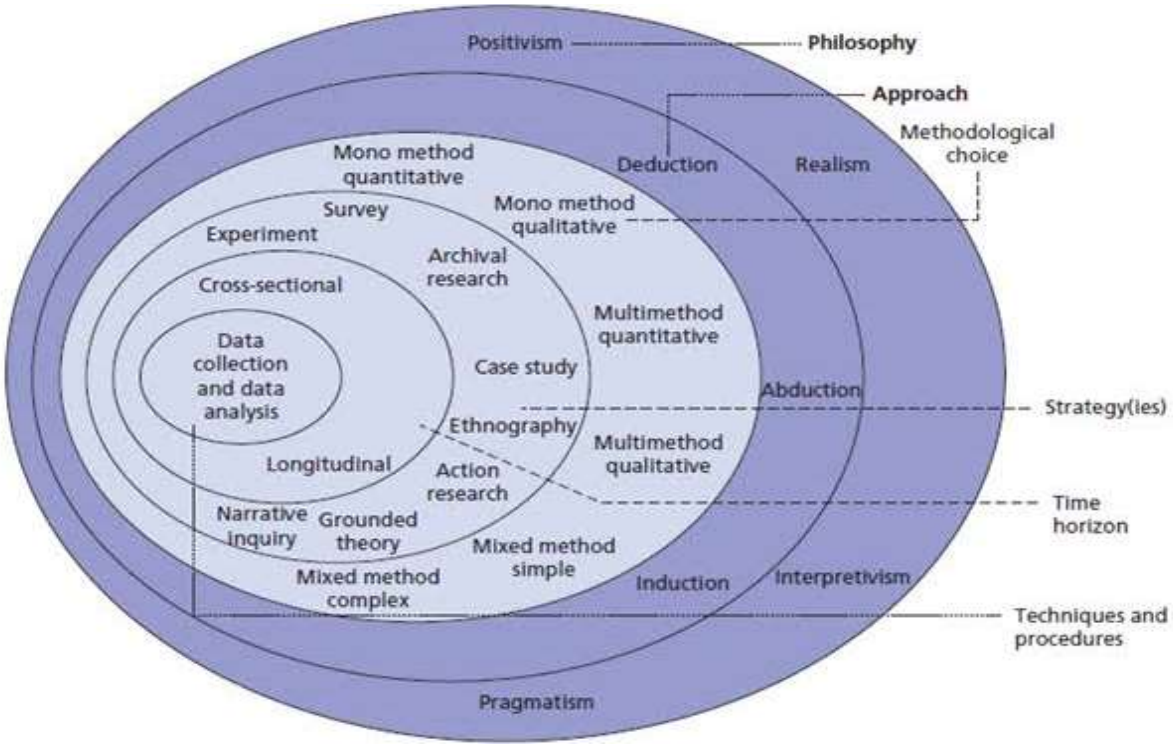


Fig. 3.1 – Research Process Onion

© Mark Saunders, Phillip Lewis, and Adrian Thornhill, 2012

Other researchers, according to Saunders et al. (2000), start with the research approach, and deciding whether to use a questionnaire or conduct interviews. Saunders et al. (2000) argue that:

> "thoughts on this question belong in the centre of the research 'onion' ……Before coming to this central point we argue that there are important layers of the onion that need to be peeled away" (p. 84)

The first of these layers is the ***research philosophy***. According to Burrell and Morgan (cited in Saunders et al., 2019), researchers make several assumptions about knowledge development. These include assumptions about realities we encounter, about human knowledge, and about the extent and ways in which the researcher's values influence the research process. These assumptions influence a researcher's research philosophy, or how he or she formulates research questions, chooses methodologies, and interprets results.

The second layer is the ***research approach*** which considers the subject of the research. The research approach is often portrayed using three contrasting approaches: deductive analysis, abductive analysis, and inductive reasoning.

The third layer is the ***methodological choice*** and considers the research method through which the research objectives will be achieved. Generally, methods are divided into quantitative methods, qualitative methods, and mixed methods.

The ***strategy layer*** is the fourth layer of the 'onion', and it is about developing a plan of how to answer the research questions. It contains clear objectives, it specifies the sources from which data will be collected, and considers probable environmental constraints such as time, access to data, location, money, and ethical issues that the research is likely to encounter (Saunders et al., 2000).

The fifth layer is the ***time horizon*** which answers the important question as to whether the research should be a "snapshot" or akin to a "diary" and be representative of events of a given period (Saunders et al., 2000).

Data analysis techniques and procedures are the sixth and most inner layer of the 'onion'. It describes how data will be collected, tabulated, and organised for further analysis.

The next section presents a description of each layer of the "onion" in the context of this research study.

1. Research Philosophy

The research question *What is of pedagogical value in the use of ICT in the classroom practices of teachers at five South African public schools* makes this research educational research which Bassey (1999) describes as:

> "Critical enquiry aimed at informing educational judgements and decisions to improve educational action. This is the kind of value-laden research that should have immediate relevance to teachers and policymakers and is itself educational because of its stated intention to 'inform'" (p. 39).

The critical enquiry for this research is about understanding how teachers use digital media forms of ICT teaching and the pedagogical reasoning and actions which influence their choice of different ICT media types.

To answer the "What" and "How" questions associated with this research enquiry, an interpretive research paradigm where the primary focus is in observing how teachers use ICT in their lessons to "understand and explain what is going on, rather than change things" (Kelemen & Rumens, 2008, cited in Saunders et al., 2019), is adopted. This study is unquestionably subjective and "value-laden," because people from various cultural backgrounds draw different conclusions and experience different social realities depending on the circumstances (Saunders et al., 2019). Despite the situatedness of lived experiences of teachers, the research seeks to establish a common thread of what represents value for computer-using teachers.

The goal of the study is to add to the body of information about how public-school teachers use ICT in their classrooms, their concerns, and any opportunities afforded by technology for successful teaching and learning.

2. Research Approach

This research study is about studying a social phenomenon i.e., the pedagogical value of ICT in classroom practices of computer-using teachers. In such a study the cause-effect link e.g., between teacher's espoused and enacted practices, cannot be easily established a priori through a theory or a hypothesis, but rather a posteriori after data is collected about the phenomenon in its natural environment, and analysed to arrive at a "possible theory" through induction (Saunders et al, 2009). Thus, this study follows an inductive research approach emanating from the study of a small sample of subjects i.e., computer using teachers, to gather qualitative and quantitative data using a variety of methods to establish whether there is empirical evidence to support a well-reasoned postulation that there is pedagogical value in the use of ICT in lessons.

3. Methodological Choice – Mixed Methods

This multi-case research study is about explaining teacher behaviour concerning the use of ICT in lessons. The mixed methods research is the best methodological choice for this study. The key element of mixed methods research, according to Johnson and Onwuegbuzie (2004), is its systematic pluralism. This study's qualitative technique relies on participant observation in order to generate a rich and detailed description of the research phenomena, which in this case is the study of teaching practices involving ICT. The quantitative approach is used to identify causality through a Stages of Concern survey of teachers' concerns, their attitudes towards ICT and beliefs about its pedagogical value.

Mixed methods research like other research forms, is conducted within a particular philosophical worldview (paradigm). Guba (cited in Creswell, 2009) defines worldview as meaning "a basic set of beliefs that guide action". The types of views that researchers hold will often drive them to adopt a specific study approach. In mixed methods studies, the pragmatic worldview is frequently chosen as the philosophical grounding. For Creswell (2009) pragmatism provides a philosophical basis for mixed methods research because it is not tied to any one system of philosophy and reality. Individual researchers are allowed to choose the study methods, strategies, and processes that best suit their needs and objectives. As a result, researchers in mixed methods research combine both quantitative and qualitative data to provide the best understanding of a research problem. In this multi-case study research, the objective is to understand how teachers employ ICT in their lessons and what influences teacher's pedagogical approach when using ICT, hence a pragmatic approach is a qualitative study of ICT usage and a quantitative survey to expound: teacher's concerns, enacted teaching practices, and beliefs.

4. Research Strategy

This section presents a high-level overview of the research strategy and its implementation through the research design. The execution of the strategy is explained in section 6 of this chapter i.e., Data Analysis Techniques and Procedures.

4.1. Overview

The middle section of the "research process onion" is about determining the research strategy to answer the research questions.

In mixed methods, the first decision is deciding on the research design**.** The decision is often a choice between a mixed model and the mixed method. A mixed model is when qualitative and quantitative approaches are combined at different stages of the research process, and a mixed method is when a qualitative phase is followed by a quantitative phase (Johnson & Onwuegbuzie, 2004). For this research study, a sequential mixed method procedure in which

the findings of the qualitative multi-case study are elaborated on or expanded on with the finding of a quantitative survey is the preferred approach.

4.2. Qualitative Case Study Design

Multi-case study research is the preferred strategy for an interpretive study where value judgement is drawn through an inductive process of analysing data from several case studies. This type of study is often preferred when the objective is to illuminate shared characteristics or to explain differences that often emanate from differences in demographics or institutional culture. A view shared by Miles and Huberman (1994) when they comment about multi-case studies:

> "by looking at a range of similar and contracting cases, we can understand a single-case finding, grounding it by specifying how and where and, if possible why it carries on as it does. We can strengthen the precision, the validity, and the stability of the findings" (p. 29).

In literature, one finds many descriptions of qualitative case studies. Merriam (1998) proposes disciplinary orientation, function, and intent as the best method for differentiating between different types of case studies. This multi-case study research is an evaluative study whose intent is to describe and explain how teachers engage ICT in their classroom practices using Laurillard (2002) Conversational Framework. Findings are subjected to a subjective judgement on the pedagogical value of ICT integration using the Amory et al. (2015) framework for effective ICT integration in education.

Once a decision is made on the research strategy, the next step is the selection of a research design to implement the strategy. For this multi-case study research, sampling principles were applied in the selection of teachers, schools, grades, and lessons to be observed.

4.3. Sampling Approach

4.2.1. Selection of Schools

A selection criterion for participating schools was established and included: township public schools (Grades 7 to 12); located in the Tshwane Districts of the Gauteng Department of Education; and schools where some of the teachers have integrated ICT in their pedagogy. The help of the district e-learning departments was enlisted to identify the five public schools that satisfied the selection criteria.

A stratified sampling approach was used to subdivide the population of schools in the Tshwane Districts into five subgroups. The Department of Basic Education quintile classification method was used where: quintile five schools are in the top 20% of an affluent community; quintile four schools are in an affluent community; quintile three schools are in a middle-income community; quintile two schools are in a poor community; quintile one schools are in the bottom 20% of a poor community. One school which fits the selection criteria was selected from each subgroup.

School S1 is a secondary school located in the affluent community of the Soshanguve township, hence classified as a quintile five public school. Each classroom at the school has an interactive whiteboard, a smartboard that is connected to the school's wide area network through the ethernet cable system. Learners and teachers have been issued with tablets and laptops. The school has an ICT Committee headed by an ICT Co-ordinator responsible for coordinating, planning and procuring ICT infrastructure for the school.

School S2 is classified as a quintile 1 school in the Soshanguve township. The ICT infrastructure in the school consists of a computer laboratory that has become dysfunctional due to outdated desktop computers. The school has a functioning local area network, a server, a Wi-fi extender in classrooms for wireless internet connectivity and non-functioning interactive whiteboards. At the time of conducting this multi-case study research smartboards in most of the classrooms were not functioning due to vandalism and theft of the smartboard's hard

drives. The school has an ICT Committee headed by an ICT Co-ordinator responsible for coordinating, planning and procuring ICT infrastructure for the school.

School S3 is in an affluent community of the Mamelodi township, hence classified as a quintile 4 school. The ICT infrastructure in the school consists of smartboards, a local area network, a server, internet connectivity using ethernet cables and non-functioning interactive whiteboards. Teachers have access to laptops and learners have been issued with laptops. However, internet connectivity has been disabled by the Gauteng Department of Education because teachers and learners are alleged to be abusing the internet through excessive personal use of non-educational activities. The school has an ICT Committee headed by an ICT Co-ordinator responsible for coordinating, planning and procuring ICT infrastructure for the school.

School S4 is in the poor community of the Soshanguve Township and is classified as a quintile 2 school. The school has a functioning local area network, a server, a Wi-fi extender in classrooms for wireless internet connectivity and non-functioning interactive whiteboards. Teachers have access to laptops. Learner's tablets have been confiscated by the Gauteng Department of Education because it is alleged that learners are using them for non-educational purposes. Most of the smartboards in the school are not functioning properly because they have been vandalised and hard drives were stolen. The school has an ICT Committee headed by an ICT Co-ordinator responsible for coordinating, planning and procuring ICT infrastructure for the school.

School S5 is a quintile 3 primary school in Atteridgeville township. The school has functioning smartboards. Grade 7 teachers and learners have tablets and laptops. The school currently does not have internet connectivity, however, there are plans to install the internet. The school has an ICT Committee headed by an ICT Co-ordinator responsible for coordinating, planning and procuring ICT infrastructure for the school.

4.2.2. Selection of Teachers

Purposeful sampling enables a researcher to use his/her judgement on the selection of cases that will best enable research questions to be answered. There are several strategies that a researcher can employ in the selection process. For this research, homogeneous sampling principles (Saunders et al., 2000) were used to select teachers who use computers in their lessons.

Teacher T1 is a Grade 8 and 9 Geography teacher. He has a Bachelor of Education degree and a post-graduate honours degree in education. Currently studying for a masters' degree in education. T1 has been using ICT in his lessons for at least one year and has been a teacher since 2019. He considers his ICT skills as intermediate between a novice and an expert. T1 has had pre-service training on the use of ICT in education in his undergraduate studies, as well as in-service training provided by the GDE on the use of smartboards, interactive whiteboards and how to access and use GDE's Digital Content. He is an ICT coordinator at his school.

Teacher T2 is a Grade 8, 9 and 10 Mathematics teacher. He has a Bachelor of Education degree specialising in natural sciences and currently studying a post-graduate honours degree in education specialising in computer-integrated education. T2 has been using ICT in his lessons for more than 5 years and has been a teacher for 8 years. He considers his ICT skills to be at the level of an expert. T2 has had pre-service training on the use of ICT in education during his undergraduate studies, as well as in-service training provided by GDE on the use of smartboards, interactive whiteboards and how to access and use the GDE Digital Content. His interest in the use of ICT in lessons was particularly influenced by how some of his lecturers used ICT in lectures during his undergraduate studies. At his school he was previously an ICT co-ordinator, a position he relinquished when the school did not accede to his request for additional compensation or incentives for taking on additional responsibilities beyond his teaching role. However, he is seen as the “IT expert” of the school whom everyone consults whenever they experience problems with IT infrastructure.

Teacher T3 is a technology and mathematics teacher for Grade 7. He is currently in his second year as a teacher and started teaching in 2020. GDE introduced smartboards at his school in 2021 hence he considers himself a novice when it comes to the use of ICT in teaching and learning. T3 has not had formal training (both pre-service and in-service) on the use of ICT in teaching however he has shown interest in ICT and currently serves as an ICT co-ordinator at his school.

Teacher T4 is a Grade 11 and 12 Accounting teacher. He has a bachelors' degree in education. T4 has 3 years of teaching experience and has been using ICT in his lessons for two years. He considers himself an expert ICT user and has had pre-service and in-service ICT training. He is an ICT co-ordinator at his school providing first-line ICT infrastructure support, responsible for training needs analysis, and provisioning of laptops for teachers and learners.

Teacher T5 teaches physical sciences to Grade 10,11, and 12 learners. He has been teaching for 28 years. His training on ICT has mainly been in-service training provided by GDE. T5 has been using ICT in his lessons for more than five years and considers his ICT skills to be intermediate i.e., neither a novice nor an expert. T5 is fully committed to computer integrated teaching and uses ICT in most of his lessons.

In summary, the purposeful sample of five teachers selected for this multi-case study research consists of:

- A homogeneous sample of ICT using teachers.
- Two novice ICT using teachers as measured by the number of years of using ICT in lessons i.e., less than two years.
- One intermediate ICT using teacher i.e. has been using ICT in lessons for two to three years.
- Two expert ICT using teachers i.e. have been using ICT in lessons for three years or more.

4.2.3. Selection of Grade

The fieldwork of this research study was conducted in 2020, the year of a global Covid-19 coronavirus pandemic which resulted in the closure of schools that were later reopened albeit limited to Grade 7 and 12. The closure of schools lasted for 3 months. Schools were reopened in June/July leaving only 2 quarters of schooling. It is for these reasons that the researcher selected Grade 7, 8, 9, 10 and 11 learners as the convenience sample (Saunders et al., 2000) because Grade 12 teachers were under pressure to make up lost time to prepare learners for the final matriculation examinations. The researcher felt that Grade 12 teachers would adopt teaching approaches that were biased towards preparing learners for assessment by covering the curriculum as quickly as possible thus creating enough time for revision. In such a situation, knowledge acquisition is often sacrificed for drill and practice. On the other hand, Grade 7 to 11 teachers were not under the same pressure as Grade 12 teachers and the assumption is that they would approach their teaching in a manner that reflects their understanding of the content, ensures knowledge acquisition, and use ICT in a manner that reflects their beliefs about the role of ICT in teaching and learning.

4.2.4. Selection of Observation Lesson Subjects

The maximum variation sample selection approach (Saunders et al., 2000) was applied to the choice of subjects that would be observed during lesson observation. Using this approach mathematics, geography, accounting, and technology studies were included in the sample of lessons to be observed. Variation of subjects is important to confirm whether there is any relationship between the digital media form and the subject matter.

4.4. Quantitative Survey Design

A survey is conducted as part of the sequential mixed method design where the qualitative multi-case study is conducted first followed by a quantitative cross-sectional survey. The cross-sectional survey is administered to a sample of five ICT using teachers selected for the multi-case study research. According to Scott and Morrison (2006), there is a wide range of survey definitions. For this multi-case study research, the preferred definition is that of Cohen et al. (cited in Scott & Morrison 2006) which defines educational research survey as:

> " Typically, surveys gather data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationship between specific events" (p. 169).

In this multi-case study research, the survey is used to describe existing conditions about teacher concerns with the use of ICT, and factors that influence enacted practices about how they use ICT.

Further detail on the instruments used to administer the survey is described in Section 6.2.3 of this chapter.

5. Time Horizon

In September 2014 the Gauteng Department of Education (GDE) Member of Executive Council (MEC), Mr Panyaza Lesufi announced the "Classroom of the Future" project, an initiative to ensure that all schools in Gauteng have connectivity in classrooms, e-learning teaching approaches are adopted, and ICT resources are used for teaching and learning. The initiative included provisioning of interactive whiteboards, network servers, teacher devices in the form of laptops and learner devices in the form of tablets. This research study is a time-bound cross-sectional study to assess the current usage of ICT in the Tshwane Districts of the GDE. Using a multi-case study research strategy, a sample of five teachers from five public schools in the Tshwane District of the GDE are the subjects of the study. One lesson by each teacher

participating in the multi-case study research is observed including a semi-structured interview and field notes taken during the lesson observation. The objective is to observe how teachers are employing ICT in their lessons in support of the GDE ICT strategy for schools.

6. Data Analysis Techniques and Procedures

The last and innermost layer of the "research process onion" focuses on data analysis techniques and procedures employed in a research study. This research employs three techniques: observation of teacher lessons, semi-structured interviews, and a Stages of Concern survey. The research techniques are supplemented with field notes for context and detailed description to enable an inductive analysis of research data.

6.1. Overview

As a research tool, observation entails the systematic recording, description, analysis, and interpretation of people's actions (Saunders et al., 2000). Gold (cited in Merriam, 1998) developed a typology of participant observation which proposes four roles in an observation: complete participant; complete observer; observer as a participant; and participant as observer. In this research study, the researcher plays the role of the observer as a participant. According to Merriam (1998) in this role, the researcher's observer activities are known to the participants. In the case of this research, participants are computer using teachers, and the researcher's participation in the study is secondary as an information gatherer. The researcher sort permission from all the role players in the Gauteng department of education (head office, district office, selected school principals, ICT using teachers at selected schools, parents of learners in classrooms lessons to be observed and learners) to conduct the research and outlined how the lesson observation will be conducted. During the lesson observation, the researcher assumed a passive "membership role" of sitting at the back of the classroom and used a video camera to record the lesson without interfering or participating in the lesson activities.

A semi-structured interview is another research technique used in multi-case study research. In our everyday life, people engage in person-to-person conversations. However, research interviews are a special type of conversation, which Dexter (cited in Merriam, 1998) define as a conversation with a purpose.

Interviews are conducted with selected ICT using teachers to establish amongst others: their pedagogical reasoning when preparing lessons where ICT is integrated into a lesson, the difference or alignment of espoused and enacted practices in so far as the use of ICT is concerned, gain an understanding of what teachers consider to be the pedagogical value of integrating ICT into their lessons and finally understand what teachers view to be constraints and enablers of effective ICT integration in education.

Change Management issues are analysed using the Stages of Concern dimension of the Concerns-Based Adoption Model. The CBAM model was developed in the 1970s and included diagnostic tools which have been continuously updated throughout the years that CBAM has been used to measure the success of educational innovation and reform. Stages of Concern are measured using the Stages of Concern Questionnaire (SoCQ) together with analytical tools to interpret teacher responses (George et al., 2013). In terms of the Level of Use dimension of the CBAM model, the multi-case study research is focusing on teachers that are already using ICT in their lessons, who might be at level 3 (Mechanical State) to 6 (Renewal) in the Level of Use of ICT in lessons. Therefore, the general assumption on the Level of Use is that all teachers in the multi-case research study are users of ICT and concerns would typically represent those of a user and not someone who is still intending to use ICT and therefore has anxiety about what the future holds.

6.2. Tools and Analysis Techniques Description

6.2.1. Lesson observation approach

An Observation is a descriptive account of details about an activity or social scene. Hence a researcher needs collect as much information as possible in order to have a thorough grasp of the phenomena under investigation. McMillan and Schumacher (2010) suggest the use of a participant observation grid, a framework for capturing critical information in an observation. Using McMillan and Schumacher (2010) guidelines, an observation guide detailed in Table 3.1 is used to capture enacted practices of teachers relating to the use of ICT in a classroom.

Table 3.1 – Observation guide

Observation	Description
Who is in the classroom	• No. of learners • What are their kinds or identities?
What is happening in the classroom	• What subject is the teacher teaching? • What are the lesson objectives? • How long is the lesson? • In what activities are learners engaged? • What is the role of ICT in those activities? • What is the role of the teacher and how does he/she organise and manage the teacher/learner interactions?
Where is the teaching taking place	• What are the physical settings of the classroom? • What natural resources and technologies are used? • How does the teacher allocate and use space and physical objects?
How does the use of ICT interrelate with the lesson objectives and the subject matter?	• How is ICT employed to achieve lesson objectives?

	• Is there any correlation between selected ICT tools and pedagogy for the subject?
Why does the teacher use ICT in the lesson	• What are his/her beliefs about ICT • What affordance of ICT did he/she exploit

A key objective of this research is to observe how teachers engage different digital media forms to achieve lesson objectives. Table 3.2 is an example of the instrument used for recording the teacher and learner interaction where ICT is used. It is based on Laurillard (2002) Conversational Framework. Instances where a teacher or a learner uses a specific digital media type, are recorded to identify:

- the type of media,
- how it is used in the teacher/learner interaction,
- in what activity of the classroom interaction it was used,
- what learning experience is facilitated through the digital media, and
- description of the learning experience.

Information captured in Table 3.2 is critical for the analysis of how ICT is used in the classroom practices of participating teachers.

Tables 3.2 – ICT Engagement Form

Classroom Interaction	Media Engaged	Media Type	Learning Experience	Learning experience description
1. ***Teacher*** can describe the conception	PowerPoint	Narrative	Attending	The teacher uses PowerPoint to focus the learner's attention on the lesson objectives and subject content.
2. ***Learner*** can describe the conception	Internet	Interactive	Investigating and Analysis	Learners are asked to conduct a quick internet search for a definition of a concept.
3. Resulting from the ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	***Learning activity not part of the conversation*** Teacher did not engage learners to confirm their understanding of the concept			
4. Resulting from the ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	***Learning activity not part of the conversation*** Learners not engaged to act on the teacher's explanation or re-description of the concept			
5. ***Teacher*** can change the task goal because of ***Learner's*** description or action	***Learning activity not part of the conversation*** Teacher unable to deal with learner misconceptions in the absence of engagement to surface understanding.			
6. A task goal can be set by the ***Teacher***	PowerPoint	Narrative	Relating experience to theory	The teacher uses PowerPoint to present practical examples of the theory covered in the lesson.

				The PowerPoint presentation includes a formative assessment of the learner's understanding of the topic content.
7. ***Learner*** can act to achieve task goal	Internet	Interactive	Investigating and analysing	Learners are encouraged to use the internet to respond to the Teacher's formative assessment
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	Mathematics application software	Adaptive	Relating theory to practice	The teacher uses mathematics software with online questions and answers. The software guides a learner to the correct answer
9. The ***Learner*** can alter their actions in response to feedback on their actions.	Mathematics application software	Adaptive	Investigating and analysing	Learners respond to an online quiz and fix their mistakes based on guidance from the software
10. ***Learners*** can adjust their actions in response to the ***Teacher's*** description or re-description.	***Learning activity not part of the conversation*** Learners not afforded opportunity to apply Teacher's description or re-description of the content			
11. ***Learners*** might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation*** Learners not afforded opportunity to articulate their understanding of the content through revision exercises or formative assessment			
12. ***Teacher*** can alter re-description by reflecting on ***Learner's*** actions.	***Learning activity not part of the conversation*** The teacher summarises the lesson content and focuses on areas where learners struggled to understand concepts being taught.			

Table 3.2 is an example of how the ICT Engagement Form would be used to record a teacher's lesson. Activities 3 to 5 and 10 to 12 of the ICT Engagement Form indicate that the "Learning activity was not part of the conversation" because activities of a teaching and learning dialogue as defined in the Conversational Framework can only be covered using several media forms to support a teaching strategy that is discursive, interactive, adaptive, and reflective.

Lessons are also evaluated to assess effective integration of ICT. Amory et al. (2015) proposes a conceptual framework of assessing the effective integration of ICT in teaching practices as outlined in Table 2.2. According to Amory et al. (2015) effective use of ICT can be assessed in three dimensions, namely:

- notions of learning,
- type of use, and
- models for learning design.

Table 3.3 - Effective integration of ICT in education

Independent variables	Pedagogical Approach						
Notions Learning	Acquisition	⟷	Participation	⟷	Contribution		
Type of Use	Instructive	⟷	Cognitive	⟷	Mediative		
Models for learning design	Reproductive	⟷	Interactive	⟷	Conversational	⟷	Transformative

Notions of learning describes the way learners learn. ICT could be used to facilitate *acquisition of knowledge* through cognitive processing of information by individual learners. Whilst in a *participation model*, learning takes place between an individual and others where information

technology is used as an enabler of interaction. *Contribution* refers to knowledge creation practices by individual learners using ICT tools such as modelling software to build something. Laurillard (2002) refers to this type of ICT as productive digital media. In this mode, ICT is mainly used by learners in self-directed discovery learning.

Type of use in Table 2.2 refers to how ICT is deployed in teaching and learning. *Instructive approaches* are instances where teachers integrate ICT in a passive and teacher centric manner. *Cognitive approaches* refer to use of ICT as a 'mind tool' e.g., to represent authentic contexts and activities in learning. ICT is used in *Mediative approaches* to aid learners in the development of knowledge, such as the use of tools to solve problems.

Models for learning design describes the pedagogical reasoning and actions which influence a teacher's choice of ICT tools to support a specific lesson objective(s). In a *reproductive approach* the lesson objective is for learners to learn and reproduce information. An *interactive approach* encourages learners to use ICT to learn by interacting with the subject content through watching video material, listening to audio material, and using computer aided instruction software which includes formative and normative online assessments. *A transformative learning design* model employs authentic tasks in teaching and learning, with designs that have real-world relevance, ill-defined and complex, that allow learners to examine ideas from various perspectives, and are integrated across subject areas.

6.2.2. Semi-structured Interviews

Semi-structured interviews are used to probe teachers' pedagogical reasoning and actions when it comes to the use of ICT as a resource for teaching. Appendix C is a sample of interview questions to probe teachers' espoused practices on the use of ICT in lessons. Interviews are conducted at least 4 hours before the lesson observation.

6.2.3. Concerns Based Adoption Model – Analytical Tools

The data collection mechanism for Stages of Concern is through a survey questionnaire. The data analysis tools are collectively referred to as the Stage of Concern Scoring Device (George

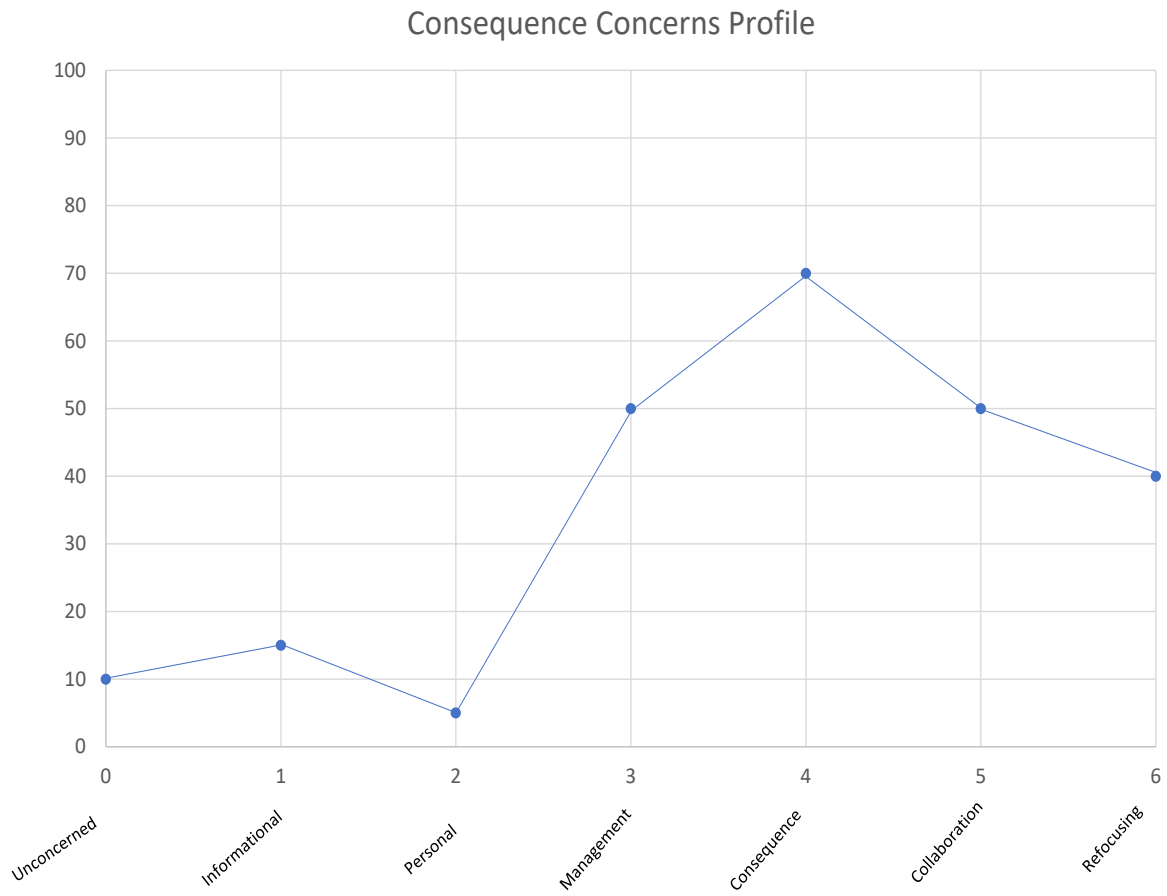
et al., 2013). The scoring device can be administered manually if the sample size is small or automated using computer software for large sample sizes. The scoring device for small samples is referred to as the Stage of Concern Quick Scoring Device (see Appendix B).

6.2.3.1. Survey Questionnaire

35 questions (see Appendix A) are mapped to each stage of concern. The questions relate to the "innovation" a department of education would have introduced in schools. For this multi-case study research, the "innovation" is the deployment of ICT infrastructure in Gauteng schools and the expectation that teachers will use this infrastructure for teaching. According to George et al. (2013) respondents mark each item of the questionnaire on a (0 to 7) Likert Scale according to how true the item seems to them. High numbers indicate high concern and a "0" indicates very low concern or completely irrelevant items.

6.2.3.2. Scoring the Stages of Concern Questionnaire

Scoring the questionnaire requires calculating a raw score for each of the seven stages. The raw scores are then captured in table B and C of Appendix B. The total scores of each stage captured in Table C of Appendix B are matched against the percentile score in table D of Appendix B. According to George et al. (2013), the percentiles are based on the responses of 830 individuals who completed the 35-item questionnaire in 1974. The individuals were carefully selected in a stratified sample of both basic education and higher education institutions. Percentile scores obtained from table D are then plotted on a graph, or "profile" in table F of Appendix B. An example of a teacher with a Consequences Concerns profile on the use of the innovation on learners/students is depicted in Figure 3.2. Profiles of respondents depicted using the graph are not necessarily a true reflection of a teacher's views about the innovation, they represent a hypothesis and should be verified with the respondents (George et al., 2013).



Source: (George et al., 2013)

Figure 3.2 Consequence concerns profile

The teacher profile in Figure 3.2 is that of an educator who is concerned about the influence of innovation on learners. In the context of ICT, the concern could be about unequal access to devices such as laptops, mobile phones, data bundles for internet access and learner abuse of ICT devices through access to prohibited websites. Once profiles of all the respondents have been plotted, the researcher should be able to construct a holistic perspective and a description of the relative intensity of the Stages of Concern about a particular innovation for all the respondents (George et al., 2013).

7. Validity, Reliability and Ethical Considerations

Educational research is conducted within a social context. Hence design considerations should go beyond the "technical" aspects as articulated in Saunders et al. (2012) "research process onion". Social concerns about validity, reliability and ethics are as important as the research design. According to Merriam (1998), the applied nature of educational research makes it imperative that researchers and other stakeholders in the educational sphere, should have confidence in the conduct of the research and the results that it produces.

Reliability refers to the extent to which research findings can be reproduced (Merriam, 1998). This section covers an overview of philosophical debates about the generalisability of qualitative research as well as strategies to test dependability or consistency of research findings and how they have been applied in the multi-case study research.

When conducting research, ethics refers to how we act or should act toward the people with whom we interact. It entails forging a bond with study participants that is based on human dignity and integrity, as well as the ability to be trusted.

7.1. Validity

In research two types of validity have been developed, namely internal and external validity (Scott & Morrison, 2006). According to Merriam (1998), internal validity is the measure of how research findings match reality. However, sociology scholars do not agree with the definition of reality. Notwithstanding the differences on the issue of what constitutes "reality", scholars are generally in agreement on strategies to enhance internal validity. These include triangulation, member checks, long-term observation, peer examination, participatory or collaborative modes of research and clarifying researcher's biases (Merriam, 1998).

External validity is concerned with the extent to which the findings of one study can be transferred to other situations i.e., how generalisable are the conclusions of a research study (Merriam, 1998). The issue of generalisability remains a hotly debated topic amongst social

scientists because of the situatedness of qualitative case studies. Most scholars believe that if generalisation is reframed to reflect qualitative inquiry's underlying assumptions, generalisation from small, non-random samples is achievable (Merriam, 1998).

Scott and Morrison (2006) further contend that positivist/empiricist researchers understand the notion of validity in a different way from interpretivist researchers. This research is conducted in an interpretive research paradigm and validity is established using Guba and Lincoln (cited in Scott & Morrison, 2006) criteria of:

- *Credibility,* which indicates whether respondents agreed that the researcher accurately portrayed their reality conceptions. This principle was applied to the Stages of Concern survey through confirmation from respondents that the Stages of Concern profiles derived from the survey responses reflect their views about ICT deployment at their schools.
- *Confirmability* indicates whether the analysis is based on data and whether the inferences drawn from the data are reasonable and useful. Espoused practices of research participants are captured through interview notes. Enacted practices are captured through video recordings of lesson observations and analysed using the ICT Engagement Form (based on Laurillard's Conversational Framework).

7.2. Reliability

Reliability is about the extent to which research findings can be replicated. Reliability is a challenge in the social sciences because human behaviour is not static, hence Merriam (1998) argues that:

> "because what is being studied in education is assumed to be in a state of flux, multifaceted, and highly contextual, because the information gathered is a function of who gives it and how skilled the researcher is at getting it, and because the emergent design of a

qualitative case study precludes a priori controls, achieving reliability in the traditional sense is not only fanciful but impossible" (p. 206).

The fact that the concept of reliability seems to be a misfit in qualitative research does not mean that it's "free for all" and that researchers do not have to worry about the credibility of their research findings. Hence Lincoln and Guba (cited in Merriam, 1998) suggest that researchers should rather focus on "dependability" or "consistency" of their research findings. Outsiders or report findings users should concur that, given the data collected, the results make sense i.e., they are consistent and dependable.

The multi-case study research report includes a detailed account of the research design, a description of the data collection and analysis approach and well a detailed account of findings. The detail is provided for the report users to decipher the consistency and dependability of the study.

7.3. Ethics

Ethical issues occur in all stages of research. Saunders et al (2000) identify the following general ethics issues in different stages of research: privacy issues of participants; voluntary nature of participation and the right to withdraw partially or completely from the research process; consent and possible deception of participants; maintenance of the confidentiality of data provided by individuals or identifiable participants and their anonymity; the reaction of participants to how the researcher seeks to collect data; effects on participants of how data is used, analysed and reported; and behaviour and objectivity of the researcher especially during collection, analysis and reporting of research findings. The researcher in this multi-case study research study is mindful of these issues and addressed them as follows:

- **Consent and possible deception of participants:**

  the researcher sort informed consent by ensuring that all the relevant stakeholders are informed about the study and consent is formalised through signed consent forms. Initial

consent was obtained from the Gauteng Department of Education (see Exhibit 1). The GDE request form informed the department about the purpose of the research, the value of the research to education, proposed research method, details of institutions involved in the research, a declaration by the researcher confirming acceptance of conditions associated with the granting of approval and a declaration by his supervisor confirming that questionnaires, interviews and lesson observations meet ethics standards as defined by the GDE. The GDE consent formed part of the submission to the Human Research Ethics Committee (HREC) of the School of Education at the University of Witwatersrand where the researcher sort permission to research to fulfil requirements towards a master's degree in education (ICTED) qualification (see Exhibit 2). Key information submitted as part of the approval process included: the purpose of the research, method of collecting data on human research participants, description of research participants, method of obtaining informed consent, protection of participant identities, and protection of data during and after the research. Once permission to conduct the research was granted by the HREC and the GDE the researcher sort permission from the Gauteng Tshwane Districts of the GDE to approach principals of five public schools to identify five computer using teachers to participate as subjects in the research (see Exhibit 3). At each school included in the research sample group, participant information sheets and consent forms were prepared and discussed with the stakeholders which included the school principal, selected teachers, learner's parents and learners. All these activities were undertaken to ensure that the research is conducted based on Informed Consent by all the stakeholders.

- **Maintenance of the confidentiality of data provided by individuals or identifiable participants and their anonymity:**

  confidentiality is managed by ensuring that research data is not shared with anyone. Only the overall teacher assessments are used in the written report. Research data (notes, questionnaires, and video material) are stored electronically on the researcher's computer.

To achieve anonymity, the research uses pseudonyms of schools and teachers. Learners are not the unit of analysis in this multi-case study research; hence they are not mentioned in the research report.

A generic description of where the schools are located is used. There is no mention of demographic information such as gender, race, and position of the teacher in a school.

- **The voluntary nature of participation and the right to withdraw partially or completely from the research process:**

  is handled in the informed consent form by giving participants an option to affirm that their participation is voluntary and have the right to withdraw at any time from the research process.

These and other measures such as how to conduct ethical interviews by avoiding demeaning questions to participants, making it clear to interviewees that they have the right to decline to respond to any question, constitute the ethical research approach adopted in this multi-case study research.

Chapter 4

Data Collection and Analysis

This chapter covers the primary research data collected from five public school teachers through unstructured interviews, lesson observation and a survey questionnaire. The researcher collected data in three stages. First, through pre-lesson interviews with selected teachers. The researcher allowed a time-lapse of two days to a week before proceeding to the next stage. Second, through lesson observation. Third, through the Stages of Concern Questionnaire administered after the lesson observation. The researcher followed this sequence to preserve the validity of each stage.

4.1. ICT Learning Support Tools

The smartboard, a large interactive display in the form of a whiteboard that can either be a standalone touchscreen computer used independently to perform tasks and operations, or a connectable device used as a touchpad to control a computer, is the most common ICT learning support tool used in most schools. At schools where there is internet connectivity, teachers tended to use a smartboard as a standalone touchscreen computer to access content stored on the devices as well as content accessed through the internet. In instances where a teacher wishes to present his/her content, the smartboard is used as a connectable device to a teacher's laptop or tablet computer.

Another digital learning *(see Figure 5.4 on page 141 for definition of digital learning)* aid found in schools that were included in the multi-case study research is the interactive whiteboard. An interactive whiteboard is a large whiteboard the size of a traditional chalkboard, that connects to a computer or an interactive projector. An Interactive whiteboard has touchscreen capabilities that only work with a stylus pen. Teachers have abandoned these devices and are now using them for writing supplementary notes of content projected through a smartboard i.e., they have become traditional "chalkboards" on which a teacher can write

using a coloured marking pen. They also serve as backup devices whenever smartboards are out of service due to technical problems.

The picture below depicts ICT infrastructure typically found at all the schools in the multi-case study research.

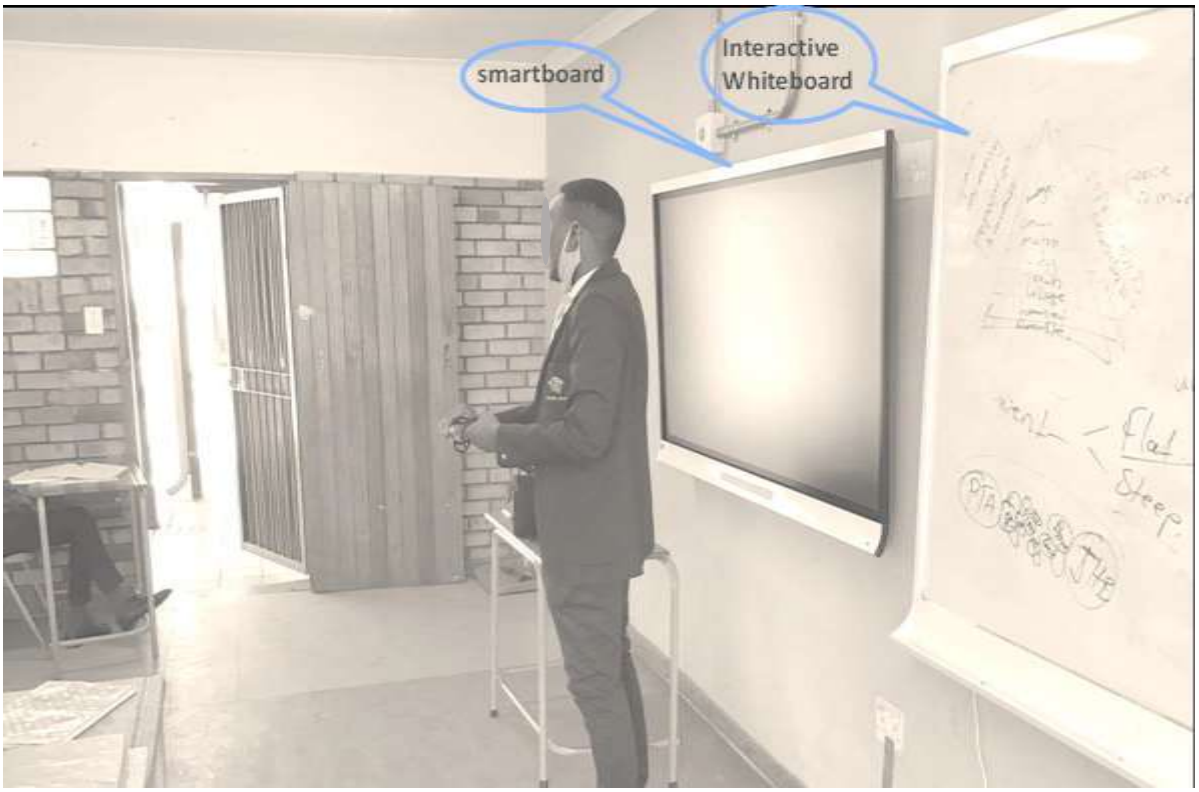


Figure 4.1. – classroom with smartboard and an interactive whiteboard

Teachers at all the schools included in the multi-case study research had access to application software such as the Microsoft Office platform accessed through their laptops or the smartboard, video content such as lessons accessed through YouTube, and content accessed through popular information search engines such as Google, Microsoft Bing and Yahoo. The most extensively used platform for content is the Gauteng Department of Education Digital Content and Online Assessment platform.

The MEC for education and youth development of the Gauteng Province Mr Panyaza Lesufi has this to say about the platform:

" Taking notes or cramming when a teacher delivers a lesson in class will be no more…..

Imagine a world where all parents can log on when assisting their children with homework.

A world where teacher's lesson plans are freely available. Imagine no further."[17]

GDE's content platform supports teaching and learning by providing interactive lessons through videos, two and three-dimensional animations with audio to enable content such as virtual experiments in subjects such as physical sciences. The platform enables learners to access revision material such as past examination papers which include step-by-step videos of how to approach and respond to exam questions. It can also be used as an online collaboration platform amongst teachers, learners, and subject advisors. Figure 4.2 is a screenshot of the GDE Digital Content landing page captured during a lesson.



[17] Source: ITWeb article of 14.10.2019 "Gauteng education's digital content platform goes live"

Figure 4.2 – GDE digital content platform

There are three repositories on the GDE digital content platform:

My Supplementary Digital Learning Resources (My SDLR): This is the main content repository used by both teachers and learners. The summary of its content includes digital lessons; study guides; e-books; multimedia content for languages; 2D/3D animation videos; teacher guides; GDE content and examination guidelines.

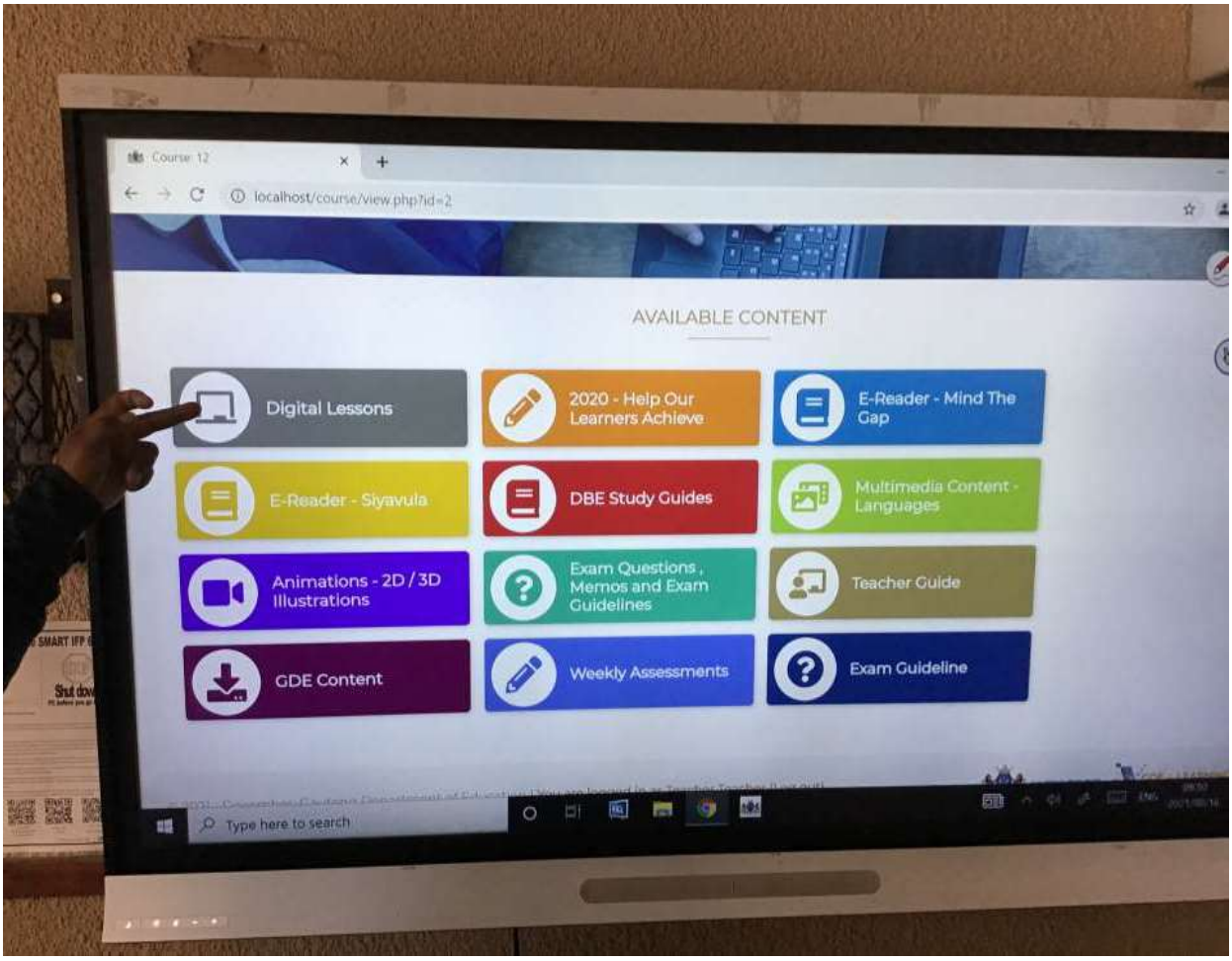


Figure 4.3 - My SDLR Menu screen

The IQ Interactive Education Platform: this is a digital whiteboard that allows teachers to write on the smartboard's touchscreen using their fingers. The picture below depicts a teacher writing on the digital whiteboard during a lesson.



Figure 4.4 - IQ Interactive Education Platform

My Core Caps Curriculum: this is a repository in which digital resources such as e-Books and Study Guides are stored for learners and teachers to access.

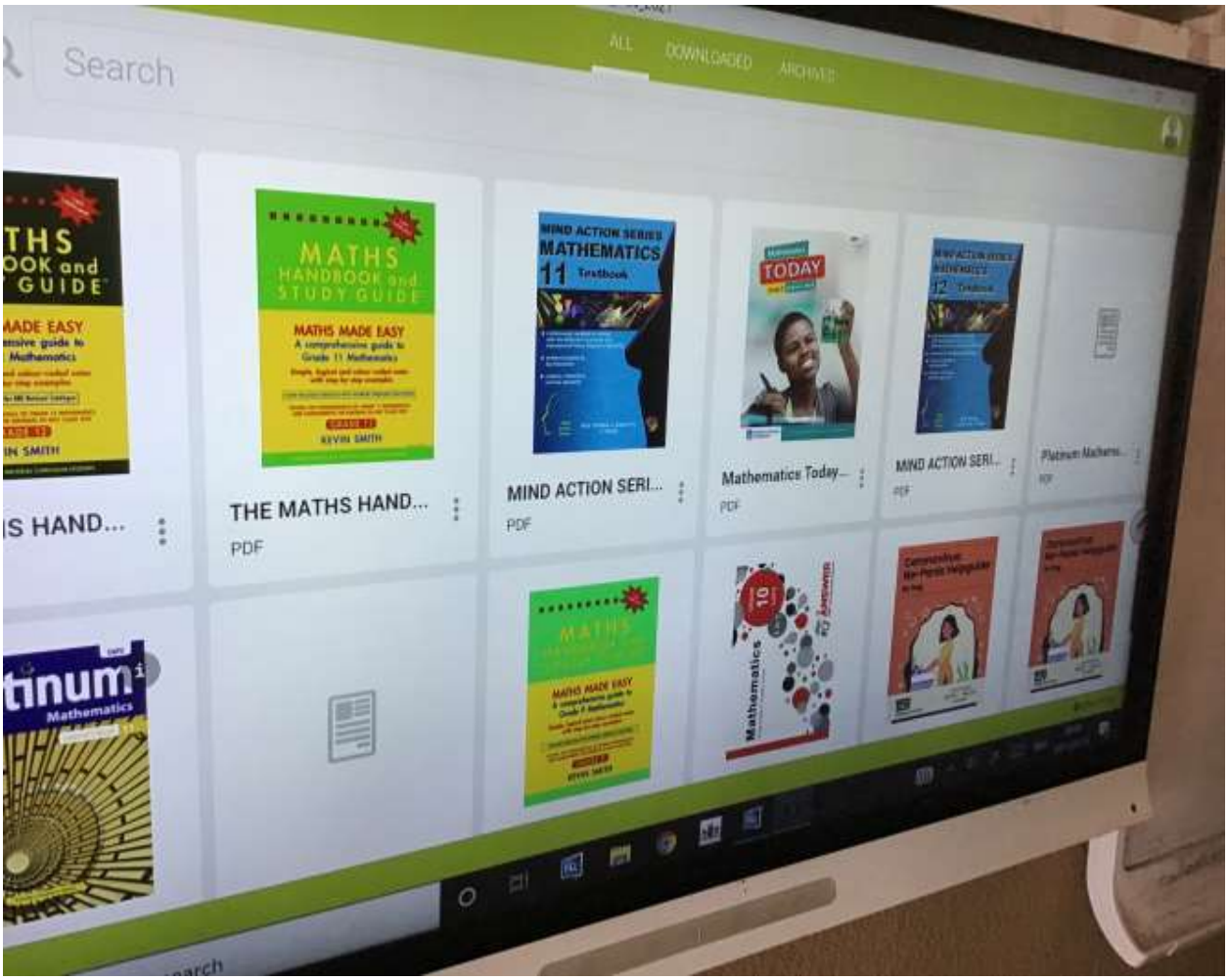


Figure 4.5 – MyCore Caps Curriculum

The use of mobile phones by learners is another innovation associated with the mobile learning capabilities of the GDE digital content platform. Through the GDE platform, learners have access to content from Siyavula, an educational technology company, through their mobile phones. The Siyavula platform provides learners with free access to high school mathematics and science textbooks and formative assessment exercises. For teachers, the Siyavula platform provides a technology-assisted assessment and monitoring platform of learner performance.

In summary, the use of smartboards and interactive whiteboards creates an opportunity for teachers to use multi-sensory, multi-faceted lesson styles, and seamless jumping from one type of digital media to another. They can do all of this in one lesson. The use of mobile phones enables distance learning and e-learning which have become critical teaching and learning channels in a Covid-19 environment. However, there are issues of vandalism and theft, universal digital access and internet data access which remain a challenge for digital integration of ICT at GDE schools.

4.2. Lesson Analysis

4.2.1. Teacher T1 - Espoused ICT Integration Practice

T1 prefers the traditional didactic approach to teach and uses the whiteboard for explanatory notes of new concepts. He sometimes uses a combination of both the whiteboard and the smartboard. The smartboard is usually connected to his laptop for reproductive and interactive models of instruction. In the reproductive mode, T1 uses tools such as Microsoft PowerPoint slides and educational videos. His belief in reproductive models of instructional is affirmed by the following statements made during the pre-lesson interview:

> *"The use of ICT is productive in teaching because it captures learner's attention"*
>
> *"It saves time since when using PowerPoint there is no writing that is taking place"*
>
> *"It also allows videos to play more especially when you want to emphasize new concepts in a lesson"*

In the interactive mode of instruction T1 believes that ICT can play a role in assisting learners with higher-order thinking skills when he makes this comment:

> *" with ICT, you allow the learners to lead the lesson, for example, you give them more activities and allow them to conduct research and explain what they understand, other than just supplying them with the answers".*

4.2.2. Teacher T1 - Enacted ICT Integration Practice

The researcher observed a Grade 9 geography lesson on the different types of urban and rural settlements. The lesson content was presented using Microsoft PowerPoint accessed from the teacher's laptop which was connected to a smartboard. Using Laurillard's Conversational framework, the analysis of how the teacher used ICT in his teaching practice is summarised.

Table 4.1 Enacted ICT practice of T1

Classroom Interaction	Media Engaged	Media Type	Learning experience	Learning experience description
1. ***Teacher*** can describe the conception	Microsoft PowerPoint	Narrative Media	Attending Coherence	The teacher uses Microsoft PowerPoint to focus learners' attention on lesson objectives and content. The presentation of content by the teacher is linear thus assisting learner cognition.
2. ***Learner*** can describe the conception	Verbal communication	Communicative	Articulating Memorising	Learners affirm their understanding of the lesson content by repeating what is presented. By regurgitating the teacher's presentation there is a danger of subjecting learners to rote learning.
3. Resulting from ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	Whiteboard	Narrative Media	Apprehending	The teacher tests the learner's understanding of difficult concepts of the lesson. He then uses the whiteboard to clarify concepts based on the learner's responses.

4. Resulting from ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	***Learning activity not part of the conversation*** Learners were not engaged to confirm that they understood the teacher's explanation of difficult concepts.			
5. ***Teacher*** can change the task goal considering ***Learner's*** description or action	***Learning activity not part of the conversation*** In the absence of interaction and a discursive dialogue, the teacher did not get the opportunity to remedy learner's misconception and refocus the lesson.			
6. A task goal can be set by the ***Teacher***	Microsoft PowerPoint	Narrative	Comprehending	The teacher included formative assessment questions in his lesson to assess the learner's understanding of the content.
7. ***Learner*** can act to achieve task goal	Verbal Communication	Communicative	Articulating	Learners who are confident that they have answers to the teacher's assessment questions raise their hands to give answers
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	Microsoft PowerPoint	Narrative	Relating theory to practice	The teacher presents pictures of different types of settlements thus summarising the lesson and practical examples behind the definition of settlements.

9. ***Learner*** can modify action in light of feedback on action	***Learning activity not part of the conversation*** Lesson ended in Activity 8.
10. ***Learners*** can adjust their actions in response to the ***Teacher's*** description or re-description.	***Learning activity not part of the conversation*** Lesson ended in Activity 8.
11. Learners might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation*** Lesson ended in Activity 8.
12. Teacher can alter re-description by reflecting on Learner's actions.	***Learning activity not part of the conversation*** Lesson ended in Activity 8.

Table 4.1 shows how T1 used Microsoft PowerPoint to present the lesson content and the whiteboard to re-describe concepts using clarification notes. The whiteboard was used as a non-ICT narrative media. Microsoft PowerPoint was used for presenting content and facilitating formative assessment.

Activities 4 to 5 and 9 to 12 of Laurillard's Conversational framework were not covered in T1's lesson because the teacher used a lecture teaching approach with very little interaction with learners. Table 4.1 affirms Laurillard's view that different media types can be used to facilitate dialogue and that a lecture is not a good example of a teaching approach envisioned through Conversational Framework where learners and teachers interact to achieve a common understanding of the content as well as the lesson objectives.

4.2.3. Teacher T1 - Change Management Issues

As stated earlier it is natural for individuals to react to educational reform in a manner that seeks answers to questions such as what's in it for me, how will I be impacted by the change and what is expected of me. The multi-case study research uses the Stages of Concern Questionnaire to profile teachers' concerns.

In the case of T1, his responses to the Stages of Concern Questionnaire resulted in a profile depicted below.

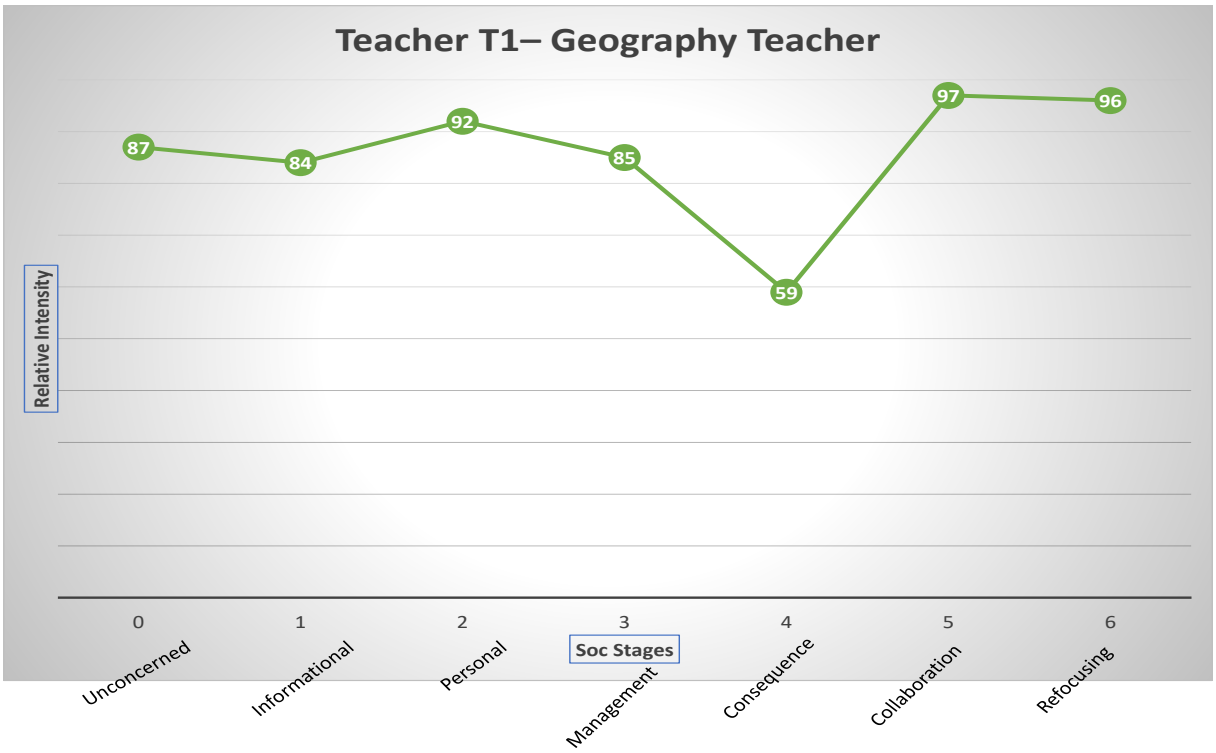


Figure 4.6 – Stages of Concern profile of T1

T1 scored the highest for Personal, Collaboration and Refocusing. This is a profile of a teacher who is concerned about the "innovation" i.e., teaching with ICT. For his lesson, T1 opted to use Microsoft PowerPoint, a linear narrative digital media which allowed him to follow a traditional lecture/presentational style of teaching where he is at the centre of the knowledge dissemination.

A high score for Personal Impact combined with relatively high scores for Concerned with Innovation, Information and Management indicates that T1 is not self-confident with the using ICT in his lessons. He would like to get additional information and experience on ICT including time management demands associated with preparing ICT infused lessons.

A high score on Collaboration and Refocusing means that he would like to understand how other teachers are using ICT in their lessons so that he can Refocus and change the way he is currently integrating ICT.

4.2.4. Teacher T2 - Espoused ICT Integration Practice

T2 is passionate about technology. His view on ICT integration in teaching practices is that:

> *"mathematics is a subject that is crucial therefore a lot of ICT integration is needed, as learners need to watch videos, interact with mathematical games and also respond to questions using ICT gadgets."*

When asked whether he prepares his lessons over and above those that are available on the Gauteng Department of Education digital content platform, his response was:

> *"Yes, I create very interesting lessons. It gives learners the sense of being in a technological world. They learn that technology devices can be used for learning and teaching".*

When asked what additional skills or knowledge he needs to integrate ICT into his teaching effectively, he responded by saying that he would like to leverage other Microsoft tools such as the Microsoft TeamViewer and Microsoft Teams to teach learners from home when he is unable to be physically at school:

> *"To teach effectively even if I am not at school, using Teamviewer or other software to remotely take over control of the smartboard and teach learners or use Microsoft Teams or other related software to teach learners remotely. When connected, I would then use a stylus pen to write on my laptop's touchscreen to interactively teach and present a lesson."*

T2's responses demonstrate his expert knowledge of how ICT can be integrated into teaching as well as his belief in the value of ICT in teaching and learning.

4.2.5. Teacher T2 - Enacted ICT Integration Practice

The researcher observed a Grade 9 mathematics revision lesson on algebraic expressions. The lesson content was presented through a combination of Microsoft PowerPoint, YouTube video, Microsoft Whiteboard, Mathematics Application Software called Siyavula, available on the GDE digital content platform and accessible to learners through mobile phones and laptops. The teacher's laptop was connected to a digital smartboard. Laurillard's

Conversational Framework is used to analyse how the teacher used ICT in his lesson and summarised as follows:

Table 4.2 Enacted ICT practice of T2

Classroom Interaction	Media Engaged	Media Type	Learning Experience	Learning experience description
1. ***Teacher*** can describe the conception	PowerPoint	Narrative	Attending	The teacher uses Microsoft PowerPoint to focus the learner's attention on the lesson objectives and content.
2. ***Learner*** can describe the conception	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
3. Resulting from the ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
4. Resulting from the ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			

5. ***Teacher*** can change the task goal because of ***Learner's*** description or action	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
6. A task goal can be set by the ***Teacher***	Verbal Communication	Communicative	Articulating	The teacher asks learners to use Siyavula software and navigate to algebraic expressions exercises.
7. ***Learner*** can act to achieve task goal	Workbooks Intelligent tutor software	Narrative Adaptive	Apprehending Relating theory to practice.	Learners write detailed steps in their workbooks of how they derived the answers. Learners capture answers on Siyavula. The software provides instant feedback on correct or incorrect answers.
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	Verbal Communication Microsoft Whiteboard	Communicative Narrative	Articulating Coherence	The teacher checks learners' workbooks and highlight incorrect steps in exercises and congratulates those with correct answers. The teacher uses the digital whiteboard on his laptop to demonstrate how to arrive at the correct answer for the exercises.

9. The ***Learner*** can alter their actions in response to feedback on their actions.	Intelligent tutor software	Adaptive	Clarifying internal relations	Learners use Siyavula's tips and recommended approach on how to answer the exercises. Learners are given a further opportunity to compare the Siyavula approach with the teacher's approach projected on the smartboard.
10. Learners can adjust their actions in response to the Teacher's description or re-description.	Intelligent tutor software	Adaptive	Relating theory to practice	Learners continue with the Siyavula exercises and apply knowledge gained from feedback from the Teacher on prior exercises as well as the Siyavula tip, to new exercises.
11. Learners might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation***			
12. Teacher can alter re-description by reflecting on Learner's actions.	Video	Narrative	Experiencing	The teacher concludes the lesson by playing a YouTube video of a lesson on algebraic expression presented by another teacher to reaffirm methods and approaches used during his lesson

Table 4.2 outlines a mathematics revision lesson. After explaining the objectives of the lesson, using Microsoft PowerPoint, the teacher proceeded to set task goals using the Siyavula intelligent tutor software for mathematics. Siyavula is an adaptive media because it can accept learners' answers to a mathematics exercise as input and display an answer as output indicating whether the answer is correct or incorrect. In the case of incorrect answers, it provides a remedial step by step explanation of how to derive the correct answer. Scaffolding was also provided by the teacher using the digital whiteboard software on his computer which was projected through the smartboard. Whilst the teacher had the option of using the digital whiteboard on the GDE digital content platform, he chose to use his laptop which changed the "power dynamics" to a learner-centred approach because the teacher was able to teach from his desk without having to stand in front of learners. His positioning levelled the “playing field” because everyone i.e., teacher and learners were all engaged in the same task of working out the algebraic expressions from their desks. The use of the video at the end of the lesson enabled the teacher to capture the learner's attention and ensure that learner understand how to simplify algebraic expressions by showing an example of another teacher working through exercises and applying mathematical principles covered in previous lessons that learners could relate to.

T2’s lesson was a revision lesson hence activities 2 to 5 of the Conversational Framework were not part of the dialogue. The teacher did not introduce new content but focused on what learner already knew, hence there was no need to learners and the teacher to align their conception of the content. However, activities 6 to 12 of the Conversational Framework were comprehensively covered using a combination of ICT and Non-ICT media forms to accomplish a dialogue that is interactive, adaptive, and reflective.

4.2.6. Teacher T2 - Change Management Issues

The researcher administered the Stage of Concern Questionnaire to find out possible issues that could be raised by a teacher that has fully embraced ICT integration into his teaching practices. The profile below is that of teacher T2.

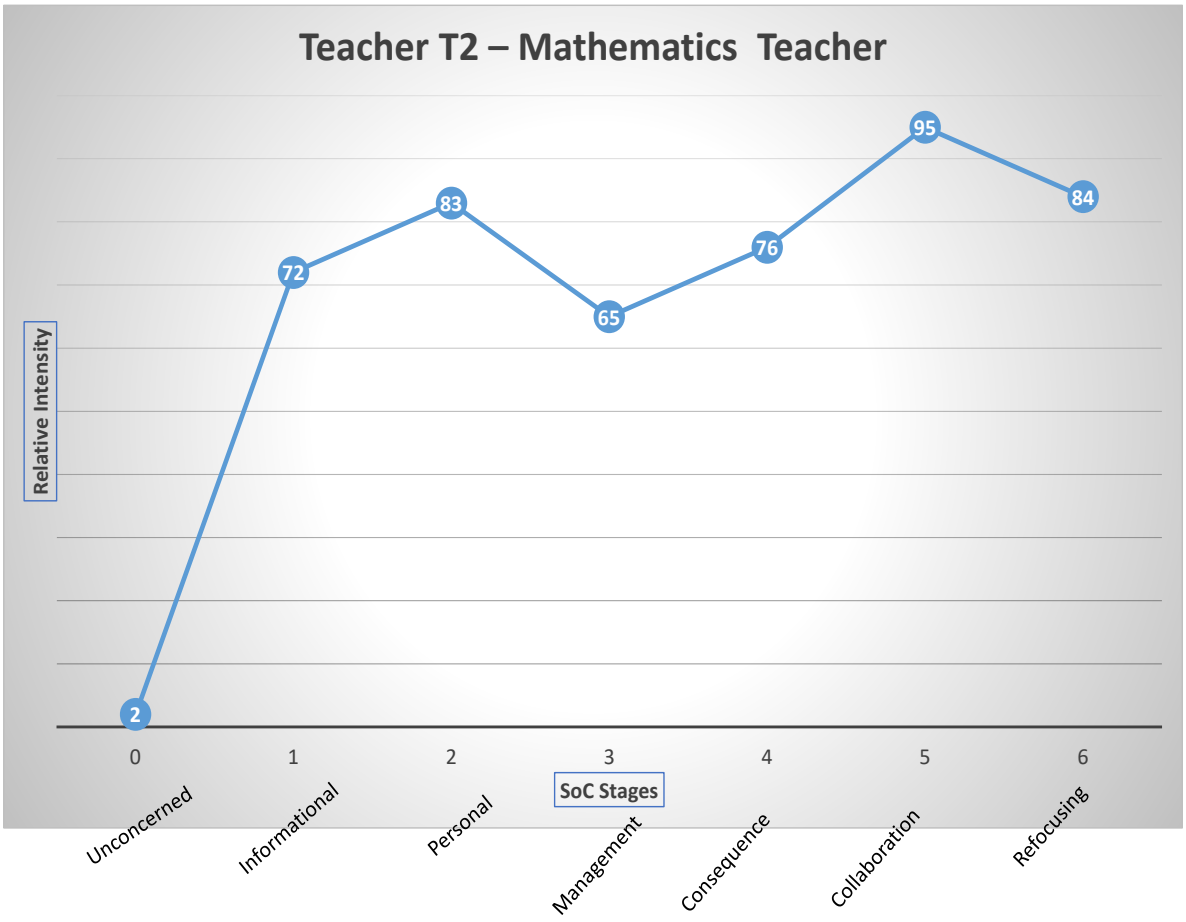


Figure 4.7 – Stages of Concern profile of T2

Whilst T2 is not concerned about ICT integration in teaching, it does not mean that he is not engaged. He scored the highest on Personal impact, Collaboration and Refocusing. During the pre-lesson interview, T2 expressed frustration with the lack of incentives and rewards for his time spent assisting other teachers in his previous capacity as the school's ICT coordinator. He relinquished this role when it became clear to him that his efforts would not be rewarded. Given his expert knowledge of how to use ICT in teaching, he has a desire to collaborate with

other teachers and share his knowledge. He would also like to refocus his use of ICT and use remote teaching approaches using remote connection capabilities of ICT.

4.2.7. Teacher T3 - Espoused ICT Integration Practice

T3 values the role of ICT in teaching because it offers vicarious experiences to learners especially in subjects such as technology, a subject where learners learn how humanity can meet its needs by changing the physical world and manipulating materials using tools. This is what he had to say about ICT integration:

> *"I think it can be very beneficial for the learners especially in technology, for example, the learners are required to create a certain project like a crane, I can play them different videos from the smartboard giving them different strategies on how they could make the project using the ideas they are seeing from the videos"*

4.2.8. Teacher T3 - Enacted ICT Integration Practice

The researcher observed a Grade 7 Technology lesson on simple mechanisms that are used in complex machines. The mechanisms are a set of moving parts that use movements and force to do work such as linear movement, rotary movement, reciprocating movement, and oscillating movement. The teacher chose to present the lesson content through Microsoft PowerPoint running on his laptop and projected through the smartboard. Using the Conversational Framework, the lesson analysis is as follows:

Table 4.3 Enacted ICT practice of T3

Classroom Interaction	Media Engaged	Media Type	Learning Experience	Learning experience description
1. Teacher can describe the conception	Microsoft PowerPoint	Narrative	Attending Coherence	The teacher uses Microsoft PowerPoint to focus the learner's attention on the lesson objectives and content. The presentation of content by the teacher is linear thus assisting learner cognition.
2. ***Learner*** can describe the conception	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.			
3. Resulting from the ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.			
4. Resulting from the ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.			
5. ***Teacher*** can change the task goal because of ***Learner's*** description or action	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.			

6. A task goal can be set by the ***Teacher***	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
7. ***Learner*** can act to achieve task goal	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
9. The ***Learner*** can alter their actions in response to feedback on their actions.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
10. ***Learners*** can adjust their actions in response to the ***Teacher's*** description or re-description.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
11. ***Learners*** might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.
12. ***Teacher*** can alter re-description by reflecting on ***Learner's*** actions.	***Learning activity not part of the conversation*** Teacher did not engage in a dialogue/conversation with learners.

Table 4.3 is a summary of a monologue lesson in which the teacher did not attempt to engage learners. He took advantage of the accessibility affordances of ICT which enabled him to cover a lot of content in his lesson. He could have achieved the same objective using a textbook. His espoused practices are also not aligned with his enacted practice because video material could have been ideal for demonstrating different forms of simple mechanisms.

4.2.9. Teacher T3 - Change Management Issues

The researcher administered the Stage of Concern Questionnaire to find out possible issues raised by the teacher about ICT integration. The profile below is that of teacher T3.

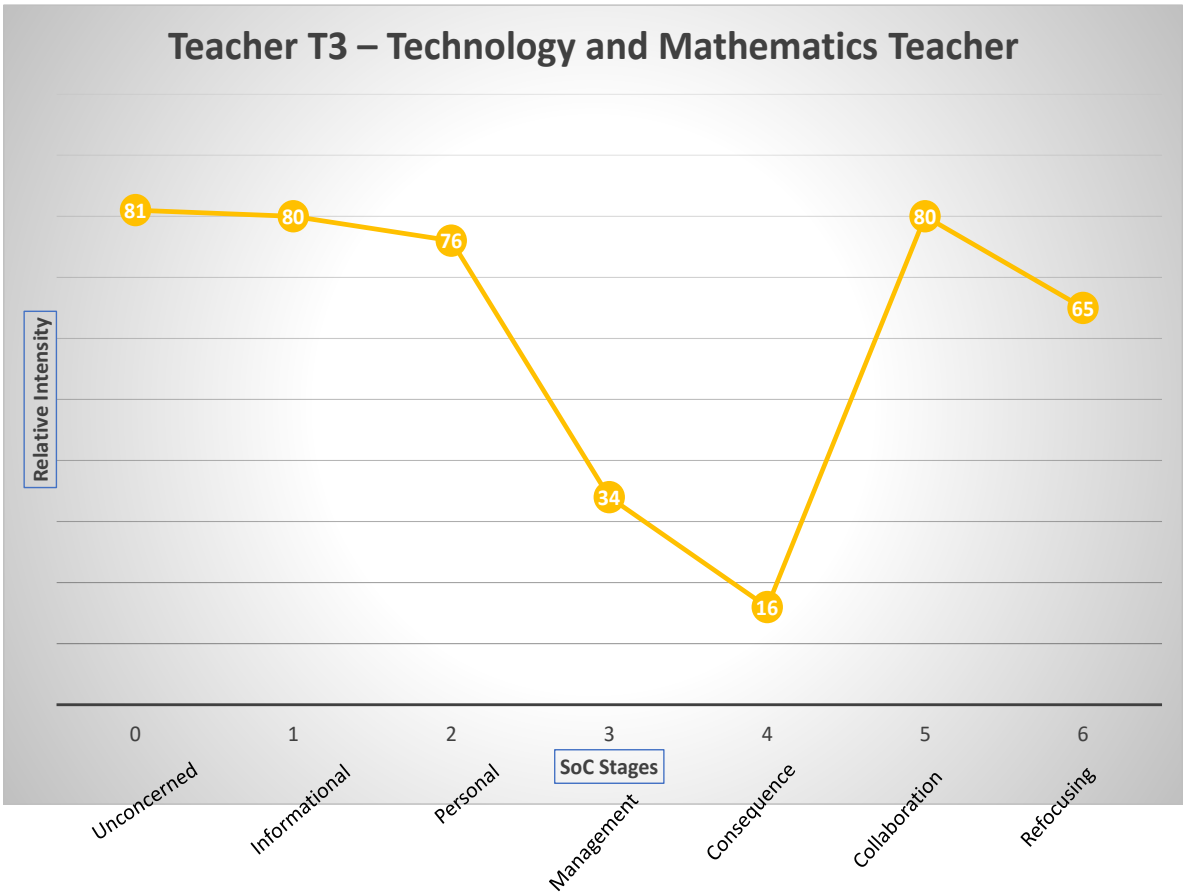


Figure 4.8 – Stages of Concern profile of T3

T3's profile is that of a teacher who is concerned about the use of ICT in teaching, who needs more information on the pedagogical integration of ICT into lessons and who would like to know more about how other teachers are using ICT in their lessons. His score on personal impact and knowledge of ICT is also high and in line with comments made in the pre-lesson interview that he had not had any formal training on ICT in education and had been using ICT since the beginning of 2021 thus making him a novice user.

4.2.10. Teacher T4 - Espoused ICT Integration Practice

T4 uses ICT in his lessons for approximately 40% of his teaching time. His main concern is the amount of time he must invest in preparing an ICT integrated lesson. This is what he had to say about ICT integration in his lessons:

> *"Personally, I don't use it most of the time out of ten I would say four hours. It helps me in keeping learners focused and interested especially the Kahoot application, otherwise ICT would inconvenience my teaching."*

By "inconvenience" he is referring to instances where internet connectivity is absent or when the smartboard has jammed and rendered unusable.

When asked whether he prepares his own ICT integrated lessons, his response was:

> *"I prepare and its time consuming. You spend hours searching for resources that will be spoken about for a minute."*

He prefers using ICT for formative assessments using Kahoot, a game-based learning application which uses user-generated multiple-choice quizzes that learners can access via a web browser or a mobile phone.

4.2.11. Teacher T4 - Enacted ICT Integration Practice

The researcher observed a Grade 11 accounting revision lesson on cash management (budgeting and projection). T4 used Kahoot, a game-based application software to facilitate classroom conversation. Learners had to sign into Kahoot using their smartphones. They could only use smartphones because the internet connection on GDE issued tablets is disconnected due to alleged abuse of devices by learners on private and social usage and very little usage

for educational purposes. Learners were organised into groups to enable those who do not have smartphones to also contribute to discussions. At the end of the lesson, T4 presented the digital podium using data collected by Kahoot on learners or groups that obtained 1st, 2nd and 3rd position in the quiz game. Using the Conversational Framework, the lesson discourse is summarised as follows:

Table 4.4 Enacted ICT practice of T4

Classroom Interaction	Media Engaged	Media Type	Learning Experience	Learning experience description
1. Teacher can describe the conception	Verbal	Narrative	Attending	The teacher presents the objectives of the lesson and projects the Kahoot game on the smartboard
2. ***Learner*** can describe the conception	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
3. Resulting from the ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
4. Resulting from the ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			
5. ***Teacher*** can change the task goal because of ***Learner's*** description or action	***Learning activity not part of the conversation*** A revision lesson, hence, the conversation starts in Activity 6.			

6. A task goal can be set by the ***Teacher***	Kahoot game-based learning software	Interactive	Relating theory to practice	The teacher asks learners to use the Kahoot software and answer quizzes on cash budgeting. These quizzes are multiple-choice questions prepared by the teacher.
7. ***Learner*** can act to achieve task goal	Workbooks Kahoot game-based learning software	Narrative Interactive	Apprehending Investigating and Analysis	Learners write detailed steps of how they arrived at their answer for the exercises in their workbooks. Learners capture answers to multiple-choice questions on Kahoot.
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	Kahoot game-based learning software	Communicative	Reflecting on experience	The teacher projects a summary of learner answers on the smartboard. Kahoot indicates no. of learners who selected a particular answer from the multiple-choice as well as the correct answer. This enables the teacher to get a sense of learner misconceptions and knowledge gaps.
9. The ***Learner*** can alter their actions in response to feedback on their actions.	***Learning activity not part of the conversation*** The teacher proceeded to Activity 12 after showing the results of the multi-choice quiz in Activity 8.			

10. ***Learners*** can adjust their actions in response to the ***Teacher's*** description or re-description.	***Learning activity not part of the conversation*** The teacher proceeded to Activity 12 after showing the results of the multi-choice quiz in Activity 8.			
11. ***Learners*** might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation*** The teacher proceeded to Activity 12 after showing the results of the multi-choice quiz in Activity 8.			
12. ***Teacher*** can alter re-description by reflecting on ***Learner's*** actions.	Whiteboard	Narrative	Coherence	The teacher uses the whiteboard to re-describe concepts and correct misconceptions.

Table 4.4 is a summary of a supportive learning approach where technology was used to observe learners' knowledge gaps and thus enable the teacher to initiate remedial action. Technology was also used to provide group performance feedback and recognition through the digital podium. The use of the Kahoot game-based learning software generated a lot of excitement in the classroom whilst learning was taking place, as evidenced by the type of clarification questions from learners.

4.2.12. Teacher T4 - Change Management Issues

The researcher administered the Stage of Concern Questionnaire to find out issues raised by the teacher about ICT integration. The profile below is that of teacher T4.

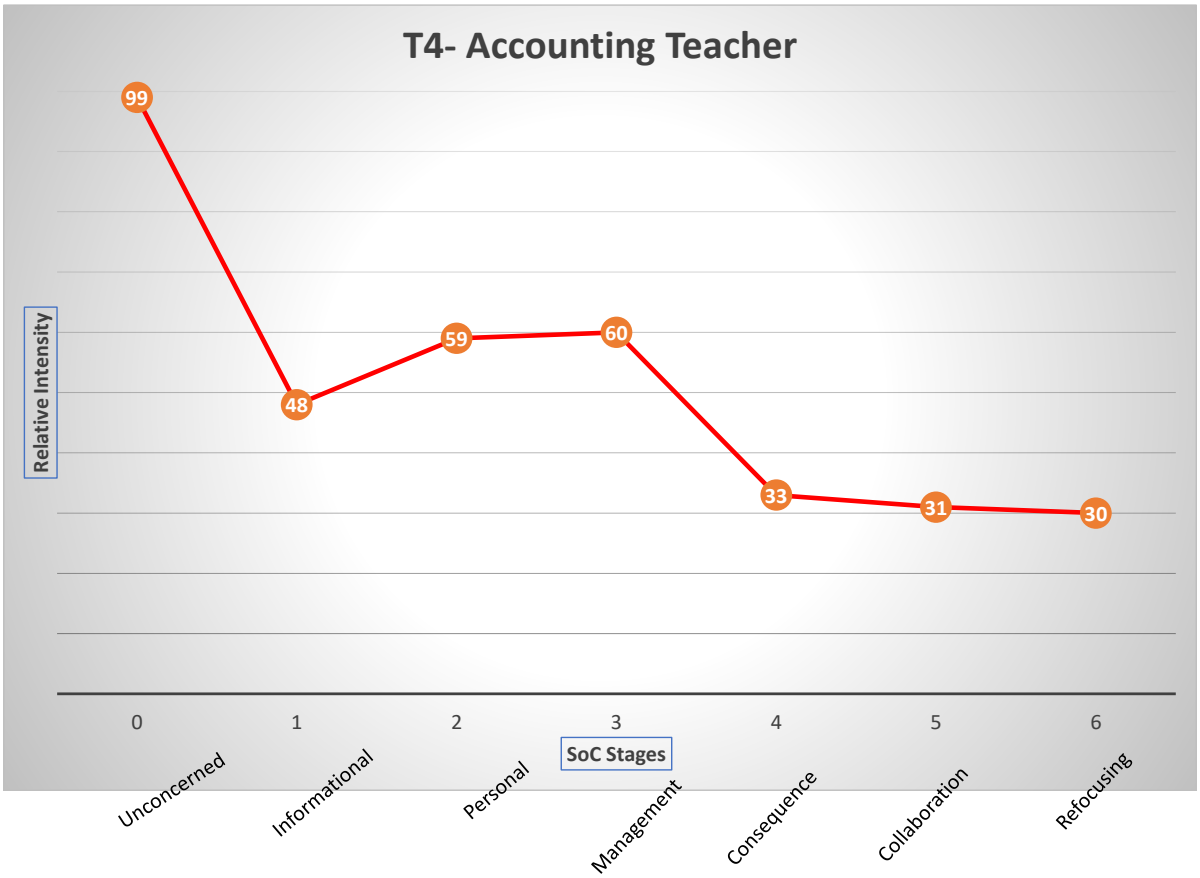


Figure 4.9 – Stages of Concern profile of T4

T4's profile represents a typical profile of an innovation non-user i.e., high scores in stages 0 – 3 and low scores for stages 4 – 6. Though T4 is not a 100% non-user because a medium score

on the Informational Stage indicates that he is not concerned about his knowledge of ICT integration in lessons. However, a higher score in the Personal and Management Stage indicates concerns about the impact of ICT integration on how he manages his time either assisting colleagues as part of his ICT coordinator role at his school or preparing ICT mediated lessons. The profile collaborates what T4 mentioned in the pre-lesson interview that he spends about 40% of his teaching time using ICT in his lessons. He was also concerned about the amount of time it takes to prepare ICT integrated lessons.

4.2.13. Teacher T5 - Espoused ICT Integration Practice

T5's commitment to ICT is influenced by his understanding of affordances of ICT as defined by Conole and Dyke (2004). In the pre-lesson interview, he specifically cited the accessibility, diversity, multi-modal and non-linear affordances of ICT as beneficial for him and learners.

According to T5, ICT enables a multi-sensory and non-linear learning pathway. T5 supports this view when he makes this comment about the benefits of ICT integration in lessons: *"Yes, there are benefits because learners can see and hear the lessons and even do some exercises"*

T5 attributes improvement in learner's performance to the affordance of accessibility when he makes the following comment: *"The improvement is that they can access learning materials on their tablets to enhance and supplement what we give them as hard copies".*

For T5 the affordance of accessibility is of importance to him when preparing his lessons as it enables him to access various content for use in his lessons. He comments about the benefits of ICT in lesson preparation as follows: *"Yes, it made my preparations easy and interesting".* By "easy" he is referring to access to various content sources such as the GDE digital content repository, and access to vast amounts of information from the Worldwide Web through search engines.

He also feels that he is adequately prepared to integrate ICTs into his teaching because the diversity affordance of ICT (e.g., narrative media, interactive media, and adaptive media)

allows him to mediate teaching of content especially when he teaches difficult concepts. This is what he had to say: *"Yes, I use ICTs frequently, especially when explaining some abstract concepts".*

In teaching T5 finds the multi-modal affordances of ICT to be most productive when: *"teaching using interactive videos as well as a virtual laboratory".*

4.2.14. Teacher 5 - Enacted ICT Integration Practice

The researcher observed a Grade 11 physical science revision lesson on electrolysis, a process by which electric current is passed through a substance to effect a chemical change. Learners experience this physics phenomenon in their daily lives through devices that use batteries such as their mobile phones, cars, flashlight, and any battery-operated device. However, the chemical process that results in battery charging is complex and abstract, hence the teacher had the challenge of simplifying an everyday physics phenomenon in a manner that would assist learners to comprehend the laws of physics at play in an electrochemical process.

T5 adopted a multimodal approach to his lesson involving the use of a digital whiteboard, pre-recorded GDE lesson video (including sound, visual material, and text) and an interactive video of an electrochemical experiment. The table below is a summary of the classroom interaction using Laurillard's Conversational framework.

Table 4.5 Enacted ICT practice of T5

Classroom Interaction	Media Engaged	Media Type	Learning Experience	Learning experience description
1. Teacher can describe the conception	Digital Whiteboard	Narrative	Attending	The teacher uses the digital whiteboard to focus the learner's attention on the lesson objectives and content.
2. ***Learner*** can describe the conception	Verbal	Communicative	Articulating	Learners assist the teacher in explaining the various steps of the electrolysis chemical reaction thus displaying their understanding of the concept.
3. Resulting from the ***Learner's*** thought or action, the ***Teacher*** can re-describe***.***	Electrolysis lesson video Simulation software	Narrative Adaptive	Apprehending Relating theory to practice	Detailed content on electrolysis is presented to learners through a video. The teacher conducts a virtual experiment using simulation software that accepts input and learners are challenged to predict the output of the experiment.
4. Resulting from the ***Teacher's*** re-description or the ***Learner's*** action, the ***Learner*** can re-describe.	Verbal	Communicative	Articulating	Learners predict the outcome of the experiment and the chemical reaction based on the input, thus displaying knowledge, and understanding of the topic.

5. ***Teacher*** can change the task goal because of ***Learner's*** description or action	Simulation software	Adaptive	Clarifying internal relations	The teacher uses the virtual experiment to clarify learner misconceptions on electrolysis.
6. A task goal can be set by the ***Teacher***	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			
7. ***Learner*** can act to achieve task goal	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			
8. A ***Teacher*** can create a universe in which ***Learners*** receive intrinsic feedback on their action.	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			
9. The ***Learner*** can alter their actions in response to feedback on their actions.	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			
10. ***Learners*** can adjust their actions in response to the ***Teacher's*** description or re-description.	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			
11. ***Learners*** might adjust the re-description by reflecting on the engagement.	***Learning activity not part of the conversation*** The lesson ended in Activity 5.			

12. ***Teacher*** can alter re-description by reflecting on ***Learner's*** actions.	***Learning activity not part of the conversation*** The lesson ended in Activity 5.

Table 4.5 is a summary of a lesson where the teacher leveraged the diversity and multi-modal affordances of ICT to teach abstract physical science concepts and demonstrate the practical application of scientific principles. ICT enabled the teacher to follow different pedagogical approaches starting the lesson with a didactic teaching approach using the digital whiteboard to summarise the concepts of electrolysis and playing a video to present detailed content on electrolysis. T5 then used simulation software to conduct a virtual experiment and used cognitive affordances of supportive and dialogic learning to analyse and discuss the result of the experiment with learners.

4.2.15. Teacher T5 - Change Management Issues

The researcher administered the Stage of Concern questionnaire to find out T5's change management issues about ICT integration. The profile below is that of teacher T5.

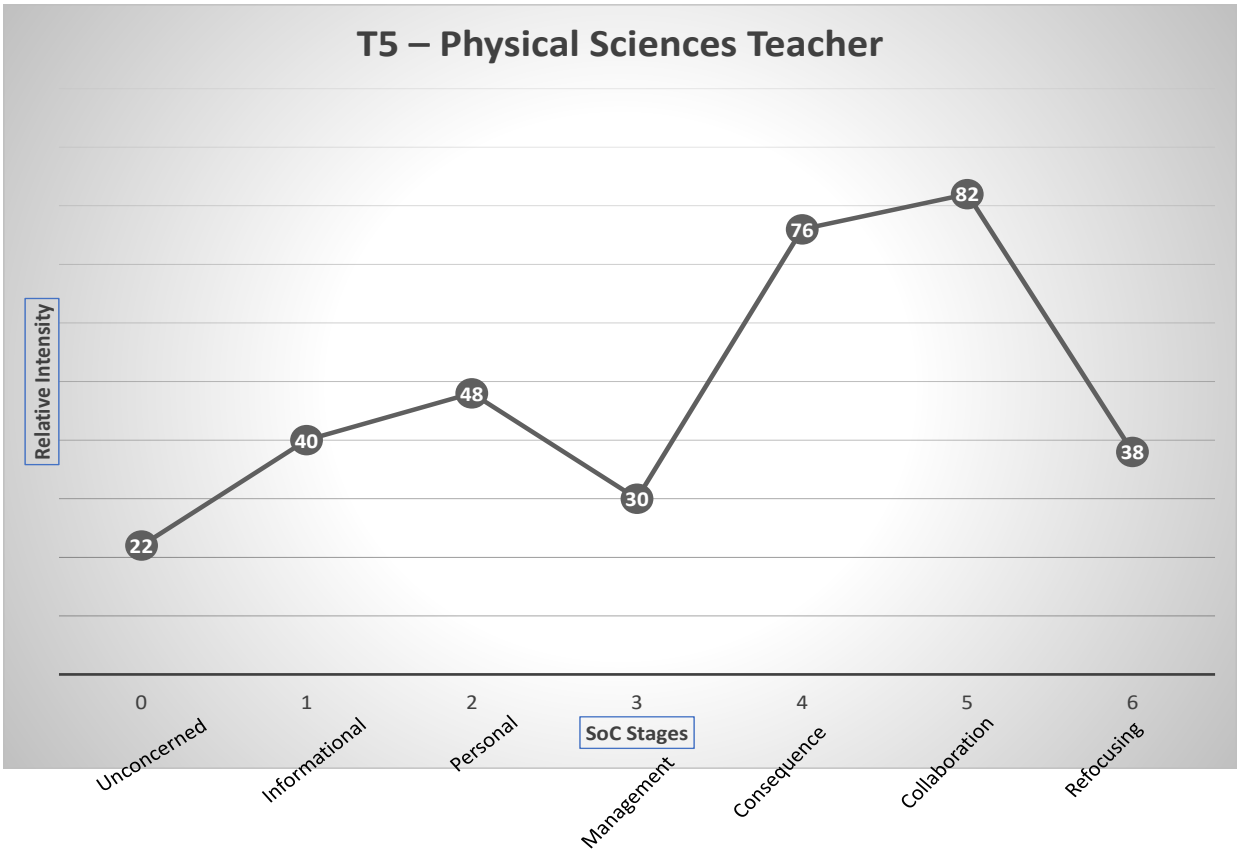


Figure 4.10 – Stages of Concern profile of T5

T5's profile is that of an ICT user who is not concerned about ICT integration in teaching. His highest concerns are in stages 4 – Consequence and stage 5 – Collaboration. Consequence relates to a teacher's concern with the impact of ICT on pedagogy and learning. Is the pedagogical approach enhanced or constrained by ICT? Are learners experiencing cognitive overload because of the use of multimodal media? These are typical questions associated with consequences concerns. Collaboration concern has been raised by all the teachers who participated in the multi-case study research who are curious to know how their colleagues are using ICT in their lessons. They expressed this concern because of a desire to learn and improve ICT integration in classroom practices.

4.3. Conclusion

"The process of teaching is the process of interaction between teachers and students, and also between students themselves. The ways and efficiency of the interaction between teachers and students or between the students and students, will determine the success or failure of the teaching" (Chai, 2015, pg. 844)

The ICT Engagement Form is used to analyse the teacher lessons. It demonstrates that teachers use ICT in a context specific manner to support teaching objectives. It also demonstrates how ICT supports various types of dialogue in the process of interaction between the teachers and the learners. As indicated by Chai (2015) the ways and efficiency of the interaction determine the success or failure of the teaching. Change management issues raised by teachers gave context on why they chose specific approaches in their use of ICT in lessons.

The next chapter concludes the research by analysing trends emanating from the Stages of Concern survey, ICT integration approaches associated with the lessons, the extant to which the research questions were addressed and a final comment on the study's conceptual framework.

Chapter 5

Research Findings and Conclusion

The objective of the multi-case study research was to understand whether ICT using teachers believe that there is pedagogical value in its use in classroom practices. The researcher conducted unstructured interviews with five teachers participating in the multi-case study research to understand participants' attitudes and beliefs about ICT in education as articulated through their espoused practices on the use of ICT. Lessons of the five participating teachers were observed to record enacted practices thus creating an opportunity to compare espoused practices to the actual use of technology in lessons. A Stages of Concern survey was conducted to identify change management issues that might have a bearing on the teacher's attitude towards ICT and thus influence how they use it in their lessons. Data collected from the observation and the survey is analysed in Chapter 5 of the research report. The research findings are derived from analysing the extent to which the research sub-questions were addressed in the research data.

The next section describes findings in the context of the research sub-questions.

What is deemed by teachers to be of pedagogical value in the use of ICT in the classroom?

T1 (Geography teacher) and T3 (Mathematics and Technology teacher) were the least experienced (have been using ICT in their lessons for less than 2 years) in the use of ICT in teaching. Their pedagogical reasoning and actions were about knowledge transfer to learners by encouraging individual knowledge acquisition through a didactic teaching approach. They used ICT as an instruction tool to present content through a Microsoft PowerPoint presentation. Their instructional design represents a reproductive approach to instructional design though T1 also included elements of interactive activities in his lesson through a formative assessment included in his lesson. T1 and T3's pedagogical approach is summarised

using Amory et al. (2015) framework for effective ICT integration. The grey shaded blocks represent the learning pathway as presented through T1 and T3's lessons.

Table 5.1 Learning pathway for T1 and T3's lessons

Independent variables	Pedagogical Approach						
Notions of learning	**Acquisition**	⟷	Participation	⟷	Contribution		
Type of Use	**Instructive**	⟷	Cognitive	⟷	Mediative		
Models for learning design	**Reproductive**	⟷	**Interactive**	⟷	Conversational	⟷	Transformative

For T1 and T3, ICT does not offer an opportunity to explore new pedagogical approaches in which technology is infused in the delivery of content, thus creating possibilities for heightened learner engagement. They used ICT as a modern digital medium to support traditional didactic teaching approaches. Microsoft PowerPoint presented through the smartboard enabled them to gain learner attention, present content in a coherent structure and facilitate apprehension of content by learners.

In terms of the affordances of ICT, T1 and T3 employed general affordance such as accessibility, to cover large volumes of content that could not be easily taught using the traditional whiteboard or textbook.

T2 (Mathematics teacher), T4 (Accounting teacher) and T5 (Physical Science teacher) are experienced ICT using teachers who have been using ICT in their lessons for more than three years. They employed ICT to achieve multiple learning objectives. T2 used ICT for both acquisitive and participative knowledge development. T4 used a participative knowledge development approach when he organised his learners into groups to answer accounting multiple choice questions using mobile phones and a game-based educational software. T5's lesson objective was revision to affirm knowledge acquisition. However, T5 leveraged multi-modal and multi-sensory affordance of ICT to scaffold learner knowledge acquisition using

narrative media (a video which included images and sound), vicarious experience (using virtual experiment) and the smartboard as a narrative media by writing notes on the "digital whiteboard". T2, T4 and T5's pedagogical integration of ICT in lessons is summarised below. The grey shaded blocks represent the learning pathway as presented through the lessons.

Table 5.2 Learning pathway for T2, T4 and T5's lessons

Independent variables	Pedagogical Approach						
Notions of learning	Acquisition	⟷	Participation	⟷	Contribution		
Type of Use	Instructive	⟷	Cognitive		Mediative		
Models for learning design	Reproductive	⟷	Interactive	⟷	Conversational	⟷	Transformative

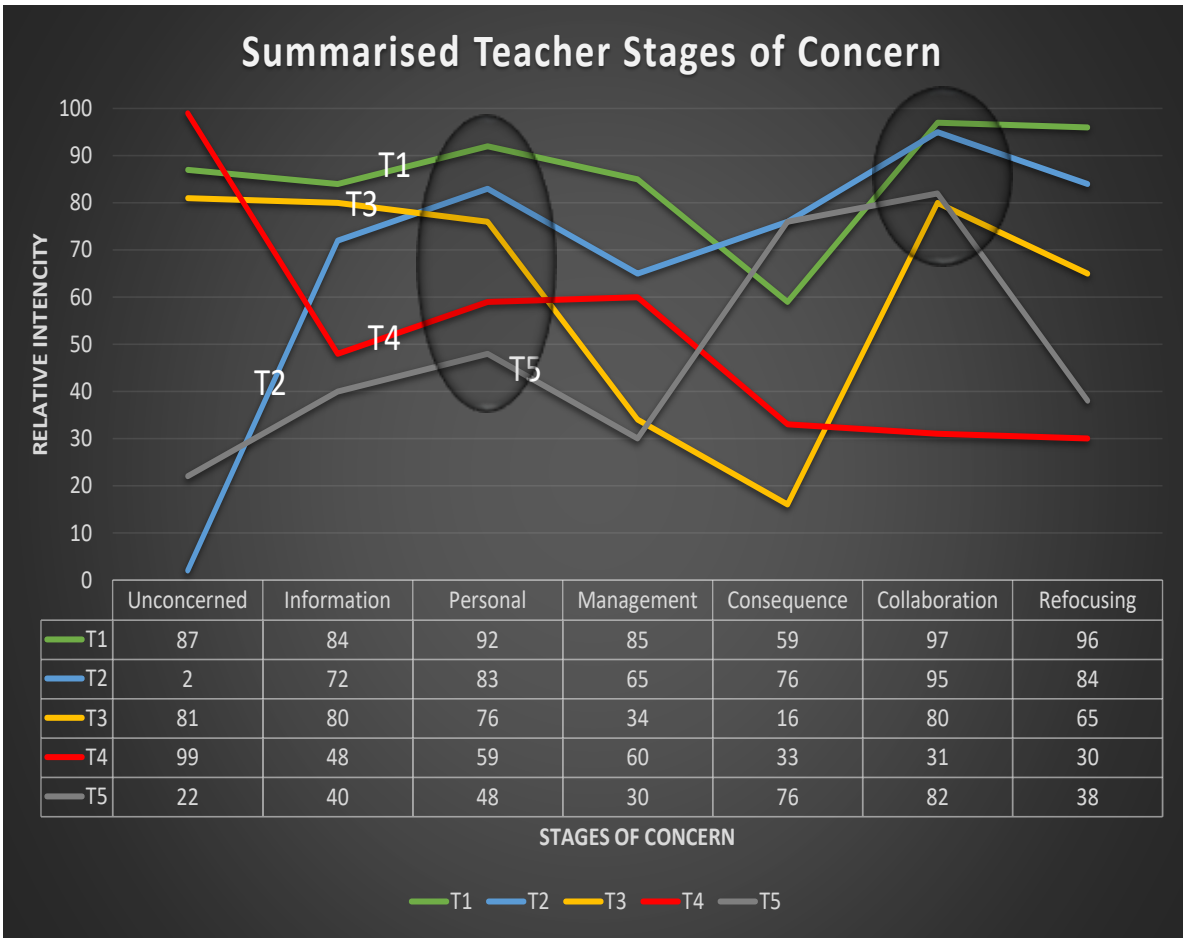
Haines (2015) conducted a longitudinal study that monitored how perceptions and application of affordances of computer-mediated communication tools developed over time. For the study, Haines (2015) defined affordances "as the potential that teachers perceive in a particular technology tool that will support learning and teaching activities in their educational contexts" (p. 166). The study concluded that perceptions of specific learning affordances develop over time and through use. Initially, teachers rely on generic affordances and then employ specific affordances in support of individual pedagogical objectives. Similar findings can be discerned from this multi-case study research in that inexperienced ICT using teachers relied on generic affordances whilst experienced teachers exploited context-specific and diverse affordances in support of their lesson objectives. However, limitations of this study are that findings are based on observations of one lesson per participant. It is plausible that in a different context, an inexperienced ICT using teacher could demonstrate a deep understanding of the pedagogical value of ICT integration based on their knowledge of specific learning affordances of ICT and not necessarily technological prowess.

To what extent are teachers' espoused practices reflected in their enacted practices?

The researcher's inference from this multi-case study is that espoused and enacted practices of ICT using teachers are aligned and influenced by teachers' knowledge of ICT's affordances. Knowledge of affordances is influenced by a teacher's experience with using ICT in lessons as confirmed by Haines (2015) findings. The research findings are similar to Ertmer et al. (2012) findings that in the absence of 1st order barriers associated with infrastructure, teachers who believe in teaching with ICT can leverage its affordances to achieve lesson objectives. Ertmer et al. (2012) research study also found that teachers who hold constructivist views about learning were likely to use ICT to support a learner centred teaching approach. The research study did not probe teachers' views on different learning theories, hence the alignment of espoused and enacted practices in as far as learning theories are concerned was not addressed.

What are the teacher concerns with the use of ICT in classroom practices?

Educational reform initiatives such as the introduction of ICT in teaching practices as proposed by the Gauteng Department of Education, have a direct impact on teachers and require change management interventions to manage anxieties about the reform. The multi-case study research uses the Concerns Based Adoption Model (CBAM) as an analytic tool of the teacher concerns associated with the use of ICT in Gauteng public schools. The focus is on teacher feelings and motivation towards the use of ICT, as well as their actions as they assimilate the impact of ICT on their classroom practices. Below is the summary of profiles of five teachers' responses to the SoCQ survey.



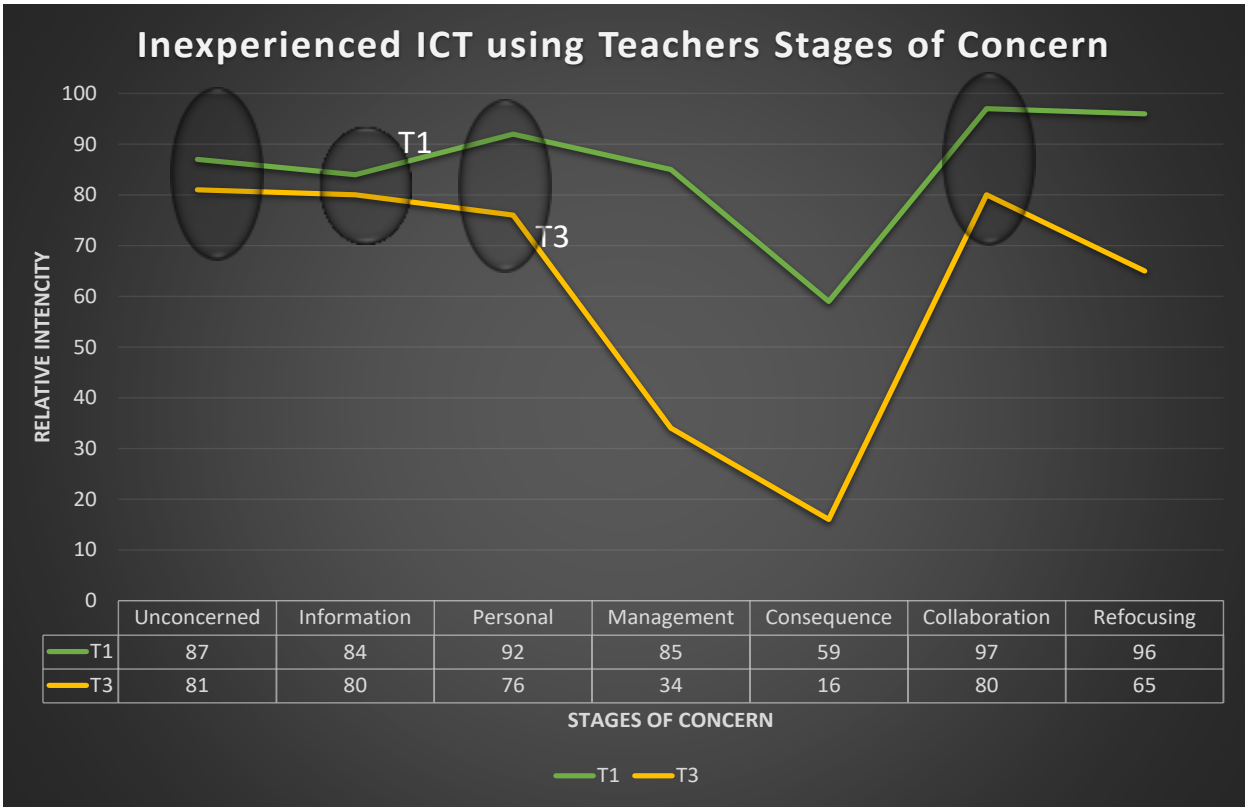
	Unconcerned	Information	Personal	Management	Consequence	Collaboration	Refocusing
T1	87	84	92	85	59	97	96
T2	2	72	83	65	76	95	84
T3	81	80	76	34	16	80	65
T4	99	48	59	60	33	31	30
T5	22	40	48	30	76	82	38

Figure 5.1 – Summary of Teacher's Stages of Concern

The circles in Figure 5.1 depict common concerns for most teachers in the multi-case study research. Teachers are concerned about the need to collaborate with peers, share experiences and enhance understanding of the pedagogical value of ICT. They are also concerned about the personal impact on learning outcomes associated with how they use ICT in their pedagogical approach. Harris (2016) in her research on teacher professional development concludes that it is most effective when it is active, reflective, sustained, job-embedded, coherent, in-depth, and focused upon teaching of the curriculum. She sites collaborative lesson observation and peer coaching, collaborative curriculum materials development where educators collaborate to construct technology-enhanced curriculum material, and a community of practice approach where teacher's technological and pedagogical content knowledge is developed through processes of identity development and practice that are

contextually and communally delivered, as examples of teacher collaboration to enhance self-efficacy in the use of ICT in teaching and learning. District offices of various provincial education departments could play an important role in coordinating these types of collaboration sessions. Learning by doing and observing others could ease teachers' anxieties about personal impact.

Figure 5.2. depicts T1 and T3 (the inexperienced ICT using teachers) profiles. The profiles are similar and only differ in relative intensity. For these teachers, information on how to integrate ICT into their lessons, ICT's impact on their pedagogical approach, and collaboration with other ICT using teachers to learn from them on how best to use ICT to achieve lesson objectives, are their main concerns. Hence, they both used Microsoft PowerPoint, a narrative media, to structure an information delivery that supports a didactic teaching approach, where ICT only serves as a replacement for the traditional chalkboard.



	Unconcerned	Information	Personal	Management	Consequence	Collaboration	Refocusing
T1	87	84	92	85	59	97	96
T3	81	80	76	34	16	80	65

Figure 5.2 – Inexperienced ICT using teachers' Stages of Concern profiles

Figure 5.3 depicts the profile of T2 and T5 (experienced ICT using teachers) with similar profiles, which differ only in relative intensity. These teachers are unconcerned about the use of ICT in education but concerned about the impact (consequence) of using ICT on learning and the subsequent performance outcomes as influenced by technology-infused teaching practices. They would like to collaborate with other ICT using teachers to affirm their approach, share experiences and learn from others. The cumulative effect of experienced ICT using teacher's concerns may lead to refocusing, as demonstrated by T2. Refocusing implies that a teacher would reconsider their use of ICT by either stopping to use it in their lessons, minimising its use to specialised tasks such as using it as an assessment tool (an approach adopted by T4), or optimising its use by exploiting ICT's advanced features to address social and environmental challenges e.g., T2 was concerned with teacher absenteeism emanating from the Covid-19 pandemic, novel use of ICT in this situation is to exploit its remote access capabilities which enable a teacher to use and navigate a smartboard from home as though she/he was physically present in a classroom.

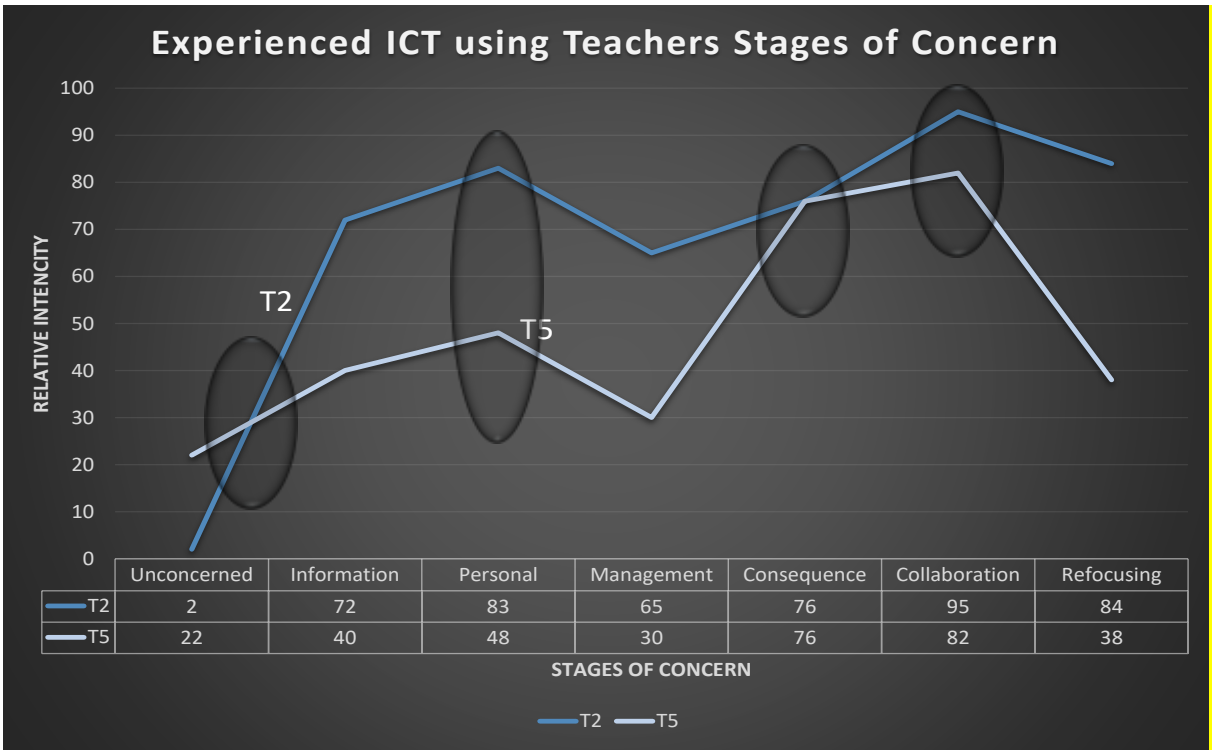


Figure 5.3 – Experienced ICT using teachers' stages of concern profiles

Profiles in Figure 5.1 are from a purposive sample of five ICT using teachers. Despite the small sample size, trends emerged that could be useful to the Gauteng Department of Education. Inexperienced ICT using teachers are asking for more information about ICT in education to strengthen their self-confidence and efficacy with ICT. All the teachers engaged in the study are asking for knowledge sharing sessions, affirmations, best practices, and experiences of other teachers on the use ICT in lessons. A Stage of Concern survey involving a large sample size that is representative of all districts of the Gauteng Department of Education could yield interesting insights at both the macro-level e.g., implementation issues, collaboration issues, and capacity building issues and micro-level e.g., impact on personal time, and consequence issues.

Final Comment

The study is anchored on a conceptual framework which considered mediation and the Conversational Framework as key components of the pedagogical framework, change management as a theoretical concept for managing large-scale educational reform programmes and individual anxieties associated with change, and affordances of ICT and the expansion of the educational practice framework as a means of recognising the value of ICT in education.

Feuerstein (cited in Kozulin & Presseisen, 1992) postulates that teacher mediation influences learner's propensity to learn if there is intentionality and reciprocity in mediation, when there is mediation of transcendence and mediation of meaning. The researcher observed lessons of T1 and T3, inexperienced teachers who engaged in what the change frame for developing competence in digital learning[18] refers to as Teacher-Led teaching practice as depicted in Figure 5.4. A Teacher-Led practice is one where the teacher dominates in a lesson where there is limited use of digital tools. The enacted ICT Conversational Framework activities of T1 and T3's lessons demonstrate limited teacher-learner interaction thus limiting learning opportunities in the absence of intentionality and reciprocity in the teacher's mediation. T2, T4 and T5 are the experienced teachers engaged in what DBE's change frame refers to as

[18] *"Professional Development Framework for Digital Learning"* of the Department of Basic Education, 2019

Digital Teaching and Digital Learning. According to DBE's change frame, in Digital Teaching tools remain in hands of the teacher or under the teacher's control with limited exploitation of digital resources by learners even though there is a 1:1 device to learner ratio e.g., tablets issued to learners. Nevertheless, in Digital Teaching the teacher employs digital tools to facilitate mediated learning as defined by Feuerstein. T5's physics lesson was a classic example of Digital Teaching. The DBE defines Digital Learning as a learner-centred and transformative pedagogical approach where digital resources are permanently in the hands of learners and both the teacher and learners fully exploit these resources to facilitate a discursive, adaptive, interactive, and reflective dialogue as defined through the Conversational Framework activities. T2 and T4's lesson are good examples of Digital Learning.

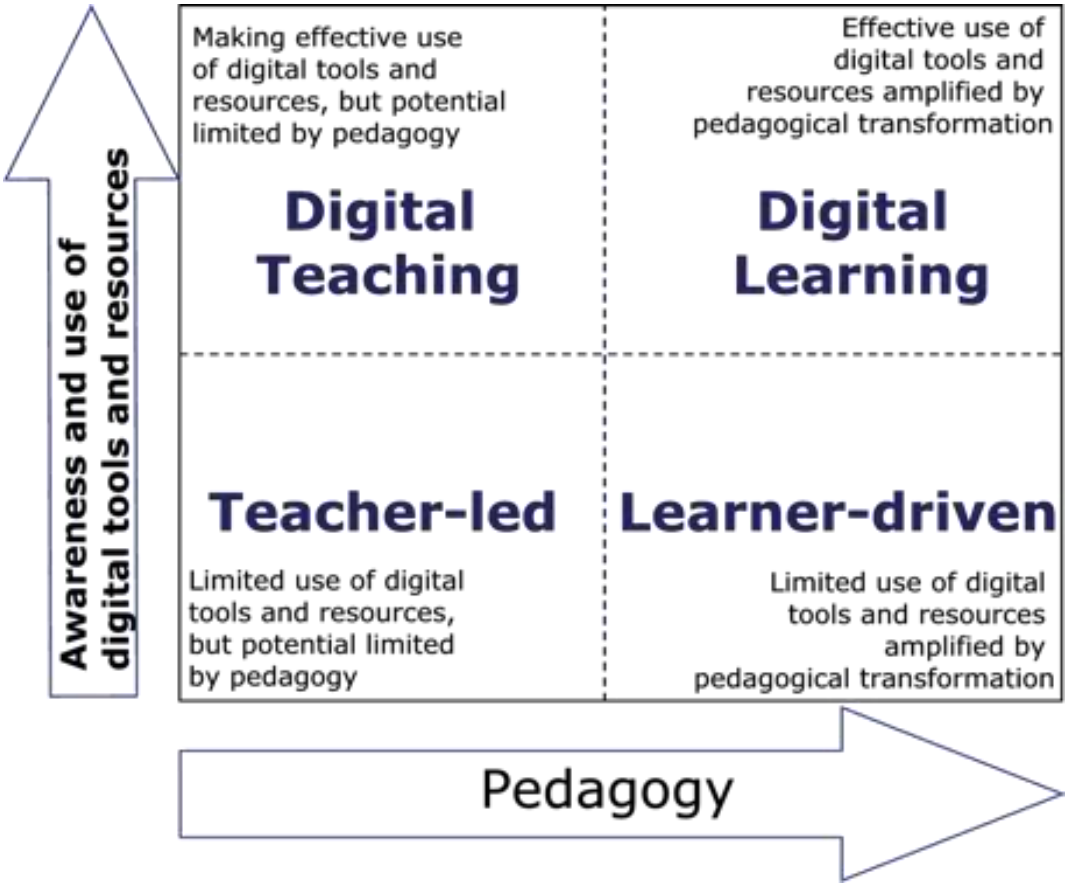


Figure 5.4 – Change Frame for developing competence in digital integration in teaching and learning

(Source: *"Professional Development Framework for Digital Learning"* of the Department of Basic Education, 2019)

The findings demonstrate that teachers who demonstrated Digital Teaching skills or facilitated a Digital Learning environment, understood the pedagogical value of ICT in education which manifests amongst other things, in affordances of ICT. These could be in a form of technical affordances, cognitive affordances or general affordances as defined by Conole and Dyke. The question is whether knowledge of affordances was obtained through formal or informal interventions. The researcher advocates for a formal affordances knowledge development approach for ICT using teachers.

Fullan (2016) reminds us that for a large-scale change or a system-wide change programme to succeed we need to recognise that successful reform strategies are socially based and action-oriented. Collaboration leads to trust and the strengthening of social capital and cohesion. Therefore, if most teachers are calling for collaboration, it affirms the importance of the ICT programme to teachers and the value that they attach to peer-to-peer collaboration. Another principle of managing successful system-wide change programme is the issue of capacity building, and the need to focus on it at the early stage of a change programme. If teachers after two to three years of using ICT feel a need for more information, then that points to a failure in capacity building and the need to refocus on it.

Finally, the conceptual framework postulates that for Provinces that are advocating for ICT to be used in classroom practices, should encourage teachers to adopt Digital Teaching as the initial pedagogical approach towards a learner centred Digital Learning environment. However, the adoption and value realisation of using ICT in teaching is likely to succeed if it is driven through a deliberate change management programme.

References

- Amory, A., Rahiman, F., & Mhlanga, E. (2015). *Rapid research on the use of ICT in Education*. South African Institute for Distance Education. Google Scholar
- Anderson, S. (1997). Understanding teacher change: Revisiting the concerns based adoption model. *Curriculum Inquiry*, *27*(3), 331-367. http://doi.org/10.1080/03626784.1997.11075495
- Angeli, C. & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*, 154 – 168. http://doi.org/10.1016/j.compedu.2008.07.006
- Angeli, C., Valanides, N., & Christodoulou, A. (2016). Theoretical considerations of technological pedagogical content knowledge. *Handbook of Technological Pedagogical Content Knowledge (TPACK) for educators* (2nd Ed.). Routledge. https://doi.org/10.4324/9781315771328
- Barber, M., Chijioke, C., & Mourshed, M. (2010). Education: How the world's most improved school *systems keep getting better*. McKinsey & Company. www.mckinsey.com
- Bassey, M. (1999). Case study research in educational settings. McGraw-Hill Education. Google Scholar
- Badenhorst, C. (2007). Research writing: Breaking the barriers. Van Schaik Publishers. https://www.vanschaiknet.com/book/view/259
- BECTA. (2004). A review of the research literature on barriers to uptake of ICT by *teachers*. British Educational Communications and Technology Agency. https://dera.ioe.ac.uk/1603/1/becta_2004_barrierstouptake_litrev.pdf
- Bitner, N. & Bitner, J. (2002). Integrating Technology into the classroom: Eight keys to success. *Journal of Technology and Teacher Education, 10*(1), 95 - 100. https://www.learntechlib.org/primary/p/9304/.

- Block, J. H., & Burns, R. B. (1976). Mastery learning. *Review of Research in Education*, *4*(1), 3-49. https://doi.org/10.3102%2F0091732X004001003
- Castells, M. (1999). *Information technology, globalisation, and social Development*. United Nations Research Institute for Social Development. United Nations Research Institute
- Chai, K. (2015). The principles and the ways of classroom interaction. *Proceedings of the 1st International Conference on Arts, Design and Contemporary Education*. https://doi.org/10.2991/icadce-15.2015.204
- Chen, C. (2008). Why do teachers not practice what they believe regarding technology integration?. *The Journal of Education Research, 102*(1), 65 – 75. https://doi.org/10.3200/JOER.102.1.65-75
- Chisholm, L. (2005). The politics of curriculum review and revision in South Africa in Regional context. *Compare: A Journal Of Comparative And International Education*, *35*(1), 79-100. http://doi.org/10.1080/03057920500033563
- Chomsky, N. (1959). A review of B.F. Skinner's verbal behavior. *Language*, *35*(1), 26 – 58. https://chomsky.info/1967____/
- Chomsky, N. (1971). *The case against B.F. Skinner.* New York Review of Books. https://www.ehu.eus/HEB/KEPA/The%20Case%20Against%20B.F.%20Skinner.pdf.
- Christie, P. (2008). *Opening the doors of learning: Changing schools in South Africa*. Heinemann
- Conole, G., & Dyke, M. (2004). What are the affordances of information and communication technologies? *ALT-J*, *12*(2), 113 - 124, http://doi.org/10.1080/0968776042000216183
- Cooper, P. A. (1993). Paradigm shifts in designed instruction: From behaviorism to cognitivism to constructivism. *Educational Technology, 33*(5), 12–19. http://www.jstor.org/stable/44428049
- Cox, M., Webb, M., Abbott, C., Blakeley, B., Beauchamp, T., & Rhodes, V. (2003). *ICT and pedagogy: a review of the research literature*. British Educational Communications and Technology Agency (Becta)

- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Sage Publications. https://psycnet.apa.org/record/2008-13604-000
- Crain, W. C. (1992). *Theories of development: Concepts and applications* (3rd ed.). Prentice-Hall.
- Crook, C. (1994). *Computers and the collaborative experience of learning*. Routledge
- Cuban, L. (1986). *Teachers and Machines*. Teachers College Press.
- Cuban, L. (1996). *Techno-Reformers and classroom teachers*. Education Week. Education Week
- Department of Basic Education, (2004). White Paper on e-Education: Transforming learning and teaching through Information and Communication Technologies (ICTs). *Government Gazette No. 26734.* Department of Basic Education
- Department of Basic Education. (2015*). Action Plan to 2019 Towards the Realisation of Schooling 2030.* Government of the Republic of South Africa. Department of Basic Education
- Draper, S. W. (2009). What are learners actually regulating when given feedback? *British Journal of Educational Technology. 40*(2), 306-315. https://doi.org/10.1111/j.1467-8535.2008.00930.x
- Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for Technology integration. *Educational Technology Research and Development*, 47(4), 47 - 61. http://doi.org/10.1007/bf02299597
- Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for Technology integration?. *Educational Technology Research and Development*, 53(4), 25 - 39. http://doi.org/10.1007/bf02504683
- Ertmer, P. A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education, *59*(1), 423 – 435. http://doi.org/10.1016/j.compedu.2012.02.001

- Fielding, O. (2014). *Unplugged: how to live mindfully in a digital world.* Carlton Books Limited
- Fu, J.S. (2013). ICT in Education: A critical literature review and its implications. *International Journal of Education and Development using Information and Communication Technology, 9*(1), 112 – 125. https://files.eric.ed.gov/fulltext/EJ1182651.pdf
- Fullan, M. (2013). *Stratosphere: Integrating Technology, Pedagogy, and Change Knowledge.* Pearson. https://michaelfullan.ca/books/stratosphere/
- Fullan, M., Langworthy, M. (2014). *A rich seam: How new pedagogies find deep learning*. Pearson. https://www.michaelfullan.ca/wp-content/uploads/2014/01/3897.Rich_Seam_web.pdf
- Fullan, M. (2016). *The New Meaning of Educational Change* (5th ed.). Routledge. Routledge.com
- Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953–1960. https://doi.org/10.1016/j.compedu.2011.04.010
- George, A. A., Hall, G. E., & Stiegelbauer, S. M. (2013). *Measuring implementation in schools: The stages of concern questionnaire*. SEDL. https://sedl.org/cbam/socq_manual_201410.pdf
- Greeno, J.G. (1997). On claims that answer the wrong questions. *Educational Researcher, 26*(1), 5 – 17. https://doi.org/10.3102/0013189x026001005
- Greeno, J., Collins, A. & Resnick, L. (1996). Cognition and learning. In Berliner, D. & Calfee, R. (eds.), Handbook of Educational Psychology, 77, 15 – 46. Google Scholar
- Haines, K. J. (2015). Learning to identify and actualize affordances in a new tool. *Language Learning and Technology, 19*(1), 165 – 180. https://scholarspace.manoa.hawaii.edu/bitstream/10125/44407/1/19_01_haines.pdf

- Hammond, M. (2010). What is an affordance and can it help us understand the use of ICT in education. *Education and Information Technologies, 15*(3), 205 - 217. https://doi.org/10.1007/s10639-009-9106-z
- Harris, J. (2016). In-service teachers' TPACK development: Trends, models, and trajectories. In M. Herring, M. Koehler, and P. Mishra (Eds.), *Handbook of technological pedagogical content knowledge for educators* (2nd ed.). 191 – 205. Routledge.
- Hennessy, S., Harrison, D., & Wamakote, L. (2010). Teacher factors influencing classroom use of ICT in Sub-Saharan Africa. *Itupale Online Journal of African Studies, 2*, 39 - 54. https://www.researchgate.net/publication/228399541_Teacher_factors_influencing_classroom_use_of_ICT_in_Sub-Saharan_Africa
- Hew, K., & Brush, T. (2006). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research And Development*, *55*(3), 223-252. https://doi.org/10.1007/s11423-006-9022-5.
- Isaacs, S. (2007). *Survey of ICT and education in Africa: South Africa country report*. infoDev. https://www.infodev.org/infodev-files/resource/InfodevDocuments_429.pdf
- Jansen, J.D. (1997). Can policy learn? Reflections on why OBE will fail. *Southern African Review of Education with Education with Production*, *3(*1*).* https://doi.org/10520/AJA15634418_38
- Jansen, J. & Blank M (2014). *How to fix South Africa's schools: lessons from schools that work*. BookStorm
- Jonassen, D. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology Research And Development*, *39*(3), 5-14. http://doi.org/10.1007/bf02296434
- Jonassen, D. H. (1995). Computers as cognitive tools: Learning with technology, not from technology. *Journal of Computing in Higher Education, 6*(2), 40-73. https://doi.org/10.1007/bf02941038

- Johnson, D. W. (1981). Student-student interaction: The neglected variable in education. *Educational Researcher, 10*(1), 5-10. http://doi.org/10.3102/0013189x010001005
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher*, *33*(7), 14-26. https://doi.org/10.3102/0013189x033007014
- Kagan, D.M. (1992*).* Implication of research on teacher belief*. Educational Psychologist, 27*(1), 65 – 90. https://doi.org/10.1207/s15326985ep2701_6
- Karagiorgi, Y. & Symeou,L. (2005*).* Translating constructivism into instructional design: potential and limitations. *Educational Technology & Society, 8*(1), 17 – 27. http://www.jstor.org/stable/jeductechsoci.8.1.17
- Karaman, A. (2012). The place of pedagogical content knowledge in teacher education. *Atlas Journal of Science Education*, *2*(1), 56–60. https://doi.org/10.5147/ajse.v2i1.76
- Kimmons, R. (2015). Examining TPACK's theoretical future. *Journal of Technology and Teacher Education, 23*(1), 53-77. https://www.learntechlib.org/primary/p/130072/.
- Koehler, M.J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content Knowledge (TPACK)? *Journal of Education*, *193*(3), 13 – 19. https://doi.org/10.1177/002205741319300303
- Koh, T. S., & Lee, S. C. (2008). Digital skills and education: Singapore's ICT master planning for the school sector. In S.K. Lee, C.B. Goh, B. Fredriksen & J.P. Tan (Eds.), *Toward a Better Future: Education and Training for Economic Development in Singapore since 1965,* 167 - 190. The World Bank. http://doi.org/10497/15602
- Kozma, R. (2008). The knowledge ladder: Using ICT and education reform to advance economic and social development goals. Semantic Scholar
- Kozulin, A. & Presseisen, B.Z. (1992) *Mediated learning – the contributions of Vygotsky and Feuerstein: In theory and practice*. American Educational Research Association. https://files.eric.ed.gov/fulltext/ED347202.pdf
- Laurillard, D. (2002). *Rethinking university teaching: A framework for the effective use of Learning technologies*. RoutledgeFalmer.

- Levinsen, T. K. & Sorensen, B. H. (2011). Formalized Informal Learning: ICT and learning for the 21st century. *International Journal of Digital Literacy and Digital Competence (IJDLDC), 2*(1). http://doi.org/10.4018/jdldc.2011010102
- Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education.* Jossey-Bass Publishers.
- McMillan, J. H., & Schumacher, S. (2010). Research in Education: Evidence-Based Inquiry. Pearson. Google Scholar
- Mishra, P & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017 – 1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage Publications. Google Scholar
- Moallem, M. (1998). An expert teacher's thinking and teaching and instructional design models and principles: An ethnographic study. *Educational Technology Research and Development, 46*(2), 37-64. https://doi.org/10.1007/bf02299788
- National Planning Commission. (2011). *National Development Plan: Vision for 2030*. Government of the Republic of South African. National Planning Commission
- Ndlovu, N. S. (2015). *The pedagogical integration of ICT's by seven South African township secondary school teachers*. The University of Witwatersrand. Semantic Scholar
- Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*(4), 317- 328. https://doi.org/10.1080/0022027870190403
- Newhouse, C.P. (2001). Applying the Concerns-Based Adoption Model to research on computers in classrooms. *Journal of Research on Computing in Education*, *33*(5), 1 – 21 Google Scholar
- Norman, D.A. (1988). *The psychology of everyday things*. Basic Books.

- Padayachee, K. (2017). A Snapshot Survey of ICT Integration in South African Schools. *South African Computer Journal, 29*(2), 36 – 65. https://doi.org/10.18489/sacj.v29i2.463
- Pask, G. (1976). Conversational techniques in the study and practice of education. *British Journal of Educational Psychology*, *46*(1), 12-25. http://doi.org.10.1111/j.2044-8279.1976.tb02981.x
- Pelgrum, W. (2001). Obstacles to the integration of ICT in education: Results from a Worldwide educational assessment. *Computers & Education*, *37*(2), 163 - 178. http://doi.org/10.1016/s0360-1315(01)00045-8
- Pfeffer, J. and Sutton, R.I. (2000). *The Knowing Doing Gap: How smart companies turn knowledge into action.* Harvard Business School Press. Google Scholar
- Putnam, R.T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Research*, *29*(1), 4 – 15. https://doi.org/10.3102/0013189x029001004
- Prensky, M. (2001), Digital natives, digital immigrants part 1. *On the Horizon*, 9(5) , 1-6 https://doi.org/10.1108/10748120110424816
- Ramsden, P. (1992). *Learning to teach in higher education*. RoutledgeFalmes, (2nd ed.)
- Ravitch, S.M & Riggan, M. (2017). *Reason and Rigor: How Conceptual Frameworks Guide Research* (2nd Ed.). SAGE Publications
- Romeo, G. (2008). Information and communication technologies in education. In Nicola Yelland, Greg. A. Neal and Eva Dakish (Eds.) *Rethinking Education with ICT: New directions for effective practices*. 203 – 221. Sense Publishers
- Sanders, M., George, A. (2017). Viewing the changing world of educational technology from a Different perspective: Present realities, past lessons, and future possibilities. *Education and Information Technologies, 22*(6), 2915 – 2933. https://doi.org/10.1007/s10639-017-9604-3
- Saunders, M., Lewis, P., & Thornhill, A. (2000). *Research methods for business students* (2nd ed.). Pearson Education.

- Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students* (6th ed.). Pearson Education.
- Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson Education.
- Sendurur, E. (2018). The pedagogical beliefs and instructional design practices: Pre-service IT teachers' case. *Eurasian Journal of Education on Research, 75*(1), 59 – 80. https://files.eric.ed.gov/fulltext/EJ1181459.pdf
- Scott, D., Morrison, M. (2006). *Key ideas in educational research*. Continuum International Publishing Group.
- Schön, D. A. (1971). *Beyond the stable state*. Random House.
- Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews and C. Haythornthwaite (eds.) *The Sage handbook of elearning research*. Sage, 221 - 247. HAL Open Science
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14. *https://doi.org/10.3102/0013189x015002004*
- Shulman, L.S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1 – 23. https://doi.org/10.17763/haer.57.1.j463w79r56455411
- Siemens, G. (2004). Connectivism: A learning theory for the digital age. *Elearnspace.org*. Google Scholar
- Skinner, B.F. (1954). The science of learning and the art of teaching. *Harvard Educational Review*, *24*(2), 86 – 97. https://psycnet.apa.org/record/1955-02985-001
- Snoeyink, R., & Ertmer, P. (2001). Thrust into Technology: How veteran teachers Respond. *Journal Of Educational Technology Systems*, *30*(1), 85 - 111. http://doi.org/10.2190/ydl7-xh09-rlj6-mtp1
- Spaull, N. (2013). South Africa's education crisis: The quality of education in South Africa 1994 – 2011. *Report Commissioned by Centre for Development Enterprise (CDE)*. https://section27.org.za/wp-content/uploads/2013/10/Spaull-2013-CDE-report-South-Africas-Education-Crisis.pdf

- Somekh, B. (2007). *Pedagogy and learning with ICT: Researching the art of innovation* (1st ed.). Routledge. https://doi.org/10.4324/9780203947005
- Starkey, L. (2010). Teacher's pedagogical reasoning and action in the digital age. *Teachers and Teaching*, *16*(2), 233 – 244. http://doi.org/10.1080/13540600903478433
- Taylor, N., & Vinjevold, P. (1999). Teaching and learning in South African schools. In N. Taylor and P. Vinjevold (Eds.), *Getting learning right: report of the President's education initiative research project,* 131-162. Joint Education Trust.
- Teese, R & Polessel, J. (2003). *Undemocratic schooling: Equity and equality in mass secondary education in Australia*. Melbourne University Press. https://catalogue.nla.gov.au/Record/2323235
- van der Berg, S., Taylor, S., Gustafsson, M., Spaull, N., & Armstrong, P. (2011). *Improving Education Quality in South Africa*. Department of Economics, University of Stellenbosch. https://resep.sun.ac.za/wp-content/uploads/2012/10/2011-Report-for-NPC.pdf
- Webb, M. & Cox, M. (2004). A review of pedagogy related to information and Communications technology. *Technology, Pedagogy and Education*, *13*(3), 235-286. https://doi.org/10.1080/14759390400200183
- Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal*, *39*(1), 165-205. http://doi.org/10.3102/00028312039001165
- Wright, L. (2012). *South Africa's education crisis: Views from the Eastern Cape.* NISC.

Appendix A

Stages of Concern Questionnaire

Use of ICT in classroom practices

The purpose of this questionnaire is to determine what teachers who are using ICT in their lessons ("the innovation") are concerned about at various times during the ICT adoption process.

The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years' experiences using them. Therefore, many of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale.

For example:

This statement is absolutely true of me at this time.	0	1	2	3	4	5	6	(7)
This statement is somewhat true of me now.	0	1	2	3	(4)	5	6	7
This statement is not at all true of me at this time.	0	(1)	2	3	4	5	6	7
This statement seems irrelevant to me.	(0)	1	2	3	4	5	6	7

Please respond to the items in terms of your present concerns, or how you feel about your involvement with this innovation. We do not hold to any one definition of the innovation so please think of it in terms of your own perception of what it involves. Phrases such as "this approach" and "the new system" all refer to the same innovation. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement with the innovation.

Thank you for taking time to complete this task.

0	1 2	3 4 5	6 7
Irrelevant	Not true of me now	Somewhat true of me now	Very true of me now

Circle One Number For Each Item

1. I am concerned about students' attitudes toward the innovation.	0 1 2 3 4 5 6 7
2. I now know of some other approaches that might work better.	0 1 2 3 4 5 6 7
3. I am more concerned about another innovation.	0 1 2 3 4 5 6 7
4. I am concerned about not having enough time to organize myself each day.	0 1 2 3 4 5 6 7
5. I would like to help other faculty in their use of the innovation.	0 1 2 3 4 5 6 7
6. I have a very limited knowledge of the innovation.	0 1 2 3 4 5 6 7
7. I would like to know the effect of reorganization on my professional status.	0 1 2 3 4 5 6 7
8. I am concerned about conflict between my interests and my responsibilities.	0 1 2 3 4 5 6 7
9. I am concerned about revising my use of the innovation.	0 1 2 3 4 5 6 7
10. I would like to develop working relationships with both our faculty and outside faculty using this innovation.	0 1 2 3 4 5 6 7
11. I am concerned about how the innovation affects students.	0 1 2 3 4 5 6 7
12. I am not concerned about the innovation at this time.	0 1 2 3 4 5 6 7
13. I would like to know who will make the decisions in the new system.	0 1 2 3 4 5 6 7
14. I would like to discuss the possibility of using the innovation.	0 1 2 3 4 5 6 7
15. I would like to know what resources are available if we decide to adopt the innovation	0 1 2 3 4 5 6 7
16. I am concerned about my inability to manage all that the innovation requires.	0 1 2 3 4 5 6 7
17. I would like to know how my teaching or administration is supposed to change.	0 1 2 3 4 5 6 7
18. I would like to familiarize other departments or persons with the progress of this new approach.	0 1 2 3 4 5 6 7

0	1 2	3 4 5	6 7
Irrelevant	Not true of me now	Somewhat true of me now	Very true of me now

Circle One Number For Each Item

19. I am concerned about evaluating my impact on students.	0 1 2 3 4 5 6 7
20. I would like to revise the innovation's approach.	0 1 2 3 4 5 6 7
21. I am preoccupied with things other than the innovation.	0 1 2 3 4 5 6 7
22. I would like to modify our use of the innovation based on the experiences of our students.	0 1 2 3 4 5 6 7
23. I spend little time thinking about the innovation.	0 1 2 3 4 5 6 7
24. I would like to excite my students about their part in this approach.	0 1 2 3 4 5 6 7
25. I am concerned about time spent working with nonacademic problems related to the innovation.	0 1 2 3 4 5 6 7
26. I would like to know what the use of the innovation will require in the immediate future.	0 1 2 3 4 5 6 7
27. I would like to coordinate my efforts with others to maximize the innovation's effects.	0 1 2 3 4 5 6 7
28. I would like to have more information on time and energy commitments required by the innovation.	0 1 2 3 4 5 6 7
29. I would like to know what other faculty are doing in this area.	0 1 2 3 4 5 6 7
30. Currently, other priorities prevent me from focusing my attention on the innovation.	0 1 2 3 4 5 6 7
31. I would like to determine how to supplement, enhance, or replace the innovation.	0 1 2 3 4 5 6 7
32. I would like to use feedback from students to change the program.	0 1 2 3 4 5 6 7
33. I would like to know how my role will change when I am using the innovation.	0 1 2 3 4 5 6 7
34. Coordination of tasks and people is taking too much of my time.	0 1 2 3 4 5 6 7
35. I would like to know how the innovation is better than what we have now.	0 1 2 3 4 5 6 7

Please complete the following:

1. How long have you been involved with the innovation, not counting this year?

   Never___ 1 year___ 2 years___ 3 years___ 4 years___ 5 or more___

2. In your use of the innovation, do you consider yourself to be a:

   Non-user___ novice___ intermediate___ old hand___ past user___

3. Have you received formal training regarding the innovation (workshops, courses)?

   Yes No

4. Are you currently in the first or second year of use of some major innovation or program other than this one?

   If yes, please describe briefly:

Appendix B

Stages of Concern Quick Scoring Device

A

Date: _____

Site: _____ SS#: _____

Innovation: _____

B

Stage	0	1	2	3	4	5	6
	3 ___	6 ___	7 ___	4 ___	1 ___	5 ___	2 ___
	12 ___	14 ___	13 ___	8 ___	11 ___	10 ___	9 ___
	21 ___	15 ___	17 ___	16 ___	19 ___	18 ___	20 ___
	23 ___	26 ___	28 ___	25 ___	24 ___	27 ___	22 ___
	30 ___	35 ___	33 ___	34 ___	32 ___	29 ___	31 ___

C Raw Score Totals ___ ___ ___ ___ ___ ___ ___

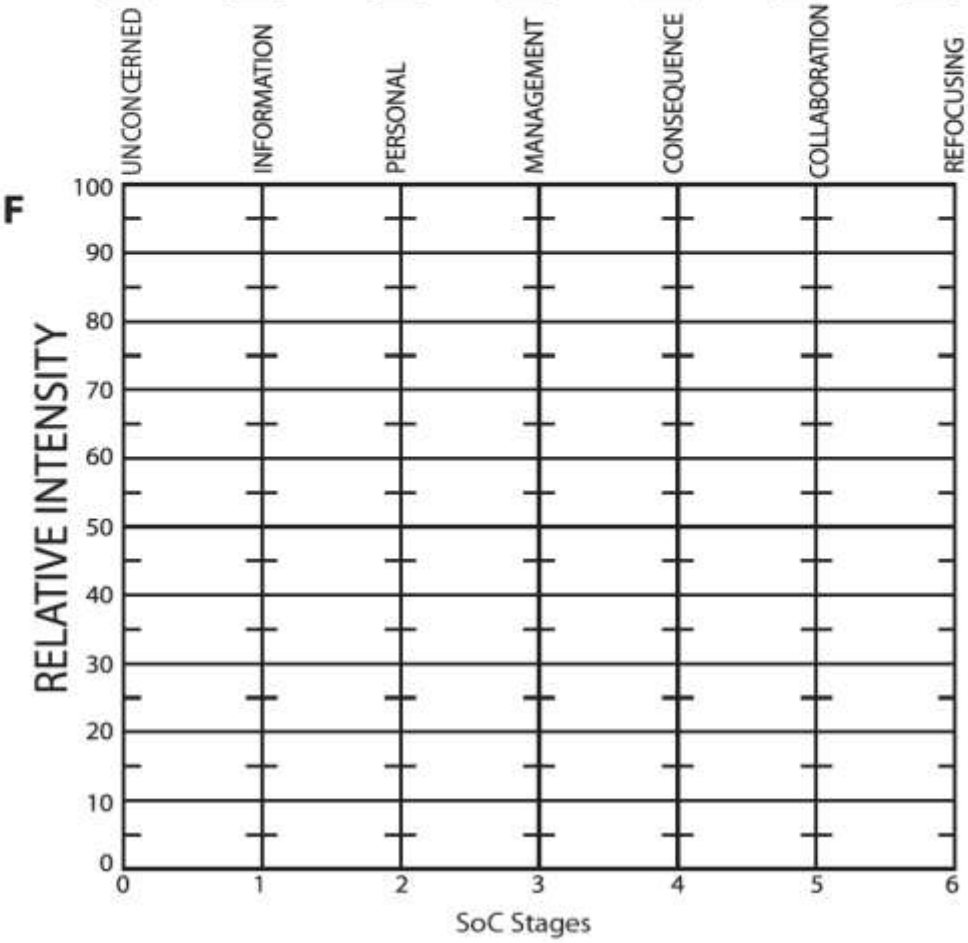
E Percentile Scores ___ ___ ___ ___ ___ ___ ___

D

Five Item Raw Scale Score Total	Percentiles for:						
	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
0	0	5	5	2	1	1	1
1	1	12	12	5	1	2	2
2	2	16	14	7	1	3	3
3	4	19	17	9	2	3	5
4	7	23	21	11	2	4	6
5	14	27	25	15	3	5	9
6	22	30	28	18	3	7	11
7	31	34	31	23	4	9	14
8	40	37	35	27	5	10	17
9	48	40	39	30	5	12	20
10	55	43	41	34	7	14	22
11	61	45	45	39	8	16	26
12	69	48	48	43	9	19	30
13	75	51	52	47	11	22	34
14	81	54	55	52	13	25	38
15	87	57	57	56	16	28	42
16	91	60	59	60	19	31	47
17	94	63	63	65	21	36	52
18	96	66	67	69	24	40	57
19	97	69	70	73	27	44	60
20	98	72	72	77	30	48	65
21	99	75	76	80	33	52	69
22	99	80	78	83	38	55	73
23	99	84	80	85	43	59	77
24	99	88	83	88	48	64	81
25	99	90	85	90	54	68	84
26	99	91	87	92	59	72	87
27	99	93	89	94	63	76	90
28	99	95	91	95	66	80	92
29	99	96	92	97	71	84	94
30	99	97	94	97	76	88	96
31	99	98	95	98	82	91	97
32	99	99	96	98	86	93	98
33	99	99	96	99	90	95	99
34	99	99	97	99	92	97	99
35	99	99	99	99	96	98	99

Concerns Based Systems International

F



Appendix C

Part A

Question
1. What subject(s) do you teach ***Comment***
2. What ICT infrastructure and application software are you able to access from your school ***Comment***
3. Do you have access to a laptop ***Comment***

4. Do your learners have access to a computer lab, laptops or tablets

Comment

5. Which ICTs do you use in your teaching?

Comment

6. What constraints have you experienced when using ICTs in your lessons

Comment

7. Is technical assistance available during your lesson presentations. If so, how effective is it to the smooth running of your lesson?

Comment

Part B

Question
1. What do you think of ICT integration into teaching and learning of the subject you teach? Are there any benefits? ***Comment***
2. Where and when do you find the use of ICTs most productive in your teaching ***Comment***
3. Have you identified any improvement in your learner's performance since you used ICTs to teach? Please explain your answer. ***Comment***

4. What do you attribute to the improvement or lack of improvement to your learner's performance since you used ICTs to teach?

Comment

5. What do you think higher-order thinking skills are?

Comment

6. How do you develop these skills in your subject teaching with or without ICT

Comment

Part C

Question
1. Do you prepare your ICT integrated lessons on your own? If yes, how do you find it? ***Comment***
2. Do you feel you are adequately prepared to integrate ICTs into your teaching?

Comment

3. Have you had formal training on how to use ICT for teaching? If yes was it part of your pre/in-service training

Comment

4. What additional skills or knowledge would you need if you were to integrate ICT into your teaching effectively?

Comment

Exhibit 1

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	13 April 2021
Validity of Research Approval:	08 February 2021– 30 September 2021 2021/88
Name of Researcher:	Nhlapho MB
Address of Researcher:	35 New Forest Road
	Forest Town
	Johannesburg
Telephone Number:	083 442 6918
Email address:	mnhlapho@yebo.co.za
Research Topic:	Pedagogical Integration of ICTs by Teachers: A case study at 5 South African public schools.
Type of qualification	Master's in Education
Number and type of schools:	5 Secondary Schools
District/s/HO	Tshwane North

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

13/04/2021

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

1. *Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. ***Because of COVID 19 pandemic researchers can ONLY collect data online, telephonically or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate. The approval letter will then indicate the type of arrangements that have been made with the school.***
4. ***The Researchers are advised to make arrangements with the schools via Fax, email or telephonically with the Principal.***
5. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
6. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
7. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
8. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
9. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
10. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
11. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
12. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
13. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
14. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
15. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
16. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Mr Gurhanil Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 13/04/2021

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

Exhibit 2

WITS SCHOOL OF EDUCATION

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

SCHOOL OF EDUCATION ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: 2019ECE037M**
PROJECT TITLE	Pedagogical Integration of ICT by Teachers: A Case Study at 5 South African Public Schools
INVESTIGATOR	Mandla Nhlapo
SCHOOL/DEPARTMENT OF INVESTIGATOR	WITS SCHOOL OF EDUCATION
DATE CONSIDERED	11 November 2019
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	Date of submission of the project report

ISSUE DATE OF CERTIFICATE 18 November 2019 **CHAIRPERSON** (Dr. Paul Goldschagg)

cc: Supervisor: Dr. Ian Moll

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** emailed to the Ethics Office: Matsie.Mabeta@wits.ac.za

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

_____ _____/_____/_____
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Exhibit 3

EDUCATION
REPUBLIC OF SOUTH AFRICA

Enquiries: P DEVCHAND/ A JOOSTE
Sub-Directorate: ISSP
Office Number: 124
Tel: 012 543 4315/16
Email: Pranay Devchand@gauteng.gov.za/
Ann.Jooste@gauteng.gov.za
Ref: 31/08/18

TO : **MR M.B. NHLAPHO**

FROM : **MS THEA COETSER**
DISTRICT DIRECTOR: TSHWANE NORTH

DATE : **29 APRIL 2021**

SUBJECT : **PERMISSION GRANTED TO CONDUCT RESEARCH**

Dear Mr. Nhlapho

It is our pleasure to inform you that the District Office grants you permission to conduct research at the requested schools approved by Head Office on the topic: ***"Pedagogical Integration of ICTs by Teachers: A case study at 5 South African public schools".***

You may only conduct the research **after contact time** to protect teaching and learning activities. The principal must be consulted regarding an appropriate time to conduct the research.

You are personally responsible for providing and utilizing your own research resources. Participants names must not appear in the research report and all appropriate ethical measures must be implemented to protect them.

Tshwane North District expects you to submit, upon completion, a summary of your research findings as stipulated in **Clause No. 14 of the GDE letter of approval you received.**

The District appreciates your contribution towards the enhancement of education in the province and District and anticipate your success with your research project.

Regards

MS THEA COETSER
DISTRICT DIRECTOR: TSHWANE NORTH

DATE: 03/05/2021

Tel: (012) 543 4302, Cell: 083 346 6953, Fax: 086 533 4568 | Email: Thea.Coetser@gauteng.gov.za
Wonderboom Junction Mall, 1st Floor, Corner Lavender & Lavender West Road,
Wonderboom, 0066, Private Bag X945, Pretoria, 0001