USER EXPERIENCES OF LEARNERS IN TECHNOLOGY-FACILITATED LEARNING IN A RESOURCE DEPRIVED CONTEXT

by

CANDICE LANGENHOVEN

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SUPERVISOR: DR R CALLAGHAN

CO-SUPERVISOR: PROF M HERSELMAN

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DECLARATION

"I declare that the thesis, I hereby submit for the degree Master in Education

General at the University of Pretoria, is my own work and has not been

submitted by me for a degree at this or any other tertiary institution."

ETHICS STATEMENT

"The author, whose name appears on the title page of this thesis, has obtained,

for the research described in this work, the applicable research ethics approval.

The author declares that she has observed the ethical standards required in terms

of the University of Pretoria's *Code of ethics for researchers and the Policy*

guidelines for responsible research."

SUMMARY

The purpose of this study is to determine how the user experiences of learners' are influenced by the use of tablets in teaching and learning in a rural school in the Eastern Cape Province. The emphasis on ICT and education has predominantly focused on the teacher and issues relating to the teacher. The focus of this study is on the learners as the receivers of technology-facilitated learning and considers their emotions, attitudes and motivation as a result of their interaction with the technology. The main research question encompasses how learners experience technology-facilitated learning in a resource deprived environment. A qualitative case study was conducted with an inductive approach from an interpretivist philosophy. Data collection included the creation of physical artefacts, interviews and observations. Data was analysed by means of thematic analysis. The foundation of the study is built upon the Activity Theory and User Experience as frameworks, which were integrated and applied as the conceptual framework. The Activity Theory was applied to determine the interaction which occurred between the learner, the teacher and the mobile tablet. User Experience was applied to define the emotions, attitudes and motivation of

learners when interacting with the tablet. The main findings signified that learners experienced both positive and negative emotions when learning was facilitated by technology. Learners' attitudes improved as a result of their interaction with the tablet. The technology greatly enhanced learners' motivation to learn. The interaction with the tablet included capturing and accessing information, reporting back and recording of information.

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ABSTRACT

Technology is infiltrating our lives and the classroom can therefore be no exception. The purpose of this study is to determine how the user experiences of learners' are influenced by the use of tablets in teaching and learning in a rural school in the Eastern Cape Province. The emphasis on ICT and education has predominantly focused on the teacher and issues relating to the teacher. The focus of this study is on the learners as the receivers of technology-facilitated learning and considers their emotions, attitudes and motivation as a result of their interaction with the technology. The main research question encompasses how learners experience technology-facilitated learning in a resource deprived environment. A qualitative case study was conducted with an inductive approach from an interpretivist philosophy. Data collection included the creation of physical artefacts, interviews and observations. Data was analysed by means of thematic analysis. The foundation of the study is built upon the Activity Theory and User Experience as frameworks, which were integrated and applied as the conceptual framework. The Activity Theory was applied to determine the interaction which occurred between the learner, the teacher and the mobile tablet. User Experience was applied to define the emotions, attitudes and motivation of learners when interacting with the tablet. The main findings signified that learners experienced both positive and negative emotions when learning was facilitated by technology. Learners' attitudes improved as a result of their interaction with the tablet. The technology greatly enhanced learners' motivation to learn. The interaction with the tablet included capturing and accessing information, reporting back and recording information, as the key uses of the tablet.

KEYWORDS

Technology-facilitated learning, tablets, experience, emotions, attitudes and motivations

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USER EXPERIENCES OF LEARNERS IN TECHNOLOGY-FACILITATED LEARNING IN A RESOURCE DEPRIVED CONTEXT

CHAPTER 1 – INTRODUCTION

A schematic representation of Chapter 1

1.1   BACKGROUND

Technology is increasingly infiltrating our lives as the world becomes more engaged and absorbed in technology and thus the classroom can be no exception (Cheung & Slavin, 2011; Smieja, 2012). Technology in schools is here to stay (Duncan, 2012) as teachers believe that technology has great potential to improve education (Keengwe & Onchwari, 2011); it provides opportunity for improved learning; and it changes the way in which teachers teach. Technology supports influential and refined learning environments as it is recognised as the golden key in facilitating technology-enhanced, learner-centred teaching and learning environments (Hermans, Tondeur, van Braak, & Valcke, 2008). Educational technology will play an increasingly significant role in the future (Cheung & Slavin, 2011) since ICT has the capacity to transform pedagogical practices in classrooms (Hardman, 2005).

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The use of Information Communication Technologies (ICTs) to enhance teaching and learning has the potential to raise standards since it increases teachers' and learners' capabilities (Chigona & Chigona, 2010). Literature shows that technology effectively advances educational abilities, therefore increasing learners' performances (Louw, Muller, & Tredoux, 2008). The use of technology allows and creates opportunity for teachers to better respond to the different needs of different learners (Lau & Sim, 2008 as cited by Chigona & Chigona, 2010).

Educational technology is defined as a variety of electronic tools and applications, which assists in delivering learning material and supports learning processes to improve learning goals (Cheung & Slavin, 2011). Current and prevalent uses of technologies internationally include: (1) Internet-based tools and activities (web quests, blogs, wikis, google documents, social bookmarking, podcasting, other web tools); (2) Software-based tools and activities (digital storytelling, educational programs and games, e-tutorials, virtual worlds, concept mapping); (3) Hardware (Interactive whiteboards, hand-held devices, student response systems and mobile devices) (Mims, Polly, & Grant, 2009). Cheung and Slavin (2011) concur and add computer-assisted instruction (CAI), integrated learning systems (ILS) and videos, to the list. Technology, specifically one-to-one devices, in schools are emerging as instructional tools throughout the world (Duncan, 2012). Schools are incorporating mobile touch screen devices in learning activities as it is affordable, versatile and familiar to learners (Kiger, Herro, & Prunty, 2012). More specifically, and for the purpose of this study, the focus will be on the integration of mobile tablets in teaching and learning.

The learners' experience of learning in a technology-facilitated learning environment will be influenced by cognitive (how they *think*), emotional (how they *feel*) and social (how they *interact*) aspects. As these emotional, cognitive and social elements of individuals' lives are transformed by new and evolving technologies, educational settings are also challenged to respond to the issues that have arisen as a consequence (Costabile & Spears, 2012). ICT can help prepare learners as it supports the development of skills such as thinking, evaluating and synthesising (Castro, 2003; Cawthera, 2003). Such skills, developed in the use of technology in education, are valuable to a constructivist approach (Newhouse, 2002). The constructivist perspective sees information, and therefore knowledge, not as something that is a given and assumed but as something that is continuously constructed and formed by learners (Donald, Lazarus, & Lolwana, 2002). An essential component of the constructivist theory of learning is the idea of proximal learning, which accepts that scaffolding is a primary requirement for a learner to create his/her own knowledge. This scaffolding is usually provided by a more

capable person, but it could also be supported by the incorporation of ICT into the teaching and learning environment. Accordingly, technology can help to form and support ideal learning environments (Newhouse, 2002).

As mentioned above, the benefits of technology in education are evident. This study will attempt to understand the learners' (user) experience of the use of tablets in education in a resource deprived context, taking into account the learners' emotions, motivations and attitudes with regards to the use of tablets. The experience of learners is significant because if learning experience influences learning achievement and performance, one could propose that if the learning experience improves, achievement and performance would consequently also improve. This experience relates to the motivation of the learner. If a learner is more motivated because of an improved experience, it could also motivate the learner to achieve and perform better. If we could understand how learners process and internalise their experience in perceptions, attitudes and emotions it may have a meaningful impact on learning.

1.2   PROBLEM STATEMENT AND RESEARCH QUESTIONS

1.2.1 PURPOSE OF RESEARCH

The purpose of this study is to determine *how* user experiences (learners' emotions, attitudes and motivation) are influenced by the use of tablets in teaching and learning in a rural school in the Eastern Cape Province. As soon as these learners' user experiences with tablets are determined, it can serve as a guide to support teachers in ensuring that the emotions, attitudes and motivations experienced by their learners, contribute to improvement of the overall teaching and learning environment.

1.2.2 PROBLEM STATEMENT

Research on ICTs in education in developing countries concentrates on physical access to resources; infrastructure; support and collegiality in schools; policies; and basic training of the teachers on how to use the technologies. There is a tendency to look at the ICTs and how they are used in the schools and not at the capabilities of teachers and learners to effectively use the technologies (Chigona & Chigona, 2010).

There is not much emphasis on finding out from learners how they feel about ICTs in schools (Hall & Higgins, 2005). Learners are the key stakeholders in education; consequently it is important to find out what drives and challenges them with regards to ICT in the classroom. This can also inform teachers' practices, thus leading to the development of a more collaborative educative process.

The focus of ICT in education has predominantly been on ICTs and teachers: teachers' capabilities (Gudmundsdottir, 2010); training (Davis, Preston, & Sahin, 2009); teachers' views (Gialamas & Nikolopoulou, 2010); teachers' attitudes towards ICT (Cavas, Cavas, Karaoglan, & Kisla, 2009); factors that influences their use of ICT (Tezci, 2011); integration of ICT (Vongalis-Macrow, Wright, & Brew, 2009); teaching behaviours (Sang, Valcke, Van Braak, & Tondeur, 2010) and teacher effect on the use of ICT (Tezci, 2009).

Continued research is needed to investigate the behaviour, facilitating conditions and experience in mobile learning (Wang, Wu, & Wang, 2009). Hence the researcher would like to re-orientate the focus on the learner as the receiver of technology-facilitated learning with the use of tablets and their experience thereof, taking into consideration their motivation, attitudes and emotions.

1.2.3 RESEARCH OBJECTIVES
The following objectives are set to address the purpose of this study:

- Describe the specific uses and applications of tablets in rural schools.
- Understand how tablets are incorporated within the teaching process in senior secondary schools in a rural context.
- Identify emotions, attitudes and motivations which arise when learning is mediated by technology (such as tablets) in school.
- Demonstrate how to incorporate Activity Theory and User Experiences as a conceptual framework for technology-facilitated learning.

1.2.4 RESEARCH QUESTIONS
In order to achieve the objectives set in the study (*cf* section 1.2.3) it is deemed necessary to answer the following research questions. Firstly, the primary research question is set, thereafter the secondary research questions are set in order to unpack the primary research question which will finally meet the purpose of the research (*cf* section1.2.1).

1.2.4.1 PRIMARY RESEARCH QUESTION
How do learners experience technology-facilitated learning in a resource deprived environment?

1.2.4.2 SECONDARY RESEARCH QUESTIONS

In order to fully explore the primary research question, the following secondary research questions need to be addressed:

a. How does interaction occur among the tablet, learner and teacher?

b. Which emotions do learners experience when learning is facilitated by technology?

c. What are learners' attitudes towards the use of tablets in school?

d. How does the use of tablets motivate leaners in school?

1.2.5 IMPORTANCE OF STUDY AND POSSIBLE CONTRIBUTIONS

This study will contribute to the ICT4RED project in the Eastern Cape. This project is discussed in more detail in in Chapter 3 (*cf* section 3.7) as part of the discussion on a resource deprived environment.

The theoretical contribution of this study is the development of a novel conceptual framework which incorporates Activity Theory (AT) with User Experience (UX). These frameworks are discussed individually (*cf* section 2.2.1 and 2.2.2) and later as a conceptual framework (*cf* section 4.2.2) and then later applied and incorporated together as a conceptual framework in addressing the primary research question (*cf* section 7.6).

The practical contribution is an understanding of the role which emotions, attitudes and motivation play when learning is facilitated by technology, to thus ensure that learners' experiences contribute to the improvement of the overall teaching and learning environment.

The personal contribution is to support teachers and learners in a rural school in the Eastern Cape.

1.3 LITERATURE REVIEW

The literature review will be divided into two main themes, namely Learning Experience (*cf* chapter 2, section 2.1 to 2.4) and Technology-Facilitated Learning (*cf* chapter 3, section 3.1 to 3.8). Learning Experience refers to all aspects which could possibly influence the learning experience of learners within the scope of this study. The theoretical frameworks underpinning the study will be discussed, i.e. Activity Theory and User Experience, which will later be developed into a conceptual framework (*cf* section 4.2.2). Activity Theory, as a theoretical framework, will elaborate on how learning experience is influenced when interaction involves an additional tool. User Experience, as a theoretical framework, will investigate the motivational and emotional experiences when a user interacts with a product, which in this case refers to a learner interacting with a tablet. In the latter part of this section significant psychological aspects are discussed which also influence the learning experience. This

discussion includes concepts such as emotions, motivation and self-concept. Furthermore, The Zone of Proximal Development and scaffolding which are important psychological concepts in this study, will also be highlighted.

The latter part of the literature review, Technology-Facilitated Learning, discusses learning theories with the purpose of showing how education has evolved from the behaviourist to a cognitive approach to where we are currently, the constructivist approach, which is concerned with learning through experience. It further demonstrates how the constructivist approach is supported by Information and Communication Technology (ICT) in education. Mobile learning, as a concept and an example of technology facilitated learning which is relevant and applicable to existing education, is also deliberated. A discussion of 21st century skills and the importance thereof illustrates the different skills, in which technology plays a significant role, which a learner requires in order to progress and succeed in his career and in life. The current education system in South Africa is also discussed in order to paint a picture of the context of this study in a broader sense. A resource deprived environment discussion serves to further highlight the context of the research for the reader as this will then help to illustrate how technology facilitates learning in such contexts.

1.4   RESEARCH PROCESS

The research methodology and process of this research study is explained in terms of the 'research onion' (Saunders, Lewis, & Thornhill, 2012) which describes the process in terms of the different layers being peeled off. As seen figure 1, the different layers consist of philosophy, approach, strategy, time horizon, data collection methods and data analysis.

Figure 1: THE RESEARCH ONION
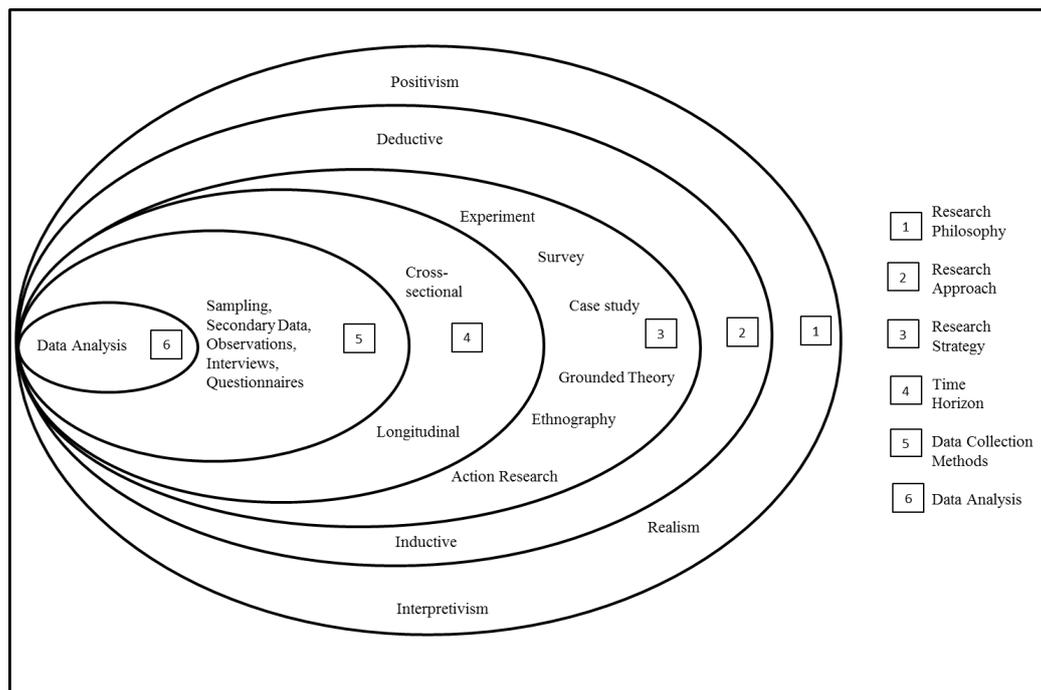
Adapted from Saunders et al. (2012)

This research study is based on the philosophy of interpretivism, following an inductive approach with case study as the research strategy. The cross-sectional study included physical artefacts, interviews and observations as data collection methods, after which the collected data will be analysed by means of thematic analysis. The detailed research methodology is presented in Chapter 4 – Research Methodology (*cf* section 4.1 to 4.7). The analysis and interpretation of the data is presented in Chapter 6 – Data Analysis (*cf* section 6.1 to 6.11).

1.5   SCOPE AND CONTEXT OF STUDY

The scope and the context of this study involve investigating the different user experiences of learners with technology-facilitated learning. Section 1.5.1 specifies the scope of the study and 1.5.2 presents the delineation of the study.

1.5.1   THE SCOPE OF THE STUDY

The focus of this study is on the experience of learners with technology-facilitated learning only. This includes the emotions and attitudes experienced by learners when learning is facilitated by technology. Furthermore the study explores how the tablet influences the learners' motivation to learn. It also includes the interaction among the learners, teachers and tablets in the observed lessons only. Learners reported on emotions, attitudes and motivations at the specific time of data collection only. Evaluating the impact of technology, or whether

the technology contributed to the improvement of the learners' academic performance, was not measured as it does not form part of the scope of the study.

1.5.2 DELINEATION OF STUDY

This research was carried out at a rural school in the province of the Eastern Cape as this was the scope and context of the ICT4RED project of The CSIR, Meraka. This project selected rural schools in the Nciba District. Only Grade 12 learners and their teachers were selected to take part in the data collection as these learners were the only learners in the schools who had been exposed to the technology at the stage of data collection. Therefore the claims made in this study cannot be generalised to all learners in all schools.

1.6 ETHICAL CONSIDERATIONS

This study is linked to The ICT4RED project of the CSIR Meraka. Permission to conduct the research was extended by the Eastern Cape Department of Basic Education (*cf* Appendix C). At the start of The ICT4RED project, the CSIR firstly obtained permission from the Chief of the community to conduct the research and a good relationship with the community has been continuously fostered. Ethical clearance was obtained from the Ethics Committee of the University of Pretoria (*cf* Appendix C). According to the policy guidelines of the University of Pretoria on the inclusion of minor children in research investigations (Human-Vogel, 2007), attention was given to protect and advance the best interests of the learners participating in the research. Human rights, including equality, human dignity, freedom, security, privacy and freedom of expression, were protected. The inclusion of the learners was based on voluntary participation and assent from learners were obtained. The assent forms were translated into Xhosa and, where necessary, the teacher was called upon to explain to the learner in his/her preferred language. Informed consent was obtained from the teachers and the learners' parents, guardians or care givers. All assent and consent forms are available, *cf* Appendix B. Privacy, confidentiality and anonymity were assured at all times. The relationship between the researcher and learners was built on trust and they were kept informed of all changes or amendments, the conditions of their participation were continuously discussed and they were provided with the opportunity to discuss their concerns freely. All research aims and procedures were explained to both the learners and teachers (Mack, Woodsong, MacQueen, Guest, & Namey, 2005). Participants were informed that they may withdraw from the study at any time should they choose to do so (Welfer, 2002). Participants were not harmed and their wellness was protected.

1.8   DISSERTATION STRUCTURE

1. Chapter 1 – Introduction

Chapter 1 provides an overview of the study, including an introduction and background to the research. It also contains the purpose, problem statement and research questions.

2. Chapter 2 – Literature Review: Learning Experience

Chapter 2 outlines important literature which covers all significant aspects of the learning experience as a research topic, including psychological aspects.

3. Chapter 3 – Literature Review: Technology-facilitated Learning

Chapter 3 outlines important literature related to the education topic of technology-facilitated learning, covering learning theories, mobile learning and 21st century skills, amongst others.

4. Chapter 4 – Research Methodology

Chapter 4 presents a thorough description of how the research will be done, including the research methodology and design followed in the study.

5. Chapter 5 – Research Results

Chapter 5 offers the raw data collected through the data collection process, this includes physical artefacts, interviews with learners, interviews with teachers and classroom observations.

6. Chapter 6 – Data Analysis

Chapter 6 presents the analysis of the data and includes all themes identified through data analysis.

7. Chapter 7 – Findings and Conclusions

In Chapter 7 the findings which emerged from the analysis is discussed, followed by conclusions and recommendations. Finally the researcher reflects on her study journey.

Figure 2 represents an outline of the chapters:

CHAPTER 1 Introduction	CHAPTER 2 Literature Review	CHAPTER 3 Literature Review	CHAPTER 4 Research Methodology	CHAPTER 5 Research Results	CHAPTER 6 Data Analysis	CHAPTER 7 Findings & Conclusions
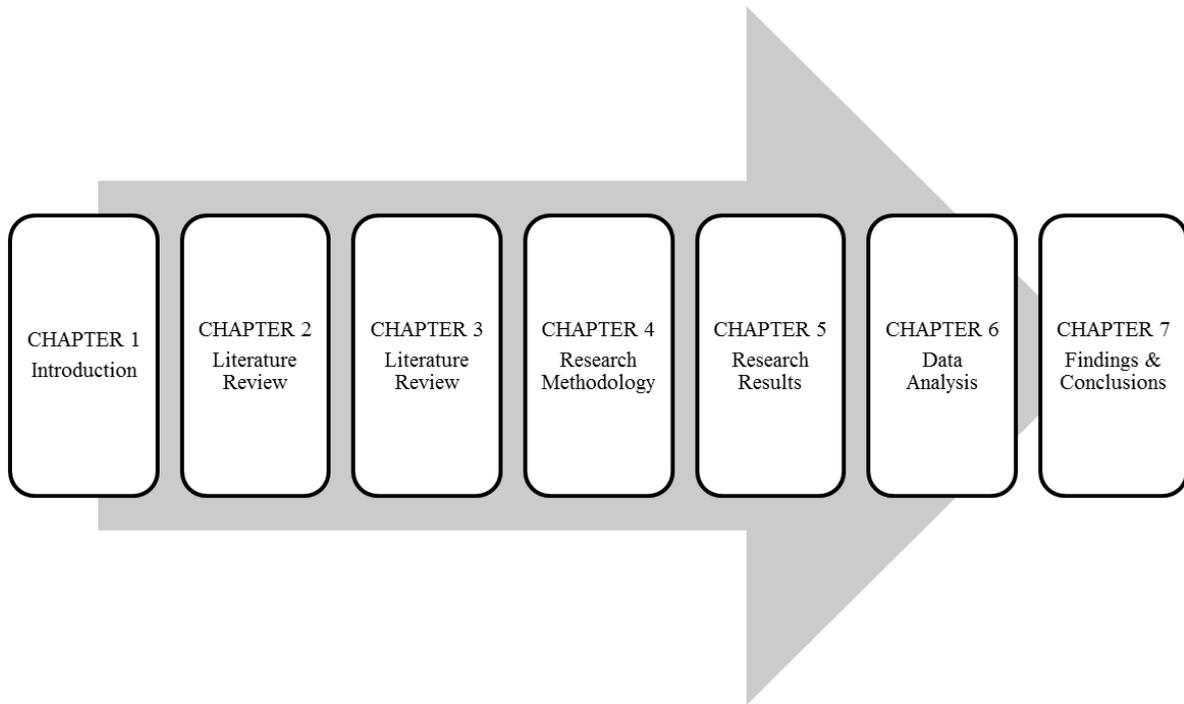
LITERATURE REVIEW CHAPTERS

The literature review of this study consists of two sections. The first section contains learning experience, *cf* chapter 2. The second section of the literature review contains technology-facilitated learning, *cf* chapter 3. The following map illustrates which literature concepts are addressed by which chapters.
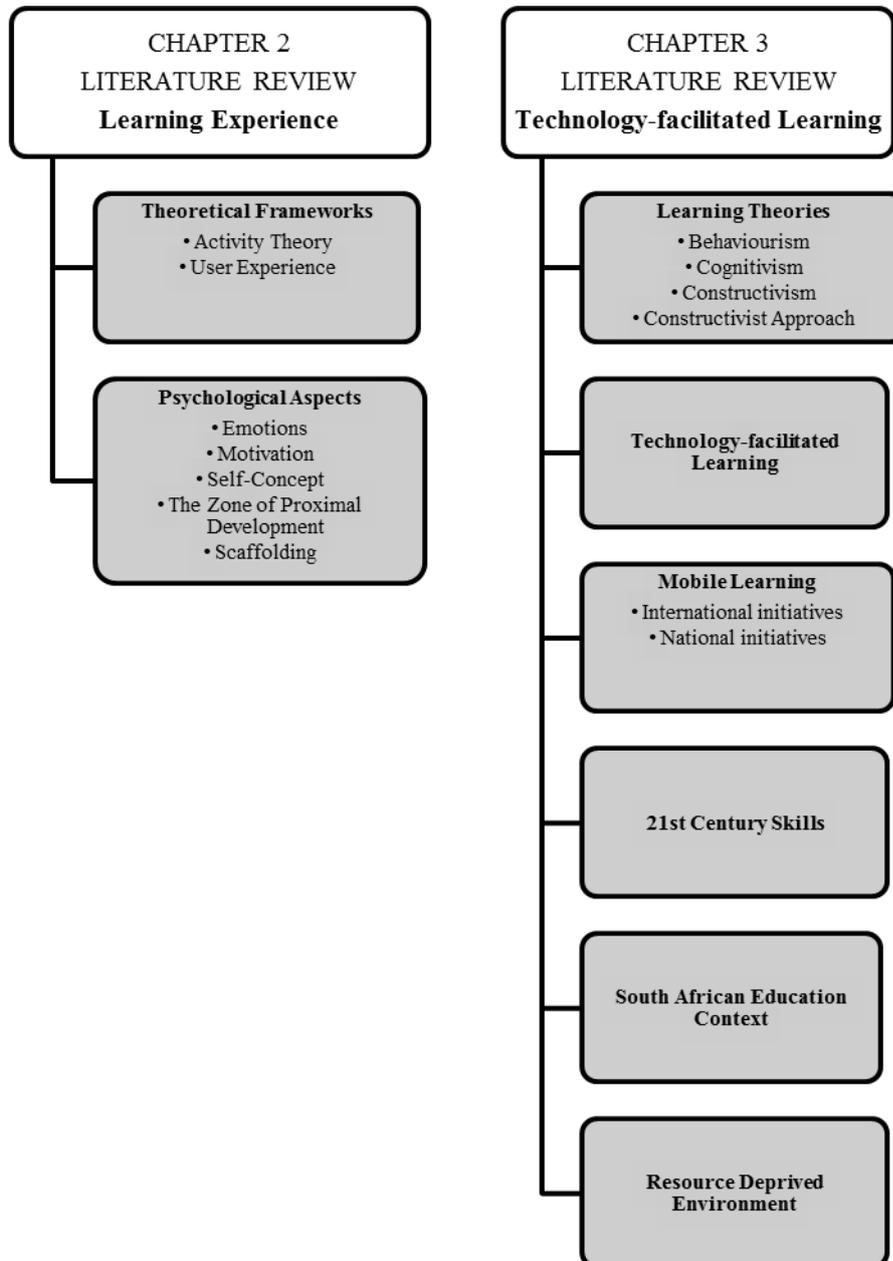
With this map in mind, the following literature figure (*cf* figure 3) encapsulates how the different concepts, as addressed by the two separate literature review chapters, fit together to describe the literature of this study as a whole. This figure is a visual representation of the concepts listed in the previous map of the literature chapters.

Figure 3: THE LITERATURE FIGURE
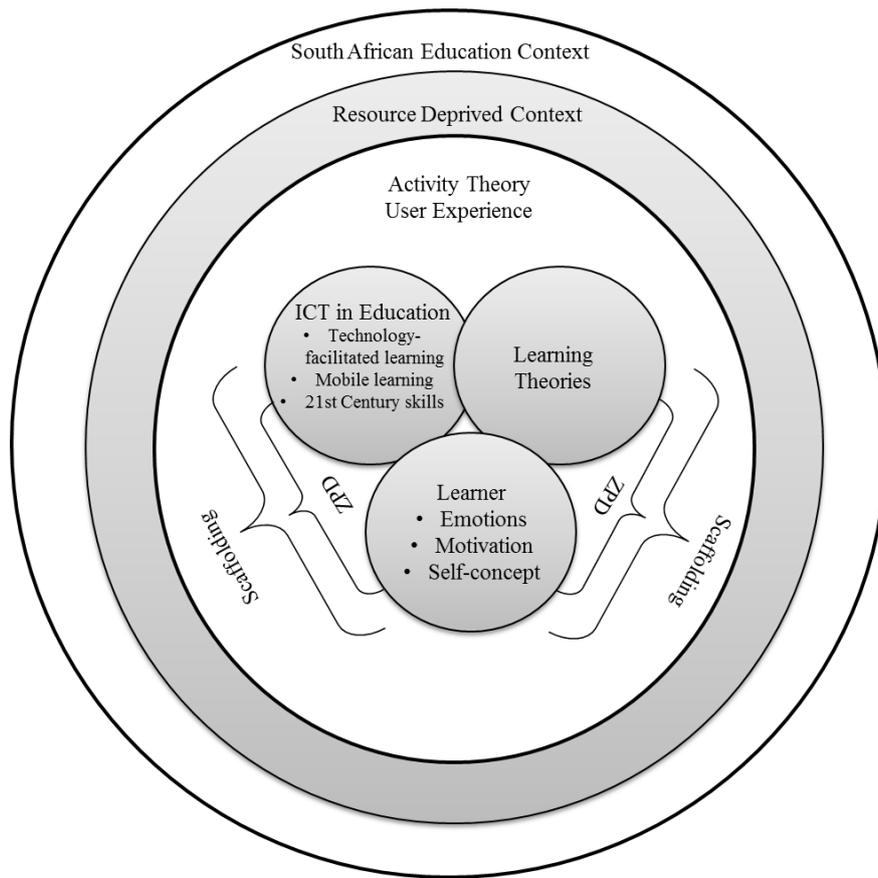
The previous figure (*cf* figure 3) strives to capture *how* the learner interacts with the technology in a classroom where education is based on a particular learning theory as followed by the teacher. The learner is made up of a set of specific emotions, motivations and self-concepts. With mobile learning as an example of technology-facilitated learning, certain 21st century skills are developed. The Zone of Proximal Development is achieved by scaffolding which is either provided by the technology or by the teacher. The interaction between the learner and technology is grounded in the theoretical frameworks of Activity Theory and User Experience. It takes place in a resource deprived context, and the broader context includes the South African education system. All concepts are discussed respectively in Chapters 2 and 3.

CHAPTER 2 – LITERATURE REVIEW: LEARNING EXPERIENCE
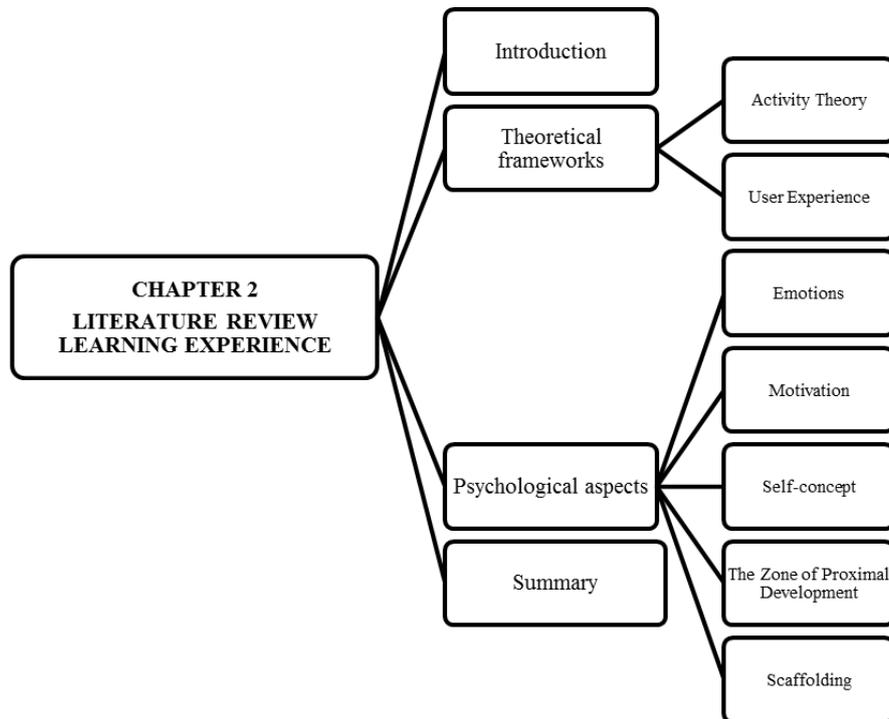
A schematic representation of Chapter 2

2.1 INTRODUCTION

This chapter involves all aspects which possibly influence the learning experience of learners within the scope of this study. The section commences with a discussion of the theoretical frameworks, which later develops into a conceptual framework (*cf* section 4.2.2). The theoretical frameworks to be discussed, which form the foundation of this study, include Activity Theory and User Experience. Activity Theory as a theoretical framework which elaborates on how learning experience is influenced when interaction involves an additional tool. User Experience, as a theoretical framework, investigates the motivational and emotional experiences when a user interacts with a product, which in this case refers to a learner interacting with a tablet. In the latter part of this section significant psychological aspects are discussed which also influence the learning experience. This discussion includes concepts such as emotions, motivation and self-concept. Furthermore, The Zone of Proximal Development and scaffolding are highlighted as both are important psychological concepts in this study. These psychological aspects are discussed individually, and how they fit together and impact on one another. All these psychological concepts form part of and influence the learning experience.

2.2 THEORETICAL FRAMEWORKS

The theoretical frameworks on which this study is grounded, includes Activity Theory and User Experience. Each of these frameworks serves a unique purpose towards finally building the foundation of this study. Activity Theory focuses on the interaction aspect when learning is facilitated by technology. User Experience focuses on the emotions, motivations and attitudes of learners when interacting with technology while learning. A discussion of each theoretical framework follows.

2.2.1 ACTIVITY THEORY

Activity Theory originated from the work of the psychologist Vygotsky and for that reason it is known as a social-psychological theory (Crawford & Hasan, 2007). Activity Theory has been developed over three generations, originally by Vygotsky in 1987, then built upon by Leontiev in 1981, after which it was further developed by Engeström in 1987 (Hardman, 2008).

Activity Theory provides a framework wherein situations, including human and technical elements, interact with each other – "subjective, creative and emotionally experienced human behaviours together with automated, logical analytic and routine modes of activity that can be embedded in modern technology" (Crawford & Hasan, 2007, p. 53).

Activity Theory is regarded as a tool to describe and clarify, rather than to predict (Isssroff & Scanlon, 2002). This study is interested in describing and clarifying the interaction between the user and the tablet, rather than predicting the interaction through the lens of the Activity Theory. Therefor Activity Theory can be considered an appropriate choice of the theory for the purpose of the research.

Activity Theory holds the view that learning is socially based and knowledge is collaboratively constructed (Hardman, 2008). Activity Theory links to the constructivist approach to learning (*cf* chapter 3 section 3.2.3 and 3.2.4) and is useful for this study as it considers Vygotsky's notion of mediation and Engeström's activity system which provides a framework for tool (technology) mediated learning.

"An activity is a form of doing directed at an object. Activities are distinguished from one another by their objects. An activity is motivated by the need to transform the object into an outcome" (Isssroff & Scanlon, 2002, p. 78). The tool-mediated relationship that exists between the subject and the object is what defines an activity; this refers to the relationship between the

doer and their purpose. An activity is stimulated by a motive and the action of the activity is directed at a goal (Hardman, 2008).

Mediation by means of tools, such as technology, is not a neutral process meaning that the tools will have an influence on the interaction between the subject and the object (Botha, Traxler, & Ford, 2008; Crawford & Hasan, 2007; Hardman, 2005). When an activity is mediated by technology it turns out to be *more* than just a means towards letting an activity happen, the technology adds to the nature of the activity (Botha et al., 2008). It also has an emotional impact on the social interactions of not only the users, but also the community and environment in which the interactions occur. This then permits entrance to virtual environments in which activities occur (Botha et al., 2008).

Activity Theory is used to study a range of situations in which technology plays a role (Isssroff & Scanlon, 2002). In education Activity Theory has been used in Higher Education contexts to observe how teaching and learning is experienced, and more specifically, how education effects that experience (Issroff & Scanlon, 2002). It differs from the application in this study as Activity Theory provided a language for telling and understanding problematic features. In the first case study, Activity Theory was used to identify how the learning community is influenced by being involved in the teaching of a science course. The second case study involved the examination of the development of a website which was aimed at assisting and supporting history learners. However, this case study was theorised from the perspective of the Activity Theory by considering changes and difficulties in the development of the website, and the surrounding practices of students and staff. It serves as a good example as it describes how the Activity Theory helped towards an understanding of how learning situations change when learning technology is added.

The Activity Theory is often used for analysis purposes (Hardman, 2005, 2008; Hashim & Jones, 2007; Jonassen & Rohrer-Murphy, 1999). Hardman (2005) used the Activity Theory as a framework to analyse changes which occurred in activities in the classroom and computer laboratory. Hardman (2008) also used the Activity Theory as a framework to investigate pedagogical practices within the classroom setting. Jonassen and Rohrer-Murphy (1999) provided a framework to analyse the development of constructivist learning environments in terms of needs, tasks and outcomes.

Amory (2010) used the Activity Theory as a lens through which to identify educational technology design principles. Activity Theory has also been used to evaluate learning

technologies in higher education. The theory was used as a framework towards understanding and describing how teachers and learners experience learning when incorporating technology by examining numerous learning situations in higher education from an Activity Theory standpoint (Scanlon & Issroff, 2005). Activity Theory has also provided a theoretical lens for examining the perceptions of teachers with regards to the learning and teaching of mathematics (Pather, 2012). In Information Systems Activity Theory has been applied to the study of socio-technical systems which facilitate multifaceted and shared activities in the workplace and everyday life (Crawford & Hasan, 2007). Based on the *purpose* of this study, it is therefore evident why Activity Theory was selected as this study also involves perceptions in teaching and learning with the use of tablets in a social-technical system in a rural school in the Eastern Cape.

Over the three generations spanning the evolution of Activity Theory, the Vygotskian view became known as the first generation. As seen in the following figure (*cf* figure 4) the first generation model consisted of a subject, which acts on the object, using a tool to arrive at an outcome. Vygotsky (1978) defined human activity as an interactive, dynamic and focused relationship between the object and the subject. The subject is continuously active, learning and growing while interpreting and reinterpreting the object (Crawford & Hasan, 2007). This means that the learner is continuously and actively learning and growing as he/she is interpreting and reinterpreting the learning process.

Figure 4: THE FIRST GENERATION OF ACTIVITY THEORY
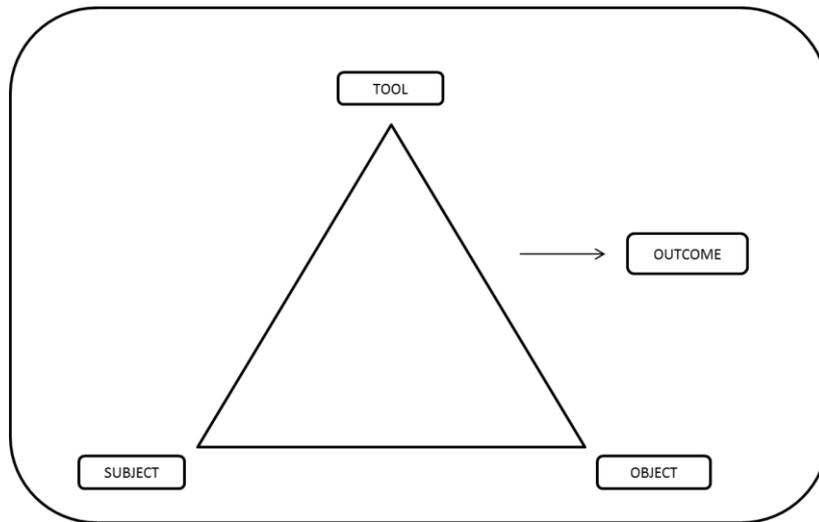
Adapted from Vygotsky (1978)

Vygotsky (Hardman, 2005) states that the area of directed activity is known as the Zone of Proximal Development (Vygotsky, 1978). Within this Zone of Proximal Development (ZPD) the learner acts with the help and assistance of an 'other' with the purpose of understanding and solving problems that he/she would not have been able to solve without that help. This also communicates the concept of scaffolding (Donald et al., 2002) where support is given temporarily in order for knowledge to be acquired. Within this 'zone' facilitation and support provide a motivation for learning which then results in change. Both these concepts, The Zone of Proximal Development and scaffolding, are discussed in more detail later in this chapter (*cf* sections 2.3.4 and 2.3.5).

As discussed previously, The Activity Theory emanating from the work of Vygotsky is known as the first generation of Activity Theory. A current version of this theory was developed by Engeström, in which he expands on Vygotsky's work by providing a beneficial empirical for analysing activity as a collective endeavour (Hardman, 2008). Vygotsky's theory, as seen in the previous figure (*cf* figure 4), was unable to take the environment and its relation with the individual into consideration, and therefore the need emerged for the theory to be further developed (Hardman, 2005, 2008; Isssroff & Scanlon, 2002). Engeström modified Vygotsky's theory of the basic relationship between the subject and the object being intervened by tools, by adding to the component of the community (*cf* figure 5).

This brings about three shared relationships between the subject, object and the community (Isssroff & Scanlon, 2002). The three shared relationships are illustrated in figure 5. The first

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relationship exists between the subject and the object and is facilitated by tools, the second relationship exists between the subject and the community which is facilitated by rules and the third relationship exists between the object and the community which is facilitated by the division of labour (Isssroff & Scanlon, 2002). Rules are obvious and unspoken customs, agreements and social relations which are acceptable within the community (Isssroff & Scanlon, 2002; Scanlon & Issroff, 2005). These rules guide the actions in a community (Scanlon & Issroff, 2005). Division of labour is the way in which the community is organised in an obvious and unspoken manner with regards to the process of transforming the object into an outcome. It proposes tasks to individual members of groups within the community, in other words it prescribes *who* is doing *what* (Scanlon & Issroff, 2005).

Engeström's model of an activity system (*cf* figure 5) supports work in information technology as it provides a tool to take account of social mediated activity (Amory, 2010). Within an activity system, an outcome is the consequence of the subject acting on the object through tools (Engeström, 1987). These tools can be either physical or psychological tools (Engeström, 1987; Vygotsky, 1978). The tools then facilitate interactions through the activity context that comprises the community and the rules and division of labour there in. In conclusion, the subject acts on the object with the purpose of transforming the object by making use of mediating artefacts to reach a specific outcome. Sequentially, the subject is influenced by the community, the rules of the system, and the division of labour within that community (Engeström, 1987).

Figure 5: THE THIRD GENERATION OF ACTIVITY THEORY
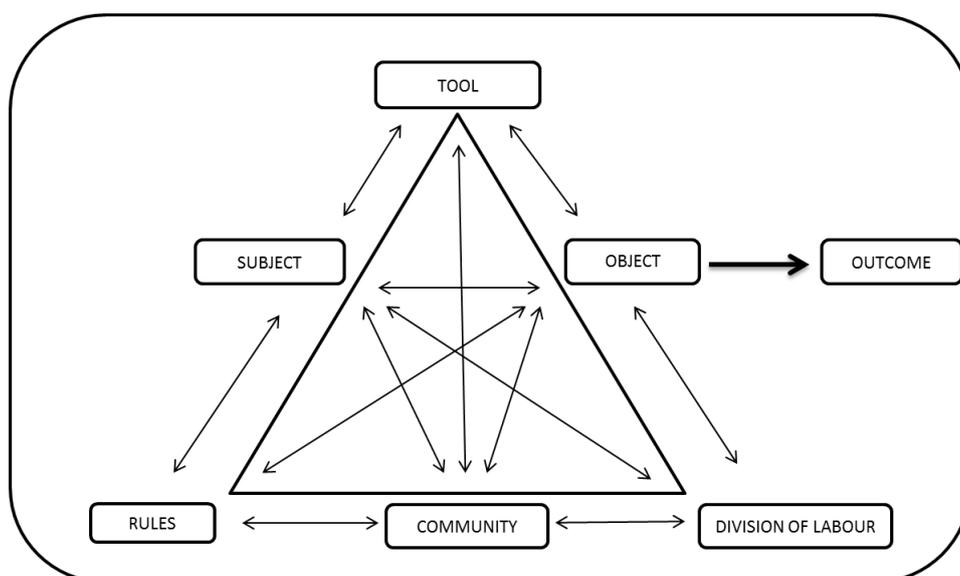
Adapted from Engeström (1987)

When viewed from Engeström's perspective, it is evident that one must consider the context in which an activity occurs in order for it to be understood and analysed. So when investigating human activity, one should examine the kinds of activities, who is engaging in the activities, what the goals of the individuals engaging in the activity are, what outcomes result from the activity, what rules define the activity, the underlying division of labour within the activity system and the compilation of the community in which the activity occurs (Jonassen & Rohrer-Murphy, 1999). The object is the mental or physical product that is wanted or required, it characterises the intention which motivates the activity, and the tool helps to convert the object into the outcome (Jonassen & Rohrer-Murphy, 1999).

The relationship that exists among the units within an activity system, according to the Activity Theory, is illustrated in the following table 1 (Engeström, 1987; Hardman, 2008):

Table 1: ACTIVITY SYSTEM RELATIONSHIP

Unit in activity system	The relationship among the units in the activity system
Subject	The focus of the study
Object	Refers to the problem on which the activity is focussed with the purpose of transforming it into a desired outcome
Tool	Facilitates the interaction taking place between the subject and the object
Rules	Includes norms, standards, agreements and social interactions
Community	Includes all parties participating in the shared object in order to arrive at the outcome
Division of Labour	Refers to the how the responsibilities, power relations and tasks are assigned at both a horizontal and vertical level in the problem space
Outcome	Refers to the end result which the subject aims for

Activity Theory distinguishes between internal and external activities (Kaptelinin, Nardi, & Macaulay, 1999). The traditional perception of cognitive processes relates to internal activities. Activity Theory highlights that for internal activities to be understood, they cannot be analysed in isolation and studied separately as the constant exchange between internal and external activities form the basis of how humans think and act. The interaction between internal and external activities underpins human cognition and activity. Internalisation occurs when

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external activities are transformed into internal activities. The internal pressures and conflicts of such an activity system motivates and drives change and development (Crawford & Hasan, 2007).

Based on the previous discussion, one can anticipate that the interaction with tablet will provoke some sort of experience by the learner and this is an internal process. This experiential process will presumably be influenced by the learner's emotions, attitudes and motivation. Thus, in order to determine the experiences of learners with tablets used in teaching and learning, it would be necessary to look at the internalisation of the emotions, attitudes and motivation that the learner has regarding the use of tablet in the learning process. This then relates to the Activity Theory of how internalisation is the transformation of external activities (learning with technology) into internal activities (experience of learning with technology). This could be very important for learning as it could suggest that if the experience is positive, the internalisation will be positive and then the outcome will be positive. Bonk and Cunningham (1998) state that emotional and motivational factors have an influence on learning. A learner's motivation to learn influences what and how much the learner learns and a learner's emotional state influences the learner's motivation to learn (*cf* section 2.3.2). Other attributes of learners also play a role and contribute to a learner's motivation to learn, these include natural curiosity, creativity and higher order thinking. The intrinsic motivation of a learner can be stimulated by tasks which are novel and difficult, tasks which are relevant to his/her personal interest, and tasks which provide a learner with personal choice and control. Motivation also has an effect on effort. For a learner to acquire complex knowledge and skills, he/she needs to put in comprehensive effort and this requires guided practice. If a learner is not motivated to learn, the learner will not be willing to apply such effort without coercion. One could then possibly suggest that, if this motivation is present, it could result in a positive experience. Motivation as a concept is discussed in depth later in this chapter, *cf* section 2.3.2.

The Activity Theory will be used to investigate the interaction of the learner with the tablet in technology-facilitated learning, *cf* figure 6. In this figure the Activity Theory is applied to the study. The following table (*cf* table 2) further illustrates the relationship within the activity system, by applying it to this study.
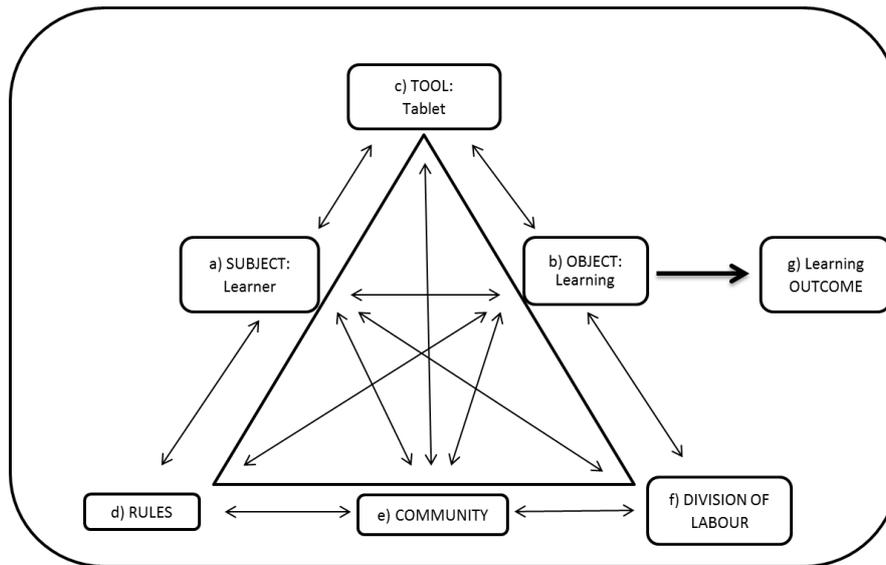
Adapted from Engeström (1987)

Table 2: APPLIED ACTIVITY SYSTEM RELATIONSHIP

Unit in activity system	The relationship among the units in the activity system	Applied to study
Subject	The focus of the study	The learner
Object	Refers to the problem on which the activity is focussed with the purpose of transforming it into a desired outcome	Learning
Tool	Facilitates the interaction taking place between the subject and the object	Tablet
Rules	Includes the norms, standards, agreements and social interactions	Norms, standards, agreements and social interactions in the classroom
Community	Includes all parties participating in the shared object in order to arrive at the outcome	Includes learners, peers, teachers, principal, parents and members of the community
Division of Labour	Refers to the how the responsibilities, power relations and tasks are assigned, both at horizontal and vertical level in the problem space	Refers to the responsibilities and controls between the teacher and learners and between the learners and peers
Outcome	Refers to the end result which the subject aims for	The learning outcome

2.2.2   USER EXPERIENCE

User experience (UX) is a concept which recently emerged in the field of Human-Computer Interaction (HCI). The interest in UX is due to HCI researchers recognising the limitations of the traditional usability framework. The main emphasis of the usability framework is on the user perception and user performance of humans when interacting with technology. UX, however, takes other aspects of human-technology interaction into consideration such as user emotions and feelings, as well as the value humans add to such interactions (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009).

There is a mutual understanding that UX is both universal and personal. UX emphasises and summarises the emotion, motivation and action within a particular physical and social context, with the focus on felt experiences instead of attributes of products (Wiklund-Engblom, Hassenzahl, Bengs, & Sperring, 2009). When one looks at experience, it is more important to focus on what users do and how they feel, rather than focusing on usability and usefulness (Law & Sun, 2012).

A clear definition of UX has not yet been agreed upon (Kujala & Miron-Shatz, 2013; Law et al., 2009). This is because UX is associated with a wide range of dynamic and unclear perceptions including emotional, affective, practical, enjoyable and appealing variables. Whether an author includes or excludes specific variables depends on the background or interest of the author and the focus of his/her study. The unit of analysis, with regards to UX, is also flexible and can range from analysing a very constricted unit to analysing a very comprehensive unit. The UX landscape is influenced by various theoretical representations, each with diverse importance such as emotion, affect, logicality, experience, value, beauty, pleasure, enjoyment etc.

Emotions play a significant role when humans interact with products and they assist a user in assessing results when using an interactive product (Kujala & Miron-Shatz, 2013). Users experience extensive emotions when interacting with a product. These emotions can be both positive and negative and vary at different times. The assumption exists that a positive emotional experience leads to a good user experience. In a study by Kujala and Miron-Shatz (2013) results showed that positive emotions were associated with a good user experience whereas a negative user experience was associated with low usability. Good user experience is regarded as an imperative goal in design and is essential to the success of a product (Kujala & Miron-Shatz, 2013).

UX seems appropriate to this study, as this theory is a person-centred framework (Battarbee, 2004) which focuses on human needs and peoples' relationship with products. Emotions are regarded as an imperative part of the user experience in human machine interaction (Kujala & Miron-Shatz, 2013; Norman, 2007). Hassenzahl and Tractinsky (2006) define UX as a result of a user's internal state, the features of a system and the context within which the interaction between the user and the system occurs. This is supported by Roto (2006) in the User Experience building blocks (*cf* figure 8). The internal state of the user includes factors such as the user's needs, expectations, motivations, predispositions, mood etc., whereas the features of a system include factors such as usability, purpose, functionality, complexity etc. (Hassenzahl & Tractinsky, 2006). There is no clear timeframe assigned to the evaluation of user experience (Kujala & Miron-Shatz, 2013).

In a pursuit of theoretical grounds for UX, Obrist et al. (2012) investigated 122 individual items relating to UX theories and theoretical frameworks. After classification, 56 items were identified which were grouped into seven major theory categories underlying nine disciplines. These seven major categories include:

– **Human/user focus**

The leading category involves understanding the individual user's emotions, motives, characteristics and cognitive processes. For this reason, psychological theories direct this category. When dealing with human-centred theories, it is necessary for designers of systems to consider issues relating to motivation and other human factors as all of these have an influence on whether the user/human will accept and/or value the product. Therefore UX evaluations, based on psychological theories, focus on temporary experiences of humans or how humans give meaning to their experiences.

– **Product/artefact focus**

Subsequently, theories which involve the product/artefact can be used as a basis for UX design. When the product/artefact is the starting point, product characteristics will form the focus of investigation. If UX evaluations are done at all, these evaluations will be based on professional considerations rather than in-depth studies of human reactions.

– **User/artefact/environment relations**

At its core this category studies the interaction and relationship between the user and the product. Psychology and design are the underlying disciplines in this category, as the significance of context and situation in UX underpinning is emphasized. For that reason, this theoretical underpinning offers support for investigating UX in real life.

– **Social nature of UX**

Instead of focusing on the individual only, as is the case in the human/user category, this category focuses on theories relating to communication and relationships between people. The focus is on social features and co-experience. This category is interdisciplinary and includes elements of sociology, design and communication as it considers experience as a collective happening and looks at how experience is reported and reflected upon.

– **Design focus**

This category includes the art and design field. Evaluation of experience is not essential in this theoretical foundation. Design contributes to HCI theory development as it offers a foundation for action research and consequently a swift understanding with an emphasis on UX.

– **Frameworks involving several themes from 1 – 5**

This category includes different perspectives as it integrates many items. The overarching theme in this category involves investigating the interrelationship between users and the users' different roles within interaction. This integrated approach supports the movement towards a more universal and holistic description of UX as it joins characteristics, rather than focussing on disjointed characteristics.

– **Broader frameworks relating to human existence**

This category summarises theoretical frameworks reflecting theoretical interpretations and understandings about human existence. In efforts to expand the HCI perspective, it is relevant to consider, for example, feminist discussions or sensitive based designs when pursuing UX and assigning it to socio-technical system debates.

From the discussion of the major categories it becomes evident that, for the purpose of this study, the main categories the researcher will focus on include the human/user category and user/artefact/environment relations. The human/user is the main focus of this study, but the environment and context of the human/user is unique and plays an important role in the study.

Arhippainen and Tähti (2003) state that there are five components which affect UX. These components, as illustrated in figure 7, include the user, the product, the context of use, social factors and cultural factors. Each of these components has a list of attributes which contribute to UX (*cf* figure 7).

Figure 7: USER EXPERIENCE COMPONENTS
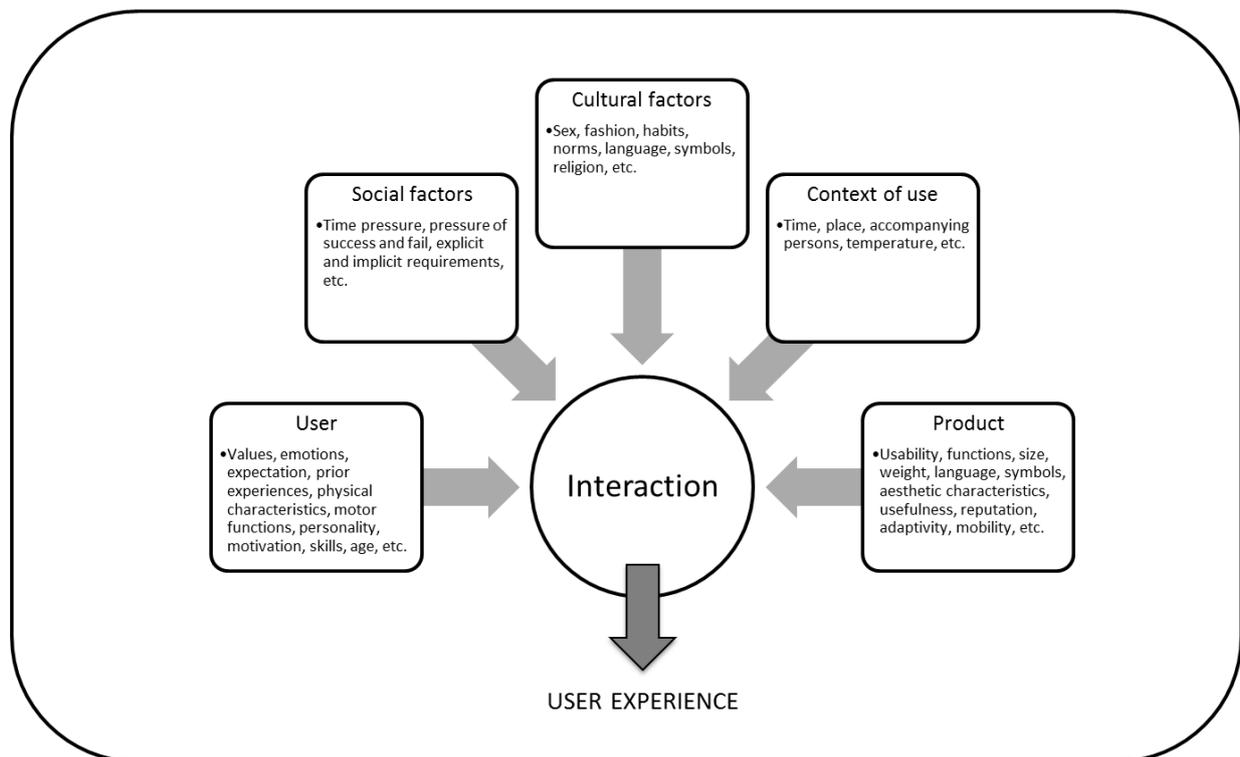
Adapted from Arhippainen and Tähti (2003)

Roto (2006) concurs with Hassenzahl and Tractinsky (2006) in identifying the UX components and defines the meaning of each component in more detail (*cf* figure 8). The three main components are identified, i.e. user, system and context. The user component involves the physical and mental state of the person interacting with the system. The system comprises of products, services, and infrastructure which all play a role in the interaction with the product under examination. The context explains the environmental, social and time-based influences, as well as the task context for the experience. The three main components are illustrated in figure 8, as User Experience building blocks. UX is subjective, meaning a user's emotional state affects and influences how the system is perceived, which then sequentially affects and influences the experience and the user's state (Roto, 2006).

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CONTEXT
Physical context
Social context
Temporal context
Task context

USER
Needs
Resources
Emotional state
Experiences
Expectations

SYSTEM
Products involved
Objects involved
Services involved
People involved
Infrastructure involved

Interaction
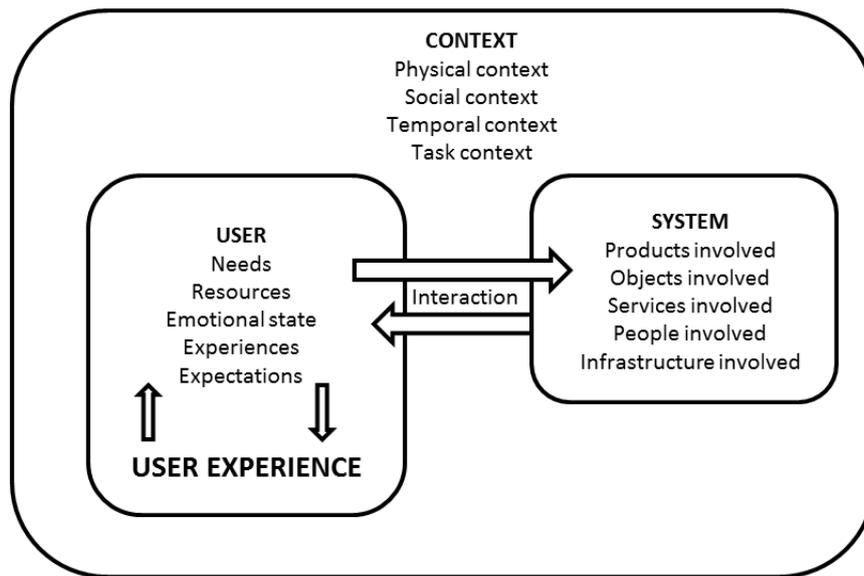
USER EXPERIENCE

Adapted from Roto (2006)

For the purpose of this study the focus will be on the *user*'s internal state referring to the learners' emotions, attitudes and motivation relating to their experience. Several researchers are in agreement that the personal experiences and expectations of the user affect their experiences (Roto, 2006). The *system* represents the product being used, in this case the tablet being used in teaching and learning. The *context* includes the resource deprived environment of the school in the Eastern Cape. With UX being subjective, as mentioned before, the learners' emotional state affects their perception of the tablet which, in turn, affects the experience and the learners' state, and this occurs within a specific context.

The following figure is a combination of Roto (2006) and Arhippainen and Tähti (2003), to assist in explaining User Experience as a theoretical framework, relevant to this study (*cf* figure 9). It demonstrates how the user's experience is influenced by his/her interaction with the product in a specific context.

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Figure 9: USER EXPERIENCE
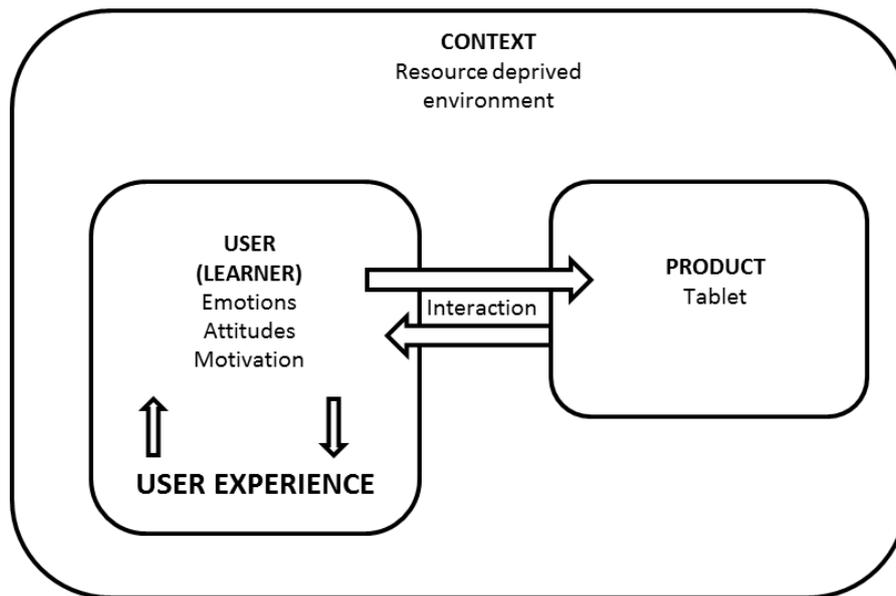
Adapted from Roto (2006)

With regards to figure 9, the emotional state of the user, which influences the learning experience, will be discussed in terms of the psychological aspects, *cf* section 2.3.1. The context of the school in the Eastern Cape, as a resource deprived environment, is further discussed in Chapter 3 (*cf* section 3.7).

2.3 PSYCHOLOGICAL ASPECTS

As mentioned in the introduction to this section (*cf* section 2.1), the focus is on learning experience, therefore it is deemed important to focus on the psychological aspects which can possibly influence the learning experience within the scope of this study. In the course of this learning experience it follows that learning is facilitated by technology and this will give rise to certain emotions. It is argued that this process will influence learners' motivation to learn. When the learners' motivation to learn is influenced, it affects the learners' self-concept. Other important educational and psychological concepts to be discussed include The Zone of Proximal Development and scaffolding. These two concepts work together, as scaffolding is necessary for a learner to reach his/her Zone of Proximal Development. All concepts are deliberated in detail in the following discussions.

2.3.1 EMOTIONS

Many different opinions exist as to the definition of an emotion, but Scherer (2005) defines it as "an episode of interrelated, synchronized changes in the states of all or most of the five

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organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism" (Scherer, 2005, p. 697). The organismic subsystems referred to in this definition include (i) *information processing subsystem* which relates to the cognitive component of emotion such as evaluation; (ii) *support subsystem* which relates to the neurophysiological component of emotion such as physical bodily symptoms; (iii) *executive subsystem* which relate to the motivational component of emotion such as action and behaviour tendencies; (iv) *action subsystem* which relates to the motor expression component of emotion such as the facial and vocal expression and (v) *monitor subsystem* which relates the subjective feeling component of emotion such as the emotional experience. In summary, an emotion is brought about by changes in systems such as evaluation, physical bodily symptoms, action and behaviour, facial and vocal expression and emotional experience.

Using this definition as a guideline (Scherer, 2005), the researcher gathered that a certain event stimulates physiological symptoms, motor expression, action tendencies and feelings. This implies that an event, such as having a tablet in the classroom to facilitate learning, will stimulate or elicit physiological symptoms, motor expressions, action tendencies and feelings in the learner. For instance, if having the tablet in the classroom is pleasant (event), the learners' muscles relax and feel warm (physiological symptoms), smiles and voices become assertive (motor expressions) and this leads to the learners' attention moving towards the activity with the tablet (action tendencies) which results in the learners being encouraged and motivated (feeling). This discussion is further supported by the Activity Theory, *cf* section 2.2.1, in the discussion of internalisation and externalisation.

Emotions have an influence on learning in school. Pekrun, Goetz, Titz, and Perry (2002) reported that during the course of 5 qualitative studies learners experience a great variety of emotions in academic settings. Previous research focused more on test anxiety than on other emotions per se. Emotions will possibly have an impact on learners' psychological and physical health, as well as their cognitive processes and performance (Pekrun et al., 2002). Pekrun et al. (2002, p. 92) refer to the term *academic emotions* summarising emotions which are directly linked to "academic learning, classroom instruction and achievement". Hence, for the purpose of this study, the focus will be on academic emotions. Emotions can be positive or negative and both of these reportedly occur in equal measure. Academic emotions involve task-related emotions, self-related emotions, as well as social emotions (Pekrun et al., 2002). Table 3 provides examples of these academic emotions, including task-related, self-related and social emotions:

Table 3: ACADEMIC EMOTIONS

Emotions	Positive	Negative
Task-related and self-related		
– Process	Enjoyment	Boredom
– Prospective (future)	Anticipatory joy	Hopelessness
	Hope	Anxiety
– Retrospective (past)	Joy about success	Sadness
	Satisfaction	Disappointment
	Pride	Shame and guilt
	Relief	
Social		
	Gratitude	Anger
	Empathy	Jealousy and envy
	Admiration	Contempt
	Sympathy and love	Antipathy and hate

Adapted from Pekrun et al. (2002)

These academic emotions (*cf* table 3) are grouped into positive and negative emotions. Task-related and self-related emotions include emotions associated with process (enjoyment and boredom). Prospective emotions, emotions associated with the future include: anticipatory joy, hope, hopelessness and anxiety. Retrospective emotions, emotions associated with the past include: joy about success, satisfaction, pride, relief, sadness, disappointment, shame and guilt. Positive social emotions include: gratitude, empathy, admiration, sympathy and love. Negative social emotions include: anger, jealousy, envy, contempt, antipathy and hate.

The Academic Emotion Questionnaire (AEQ) was designed to evaluate different achievement emotions which learners experience in academic settings (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). Achievement emotions "are defined as emotions that are directly linked to achievement activities or achievement outcomes" (Pekrun et al., 2011, p. 37). In academic settings learners experience "enjoyment of learning, hope, pride, anger, anxiety, shame, hopelessness, or boredom" (Pekrun et al., 2011, p. 36). These emotions correlate with the emotions most often reported on in a study being anxiety, enjoyment, hope, pride, relief, anger, boredom and shame (Pekrun et al., 2002, p. 93). As yet there is a lack of instruments which

measure and study emotions in educational settings. Test anxiety questionnaires are the only instruments designed to measure emotions in academic settings, but they only relate to anxiety. For that reason the AEQ was developed in an effort to measure emotions commonly experienced by learners in educational settings (Pekrun et al., 2011).

The AEQ was used to guide the researcher in asking questions relating to emotions during the interviews with learners, *cf* Appendix D. Furthermore, the AEQ was used to assist in guiding the analysis of the data collected during the physical artefact and interviews with learners and teachers (*cf* section 6.4). This study will focus on the emotions classified in the AEQ, which include enjoyment, hope, pride, relief, anger, anxiety, hopelessness, shame and boredom. Thus the input will be the artefact and interview with learners and teachers, which will then be linked to the AEQ emotions to finally arrive at the output, that being an identified emotion (*cf* figure 10).

Figure 10: LINK TO AEQ
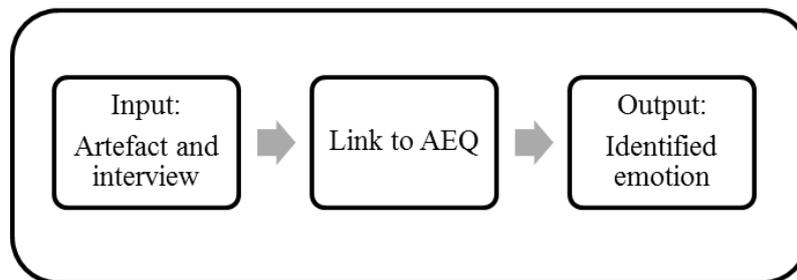
2.3.2   MOTIVATION

Motivation can be defined as "an internal state that arouses, directs and maintains behaviour" (Woolfolk, 2013, p. 430). It relates to choices made about behaviour, the time period designated to get things done, the level of involvement in chosen activities, perseverance in activities and thoughts and emotions while involved in an activity (Pintrich, 2003; Woolfolk, 2013).

Motivation explains what moves children, what gets them going, keeps them going and assists them to complete tasks (Pintrich, 2003). If a child is motivated, he/she will have a strong personal interest in a certain subject or activity (Linnenbrink & Pintrich, 2002). Behaviour can be directed and energized by an individual's drives, desires, needs, incentives, fears, goals,

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social pressure, self-confidence, interests, curiosity, beliefs, values and expectations (Woolfolk, 2013).

A distinction exists between *intrinsic* and *extrinsic* motivation. Intrinsic motivation refers to activities that are their own reward, for example a learner who studies Science outside school because he loves the subject. Extrinsic motivation is created by external factors such as punishment and reward, for example a learner works hard to achieve good grades in Science, not because he/she loves the subject. The reason for acting is what differentiates intrinsic and extrinsic motivation, whether it comes from inside or outside the learner (Woolfolk, 2013).

A study examining the ways in which technology can be applied in the classroom to motivate students, found that technology in the classroom gave the learners a strong sense of independence, helped the learners to stay motivated and also contributed to personal responsibility and a feeling of success. Technology aided them to focus on tasks and fostered professionalism and respect in the classroom among the learners, peers and teachers (Tosuncuoglu, 2012).

There are different approaches to motivation. The behavioural approach to motivation is that motivation comes from outside the learner, thus extrinsic motivation (Donald et al., 2002; Woolfolk, 2013). Behaviour is influenced by rewards and incentives with reinforcement and punishment. Woolfolk states that "a reward is an attractive object or event supplied as a consequence of particular behaviour; an incentive is an object or event that encourages or discourages behaviour" (Woolfolk, 2013, p. 433). The humanistic approach to motivation is that it comes from inside the learner and focuses on fulfilling the needs of a learner, thus intrinsic motivation (Donald et al., 2002; Woolfolk, 2013). Therefore, to motivate a learner is to encourage their inner resources such as self-esteem, self-actualisation and their capabilities and skills (Woolfolk, 2013). The constructivist approach to motivation is that it comes from inside the learner, thus intrinsic motivation (Donald et al., 2002). With the constructivist perspective of motivation, the need to learn is built into human development. This is a natural and internal driven consequence of the need to adapt. The cognitive approach to motivation is that it comes from inside the learner, thus intrinsic motivation. A learner is motivated internally by being active and curious in searching for information to solve problems (Woolfolk, 2013).

Although Donald et al. (2002) states that the constructivist approach to motivation is intrinsic, they later argue that it is both intrinsic and extrinsic when one takes into consideration the following constructivist principles:

- These principles are firstly, that learners must be challenged with what is unfamiliar in their Zone of Proximal Development (ZPD, *cf* section 2.3.4) for them to be internally motivated to face the challenge, resolve it and adapt. For the learner to do this, it is very important that he/she is motivated externally with support, guidance and encouragement, also known as scaffolding (*cf* section 2.3.5).

- Secondly, activities must connect with learners' interests and concerns, as well as challenge them at a specific stage in their development for them to be motivated.

- Thirdly, learners must interact socially and learn co-operatively with their peers, as this motivates them.

- Fourthly, learners who feel that they are actively engaged and taking control are more motivated to tackle challenges, but it is important for the teacher (externally) to promote the learners' confidence and ability, as this increases learners' sense of control over their life (Donald et al., 2002).

In this discussion of the four principles it becomes clear that for a learner to be internally motivated, it is important that he/she is also externally motivated by either the teacher or peers through support, guidance, interaction, involvement and engagement. The researcher concurs that intrinsic and extrinsic motivation should be applied in conjunction to foster enhanced motivation of a learner. Extrinsic motivation compliments intrinsic motivation and vice versa if the one is supported by the other.

Motivation to learn is viewed as a multidimensional theory with different components (Linnenbrink & Pintrich, 2002). The components which enable academic success are intrinsic motivation, learner's attributions, self-efficacy and achievement goals. Self-efficacy is the belief a learner has in his/her own ability to do a task or activity and perform well in it. Learners with self-efficacy achieve at higher levels and adapt because of their effort and persistence in academic tasks. They also tend to choose and take on challenges which are more difficult.

Attribution implies when a learner succeeds or fails academically, he/she will then evaluate and question the situation in an attempt to determine what caused their success or failure (Linnenbrink & Pintrich, 2002). These causes can be categorised into three casual dimensions namely stability, locus and controllability (Linnenbrink & Pintrich, 2002; Pintrich, 2003). Stability refers to how stable or unstable the cause is, locus involves whether the cause is internal or external of the learner and controllability refers to whether the cause can or cannot be controlled by the learner.

When referring to intrinsic motivation, the two aspects discussed are personal interest and situational interest (Linnenbrink & Pintrich, 2002). Personal interest refers to an individual learner's interest in a specific subject, task or activity. This can be determined by asking the learners whether they like and enjoy using the tablets in the learning process. Furthermore, situational interest focuses on the features of the learning context. Mitchell (1993) went further by discussing catch and hold factors as part of situational interest. Catch factors stimulate learners by grabbing their attention, while hold factors empower learners, through the use of meaningful content, to view the content as valuable or to encourage their participation in the task. Using a tablet in the classroom can catch the learners' attention but the content available for access on the tablet is important to empower the learner to view the tablet as useful. Personal interest enhances achievement by increasing learners' attention and level of persistence while situational interest enhances achievement by engaging learners in tasks. Hence, for learners to become motivated and to remain motivated, it is important to tap into their interests, both on a personal and situational level.

Achievement goals refer to the reasons why learners take on a task. Achievement goals could be mastery goals or performance goals. Ames states that "mastery goals orient learners to developing new skills, trying to understand their work, improving their level of competence, or achieving a sense of mastery based on self-referenced standards" (Ames, 1992, p. 262). Ames (1992) defined performance goals as goals that "orient learners to focus on their ability and self-worth, to determine their ability by outperforming others in competitions, surpassing others in achievement or grades, and receiving public recognition for their superior performance" (Linnenbrink & Pintrich, 2002, p. 321).

Motivational theories are used to explain how behaviour starts, where the behaviour is heading, how intense the behaviour is and what behaviour is achieved at the end (Pintrich, 2003). These motivational theories attempt to predict four common outcomes which relate to the answering of the following questions (Pintrich, 2003; Woolfolk, 2013):

1. Why do learners choose to do one activity or task over another?

2. What is a learner's level of involvement in the activity or task?

3. What causes a learner to give up or persist in the activity or task?

4. What is the learner actually achieving?

Three components are important in motivational models (Pintrich, 2003):

– Firstly, *expectancy components* which relate to a learner's belief in his/her skill or ability to perform a certain task. In this case a learner would ask him/herself whether he/she can do the specific task at hand. Expectancy components are control beliefs and self-efficacy beliefs. Control beliefs refer to how much control a learner has over his/her situation and self-efficacy beliefs are the learner's perception of his/her ability to accomplish the task in that situation.

– Secondly, *value components* which relate to a learner's beliefs regarding the interest, importance and utility of a certain task. In this a learner would ask him/herself why he/ she is doing the specific task. This has to do with goal orientation and task value. Goal orientation as such includes either mastery or performance goals. A mastery goal is "a personal intention to improve abilities no matter how performance suffers" while a performance goal is "a personal intention to seem competent or perform well in the eyes of others" (Woolfolk, 2013, p. 439). Task value involves that for a learner to achieve; he or she must perceive the task as important, must have a personal interest in the task and perceive the task as useful.

– Thirdly, affective components which relate to a learner's feelings about him/herself and his/her emotional reactions to the task. In this a learner will ask him/herself how the task makes him/her feel. The affective components involve the emotional reactions of a learner to a task and his/her performance, as well as the emotional needs of a learner.

In conclusion, the assumption made in Chapter 1 (*cf* section 1.1) seems to be true. An interested learner will be motivated, a motivated learner will learn and a learner who learns will achieve (*cf* figure 11).

Figure 11: ASSUMPTION
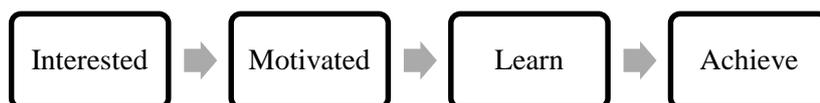
2.3.3 SELF-CONCEPT

Self-concept refers to that which learners think about themselves or what they believe to be true about themselves and their key characteristics (Donald et al., 2002). Furthermore, self-concept relates to the positive or negative value learners attach to their key characteristics (Donald et al., 2002). In other words, self-concept could be positive thoughts and beliefs about a learner's own characteristics or negative thoughts and beliefs about a learner's own characteristics. Self-concept communicates a person's own knowledge about their feelings, thoughts, expectations and attitudes (Woolfolk, 2013). The idea which a person has of him/herself is not permanent, it can change over time and from situation to situation. A learner's self-concept is made up of academic and non-academic concepts. Academic concepts include the beliefs and thoughts a learner has about areas such as verbal abilities, mathematics, computers, art and problem solving, whereas non-academic areas include a learner's thoughts and beliefs about his/her physical appearance, popularity, trustworthiness, relationships with others and emotional stability. Academic self-concept, such as a learner's view of how well he/she performs and how quickly he/she is able to learn, impacts on the learner's motivation and actions.

Self-concept develops through learners continuously evaluating themselves and asking themselves how well or poorly they are doing. They measure themselves based on the verbal and non-verbal reactions of parents, teachers, family, peers and friends. Younger children tend to entertain more positive self-concepts. As these children mature they form a more complex view of their own person, with many different influences impacting on their judgement of themselves. Many psychologists are of the opinion that social and emotional development is based on self-concept (Woolfolk, 2013). A correlation exists between self-concept and achievement. Evidence of this correlation is that performance in academic subjects reflects to self-concepts in those areas. Learners' self-concepts in relation to specific academic subjects can have a significant influence on their future, as learners tend to select subjects for further study if they have a positive academic self-concept in those subjects. In other words, if they feel successful in a subject they choose to continue with this subject, rather than choose a subject in which they feel incapable of achieving. Higher self-concept encourages higher achievement and high achievement encourages higher self-concept (Woolfolk, 2013).

2.3.4 THE ZONE OF PROXIMAL DEVELOPMENT

The zone of proximal development is "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as

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determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86).

The zone of actual development is a reflection of the current level of the learner and what he/she has already mastered or developed. The zone of proximal development reflects what is potentially possible in terms of the learners' development. Therefore, the distance between these zones shrink through the use of mediating tools, adults and peers (Vygotsky, 1978). Figure 12 illustrates the movement from the level of *actual* achievement to the level of *potential* development through mediation. Hence, with mediation a learner can move from their actual development to their potential development.
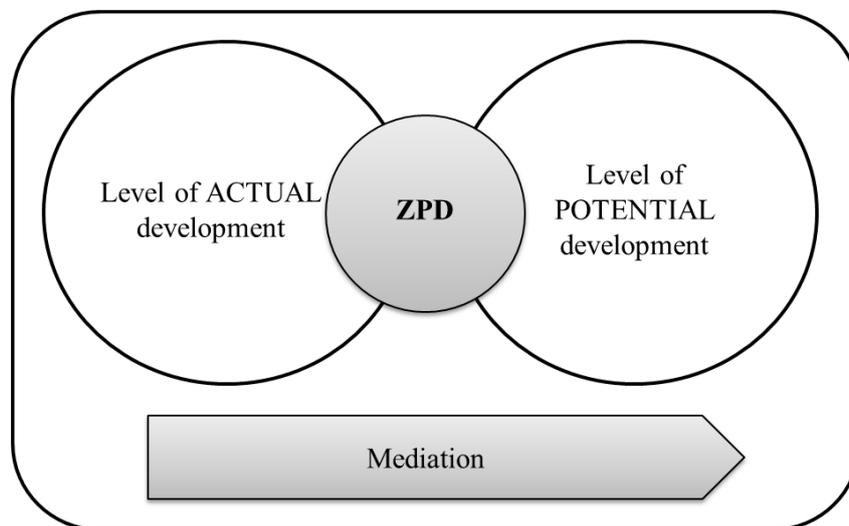
Adapted from Donald et al. (2002)

Donald et al. (2002) refer to the distance between the zone of actual development and the zone of proximal development in terms of what is familiar and unfamiliar to the learners. It is through scaffolding that learners bridge the gap between the familiar and the unfamiliar, *cf* section 2.3.5.

The shrinkage of the ZPD through mediation is illustrated in figure 13 (Shabani et al., 2010). On the left the figure illustrates the way in which the ZPD bridges the gap between what a learner cannot do, even with help, and what a learner can do by him/herself. After mediation has occurred, the ZPD shrinks and a learner is able to do a lot more by him/herself (*cf* figure 13).
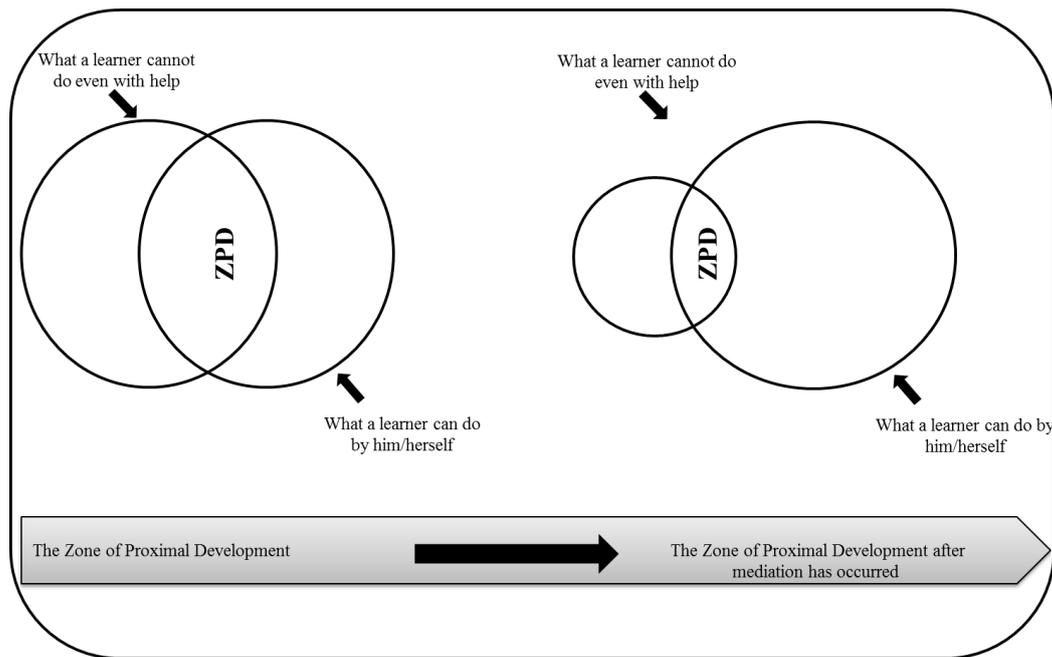
Adapted from Shabani et al. (2010)

In the context of this study, shrinkage of the ZPD can ensue when mediation with technology occurs, allowing the learner to do a lot more by him/herself than previously possible. This mediation is not only restricted to technology, the teacher or more capable peers in the classroom can also allow for the shrinkage of the ZPD.

2.3.5   SCAFFOLDING

Scaffolding refers to the support provided by an expert to a novice learner to enable the learner to complete a task or achieve a goal (Sharma & Hannafin, 2007). As the learner's ability increases, the expert's support decreases. The concept of scaffolding encourages independent functioning for as the scaffolding fades, the learner becomes more competent. This encourages independent functioning. The concept that the scaffolding fades as the learner becomes more competent. This is what distinguishes this process from other forms of assistance. The concept of scaffolding is strongly linked to Vygotsky's Zone of Proximal Development (Donald et al., 2002; Sharma & Hannafin, 2007; Van de Pol, Volman, & Beishuizen, 2010; Vygotsky, 1978; Woolfolk, 2013). The Zone of Proximal Development is the zone in which the mediation takes place, *cf* section 2.3.4 (Donald et al., 2002).

Scaffolding can either be provided face-to-face or it can be technology-facilitated (Sharma & Hannafin, 2007). Usually technology-facilitated scaffolding is directed by an expert understanding of the best ways in which to support novice learning, whilst also taking into consideration the learner's individual needs and the impact of the context. Integral to

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scaffolding is the requirement that the expert understand the learner's role; customises support to suit the learner's needs and considers the learner's ability to use and interact with tools. Technology-facilitated scaffolds assist in motivation to draw and maintain learners' attention (Sharma & Hannafin, 2007).

Sharma and Hannafin (2007) differentiate between hard and soft scaffolds to facilitate complete customisation in technology facilitated learning. Soft scaffolds involve support provided by a human as an expert who can customise and negotiate the support provided. Hard scaffolds involve support which is primarily mediated by technology and which is fixed and inflexible. Although technology can assist in scaffolding as a technological tutor, it still cannot replace the customised and sensitive support which a human tutor can supply (Sharma & Hannafin, 2007).

Scaffolding only temporarily supplies support (Donald et al., 2002). The steps involved in the process of scaffolding are as follow:

− The first step in the scaffolding process involves identifying which key concepts and forms or learning strategies should be scaffolded.

− The second step involves connecting the new knowledge to that which is already familiar to the learner. This entails translating the teacher or expert's understanding of the key concepts and learning strategies into forms that are suitable for the level of the learners. This will also require that the teacher understands the different needs of the individual learners.

− The third step, the first stage in the scaffolding, entails explaining, demonstrating, modelling, probing, asking questions or asking learners to report back on concepts.

− The fourth step, the second stage of scaffolding, involves learners practicing, adapting and refining the concepts after they have grasped what the teacher has scaffolded. This stage requires the teacher to continue with the support by probing, re-explaining and motivating the learners to enable them to advance from their current understanding of the concepts.

− The fifth and final step, the third stage of scaffolding, requires the teacher to slowly but surely reduce his/her support and contribution as the practice begins to take effect. To accommodate the different learning needs of individual learners this 'fading' will be done at different phases with the different learners, depending on their level of understanding (Donald et al., 2002). The fading of support is illustrated in figure 14.

The first two steps are the preparatory steps for scaffolding whilst the last three steps refer to the actual scaffolding taking place in the classroom.

As already stated, mediation takes place within the Zone of Proximal Development, *cf* section 2.3.4. It is within this zone that with the help of a teacher, parent, peer or technology a learner advances from the unfamiliar to the familiar.

Scaffolding is an approach used in constructivist learning (*cf* section 3.2.3 and 3.2.4) to support learners in developing their knowledge (Woolfolk, 2013). Part of Vygotsky's theory to develop learners cognitively to thus optimise understanding, requires that learners struggle and brawl with challenges in their Zone of Proximal Development. Hence, to operate in that Zone of Proximal Development, learners need scaffolding.

Scaffolding relates to the constructivist learning theory, and more specifically, inquiry based and problem-based learning, *cf* section 3.3.3 (Roblyer & Doering, 2013; Woolfolk, 2013). Inquiry based learning is an "approach in which the teacher presents a puzzling situation and students solve the problem by gathering data and testing their conditions" (Woolfolk, 2013, p. 366). Problem-based learning involves "methods that provide students with realistic problems that don't necessarily have 'right' answers" (Woolfolk, 2013, p. 367). Scaffolding is mentioned as a theory in the constructivist approach section, *cf* section 3.2.4.

Most educational psychologists have come to an agreement that scaffolding has three characteristics (Van de Pol et al., 2010).

- The first characteristic requires the teacher to offer support on a contingency basis and to make provision for unforeseen circumstances which can arise in the classroom during teaching. This calls for the teacher to be constantly able to alter, set apart and tailor responses to meet the needs of every learner.
- The second characteristic requires that the teacher fades the support provided. This means that the teacher must progressively withdraw support and assistance as the learners' skill, knowledge and understanding develop and expand.
- The third characteristic of scaffolding requires the teacher to transfer responsibility to the learner, so that the learner takes on more and more responsibility and ultimately takes ownership of their own learning (Van de Pol et al., 2010).

Scaffolding methods which support learning activities include feedback, hints, instruction, explanation, modelling and questioning (Van de Pol et al., 2010). Feedback entails supplying the learner with information regarding his/her performance. Giving hints involves the teacher providing the learner with clues and suggestions to help the learner progress towards the solution. In these circumstances it is the teacher's intention to not provide the learner with the complete solution, or give detailed instructions to reach the solution. On the other hand, instruction entails the teacher giving instruction to learners on what to do or the teacher explaining to the learners how and why something must be done. Explaining involves the teacher giving more detailed information to learners, as well as clarification in the instances where learners require it. Modelling refers to the learners being presented with behaviour for imitation by the teacher, for example demonstrating a skill to the learners. Questioning requires the teacher to ask questions which call for an active response from the learners, thus the learners need to think about their response and then articulate that thought (Van de Pol et al., 2010).

Figure 14 represents a conceptual model of scaffolding which illustrates its three main characteristics as discussed namely contingency, fading and transfer of responsibility. This figure illustrates the progressive fading of the teacher's support, making use of the methods of scaffolding (feedback, hints, instructing, explaining, modelling and questioning) with the learner responding to the scaffolds provided by the teacher and how the gradual transfer of responsibility empowers the learner to take charge of his/her own learning.

Figure 14: CONCEPTUAL MODEL OF SCAFFOLDING
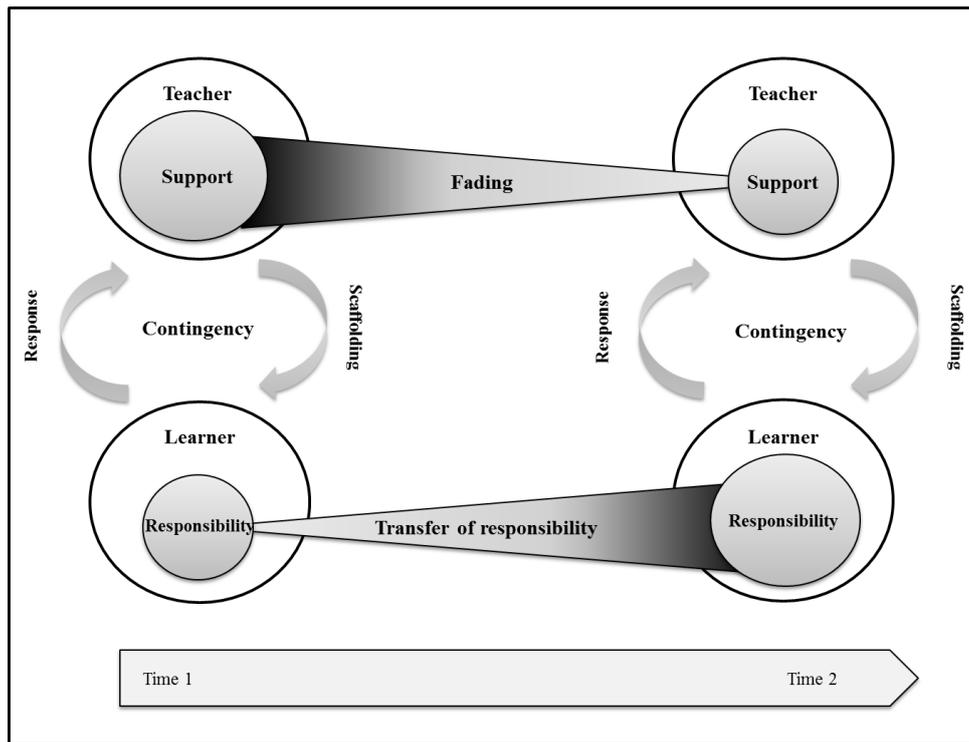
Adapted from Van de Pol et al. (2010)

In the previous figure, *cf* figure 14, the movement from the unfamiliar to the familiar within the Zone of Proximal Development is observable, with scaffolding supporting the learners to deal with their challenges through making use of the teacher's knowledge, support and assistance to understand a problem and then move forward without support. In the following figure (*cf* figure 15), the Zone of Proximal Development is added to illustrate the area in which the mediation, thus scaffolding, takes place.

Figure 15: CONCEPTUAL MODEL OF SCAFFOLDING WITHIN THE ZPD
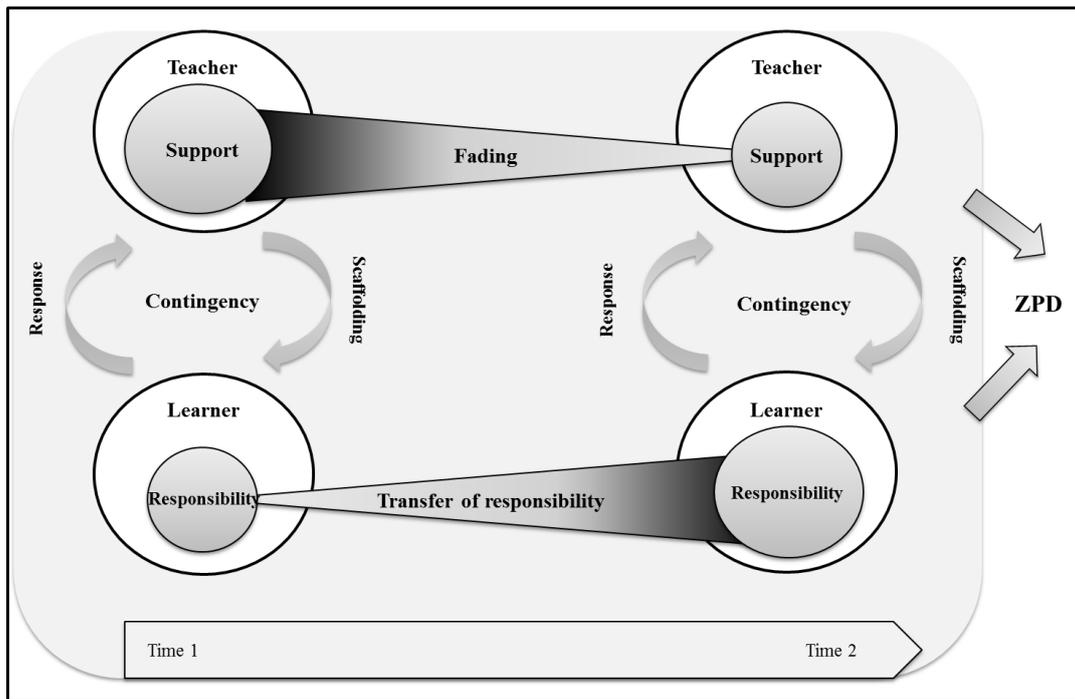
Adapted from Van de Pol et al. (2010)

2.4 SUMMARY

This chapter presented the learning experience of learners. The chapter commenced with a discussion of the theoretical frameworks in section 2.2. Activity Theory, as theoretical framework, elaborated on how learning experience is influenced when interaction involves an additional tool in section 2.2.1. User Experience, as a theoretical framework, investigated the 'felt experiences' when a user interacts with a product which, in this case, refers to a learner interacting with a tablet in section 2.2.2. Significant psychological concepts which influence learning experience and play an important role in learning were presented in section 2.3. This discussion included concepts such as emotions, motivation and self-concept in section 2.3.1 to section 2.3.3. Furthermore, The Zone of Proximal Development and scaffolding were discussed as significant psychological concepts important to this study in section 2.3.4 and section 2.3.5. These psychological aspects were discussed individually, as well as a combination which fit together and impact upon one another. All of these psychological concepts form part of and influence the learning experience.

CHAPTER 3 – LITERATURE REVIEW: TECHNOLOGY-FACILITATED LEARNING
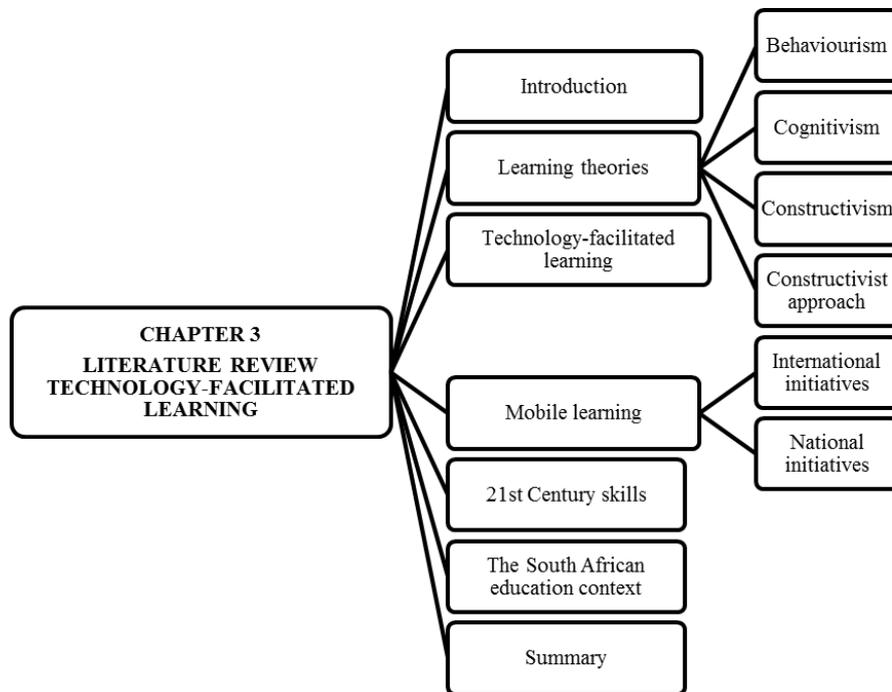
A schematic representation of Chapter 3

3.1   INTRODUCTION

This chapter of the literature review embarks with a discussion of the learning theories with the purpose of showing *how* education has moved from a behaviourist to a cognitive approach to where we are currently - a constructivist approach which is concerned with learning through experience. This section then moves on to demonstrate how the constructivist approach is supported by Information and Communication Technology (ICT) in education, with a focus on technology-facilitated learning. The discussion then progresses to the topic of mobile learning as an example of technology facilitated learning which is relevant and applicable to existing education. Twenty-first century skills, in which technology plays a significant role, and their importance are touched upon as these different skills are required by learners who wish to progress and succeed in their careers and in life. The current education system in South Africa supplies the context of this study in a broader sense, which then evolves into a discussion regarding resource deprived environments which serves to further enlighten the reader regarding the context of the research. Lastly it is illustrated how technology facilitates learning in such contexts.

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3.2   LEARNING THEORIES

It is necessary to discuss the main learning theories including behaviourism, cognitivism and constructivism in order to demonstrate how learning has moved from the behaviourist and cognitivist approach to a constructivist approach, the current approach in education, which is supported by the use of technology in the classroom.

3.2.1 BEHAVIOURISM

Behaviourist learning theory is based on observable behaviour. Functions of the mind are not taken into consideration. Knowledge is gained when behaviour is modified, thus learning is perceived as a change in behaviour. This behaviour can be trained or conditioned using positive or negative reinforcement. Learners are not actively involved and engaged, they are passive in the learning process (Stavredes, 2011). Roblyer and Doering (2013) distinguishes between two effective instructions namely directed instruction and inquiry-based learning. Directed instruction is based on objectivism which relates to behaviourism and inquiry-based learning which relates to constructivism (*cf* section 3.2.3). This differentiation between objectivism and constructivism is further supported by Jonassen (1991). Directed instruction involves a predefined set of facts which is transmitted to the learners by means of teacher-centred activities (Roblyer & Doering, 2013). This entails the teacher deciding beforehand what will be discussed and only this is presented to the learners. The learners do not play an active role in guiding the discussion, the teacher transfers the knowledge and the learner receives the knowledge. Objectivism is rooted in realism or positivism as a paradigm as the belief exists that knowledge exists external to the human condition (Jonassen, 1991).

The behaviourist approach views learning as a change in behaviour which can be trained using positive or negative reinforcement (Donald et al., 2002; Stavredes, 2011; Woolfolk, 2013). This training of behaviour is known as conditioning and two types are identified: classical conditioning and operant conditioning. A well-known behaviouristic learning process is classical conditioning which was defined by Ivan Pavlov in the 1920s. Classical conditioning involves the connotation of involuntary responses with new stimuli (Woolfolk, 2013). A reaction is triggered as an event takes place which activates behaviour. The other behaviouristic learning process is operant conditioning, which was defined by Skinner in the 1950s, which allows for new behaviour to be acquired (Woolfolk, 2013). Skinner held the view that the inner processes of an individual were not relevant as it is not possible to prove those inner processes, and therefor the focus should rather be on the cause-and-effect relationship which can be observed (Hung, 2001). Operant conditioning involves learning in which intentional behaviour

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is either strengthened or weakened by events that precede an action (antecedents) or events that follow an action (consequences) (Woolfolk, 2013). In learning, a stimulus will lead to either a positive or negative consequence. The type of consequence which follows a behaviour has a specific effect on the individual. If a learner behaves in a certain way and the consequence is reinforcement, the effect is repeated or strengthened behaviour. If a learner behaves in a specific way and the consequence is punishment, the effect is decreased or weakened behaviour. Therefore positive reinforcement, such as a reward, and negative reinforcement, such as unpleasant consequences, encourages behaviour. On the other hand punishment decreases or suppresses behaviour. In short, with classical conditioning a link is made between two stimuli, and with operant conditioning a link is made between behaviour and consequences (Stavredes, 2011). Hence, in the paradigm of behaviourism, a learner is trained (conditioned) to react based on a stimulus (Hung, 2001).

3.2.2 COGNITIVISM

Cognitivism is not concerned with behavioural reactions, but rather with what learners know and how they obtain that knowledge (Jonassen, 1991). Hence the shift away from behaviourism by recognising the mind, as well as considering the mental processes and functions (Jonassen, 1991).

Cognitivist learning theory focuses on understanding how human memory works to gain knowledge and to stimulate learning. In order to transfer knowledge to a new situation, the information needs to be relevant and presented in a specific way. This transfer has to do with cognitive processes such as attaining learners' attention; encouraging the recall of past knowledge; providing guidance and feedback and assessing achievement to retain and transfer what has been learnt (Stavredes, 2011). Cognitivism views "knowledge as a storehouse of representations, which can be called upon for use in reasoning and which can be translated into language" (Hung, 2001, p. 282). The cognitivist approach perceives the mind as an information processor with memory as an important function (Hung, 2001). This memory involves short-term, long-term and working memory (Hung, 2001). Long-term memory refers to knowledge that is stored permanently by an individual (Woolfolk, 2013). Short-term memory refers to a section of the memory system which grasps information for approximately 20 seconds (Woolfolk, 2013). Working memory involves the information which an individual focusses on at a given moment (Woolfolk, 2013).

3.2.3 CONSTRUCTIVISM

Constructivist learning theory holds that knowledge and meaning are created by incorporating previous information, views and experiences (Stavredes, 2011). Cognitive constructivism (Piaget 1985 in Stavredes, 2011) suggested that knowledge cannot merely be transferred to a person, it must be built and formed through experience. Social constructivism (Vygotsky 1978 in Stavredes, 2011) suggested that learning cannot be detached from the social setting within which it occurs. Hence, meanings cannot be separated from an individual's own interpretation (Hung, 2001). Constructivism investigates how an individual's mind constructs and builds knowledge through discovery (Hung, 2001). As mentioned above, *cf* section 3.2.1, Roblyer and Doering (2013) distinguishes between directed instruction, which is associated with behaviourism, and inquiry-based learning. Inquiry-based learning relates to constructivism as the teacher serves as a facilitator and the learner generates his/her own knowledge (Roblyer & Doering, 2013). This knowledge is constructed through previous experiences which are made up of psychological structures and views that are used to interpret and understand events and objects (Jonassen, 1991). A learner plays an active role in constructing his/her own knowledge, with the focus being on creating that knowledge rather than acquiring it (Hung, 2001; Roblyer & Doering, 2013).

The important epistemological theory of constructivism embraces the tenet that individuals create meaning from their experiences (Hung, 2001; Jonassen, 1991). This means that all individuals perceive external reality differently, since each individual has a distinctive collection of experiences associated with the world and the way in which they view it (Jonassen, 1991).

In conclusion, *behaviourism* deals with a stimulus and response; *cognitivism* deals with information transmission and processing and *constructivism* deals with the personal discovery of knowledge (Hung, 2001). Due to the behavioural theories excluding the mind from the learning process, there was a paradigm shift from the behaviouristic approach (Jonassen, 1991). Learning theories have thus moved from the behaviourist, which disregarded the mind, to the cognitivist approach, which included the mind, to a constructivist approach, which views knowledge as more than a mental state (Hung, 2001; Jonassen, 1991; Roblyer & Doering, 2013; Stavredes, 2011; Woolfolk, 2013). The constructivist approach is supported and reinforced by the notion of using technology in the classroom.

3.2.4 CONSTRUCTIVIST APPROACH

The constructivist pedagogy is supported by Information and Communication Technology (ICT) in education as learners use technology to explore and understand ideas (Chigona, Chigona, Kausa and Kayongo, 2010). The constructivist approach is learner-centred (Duncan, 2012; Hermans et al., 2008; Smieja, 2012) and promotes higher order thinking, problem solving and critical thinking (Barlow-Jones & van der Westhuizen, 2011; Chigona et al., 2010; Loveless & Dore, 2002). This constructivist approach is also supported by The White Paper on e-Education (Department of Education, 2004) and teaching and learning according to this method will help achieve the curriculum goals. Technology-facilitated learning is important to enhance learners' knowledge, creativity, teamwork skills and innovation in the classroom. These skills will help equip them for their future careers (Vanwelsenaers, 2012).

Constructivist views resulted from a combination of concepts such as social activism (Dewey), social cognitive theory (Bandura), scaffolding theory (Vygotsky), child development theory (Piaget), discovery learning (Bruner) and multiple intelligences theories (Gardner) (Roblyer & Doering, 2013). The following discussion further elaborates on how technology supports these different theories listed above (Roblyer & Doering, 2013).

Social activism holds the view that learning involves social interaction between learners regarding issues and problems which directly concern them. The implication this view has on education is that teaching should focus on collaborative activities and connections to the real-world. Technology can support opportunities for collaboration and visual presentations, made possible by technology, can help learners to make the connection between abstract concepts and how these can be applied to real-world situations.

Learning with modelling involves learning which occurs indirectly through exhibiting others' behaviour. Therefor instruction should deliver models which exhibit those skills which the learners should be acquiring. Technology enables demonstration through videos depicting good presentation of skills by learners which, in turn, could increase self-efficacy through self-modelling.

Scaffolding entails that a learner works at his/her best when they are assisted by an expert, such as a teacher, to build on existing knowledge (*cf* section 2.3.5). This implies that instruction should be tailored for each learner's individual requirements and preferences. Technology

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provides visual scaffolds which support various ways to study similar material and thus helps learners to grasp multifaceted concepts. The concept of scaffolding was discussed in more detail in the previous chapter, *cf* section 2.3.5.

Child development as a theory states that learning abilities differ at each developmental stage and progression is made as children discover their environments through the different developmental stages. This implies that instruction should be coordinated with the learners' stage of development and learners must be afforded opportunities to discover and explore. Technology offers 'electronic manipulatives' which support discovery and exploration activities to match different stages of development.

Discovery learning holds the view that learners comprehend and remember concepts better through interacting with their environment. Teachers should provide learners with the opportunity to discover concepts themselves, through free exploration. Technology delivers a wide variety of environments and information for learners to discover and explore.

The theory of multiple intelligences implies that, depending on the learner's preferred method of intelligence, learning should transpire on several levels and be presented in multiple ways. Multimedia, which is made possible through technology, provide various channels for learning the identical content (Roblyer & Doering, 2013).

3.3   TECHNOLOGY-FACILITATED LEARNING

Technology-facilitated learning, also referred to as technology-enhanced learning (Gulati, 2008), involves the use of technological devices and tools to facilitate and assist in the teaching and learning process in order to finally enhance learning.

Since the world is changing so rapidly, one cannot define education by holding to specific skills or specific information. The focus should rather be on general capabilities which will help learners to cope with technological change (Roblyer & Doering, 2013).

Education goals have shifted from emphasising the need for basic skills, such as writing, reading and calculation, towards the procurement of more universal capabilities, such as skills which will help learners cope with changes and challenges brought about by technology (Roblyer & Doering, 2013). Twenty-first century skills strongly support this belief, *cf* section 3.5.

It is not a novel idea to use technology in the classroom to improve education. Laptops, iPods, Kindles and iPads are just a few of the one-to-one devices that schools are acquiring for educational purposes (Duncan, 2012). The tablet as an educational tool has potential to exert a positive influence on learning (Smieja, 2012). The tablets used in the studies refer mainly to the iPad (Duncan, 2012; Smieja, 2012; Vanwelsenaers, 2012). The tablet is perceived as an essential tool which contributes to learners' motivation and consequently to their learning (Duncan, 2012). With the emergence of one-to-one devices, such as the tablets, the role of the classroom teacher is beginning to change. Results of a study in the US (Duncan, 2012) found the tablet to be helpful, faster and more fun compared to the traditional way of teaching. Ninety percent of the learners in the study perceived the tablet as a tool which aids and supports their learning. Learners preferred taking tests on the tablets rather than on paper and also preferred reading on the tablet rather than a book. Tablets are perceived as a valuable, motivational learning tool. Learners identified the tablet as the biggest motivating factor in school, followed by the teacher and then parents.

Current uses for tablets in schools (Smieja, 2012) include communication and note taking, assessments, instructional tools and pedagogical uses. Tablets facilitate and enable learning through engagement, access to resources such as internet and opportunities for communicating about subjects.

Merely *having* technology in the classroom does not however automatically translate into positive educational results, the teacher must implement rigorous teaching practices supported by technology to enhance student learning (Keengwe & Onchwari, 2011; Smieja, 2012). Marzano et al. (2001) as mentioned by Smieja (2012), emphasised the significance of learners creating and challenging assumptions through discovery learning, problem-solving and experimenting. Teachers who make use of and apply technology in their classrooms (Vanwelsenaers, 2012) may gain access to resources which are inaccessible to teachers who do not utilise this teaching strategy and consequently do not have the opportunity to improve learning in their classrooms.

Technology use supports students' learning needs in numerous ways (Roblyer & Doering, 2013). It provides the opportunity to grasp and retain skills which they learn as a result of repetition and practice. The use of technology creates an environment in which this practice is

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effective as learners are able to do it in their own privacy, at their own pace and learners receive immediate feedback. Unfamiliar and abstract concepts in Science and Mathematics can be illustrated using interactive software and simulations. Learners are then able to visualise concepts which, in turn, help them to understand the subject matter better. Simulations and spreadsheets are examples of tools that can assist learners in understanding concepts which would not have been possible without the use of technology. The internet connects learners with the outside world, providing them with access to unique information sources, data, research and knowledge which might not otherwise be easily obtainable. Through using the internet and email tools, learners are able to work at a much faster pace than would have been possible had they been using traditional methods. Independent learners, who are able to guide themselves, can learn on their own by accessing lectures and distance learning materials.

Technology has the capacity to turn *disabilities* into *capabilities* as learners with disabilities rely on features provided by technology to navigate their reality. Software tools offered by technology save time when doing tasks as it allows for the swift and easy adjustments of documents. Mobile and handheld technologies, with integrated learning systems, provide teachers with the opportunity to evaluate learners, track their progress and provide them with instant feedback. This assists teachers in quickly ascertaining where modifications and/or supplementary work regarding the learning program is needed so that the desired outcomes can be reached. Access to the necessary software and simulations saves money as it replaces materials such as worksheets, hand-outs, experiment equipment etc. (Roblyer & Doering, 2013).

Technologies can also assist in addressing the problem of unmotivated learners (Roblyer & Doering, 2013). The visual and interactive qualities of technology direct learners' attention to learning tasks. Low-level skills such as calculation, making corrections to drafts, spelling and grammar checks are all enabled by technology and this results in learners being more motivated to learn and master high level skills. In other words, when basic things are made easy, learners are more motivated to learn skills which are more complex. Leaners are motivated when they see *how* what they are learning could be applied to real-world situations and this, in turn, adds value to their future life and work. In addition when learners see the application as having bearing on real life they want to apply it to their daily lives. When learners can publish their work, they become more motivated as well because there is a connection to an audience outside the classroom. Learners also tend to be more motivated when working cooperatively and this

is also made possible through technology. The concept of *motivation* was discussed in depth in the previous chapter, *cf* section 2.3.2.

The use of technology assists in motivating and engaging learners. Technology thus supports learning needs whilst also preparing learners for future learning in which the mastery of 21st century skills is a necessity (Roblyer & Doering, 2013). Learners need to be *technologically literate* in order to acquire these skills. They must be able to analyse and use information (*information literacy*) as well as be able to understand, interpret and appreciate the denotation of graphic messages (*visually literate*). Twenty-first century skills are discussed later in this chapter, *cf* section 3.5, following the discussion on mobile learning.

3.4   MOBILE LEARNING

Mobile learning is a term currently used to indicate learning through the use of handheld computers, mobile phones and other mobile devices (Botha, 2011). Mobile learning is the integration of mobile technologies into the traditional classroom environment, or distance learning environments, with the aim of complementing and adding value to existing learning models (Motiwalla, 2007). Mobile learning enables learners to learn through a wireless communication tool by making use of a mobile device (Chen, Kao, & Sheu, 2003). Mobility and communication play a vital role in the learning process (Sharples, Taylor, & Vavoula, 2005), and this is made possible through mobile learning.

Mobile learning is about more than just mobile technologies used in education, Traxler (2009) argues that when looking at a definition for mobile learning, it is important to consider *how* it differs from other forms of learning. With the focus also being on learning experience, mobile learning creates an environment in which a sense of ownership is cultivated in a learner in an environment which is both informal and portable (Traxler, 2009). Mobile learning supports personalised, situated and authentic learning. *Personalised* in that it caters for different learning styles, *situated* in that learning can take place during an activity and *authentic* as it consists of interesting and relevant real-world problems (Traxler, 2009). Mobile learning affords learners the opportunity to learn across space and time, and move from topic to topic (Sharples et al., 2005). Sharples et al. (2005) agree with Motiwalla (2007) and Traxler (2009) that mobile learning is not a new concept but that it rather casts new light upon current practices of learning by looking at it from a fresh angle.

Mobile learning creates an environment for learning with unique characteristics. Mobile learning allows for urgency of a learning need as a learner can, with the mobile device, find

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answers immediately and efficiently. It enables the learner to initiate knowledge acquisition and to do so on demand. The learning setting becomes mobile as the device is portable, making learning possible *anytime and anywhere* and not limited to the physical confines of the classroom. The interactive nature of the learning process permits for communication with peers, teachers, experts and other material through the use of videos, emails, systems and tools. Wireless applications provide an opportunity for learning to be embedded in the learner's daily life as it is presented in a realistic context. Mobile learning is also characterised by the ability to integrate instructional content by making use of different information resources to support flexible and multidimensional learning (Chen et al., 2003).

Botha (2011) is in agreement with Chen et al. (2003) but adds that mobile learning also allows for context aware applications which adapt the content of a service automatically as it senses a learner's situation. Mobile learning also has the ability to facilitate diverse pedagogies whilst affording learners the opportunity to create content. Another characteristic is that mobile learning disrupts the concept of the traditional classroom.

Table 4 illustrates the merging of learning and technology (Sharples et al., 2005). It shows how technology matches new learning approaches. This table indicates that technology is suited to and supports new learning practices and this process is made possible through mobile learning.

Table 4: MERGING OF LEARNING AND TECHNOLOGY

New Learning		New Technology
Personalised	⟷	Personal
Learner centred	⟷	User centred
Situated	⟷	Mobile
Collaborative	⟷	Networked
Ubiquitous	⟷	Ubiquitous
Lifelong	⟷	Durable

Source: Sharples et al. (2005)

With the use of mobile learning on the increase and with all the advantages it has to offer, there are many global initiatives which endeavour to incorporate mobile technology in education. A brief discussion of a few mobile learning initiatives, chosen from many others around the world, follows.

3.4.1 INTERNATIONAL INITIATIVES

Worldreader is an initiative in which donated Kindle e-readers provide children with access to digital books in Ghana. The Worldreader app is a mobile phone-based e-reader with a library of books. It has expanded to other African countries including Nigeria and Ethiopia (Vosloo, 2014).

Eneza Education in Kenya is a mobile assistant for teachers and a platform which improves learner engagement with the aim of increasing performance. Parents and schools have access to quizzing platforms, dashboards where they can view learners' performances and Eneza also provides tips to assist the learners. Learners thus have access to educational content and to their teachers when they need assistance (Briggs, 2014).

UNESCO is piloting a program in Nigeria which focusses on English teachers. With this program, messages are sent out daily to teachers with examples of how to teach English language. The format of the messages is such that it is compatible with and can be viewed on low-cost devices which are prevalent in Nigeria. Positive teacher feedback states that the support provided has helped them to improve their teaching (Briggs, 2014).

In New Zealand, the most remote and geographically isolated communities are reached with a high tech vehicle which serves as a mobile learning centre (Murray, 2014). These mobile learning centres are equipped with the latest technology and educational resources. It also provides an opportunity for learners to create digital content.

The Millbug Vuya Tablet PC is a tablet designed for African countries. It is solar powered which allows for mobile computing in areas where access to electricity is erratic. The aim of these tablets is to target rural areas and provide them with the opportunity to enable e-learning (PC Tech Magazine, 2014). Mobile learning has made it possible to reach learners and teachers in resource deprived environments, as it provides access to educational resources which was previously not possible.

3.4.2 NATIONAL INITIATIVES

Yoza cellphone stories is a project which provides downloads of stories and novels. Mobile novels (m-novels) are available to download and read, and users can comment on the stories and vote for their favourites (Vosloo, 2014).

Dr Maths on MXit offers maths tutoring on a mobile social network. MXit is Africa's biggest domestic mobile social network. Learners have access to maths tutors who offer help in the

evenings when learners need help with homework. For many learners this is the most qualified assistance they have access to, due to factors such as illiteracy levels of parents and guardians, and the absence of parents and guardians. Another reason for the success of this initiative is the fact that it is exceptionally inexpensive (Vosloo, 2014).

Education Delivered Intelligently (EDI) is a project run by Ambit Technologies which created a solar classroom in a container with tablets and an interactive board for the teacher. The content is in line with the prescribed national curriculum as it was designed in conjunction with government. The power generated by the solar panels supplies electricity to the school as well. This solar classroom is the first in South Africa and is situated in the rural area of Thembisa, Gauteng (Aljazeera, 2014).

Via Afrika started an initiative in 2014 to supply rural areas with digital education centres. These centres are re-purposed container libraries and can be found at schools in Mpumalanga, Free State and Limpopo. Each centre has 15 tablet devices which have been loaded with educational programs, electronic textbooks, applications and tools developed by Via Afrika (Fin24, 2014).

The discussion of international and national mobile learning initiatives provided examples of learning environments which have been mobilised and therefore became more accessible. These 'new' learning environments, facilitated by the use of mobile learning, creates opportunities for the fostering of 21st century skills (*cf* section 3.5). These learning environments are important to this study as it shows *how* mobile learning enables learning opportunities and overcomes boundaries set by factors contributing to a resource deprived environment. The concept of a resource deprived environment is explained in section 3.7. The discussion also includes factors which contribute to an environment being classified as *resource deprived*, *cf* section 3.7.

3.5   21st CENTURY SKILLS

It has become necessary for learners to acquire 21st century skills in education. The question thus arises: What exactly are 21st century skills? The main reason to define 21st century skills can be ascribed to the introduction of ICTs in the world which provide learners with new *opportunities* but also present new *challenges*. Due to the emergence of ICT in the 21st century, the need arose to adapt education from the 20th century. To compete in this new technological world, learners need to acquire certain skills to equip them for this new era. The reality is that the new emerging workforce necessitates that learners become problem solvers, independent

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thinkers and decision makers (Binkley et al., 2010; Dede, 2010; Metiri Group & NCREL, 2003; Partnership for 21st Century Skills, n.d.; Roblyer & Doering, 2013; Silva, 2009). The emphasis has shifted from what units of knowledge learners have to what learners can do with the knowledge they have (Silva, 2009).

Many different frameworks have evolved to assist learners in acquiring these 'must-have' 21st century skills which will benefit both their personal lives and their careers (Binkley et al., 2010; Dede, 2010; Roblyer & Doering, 2013). Three significant frameworks are: The Partnership for 21st Century Skills (P21), The EnGauge Framework from The North Central Regional Educational Laboratory (NCREL) and the Metiri Group and The International Society for Technology in Education (ISTE).

In 2002, The Partnership for 21st Century Skills developed a Framework for 21st century learning (Partnership for 21st Century Skills, n.d.). According to this framework, 21st century skills involves a combination of specific skills, content knowledge, literacies and expertise which are essential for a learner to master in order to be successful in his/her career and life. The Framework consists of 21st century student outcomes which are presented in the following figure:
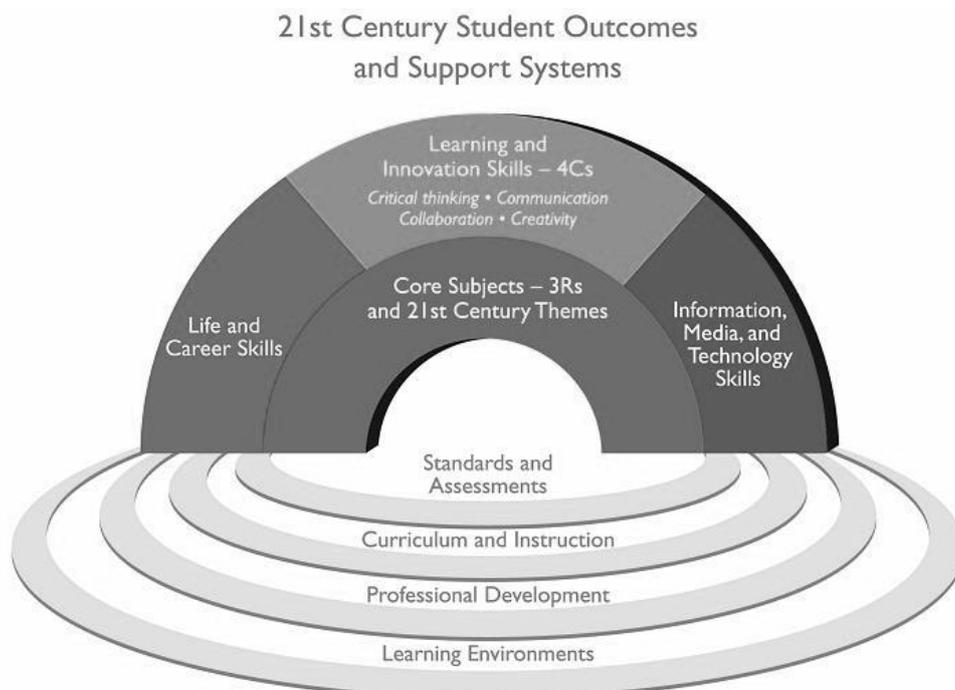
Source: Partnership for 21st Century Skills

The rainbow represents the different elements, but it is important that the elements are viewed as interrelated entities in the process of fostering 21st century skills. In order to master 21st century skills it is vital to master the core subjects which include English, foreign languages, Mathematics, Science, Economics, Geography, Arts, History, Government and Civics. Furthermore, the themes include *global awareness* which makes it possible to understand global issues and *other cultures* making it possible to work collaboratively and with respect in different contexts. Financial, Economic, Business and Entrepreneurial Literacy is important in recognising the role of economy in society. With an understanding of the role of the economy a learner is empowered to make correct economic choices in his/her personal life, as well as utilising entrepreneurial skills to optimise career possibilities. Civic Literacy enables one to make appropriate civic decisions and highlights the importance of exercising all rights and obligations whilst also being aware of governmental procedures. Health Literacy, another theme, requires an understanding of basic health tenets including nutrition, diet, physical exercise, stress reduction and risk prevention in order to live a healthy life. It is also important to be aware of public health issues. Environmental Literacy relates to knowledge regarding the environment, the impact of society on the environment, understanding environmental issues and taking action to address challenges.

Another outcome is that learners acquire learning and innovation skills. These skills include creativity and innovation, critical thinking and problem solving, and communication and collaboration. These are skills, separate from academic content, which learners need to acquire to facilitate learning and thinking (Dede, 2010). These skills link with constructivism, as discussed previously in this chapter (*cf* section 3.2.3 and 3.2.4). Creativity is to think in an original and imaginative way (Woolfolk, 2013). Critical thinking involves "evaluating conclusions by logically and systematically examining the problem, the evidence and the solution" (Woolfolk, 2013, p. 343). Problem solving is the ability to create new solutions, explanations and answers for problems and questions (Woolfolk, 2013).

An additional element includes information, media and technology skills. Information literacy involves accessing information effectively and evaluating that information critically. It further involves applying the information to the issue at hand. Media literacy entails analysing media by examining and understanding media messages, including ethical issues regarding the use of and the access to media. Creating media presupposes an understanding of media tools and then the skills to use these tools effectively, whilst considering different environments. ICT literacy is all about effectively applying technology, thus using technology to not only do research but

to also access, evaluate, organise and communicate information. It requires using technology to learn skills and content (Dede, 2010).

Life and career skills are another important element as these skills help individuals to steer both their work and life environments in an ever competitive world. These skills call for individuals to be flexible, to adapt to change, to work independently, to self-direct the management of their goals and time, to interact with others, to work in diverse teams, to be productive and responsible, to lead others and to have a sense of social responsibility.

The support systems presented at the bottom of the figure (*cf* figure 16) relate to elements which apply to teachers when ensuring that learners master 21st century skills. The support system includes 21st century standards and assessments, curriculums and instructions, professional development and learning environments.

In 2003, The EnGauge Framework included topics like digital-age literacy, inventive thinking, effective communication and high productivity (Metiri Group & NCREL, 2003). Each cluster can be broken down into different skills, as illustrated by the following figure:

Figure 17: ENGAUGE 21st CENTURY SKILLS
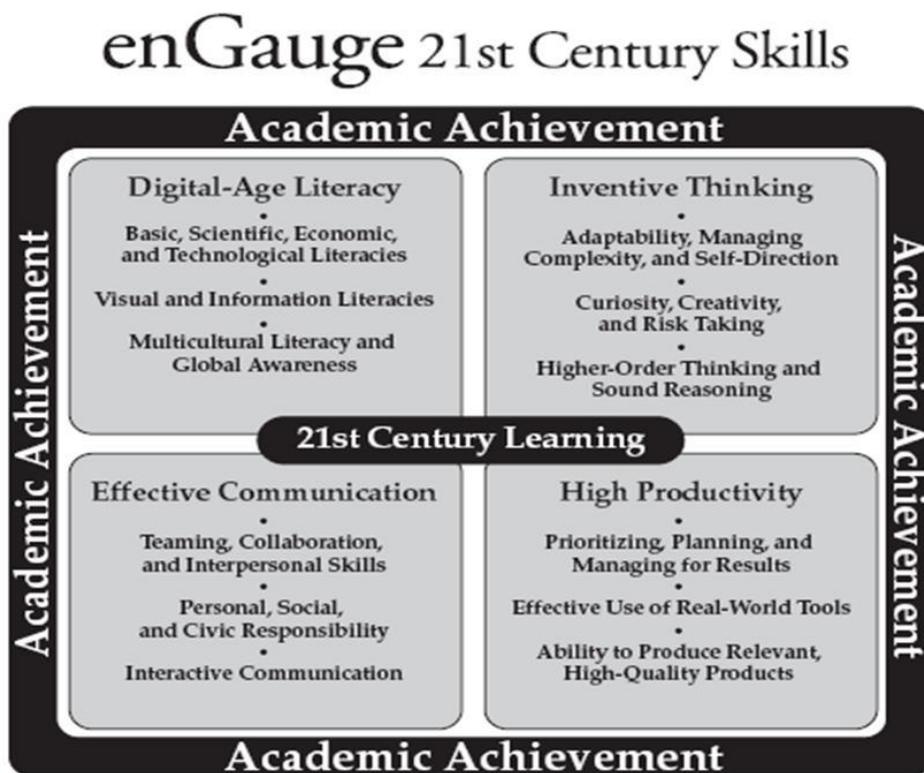
Source: Metiri Group & NCREL (2003)

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In 2007, The International Society for Technology in Education (ISTE) listed the ICT skills which they considered central to 21st century skills - the basic skills which learners should meet (Dede, 2010; Roblyer & Doering, 2013). These skills are creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving and decision making; digital citizenship and technology operations and concepts. Many similarities exist between the ISTE and P21 skills.

In 2010 Binkley et al. (2010), after studying different documents on 21st century skills, proposed the KSAVE framework as a 21ste century skills framework. KSAVE refers to **k**nowledge, **s**kills, **a**ttitudes, **v**alues and **e**thics. The KSAVE model consists of 10 skills which have been grouped into 4 categories. The 4 categories include skills to equip learners in ways of thinking, ways of working, skills to provide them with tools for working and finally skills to equip them to live in the world.

Category 1: *Ways of thinking*

1. Creativity and innovation
2. Critical thinking, problem solving and decision making
3. Learning to learn

Category 2: *Ways of working*

4. Communication
5. Collaboration

Category 3: Tools for working

6. Information literacy
7. ICT literacy

Category 4: Living in the world

8. Citizenship (national and international)
9. Life and career
10. Personal and social responsibility, which includes cultural awareness and competence

From this KSAVE model it is evident that this framework encompasses most of the skills discussed in the previous frameworks for 21st century skills.

Table 5 summarises the discussion of 21st century skills and the different frameworks. The table provides the skill set which is considered to be a 21st century skill and in parallel the framework which supports the skills. The three main skill sets are a summary of the key shared skills identified across the different frameworks.

Table 5: 21st CENTURY SKILL SETS AND FRAMEWORKS

Skill set	Framework in support of skill set
Innovation skills: • Critical thinking • Creativity • Problem solving • Decision making	Partnership for 21st Century Skills (P21) EnGauge Framework The International Society for Technology in Education (ITSE) KSAVE model
ICT skills: • Technological literacy • Information literacy • Media literacy	Partnership for 21st Century Skills (P21) EnGauge Framework The International Society for Technology in Education (ITSE) KSAVE model
Life skills: • Communication • Collaboration • Personal responsibility • Social responsibility	Partnership for 21st Century Skills (P21) EnGauge Framework The International Society for Technology in Education (ITSE) KSAVE model

One of the aims of the ICT4RED project is to foster 21st century skills and competencies in resource deprived environments (Herselman & Botha, 2014). These skills and competencies include critical thinking, communication, problem solving, creativity, ICT confidence and collaboration (Herselman & Botha, 2014). These skills form part of the White Paper on e-Education as the ICT policy (Department of Education, 2004). In Williams (2014) assessment of 21st century skills for the ICT4RED project, various definitions were evaluated. These evaluations included American Assessment of Colleges and Universities, Partnership for 21st

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Century Skills, Organisation for Economic Cooperation Development, Metiri Group NCREL EnGauge Framework and International Society for Technology in Education. It was found that the skills and competencies which were identified as goals to be achieved in the ICT4RED project, correlated with that which is regarded as 21st century skills, as sourced from different definitions set forth by various institutions (Williams, 2014).

Figure 18 was applied in the ICT4RED project, with 21st century skills and competencies as the final point for evaluation regarding the impact of the project. The skills and competencies for final evaluation included critical thinking, problem resolution, communication, collaboration, creativity and ICT confidence (*cf* figure 18).

Figure 18: ICT4RED FRAMEWORK
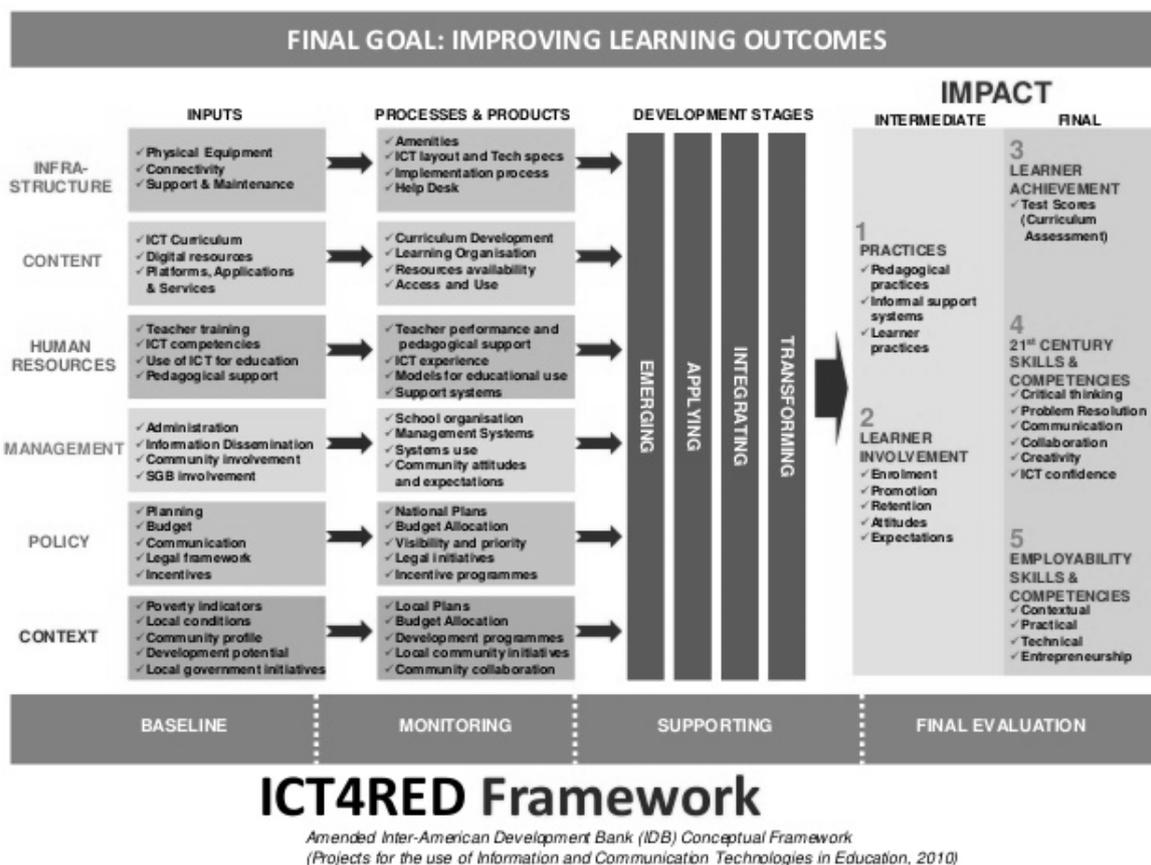
Source: Herselman and Botha (2014)

For the purpose of this study the focus will be on the *ICT confidence as a 21st century skill* which is fostered in learners through the use of technology-facilitated learning and *the attitudes of the learners* as noted under learner involvement (*cf* figure 18).

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3.6 THE SOUTH AFRICAN EDUACTION CONTEXT

South Africa has a unique context and, it follows, many unique challenges when compared to European and American systems. A brief discussion regarding the current state of education in South Africa provides a necessary backdrop to the rest of the study.

Although the Matric results have improved (Astrotech, 2013), the reality of education in the South African education system, especially when compared to the rest of the world, seems bleak. In a ranking of 62 countries, South Africa was placed last in terms of the quality of mathematics and science education (Gernetsky, 2012). In The World Competitiveness Report for the period of 2012 to 2013, South Africa was placed 133rd out of 142 countries in terms of the quality of its educational system (Astrotech, 2013). In 2014, according to the World Economic Forum's Global Competitiveness Report, South Africa ranked last out of 148 countries in terms of the quality of maths and science education and 146th in terms of the overall quality of education (Africa Check, 2014).

Some goals, as set out in the 2014 action plan of the Department of Basic Education to improve education, include ensuring an environment which motivates and encourages learners to go to school to learn and teachers to teach, increasing learner access to a variety of different forms of technology to enrich learning, improving the average performance across all grades and increasing learner proficiency in mathematics and physical science (Department of Basic Education, 2012).

The Annual National Assessment (ANA) was presented by the Department of Basic Education in 2011 as a policy to assess progress in learner achievement annually (Department of Basic Education, 2014b). The ANAs form part of the 2014 action plan of the Department of Basic Education, with the aim of ensuring that at least 60% of South African learners achieve acceptable literacy and numeracy levels. The emphasis is on literacy and numeracy as these present the fundamental introductory skills upon which successful learning is further grounded. The ANA includes learners in Grades 1-6 and Grade 9 (since 2012) and from 2015 Grades 7 and 8 learners will also be included in an effort to establish their levels of competency in literacy and numeracy. Learner achievement is rated according to a seven point scale, *cf* table 6:

Table 6: SEVEN POINT ACHIEVEMENT SCALE

Rating code	Description of competence	Percentage
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 – 79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 – 29

Source: Department of Basic Education (2014b)

The results of the ANA, from 2011 to 2013, for *literacy* are presented in table 7:

Table 7: ANA RESULTS (LITERACY)

Grade	2011	2012	2013
1	59	58	60
2	52	55	57
3	35	52	51
4	34	43	49
5	28	40	46
6	28	43	59
9	*	43	43

* Grade 9 tests were not written in 2011

Source: Department of Basic Education (2012 & 2013b)

The results of the ANA, from 2011 to 2013, for *numeracy* are presented in table 8:

Table 8: ANA RESULTS (NUMERACY)

Grade	2011	2012	2013
1	63	68	60
2	55	57	59
3	28	41	53
4	28	37	37
5	28	30	33
6	30	27	39
9	*	13	14

* Grade 9 tests were not written in 2011

Source: Department of Basic Education (2012 & 2013b)

The literacy results of the ANA indicate an improvement across most grades, from 2011 to 2013. A progress in numeracy, across most grades, can be seen from 2011 to 2013. However, the most noteworthy aspect is that Grade 9 performance in numeracy (Mathematics) is below expectation as the competence level is not achieved.

The matric results of the National Senior Certificate Examinations are presented in table 9. A substantial improvement can be seen from 2009, in which the pass rate was 60,6%, to 2013, in which the pass rate was 78,2%, with a decrease in 2014, with a pass rate of 75.8%.

Table 9: NATIONAL SENIOR CERTIFICATE EXAMINATION RESULTS

Year	Pass rate
2009	60, 6%
2010	67, 8%
2011	70, 2 %
2012	73, 9%
2013	78, 2%
2014	75,8%

Source: Department of Basic Education (2014a)

The overall Grade 12 achievement rates, as presented in the following three tables, also show an improvement from 2010 to 2013 in Mathematics, Mathematical Literacy and Physical Science. However, a decline can be seen in Mathematical Literacy in learners achieving 40% and above.

The overall achievement rates in Mathematics are presented in the following table 10:

Table 10: MATHEMATICS ACHIEVEMENT RATES

Year	Percentage of pupils achieving 30% and above	Percentage of pupils achieving 40% and above
2010	47.4	30.9
2011	46.3	30.1
2012	54	35.7
2013	59.1	40.5

Source: Department of Basic Education (2013a)

The overall achievement rates in Mathematical Literacy are presented in the following table 11:

Year	Percentage of pupils achieving 30% and above	Percentage of pupils achieving 40% and above
2010	86	64.7
2011	85.9	65
2012	87.4	61.4
2013	87.1	62.4

Source: Department of Basic Education (2013a)

The overall achievement rates in Physical Science are presented in the following table 12:

Year	Percentage of pupils achieving 30% and above	Percentage of pupils achieving 40% and above
2010	47.8	29.7
2011	53.4	33.8
2012	61.3	39.1
2013	67.4	42.7

Source: Department of Basic Education (2013a)

Even though the tables (*cf* tables 10 to 12) show progress, one should keep in mind that the benchmark presented in the tables are: 30% and above, and 40% and above, when the aim should be higher.

Although improvements in the National Senior Certificate pass rate and Annual National Assessment results are noted, it does not correlate with the World Rankings in the Global Competitiveness Report which places South Africa at the bottom. Another distressing statistic is that only 42.5% of learners, who enrolled for school in 2003, wrote their Grade 12 examination in 2014 (SAPA, 2015). From 2013 to 2014 only 66.8% of learners who were in Grade 11 moved on to Grade 12 (SAPA, 2015). This raises the question as to *where* the other 57.5% of the enrolments and the other 33.2% of Grade 11 learners have gone.

Figure 19 depicts the educational ecosystem in South Africa. This figure illustrates that the Department of Basic Education is responsible for decisions regarding policy and leadership and that the provincial departments of education, districts, circuits and schools are at the implementation level. On the left, the formal school education system is presented and on the right, the education stakeholder community is presented. Responsibilities of the different stakeholders, within this ecosystem, are presented in the middle (*cf* figure 19).

Source: Herselman and Botha (2014)

Although this section has presented data regarding levels of performance in subjects, including results of the ANAs and Matric Senior Certificate examinations, this study does not intend to measure any results in terms of academic improvements of learners. This is also indicated in the scope of the study (*cf* section 1.5.1). The presentation of these results serves merely to paint the picture of the South African education system.

Challenges facing teaching and learning in South Africa include: the repercussions of unequal education due to apartheid, level of poverty in rural communities; poor quality of learning and teaching; lack of accountability, inefficiencies and corruption in the system; unsuccessful

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management and leadership; constant changing of curriculums and ineffective application of the language policy (Prinsloo, 2012). Identified challenges as regards the implementation of ICT includes: lack of delivery of government initiatives; shortage in ICT skills and capabilities; lack of ICT infrastructure and funding; need for technical support regarding ICT; need for pedagogical support for teachers, lack of commitment and ownership from communities as well as monitoring and evaluation of implementation of ICT (Presidential National Commission on Information Society & Development, 2007). The Whitepaper on e-Education aimed to address these challenges facing the education system in South Africa. The goal of the Whitepaper on E-Education is to ensure that every learner and teacher would be ICT proficient by 2013 (Department of Education, 2004). The objectives set out in order to reach this goal include: access to ICT infrastructure; ICT professional development; connectivity; content development; content delivery; community commitment and research and development (Department of Education, 2004). The reality is that since the White Paper on E-Education was written in 2004, no guidelines were provided to schools on how to address or reach the E-Education objectives, especially at classroom level (Czerniewicz & Hodgkinson-Williams, 2005; Thomson, Nixon, & Comber, 2006; Vandeyar, 2010). The ICT4RED initiative in the Eastern Cape is an example of how the white paper could be integrated, empowering teachers to use mobile technology to support teaching and learning which could motivate learners to achieve better results.

Many challenges facing the South African education system are rooted in poverty and unequal opportunities. These challenges are especially prevalent in disadvantaged communities where the lack of resources impacts negatively on the communities. The following section (*cf* section 3.7) deliberates on how factors, present in rural or disadvantage communities, contribute to these communities being classified as *resource deprived* or *constrained environments*.

3.7   A RESOURCE DEPRIVED ENVIRONMENT

When studying rural or disadvantage communities confusion exists regarding the use of the terms *deprived* and *constrained* in relation to available resources.

A resource constrained environment is described by Anderson, Anderson, Borriello and Kolko (2012) as an environment where there are low-income communities and low bandwidth. These environments provide unique constraints (e.g., cultures where people are unfamiliar with or afraid of technology and/or environments where power and network connectivity are scarce and expensive). Resource constrained communities are found in rural areas (Sargent &

Hannum, 2009). A resource-constrained area is an area in which resources are limited (Thursz & Fontanet, 2014). Kornai (1979) describes a constraint as a shortage, when targets cannot be met or exceeded due to constraints. A resource constraint is for example when production activities exceed the volume of available resources (Kornai, 1979).

According to Tunstall and Lupton (2003) deprived area indicators include factors such as economic activity, income, education, health and housing. Economic activity refers to whether a person is unemployed, economically inactive or a non-earner. Income deals with whether a person has no car and has a low income (Tunstall & Lupton, 2003). Education refers to whether a person has any qualifications or whether he/she is illiterate. Health as an indicator deals with mortality rates, long term illnesses, low birth weight, health behaviour and mental health. Housing involves whether a home is overcrowded, lacks amenities, or might be unsuitable to live in. Others factors which also play a role in deprived areas include the composition of the household, ethnicity, access to services, mobility, dilapidated land and savings.

Pearce, Witten, Hiscock and Blakely (2007) hold forth that the socio-economic position of individuals living in an area is what classifies an area as being deprived. A deprived area is an area which is socially and economically disadvantaged. Contextual properties have an influence on the classification of an area as deprived or non-deprived, where the former refers to poorer or low income areas and the latter to richer or high income areas.

According to Pearce et al. (2007) three domains play a role when categorising an entity or area according to contextual factors and they are social characteristics, physical characteristics and community resource access.

It seems as that, in terms of environment, *resource constrained* and *resource deprived* have a similar meaning. For the purpose of this study, the term resource deprived will be used when discussing the environment in which the study was done and the challenges facing the community who live in it.

When one compares South Africa to developed countries, one becomes aware of a digital divide. This digital divide also exists within South Africa (Gudmundsdottir, 2010) regarding learners who are disadvantaged due their socio-economic status. It is important to grasp that for learners to benefit from ICT in education, it should be placed in the local context. The disadvantages regarding ICT (Herselman, 2003; Legotlo, 2014) faced by rural schools in South Africa include lack of infrastructure and physical, technological and educational resources;

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remotely located schools; lack of qualified, experienced and skilled teachers; lack of teacher training; lack of library facilities and transport facilities and large learner to teacher ratios. The realities of rural schools in South Africa impact on learning (Legotlo, 2014). The geographical location of rural villages is a difficult environment for children to navigate for children. The environment impacts on learning as schools do not provide school transport, have no electricity and some learners have to cross rivers on their way to school. On rainy days learners are thus often just not able to attend school as the rivers are full and dangerous or even impossible to cross. Nutrition programs in these schools are not functioning effectively due to supply process challenges (Legotlo, 2014). Schools have little or no sport facilities, generally schools would have a soccer field and some netball fields, but no tennis courts, no cricket pitches or athletic track and no swimming pool. Toilet facilities are either in a terrible state or absent. The absence of suitable persons to guide crèches subsidised and ECD (Early Childhood Development) centres means that there is almost no pre-school preparation available for children. Another reason for the lack of pre-school preparation is because schools are being filled to capacity and therefor there is a lack of physical space in public schools. Another reality of rural schools is that the *home* and *school* language is not the same and this impacts negatively on learning. In addition to this, not all schools are subsidised (Legotlo, 2014).

A study of teachers in a deprived context in South Africa ascertained that they appreciate the value and significance of ICT in education and that they are enthusiastic to embrace and adopt ICT (Bytheway, Cox, Dumas, & van Zyl, 2012). They do however feel that they do not have the ability and necessary support to use ICT successfully and effectively. Regardless of the establishment of infrastructure, the adoption of ICT among teachers does not just occur automatically (Bytheway, Sadeck, Dumas, Chigona, Chigona, Mooketsi, Rega & Fanni, 2010). ICT has the potential to assist in addressing challenges such as under-qualified teachers and insufficient resources (Hardman, 2005), however these are the very environments in which teachers struggle the most to integrate ICT into teaching and learning. The impact of the developing context is evident - in disadvantaged areas teachers often have insufficient ICT and pedagogical competencies and learners have low technical skills. Consequently, teachers tend to *not* focus on teaching the subject content as they spend valuable time navigating and applying technology (Chigona & Chigona, 2010). The main barriers to ICT integration are lack of access to resources such as ICTs, lack of access to technical support and insufficient time (Nkula & Krauss, 2014; Presidential National Commission on Information Society & Development, 2007). Other barriers include insufficient or no teacher training and no

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professional development in terms of ICT (Nkula & Krauss, 2014; Presidential National Commission on Information Society & Development, 2007). It is also noted that teacher attitudes and beliefs further pose difficulties to the integration of ICTs (Nkula & Krauss, 2014).

In resource deprived environments schools do not have access to traditional educational materials, as they cannot afford it (Briggs, 2014). It is in these environments that mobile devices have stepped up to help bridge the gap. Many government initiatives in South Africa aim to improve learner performance by providing disadvantaged schools in rural areas with modern technology. By investing continuously in ICT in education, the government strives to ensure that South Africa is on par with global standards in terms of education. The government's investment in ICT in education will continue to ensure South Africa meets global standards in terms of education (All Africa, 2014b).

The ICT4RED project, which is led by The CSIR, is the ICT aspect of the bigger Technology for Rural Education Development (TECH4RED) research project which aims to contribute precisely to these resource deprived environments of the rural communities in order to improve people's lives through technology-led innovation (All Africa, 2014a; Nkula & Krauss, 2014).

In an attempt to further define a resource deprived environment, the scene of the schools selected for the ICT4RED project will be described in more detail. The schools are situated between Cofimvaba and Qamata, two small towns in the Eastern Cape. Most of the schools are approximately 79 kilometres from Queenstown (Herselman & Botha, 2014). Xhosa is the primary language spoken in the district, even though school exams are written in English (Herselman & Botha, 2014). The Nciba School District (*cf* figure 20) has a population estimated at 35 500 people (Stats South Africa, 2011).

Figure 20: THE NCIBA SCHOOL DISTRICT IN THE EASTERN CAPE
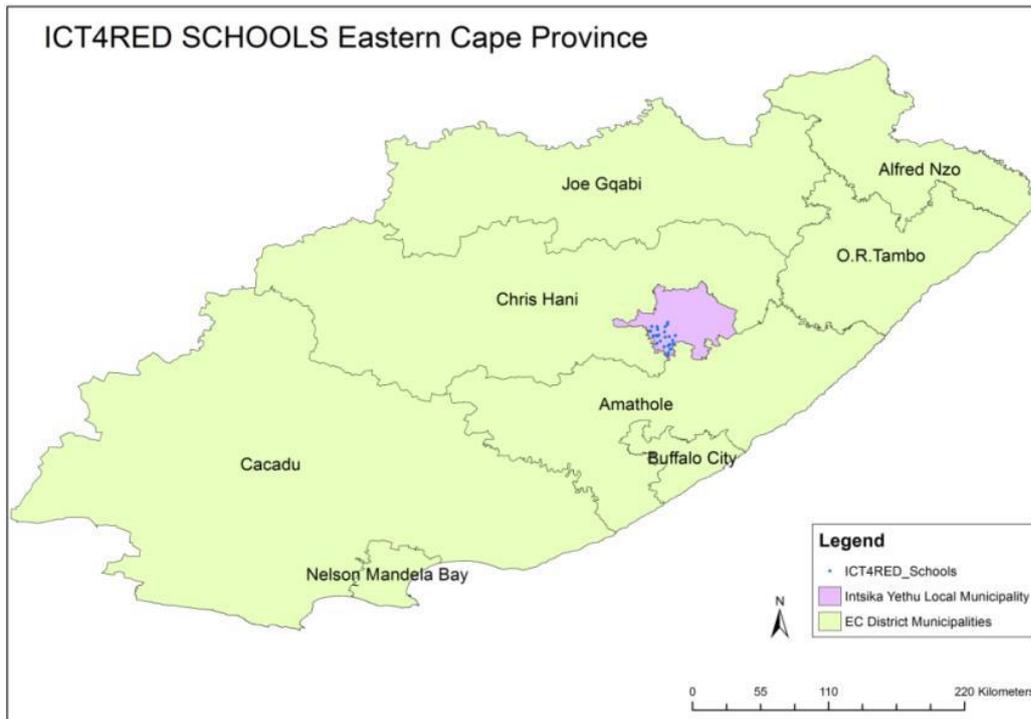
Source: Herselman and Botha (2014)

Figure 21: THE ICT4RED SCHOOLS BETWEEN COFIMVABA AND QAMATA
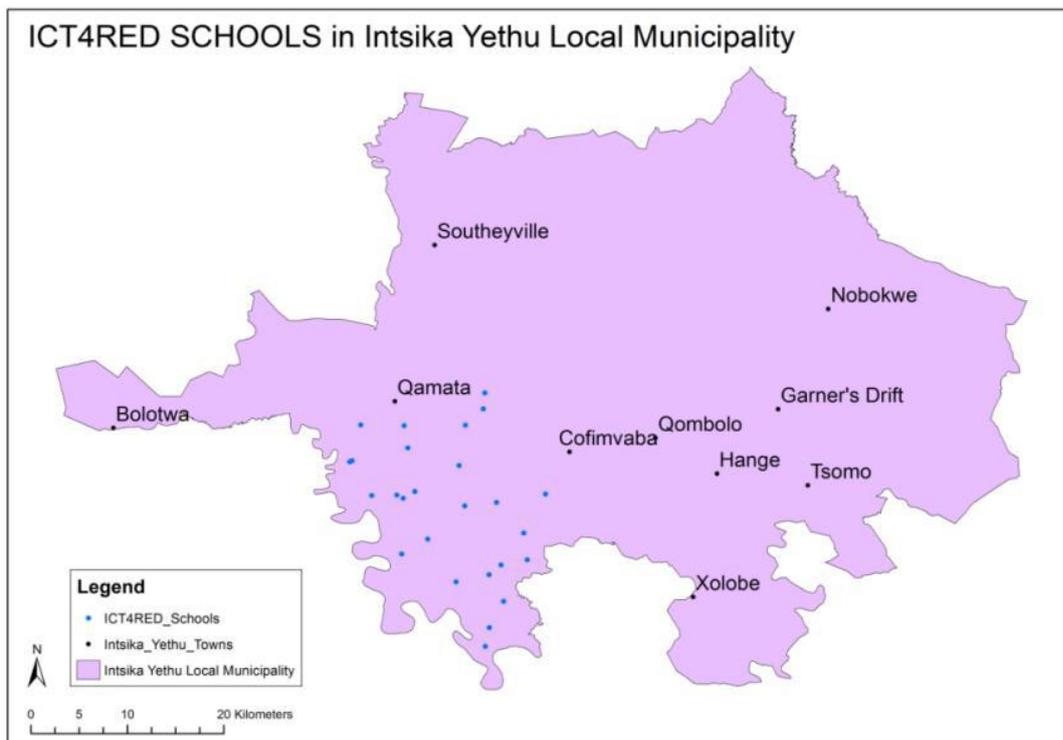
Source: Herselman and Botha (2014)
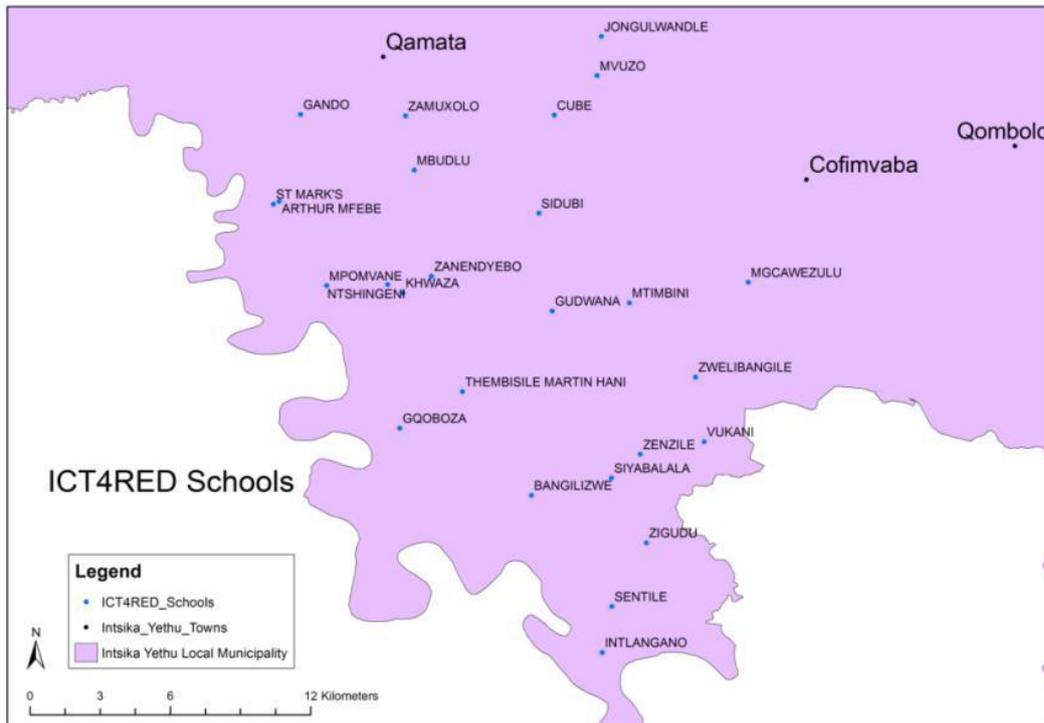
Source: Herselman and Botha (2014)

The small villages, which make up this municipality, are spread over the area and can be accessed by gravel roads. Some schools are almost impossible to reach in the rainy season due to the poor infrastructure of these gravel roads (Herselman & Botha, 2014; Legotlo, 2014). The poor road infrastructure contributes to wear and tear on vehicles and therefor teachers, who have vehicles, share transport. This approach also saves on petrol expenses. Social challenges prevalent in this area include poverty, unemployment and drug abuse (Herselman & Botha, 2014; Legotlo, 2014).

The Eastern Cape Education Department has faced educational legacy and infrastructure challenges unfailingly over the past years. A survey done in 2011/2012 (CSIR, 2012) established that the 26 schools which form part of the district included more or less 16 district officials, 350 teachers and 6 500 learners. This contributed to a 30:1 learner teacher ratio. The 26 schools were made up of 1 junior primary school, 6 senior primary schools, 16 junior secondary schools and 3 senior secondary schools (*cf* figure 22). The survey (CSIR, 2012) also established that 40% of all schools in the Nciba school district had no, or at best erratic, access to electricity and 66% of the schools had either no, or erratic, access to water. Sanitation is another continuing challenge which this district faces. Communication infrastructure, such as

Internet, did not exist. The challenges identified in the survey suggests that this area could be categorised as *resource deprived* (Herselman & Botha, 2014).

Therefore, from the previous discussions, the conclusion drawn is that the factors which contribute to the classification of a resource deprived environment include challenges which relate to:

- Physical infrastructure
- Road infrastructure
- Technology infrastructure
- Electricity
- Sanitation
- Water supply
- Educational resources
- Qualified teachers
- Learner and teacher ratio

Figures 23, 24 and 25 are photos sourced from the ICT4RED project book (Herselman & Botha, 2014).

Figure 23: A HUT IN THE EASTERN CAPE

Source: Herselman and Botha (2014)

Figure 24: TEACHER AND LEARNERS WORKING ON THEIR TABLETS

Source: Herselman and Botha (2014)

Figure 25: PRIMARY SCHOOL LEARNERS WORKING ON THEIR TABLETS

Source: Herselman and Botha (2014)

3.8 SUMMARY

This chapter embarked with a discussion regarding learning theories in section 3.2. The purpose was to show *how* education has moved from a behaviourist to a cognitive approach and finally (and currently) a constructivist approach which is concerned with learning through experience. This section then moved on to demonstrate how the constructivist approach is supported by ICT in education, with an explanation of technology-facilitated learning in section 3.3. The

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discussion then progressed to focus on mobile learning in section 3.4 as an example of technology facilitated learning which is relevant and applicable to existing education. Some examples of international and national mobile learning initiatives were also provided. Section 3.5 discussed the importance of 21st century skills. The current education system in South Africa was then probed to supply the broader context and background of this study in section 3.6. A resource deprived environment was discussed in section 3.7 to further enlighten the reader as to the context of the research.

To summarise both literature review chapters, figure 26, visually presents all concepts discussed in Chapters 2 and 3.

Figure 26: THE LITERATURE FIGURE
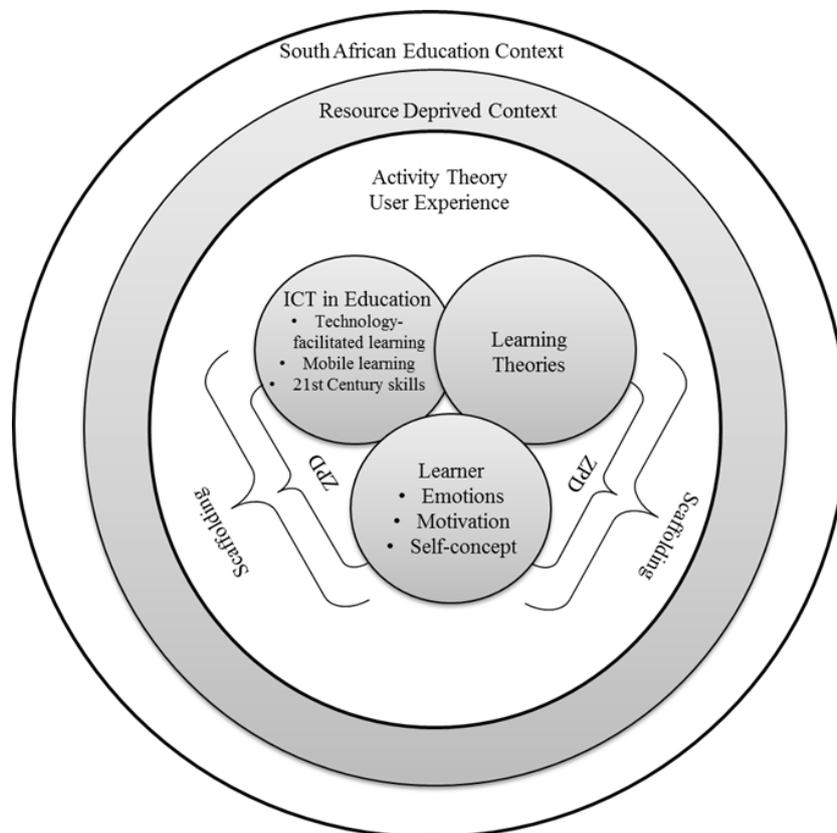
Figure 26 illustrates the way in which learners interact with the technology in a classroom where education is based on a particular learning theory embraced by the teacher. The learner contains a set of specific emotions, motivations and self-concepts. With mobile learning as an example of technology-facilitated learning, certain 21st century skills are developed. The Zone of Proximal Development is achieved by scaffolding, provided by either the technology or the

teacher. The interaction between the learner and technology is grounded in the theoretical frameworks of Activity Theory and User Experience. It takes place in a resource deprived context, and the broader context includes the South African education system.

CHAPTER 4 – RESEARCH METHODOLOGY
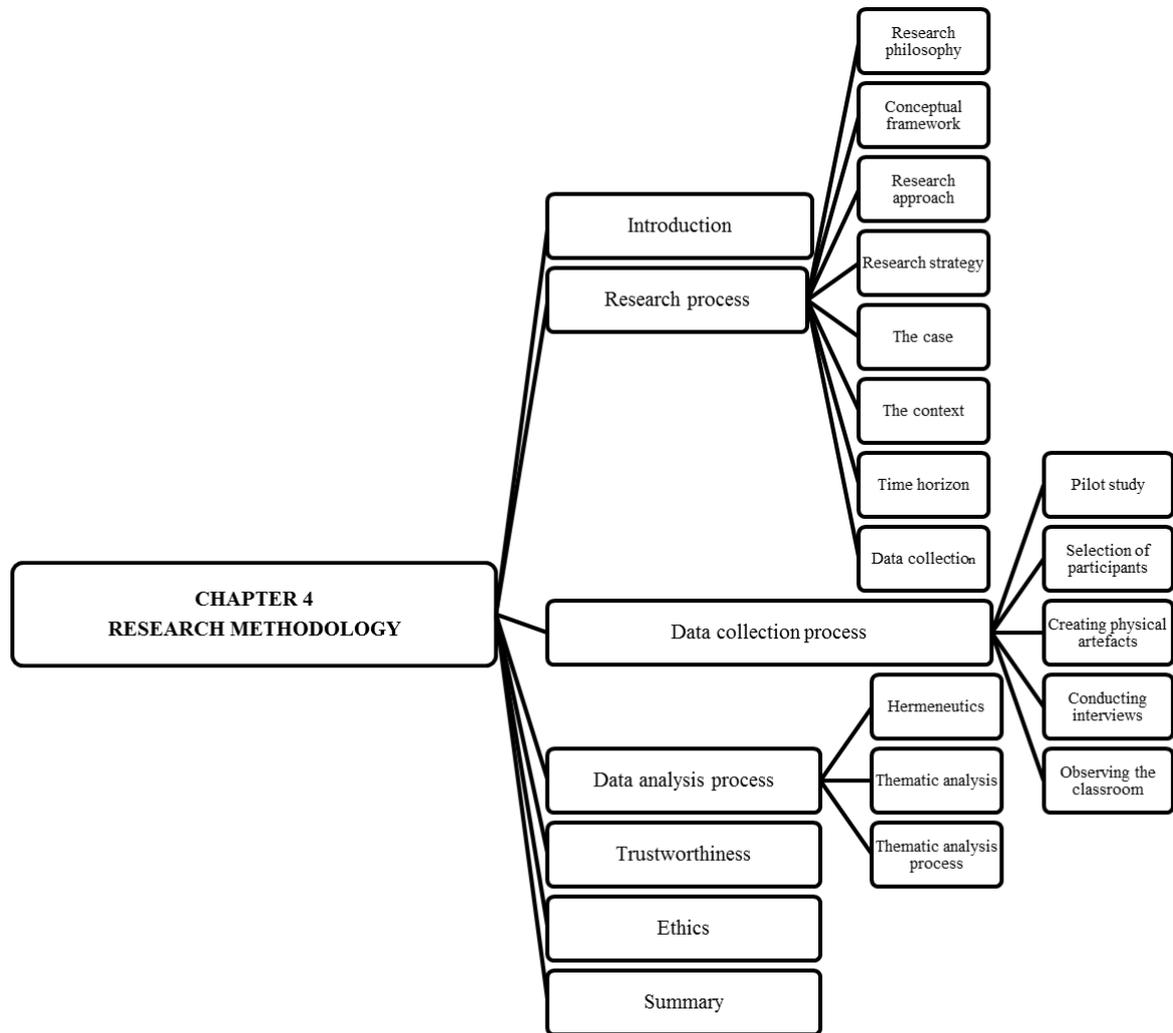
A schematic representation of Chapter 4

4.1   INTRODUCTION

The research methodology explains the theory of *how* the research study is carried out. It includes the theoretical and philosophical assumptions on which the research study is based and the methods adopted in the study (Saunders et al., 2012). The research methodology describes the process in which the research study will be undertaken.

As the methodology explains how the research will be carried out, it is necessary to once again state the research questions that need to be addressed as well as the purpose of the study.

The primary research question investigates how learners' experiences are influenced by the use of technology-facilitated learning, more specifically the use of tablets in education. In order to unpack the primary research question, it is essential to answer questions regarding the emotions

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which learners experience when using tablets in education, their attitudes towards the use of technology in learning and the influence technology has on learners' motivation to learn. The secondary research question centres on the interaction among the learner, tablet and teacher in the classroom when learning is facilitated by technology.

The purpose of these questions is to describe specific uses and applications of tablets in rural schools, to understand how tablets are incorporated in the teaching and learning process and to identify the emotions, attitudes and motivation which arise when learning is mediated by technology, such as tablets. Another objective is to demonstrate how to incorporate Activity Theory and User Experiences as a conceptual framework for technology-facilitated learning.

In the previous chapter a review of the literature was presented. In this chapter the research methodology for this study is explained. A theoretical discussion on the research process onion (Saunders, Lewis, & Thornhill, 2003) is presented in section 4.2. This consists of the research philosophy, the research approach, the research strategy, the time horizon and the data collection methods. Each layer of the research process onion is then used to discuss the research methodology which was applied in this study. The conceptual framework is discussed as part of the philosophy in section 4.2.2. In section 4.3 the process followed in data collection is discussed. A description of the analysis of the data (section 4.4) is followed by the discussion of trustworthiness in the study (section 4.5). The ethical manner in which the research was conducted is presented in section 4.6. Finally, a summary highlighting the fundamentals of the research methodology adopted in the study is presented in section 4.7.

Overall, three main processes are discussed in this chapter, as presented in figure 27. These processes commence with the research process, then move toward the data collection process and finally end off with the data analysis process. Each process has a deliverable to be achieved. The deliverable of the research process involves the plan for data collection. The data collection process deliverable involves obtaining the data results and the deliverable of the data analysis process involves the interpreted results presented in themes (*cf* figure 27).
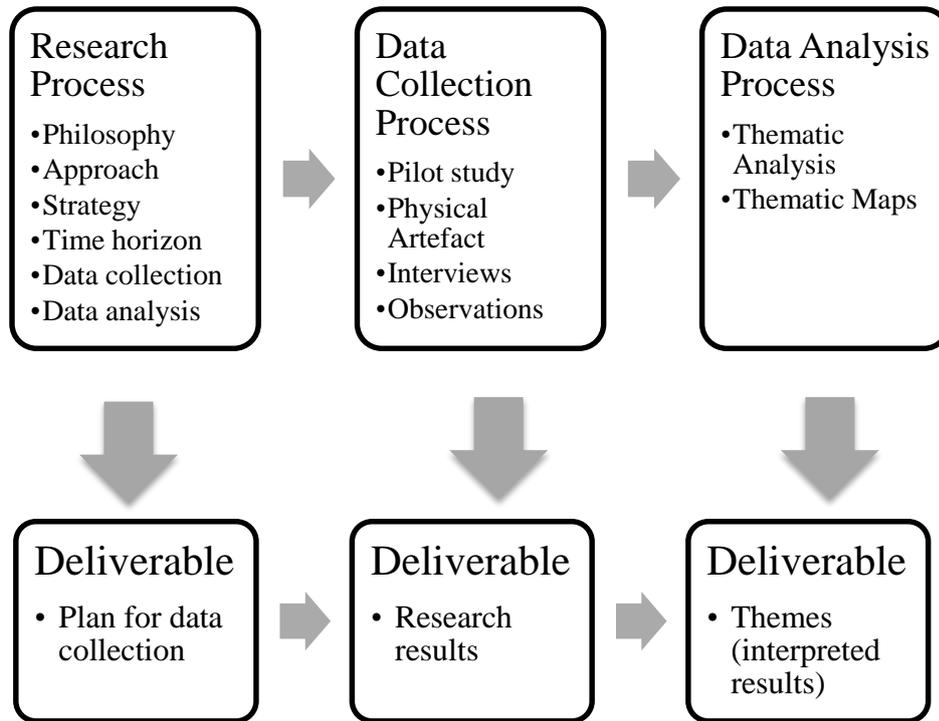
4.2   RESEARCH PROCESS

The research process addresses the first part of figure 28:

Figure 28: RESEARCH METHODOLOGY – RESEARCH PROCESS

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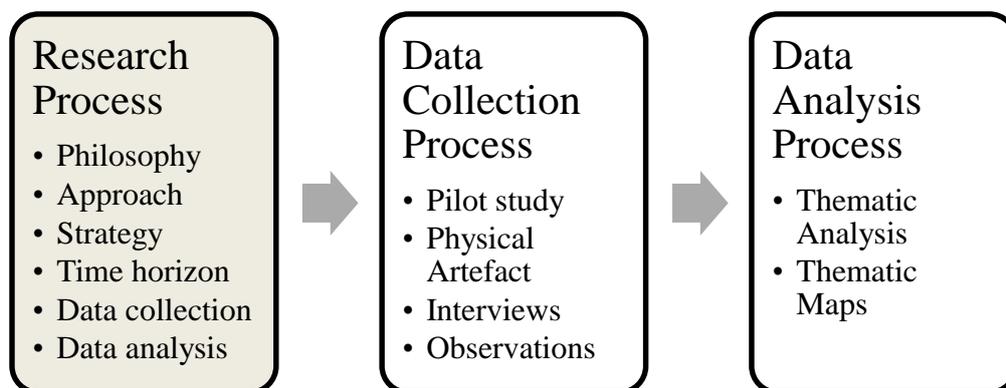
The research process is explained in terms of the 'research onion' (Saunders et al., 2003) which describes the process in terms of the different layers of the onion being peeled off. As seen in figure 29, the different layers consist of philosophy, approach, strategy, time horizon, data collection methods and data analysis.

Figure 29: THE RESEARCH ONION
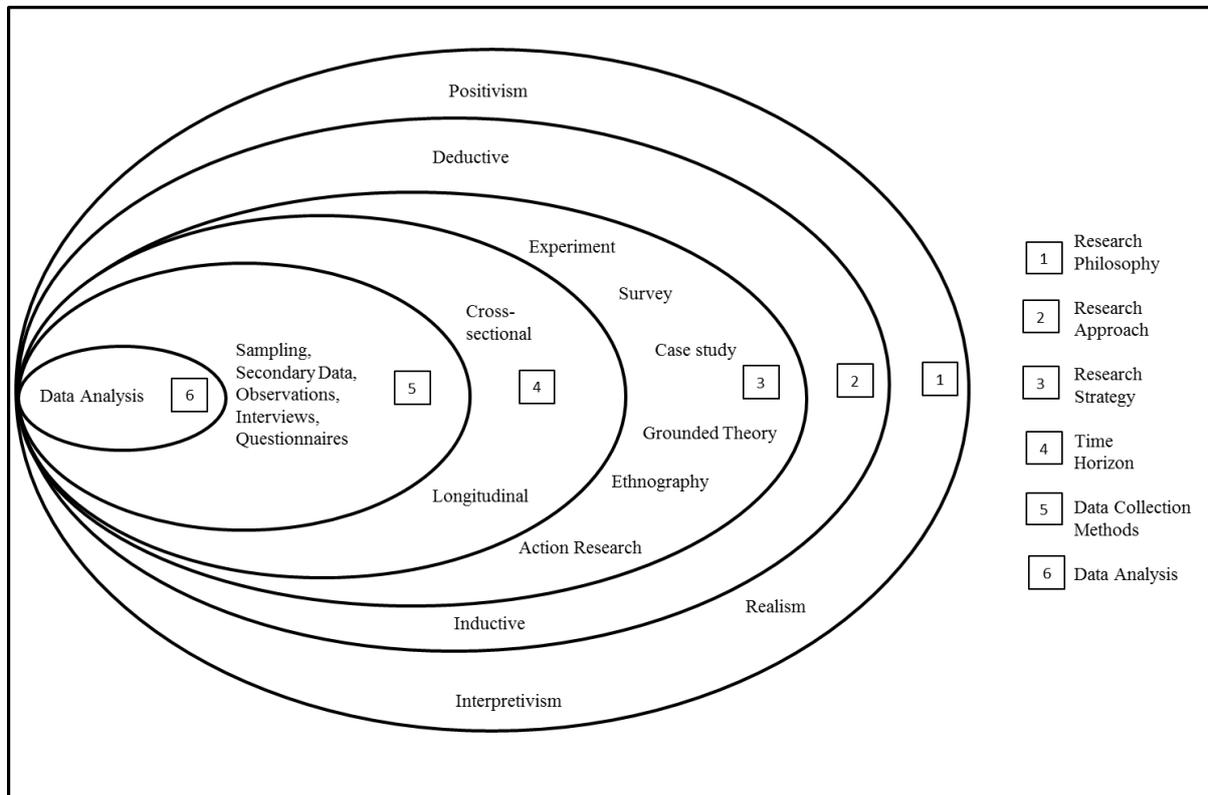
Adapted from Saunders et al. (2012)

The 'research onion' guides the research process by starting from the outer layer of the philosophy and systematically working towards the inner layer of the core of the onion, the data analysis. Each of these layers is discussed in the following sections (4.2.1 to 4.2.6).

4.2.1   RESEARCH PHILOSOPHY

Research philosophy communicates the development of knowledge and the environment of that knowledge (Saunders et al., 2012). A philosophical assumption is a paradigm and it represents a worldview of the nature of the world (Guba & Lincoln, 1994). Creswell (2009) defines worldview as the way in which a researcher orientates himself/herself in the world, including the nature of research which the researcher embraces.

Different philosophical paradigms exist but the most prominent philosophies, as illustrated in the outer first layer of the research onion, are positivism, realism and interpretivism (Saunders et al., 2003).

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- *Positivism* as a philosophy emphasises "highly structured methodology to facilitate replication and the end product can be law-like generalisations similar to those produced by the physical and natural scientists" (Saunders et al., 2012, p. 678). Positivism is linked to quantitative methods with a deductive approach (Creswell, 2009; Knox, 2004). This worldview is a scientific method with major elements being determination, reductionism, measurement and theory verification (Creswell, 2009). Positivism therefore does not suit this study as this study uses qualitative methods with an inductive approach, (*cf* section 4.2.3).

- *Realism* as a philosophy also relates to scientific enquiry. "The essence of realism is that what we sense as reality: that objects have an existence independent of the human mind" (Saunders et al., 2012, p. 136). This worldview focuses on real-world practice, is problem-centred and pluralistic and therefore applicable to mixed methods research (Creswell, 2009). This philosophy contradicts this study as this study is of the view that the objects do not exist independently from the human, but rather that objects have a direct influence on humans (Creswell, 2009).

- *Interpretivism* as philosophy is of the view that "access to reality (given socially or constructed) is only through social constructions such as language, consciousness and shared meanings (Nieuwenhuis, 2012a, p. 59). Interpretivism is linked to qualitative methods with an inductive approach to generate theory (Creswell, 2009; Knox, 2004), as the researcher looks for complexity in the meanings and views, rather than narrowing those into smaller quantities of ideas. Therefore, interpretivism is well-suited to this study.

For this study the researcher thus embraced the interpretive philosophy. An interpretivist perspective is based on the following assumptions:

- The learners can only be understood in terms of that which they communicate about themselves and the focus is on their subjective experience of technology-facilitated learning (Klein & Myers, 1999; Nieuwenhuis, 2012b).

- Placing the learners in their social contexts creates an opportunity to understand the perceptions they have of their own activities. This helps towards understanding how the learners interpret and interact with their social environments (Creswell, 2009; Klein & Myers, 1999; Nieuwenhuis, 2012b).

- Human behaviour is affected by knowledge of the social world, thus proposing that different learners experience the phenomena of technology-facilitated learning differently (Creswell, 2009; Nieuwenhuis, 2012b).

- The social world does not exist independently of human knowledge. Learners' knowledge and understanding are restricted to things they have been exposed to, their own unique experiences and the meanings they have conveyed (Creswell, 2009; Klein & Myers, 1999; Nieuwenhuis, 2012b).

It was the researchers' intention to adopt an empathetic stance (Saunders et al., 2012) to explore, understand and describe the experience of the leaners from their own point of view. The researcher relies upon the participants' views of technology facilitated learning (Creswell, 2009).

4.2.2 CONCEPTUAL FRAMEWORK

As discussed in the previous chapter (*cf* section 2.2.1 and 2.2.2), the theoretical frameworks on which this study's conceptual framework is based include the Activity Theory and User Experience. The applied theory involves composing the two separate frameworks as one framework (*cf* figure 30).

A conceptual framework is based on the collaboration of different theories to propose a suitable framework for the purpose of the study. Miles and Huberman in Athanasou, Mpofu, Gitchel, and Elias (2012) describe the conceptual framework as the researcher's map of the terrain being explored.

The conceptual framework will be built around three disciplines including: Education, Human-Computer Interaction and Psychology whilst using User Experience (UX) and Activity Theory (AT) as theoretical frameworks to develop a conceptual framework. User Experience (UX) and Activity Theory (AT) compliment and inform one another for the purpose of this study. Applying them collectively as a framework, in order to extract the experiences of the learners, will paint a 'rich picture' for interpretation.

This combined figure (*cf* figure 30) illustrates how the researcher will attempt to understand how the use of tablets in teaching and learning influences the learners' user experience in terms of motivation, emotions and attitudes.

Figure 30: CONCEPTUAL FRAMEWORK
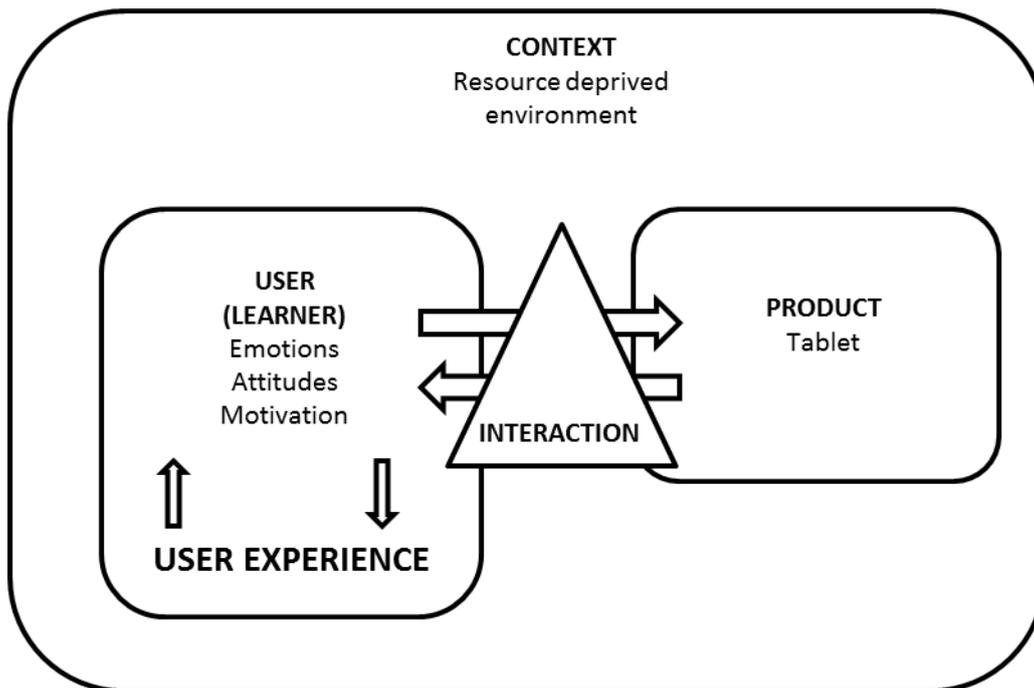
Adapted from Engeström (1987) and Roto (2006)

In the conceptual framework the Activity Theory fits into User Experience, as depicted in the figure 30. The Activity Theory is positioned in between the user and the product in an effort to understand the interaction between the learner (user) and the tablet (product). The learners' emotions, attitudes and motivation are influenced by the interaction with the tablet and the interaction with the tablet is also influenced by the learners' emotions, attitudes and motivation. This process in return produces some sort of user experience for the learner. This experience occurs within a specific context, a rural school in the Eastern Cape.

The conceptual framework will assist in answering the research questions. The Activity Theory will focus solely on describing the interaction among the learner, teacher and tablet. User Experience will focus on how the learner experiences the tablet and which emotions, attitudes and motivation play a role when learning is facilitated by technology. The conceptual framework will be applied in Chapter 7, after the results have been interpreted in Chapter 6.

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Making reference to the secondary research questions, and which theory will be applied to answer the secondary research questions:

1. How does interaction occur among the tablet, the learner and the teacher in the classroom? Activity Theory (AT) will be applied to address this research question, *cf* section 7.2.
2. Which emotions do learners experience when learning is facilitated by technology? User Experience (UX) will be applied to address this research question, *cf* section 7.3.
3. What are learners' attitudes towards the use of tablets in school? User Experience (UX) will be applied to address this research question, *cf* section 7.4.
4. What influence does motivation have when learning is facilitated by tablets? User Experience (UX) will be applied to address this research question, *cf* section 7.5.

The combined conceptual framework (Activity Theory and User Experience) will then finally assist in addressing the primary research question towards understanding how learners experience technology-facilitated learning, *cf* section 7.6. This conceptual framework demonstrates how Activity Theory (AT) and User Experience (UX) can be incorporated into a framework to explain technology-facilitated learning.

4.2.3   RESEARCH APPROACH

The research approach portrays the reasoning the researcher adopts (Saunders et al., 2012). The reasoning a researcher adopts, which defines the approach of the research, can either be *inductive* or *deductive*. The interpretivist philosophy implies that the research approach will be inductive.

- *Inductive reasoning* occurs when a "hypothesis is developed from separate and individual facts observed by the researcher which leads to a single conclusion, and when generalisations can be made from data taken from a sample to describe the characteristics of a larger population" (Leedy & Ormrod, 2005, p. 33). Inductive reasoning involves the researcher collecting data from which a theory is then developed as a result of the data analysis (Knox, 2004). Thus, theory follows the data to develop a richer theoretical perspective (Saunders et al., 2012). Induction is the process of developing a general principle on the basis of many observations gathered from experience (Thomas, 2010). Consequently, inductive reasoning goes hand in hand with qualitative studies (Creswell, 2009).
- *Deductive reasoning* occurs when a "hypothesis is developed from a theory which enables the researcher to make predictions about patterns they are likely to see in the

data if the hypothesis is true" (Leedy & Ormrod, 2005, p. 33). Deductive reasoning involves the researcher developing a theory and hypothesis and then designing a research strategy to test the hypothesis (Knox, 2004). Consequently, deductive reasoning goes hand in hand with quantitative studies (Creswell, 2009).

The main difference between inductive and deductive reasoning is the move from *reason* towards *research* (Saunders et al., 2012, p. 144). The differences between an inductive and a deductive approach are illustrated in table 13 (Leedy & Ormrod, 2005):

Table 13: INDUCTIVE REASONING VS DEDUCTIVE REASONING

Inductive reasoning	Deductive reasoning
Known premises are used to generate untested conclusions	When premises are true, the conclusion must also be true
Generalise from specific to general	Generalising from general to specific
Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data collection is used to evaluate propositions or hypotheses related to an existing theory
Theory generation and building	Theory falsification and verification

Adapted from Leedy and Ormrod (2005)

As the research approach portrays the reasoning the researcher adopts (Saunders et al., 2012), this research was conducted from an inductive reasoning perspective. As seen in the previous table (*cf* table 13), data was collected to explore technology-facilitated learning, themes were identified and then a theory was developed, in the form of a conceptual framework, as a result of data analysis (Saunders et al., 2012). Thus this study was data driven (Saunders et al., 2012) with a bottom up approach (Creswell, 2009) making meaning of the complexity of the participants' views for theory generation and building. An inductive approach is also linked to the philosophy of interpretivism (Creswell, 2009; Knox, 2004).

4.2.4 RESEARCH STRATEGY

The research strategy can be defined as a plan of how the researcher will go about answering the research questions (Saunders et al., 2012). As illustrated in the third layer of the research

onion (Saunders et al., 2003), popular research strategies include experimentation, survey, case study, grounded theory, ethnography and action research. These strategies will be discussed concisely in this section.

− *Experimental research* aims to determine the cause-and-effect relationship between variables by controlling and manipulating one or more variables (Seabi, 2012). An experiment studies the possibility of a change in an *independent* variable causing a change in the *dependent* variable (Saunders et al., 2012). An experiment is not focussed on research questions instead it makes use of predictions, called hypotheses. Therefor experimental research searches for links between variables (Saunders et al., 2012). An experiment strives to define whether a particular treatment has an effect on the outcome (Creswell, 2009). Experimental research is consequently not suited for this study as it focuses on quantitative studies making use of hypotheses.

− *Survey data* from a large population is concluded from the responses taken from a smaller sample. It can be used to describe characteristics, opinions, attitudes, beliefs and experiences (Creswell, 2009; Leedy & Ormrod, 2005; Seabi, 2012). A survey aims to generalise, from a sample to a population (Creswell, 2009). Survey research is generally linked to a deductive research approach. Often used to answer 'what', 'who', 'where', 'how many' and 'how much' questions (Saunders et al., 2012). Survey research is also referred to as descriptive quantitative research, in which people are asked questions and the answers are then tabulated (Leedy & Ormrod, 2005). Surveys can be done face-to-face, over the telephone or with questionnaires. Survey is not fit for this study as the researcher would not be able to answer the research questions based on data collected from a survey as it would not allow the opportunity to probe based on the answer of the participants.

− *Grounded theory* is an inductive approach used to generate theories from the data (Creswell, 2009; Seabi, 2012). The process of grounded theory implies constantly comparing the theory to the collected data (Creswell, 2009; Seabi, 2012). This theory has procedures to analyse data in order to build a theoretical model from the data (Creswell, 2009; Leedy & Ormrod, 2005). The focus is on a "process related to a particular topic, with the ultimate goal of developing a theory about that process" (Leedy & Ormrod, 2005, p.140). Thus, theory generation is the principal purpose of grounded theory. The purpose

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of this study is not to constantly compare the collected data to theory in order to build a theoretical model which implies that grounded theory is not suited for the purpose of this study.

- *Ethnography* aims to reach a holistic understanding of how members of a specific group, which share a common culture, make sense of their social reality (Creswell, 2007; Leedy & Ormrod, 2005; Seabi, 2012). Such a group is studied in their natural setting over a prolonged period of time (Creswell, 2007; Leedy & Ormrod, 2005). The researcher becomes part of the community by living with them, investigating and observing their everyday behaviour and making recordings (Leedy & Ormrod, 2005; Saunders et al., 2012; Seabi, 2012). For the purpose of this study the researcher does not intend to live within the community to investigate and observe their behaviour, neither does the time horizon fit the study.

- *Action research* aims to work with participants to create new knowledge which leads to change. The intention of action research is to develop solutions for practical problems (Seabi, 2012). Action research is an iterative and cyclical process comprising of five phases namely: reflect, research, plan, act and practice (Ebersohn, Eloff, & Ferreira, 2012). Each problem solving strategy should go through these phases. The researcher collaborates with the participants and they are converted into co-researchers (Seabi, 2012). The results which derive from action research should inform other contexts (Saunders et al., 2012). The aim of this study is not to develop solutions for problems, it is to understand the experience of the learners, hence action research is not suited for this study.

- *Case study* affords the opportunity to study an individual, event or program in detail for a distinct period of time (Creswell, 2009; Leedy & Ormrod, 2005). "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident" (Yin, 2003, p. 13). Case study is valuable tool to investigate a situation which is poorly understood or to investigate changes in individuals or programs over time (Leedy & Ormrod, 2005). It is relevant when the researcher is interested in the real-life context of the research (Saunders et al., 2012). The focus can be on a single case or on multiple cases, depending on the aim of the research (Leedy & Ormrod, 2005; Saunders et al., 2012; Yin,

2003). Case studies are often directed at refining action and making improved decisions (Scholz & Tietje, 2002). A case is unique and more concerned with the particular than the general (Rule & John, 2011; Scholz & Tietje, 2002; Thomas, 2010). It is necessary to look at the case as a unit form various different angles (Thomas, 2010).

Case study is the strategy adopted in this research study as it provides the researcher with a logical plan to get from the questions to the answers (Yin, 2003). Case study research is a qualitative method in which the researcher investigates a bounded system (a case) within its real-life context by means of thorough data collection with several sources of information (Creswell, Hanson, Plano, & Morales, 2007; Yin, 2003). It is a research tool which assists in explaining, describing or exploring a phenomenon (Yin, 2003). Case study allows investigators to retain holistic and meaningful characteristics and events of real-life situations (Yin, 2003). In case studies the researcher is motivated intrinsically to investigate and explore a certain case for non-scientific explanations (Scholz & Tietje, 2002). It is a idiographic study as the concepts are based on and rooted in a particular, unique and individual picture from the researcher's perspective (Thomas, 2010).

Table 14 represents a summary of the characteristics of this study based on the preceding discussion.

Table 14: CASE STUDY CHARACTERISTICS

Case study characteristics:
Qualitative method
Investigates a bounded system
Within real-life context
Collects data from several sources
Research tool to explain, describe and explore
Researcher motivated intrinsically to investigate and explore
Idiographic study
Interpretive perspective

From an interpretivist perspective the researcher strives towards a comprehensive and holistic understanding of *how* learners and teachers relate to and interact with each other in a specific situation and how they make meaning of technology-facilitated learning (Nieuwenhuis, 2012c). The learners and their interaction with the tablet will be studied in-depth for a defined period of time (Leedy & Ormrod, 2005). The research topic or phenomenon will be explored within its context (Saunders et al., 2012) and a full contextual understanding of the case will be built (Creswell et al., 2007). A case study is the relevant design for this study as the researcher wishes to gain a rich understanding (Eisenhardt & Graebner in Saunders et al., 2012) of the different emotions, attitudes and motivation embedded in the learners' experience.

The aim of the researcher is to answer the question of how learners experience technology-facilitated learning (Yin, 2003). Nieuwenhuis (2012b) and Leedy and Ormrod (2005) agree with Yin (2003) that case study is suitable to generate and explore answers to the "how" and "why" questions. Details regarding the physical environment and the historical, economic and social influences at the rural school will be obtained through observations and interviews. Recording these details, which will set the scene, will afford others insight into the situation (Leedy & Ormrod, 2005). Creswell et al., (2007) concur by stating that the investigative style of a case study involves a full description of the case and the setting of the case within related circumstances. The identification of the context will assist those who read the case study to make conclusions about the degree to which the discoveries may be generalised and applied to other situations (Leedy & Ormrod, 2005). The contextual conditions will be deliberately covered as they will be highly pertinent in this study (Yin in Creswell et al., 2007).

The researcher will offer a multi-perspective analysis by not only considering the voice and perspectives of the learners (Creswell et al., 2007), but also by interviewing the teachers to obtain their views and perspectives. The individual activities (physical artefacts) the learners will complete will be taken to an expert reviewer (educational psychologist) for interpretation and to acquire their insight.

4.2.4.1 THE CASE
Case study involves the researcher's train of reasoning about the interrelationships amongst the learner, the tablet and the teacher (Thomas, 2010).
The unit of analysis (case) is defined by Miles and Huberman in Baxter and Jack (2008) as a phenomenon which occurs within a limited context. There is obscurity in the meaning of unit

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of analysis and the case itself (Grünbaum, 2007). Patton (2002), Vaughan (1992), Miles and Huberman (1994), Stake (1995) and Yin (2003) agree that the unit of analysis is equivalent to the case itself (Grünbaum, 2007). To determine the unit of analysis the researcher will agree that at the end of the study, she wants to be able to say something about the experience of learners regarding the interaction with tablets in a resource deprived context, taking into consideration their emotions, attitudes and motivations and understanding how the tablets support learning and how the interaction takes place (Patton in Grünbaum, 2007). In other words, the units that will be analysed are the learners and within those units the focus is on their emotions, attitudes, motivation and interaction.

According to Yin (2003) there are four types of case studies namely holistic single case, embedded single case, holistic multiple case and embedded multiple case. A holistic case has a single unit of analysis whereas an embedded case has multiple units of analysis (Yin, 2003). A holistic case study is formed by a comprehensive qualitative approach that depends on phenomenological and narrative portrayals (Scholz & Tietje, 2002). Themes and hypotheses are important, however lesser so than the understanding of the case. In embedded case studies the initial and completion points are the understanding of the case as a whole in its real-life context (Scholz & Tietje, 2002).

A single case study with embedded units of analysis was selected for this study. The embedded units refer to multiple units of analysis, in this case the units of analysis are the learners. When analysing these units (learners) it is necessary to investigate their experience of learning with the tablet focusing on their emotions, attitudes, motivation and interaction. Figure 31 illustrates a single case study with embedded units of analysis.

Figure 31: A SINGLE CASE STUDY WITH EMBEDDED UNITS OF ANALYSIS
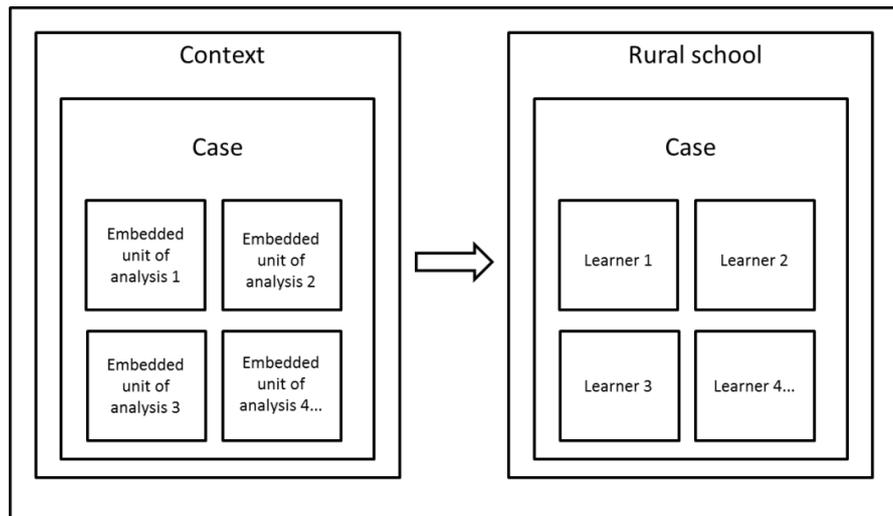
Adapted from Yin (2003)

Figure 31 depicts a graphical representation of a single case study with embedded units of analysis on the left, which is applied to the specific case study on the right. A holistic single case study with embedded units (Yin, 2003) was conducted at the rural school in the Eastern Cape in February 2014. The school was provided with electronic textbooks in June 2012 and other educational content. This school served as the blueprint for replication in other schools in the Eastern Cape. As the researcher was looking at the learners in one environment because it is a unique situation and taking the context into consideration, a single holistic case study was relevant (Yin, 2003). The embedded units look at the same issue, but how the learners experience it differently. This allowed the researcher to understand one unique case.

Criticism exists against dependence on a single case as it is incapable of providing a generalised conclusion (Nieuwenhuis, 2012c), but this is not the intent of the researcher as she is concerned with the idiographic nature of this particular situation (Nieuwenhuis, 2012b) and is aiming at gaining greater insights and understanding of the dynamics of the user experience of the tablet in the rural school. Besides the lack of generalisablity of results, the other limitation is that data collection and data analysis can be very time consuming. It takes time to collect qualitative case study data because data is collected from multiple sources of information. It is also time consuming to conduct in-depth interviews where, after the rich data has been collected, it then needs to be transcribed and analysed to identify themes and interpret underlying themes.

The strengths of case study, as a method, are high construct validity, in-depth insights and it provide the researcher an opportunity to establish a rapport with participants. Remedies to ensure construct validity (Yin in Tellis, 1997) include multiple sources of evidence which was guaranteed by making use of physical artefacts, interviews and observations. Evidence was established by making recordings and documenting transcriptions.

4.2.4.2   THE CONTEXT

The geographic area of a case study should be set (Yin, 2003). Context refers to a specific set of circumstances and conditions surrounding an event or situation (Rule & John, 2011). The discussion regarding the context of the case will be two-fold. Firstly the context regarding the bigger project, of which the study forms part, will be deliberated. Secondly the contextual circumstances of the rural school will be discussed.

The overarching aim of The ICT4RED project to contribute to the improvement of rural education through technology-led innovation (Herselman & Botha, 2014). More specifically this project aims at investigating the viability of providing electronic textbooks and other educational digital content resources to 26 schools in the Eastern Cape. The purpose is to enable recommendations and models towards scaling the project to other areas in the Eastern Cape. The scope of the project involves providing tablets to teachers, learners and district officials with the aim of testing various models in terms of the device, content, infrastructure, connectivity, integration into the school, costs, sustainability, logistics, support and maintenance, operations, change management and teacher training in order to improve learner educational performance in the circuit. This is done in parallel with existing paper-based textbooks. The approach is based on working with the teachers, learners and officials. The principles are based on open standards, minimum school disruption, sustainability, inclusivity, transparency and practicality. Principles are also based on developing local capacity and supporting local suppliers. At school level the project strives to realise 21st century schooling for improved educational outcomes. Access to ICTs is seen as a basic enabler to create the required pre-conditions for learning. Each school was supplied with Android tablets, safe storage and charging facilities, as well as local Wi-Fi network and local content server, projector and printer (Herselman & Botha, 2014).

The contextual circumstances of this study involve a rural school in a resource deprived area in the Eastern Cape. The purpose of this deliberation is to paint the setting of the school, based on the researcher's anecdotal observations. The school is an agricultural senior secondary

school, with Grade 10 to Grade 12 learners. Children were neatly dressed in school uniform, wearing them proudly. The school grounds were well maintained, although some windows were broken and some classroom doors did not close properly. The school library has been converted into a staff room for the teachers where they attend to administrative task and relax. There is a nutrition program at the school, and during break time learners line up for the one prepared meal they receive per day at the school. Learners participated in sport after school, although there are not any sports grounds. There was a church function at the school and due to the absence of a hall or large venue, all learners sat outside in the sun and some under the trees from 9:00 to 13:00. Evening classes are offered at the school, these classes are compulsory for the Grade 12 learners and optional for Grades 10 and 11. Arrangements were made with the Grade 12 learners who stay far from school to be accommodated closer to school so that everyone could attend the evening classes and benefit from them. It was evident that the school and staff place a high regard in the holistic development of the learners. In some instances it did seem as though the school was understaffed in terms of teachers. A few times classes and learners were left unattended, learners were playing on their tablets with no teacher in the classroom. Teachers share classrooms and learners move from classroom to classroom with their chairs, as there are not enough chairs. The bell is rung manually by a Grade 12 learner when instructed by a teacher to do so, which sometimes results in it not being very accurate. The intermittent chaos would seem normal for any school environment. Overall the learners are disciplined and well-mannered and the teachers are friendly and helpful. These contextual circumstances of this school correlate with the factors discussed in the resource deprived environment discussion (*cf* section 3.7).

4.2.5   TIME HORIZON

The time horizon communicates the time period related to the study (Saunders et al., 2012). The time period can be a specific point in time or it can stretch over a longer period of time. The fourth layer illustrates the two time horizons, namely cross-sectional and longitudinal (Saunders et al., 2003).

−   *Cross-sectional studies* refer to the study of a particular phenomenon at a specific time i.e. the 'snapshot' perspective. Cross-sectional studies are often used as many studies have time constraints. This time horizon is appropriate for surveys and case studies (Saunders et al., 2012).

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- *Longitudinal studies* refer to the study of a particular phenomenon over a lengthy period of time i.e. the 'diary' perspective. Longitudinal studies have the ability to study change and development as it occurs over an extended period of time, which is appropriate for ethnographic studies (Saunders et al., 2012).

Time boundaries should be set (Yin, 2003). The time period related to this study was cross-sectional in nature. It focussed on a 'snapshot' of the learners' experiences at that point in time. The aim was not to track the change in emotions, attitudes and motivation over time when using the tablets. The scope of the study was set in Chapter 1 (*cf* section 1.5.1).

4.2.6 DATA COLLECTION

Data collection describes the ways in which the research findings will be gathered. The fifth layer of the research onion indicates the five data collection methods: sampling, secondary data, observations, interviews, questionnaires, and audio and visual material (Saunders et al., 2003).

- *Sampling* is known as the process of selecting the specific entities for the study. In order to collect data, it is important to identify an appropriate sample from which to obtain data (Leedy & Ormrod, 2005). The goal of sampling is to purposefully select the individuals for the study (Creswell, 2009). Sampling serves the purpose of setting boundaries to qualitative research (Creswell, 2009). Miles and Huberman find it necessary to include the following four aspects when discussing the participants: "the setting (where the research will take place), the actors (who will be observed or interviewed), the events (what the actors will be observed or interviewed doing), and the process (the evolving nature of events undertaken by the actors within the setting)" (Creswell, 2009, p. 178). The individuals selected for this study and how they were chosen will be discussed in detail in section 3.3.2 of this chapter.

- *Secondary data* refers to data which has already been gathered for other purposes (Saunders et al., 2012). The idea is to take the previous data gathered and analyse it to derive additional knowledge, altered knowledge, diverse interpretations or further conclusions. The different types of secondary data include documentary secondary data, survey secondary data and multiple secondary data. This way of collecting data saves time, is less expensive and is an unobtrusive measure. Unfortunately, it could be that the data was originally collected with a specific purpose in mind which does not necessarily match your need (Saunders et al.,

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2012). This form of data collection is not suited to this study as the researcher wishes to gain the learners' first-hand experiences of technology facilitated learning.

– *Observations* are data collection methods that observe people's behaviour (Saunders et al., 2012). It is a systematic process through which the behaviour observed, is recorded. Observations provide an insider's perspective, allowing the researcher to see, hear and experience reality in the way that the participants do (Nieuwenhuis, 2012c). It is important to have a clear purpose and focus for the observation before gathering the data. It is also important to be open, honest and truthful in the role of observer (Nieuwenhuis, 2012c). The researcher's role ranges from being an active to a passive observer. Observations can be grouped into four groups: complete participant, observer as participant, participant as observer and complete observer (Creswell, 2009; Nieuwenhuis, 2012c; Saunders et al., 2012).

– *Interviews* are focused conversations between the researcher and participants, in which the researcher asks questions to the participants to gather information in order to see the world through their eyes. Interviews provide access to information which is not obtainable through other means of data collection (Nieuwenhuis, 2012c). Three types of interviews exist (Saunders et al., 2012). Interviews can be unstructured with no predetermined list of questions, semi-structured in which the interview starts with interview themes but the interviewer is prepared to vary from it, or structured with a set of questions in a predetermined way (Saunders et al., 2012).

– *Questionnaires* is a "general term used to include all methods of data collection in which each person is asked to respond to the same set of questions in a predetermined order" (Saunders et al., 2012, p. 416). The researcher constructs a set of questions which each participant has to answer, typically in a form that requires the participant to indicate the answer to close-ended questions (Nieuwenhuis, 2012c). Questionnaires make it possible to effectively reach large number of participants inexpensively (Nieuwenhuis, 2012c). The researcher does not intend to reach a large number of participants in order to answer the research question. This form of data collection also does not allow the opportunity for explanation based on the answers of participants in the way that interviews do, for instance.

– *Audio and visual material* is another way of collecting qualitative data. This can be done in the form of photographs, videotapes, art objects, film or computer software (Creswell, 2009). The form of data collection through art objects is also referred to as physical artefacts, image based methods or graphic elicitation (Bagnoli, 2009; Rule & John, 2011; Thomas, 2010; Vannini, Aguirre Sánchez, Rega, & Cantoni, 2013). The advantages of this data collection method is that it is unobtrusive, creative and it gives a researcher direct access to the participant's reality (Bagnoli, 2009; Creswell, 2009; Thomas, 2010).

Case study relies on multiple data sources (Creswell et al., 2007). Consequently, for the purpose of this study, the data collection instruments included physical artefacts, interviews and observations. These data collection instruments, and how each instrument was used, will be discussed in the following section.

4.3   DATA COLLECTION PROCESS

The data collection process addresses the second part of figure 32:

Figure 32: RESEARCH METHODOLOGY – DATA COLLECTION PROCESS
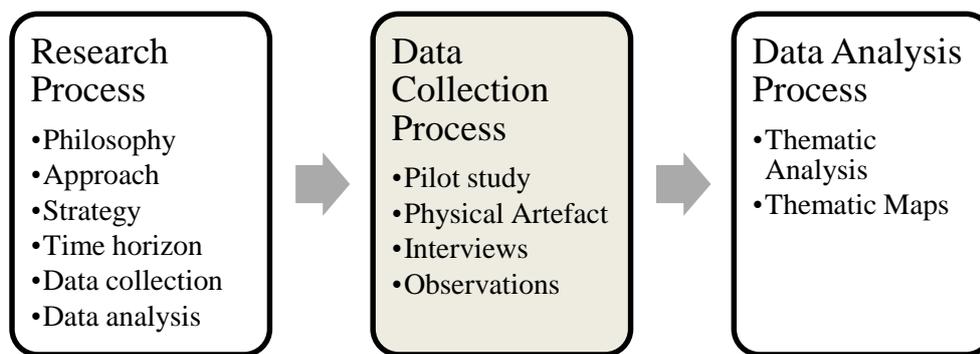
The data collection for this study commenced with a pilot study in order to finalise the data collection instruments. When the research instruments were refined and finalised, the actual data collection began. This process was initiated with an individual activity with the learners in which they made a physical artefact, this was followed with an individual interview with the learners. Individual interviews with teachers were also conducted where after classroom

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observations were made. This data collection process, along with the different activities, will all be discussed in detail in the following sections. Figure 33 depicts the data collection process as deliberated in the previous discussion.

Figure 33: THE DATA COLLECTION PROCESS
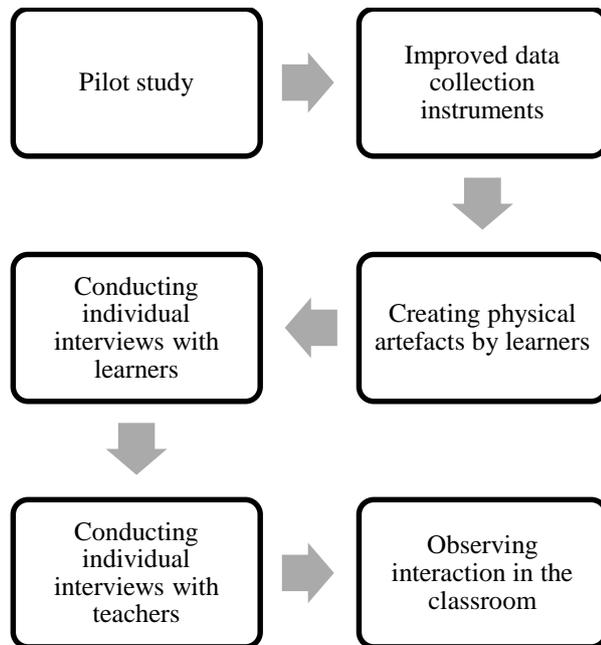
4.3.1 PILOT STUDY

Prior to data collection, the researcher conducted a pilot study at a school to determine whether data collection instruments needed improvement or adjustments before actual data collection commenced. The school which was selected for the pilot study had an established relationship with the university and the school was willing to assist. Furthermore, the researcher had visited the school on a previous occasion and it was conveniently close to where the researcher stayed. The school is a private high school where tablets form part of everyday teaching and learning. The participants of the pilot study included a learner and a teacher. Firstly, all the necessary consent was obtained from the principal, teacher, learner and parents of the learner (*cf* Appendix A). On the day of the pilot study the purpose of the activity was discussed and a rapport was established with both learner and teacher. The researcher explained the physical artefact to the learner and elaborated on what was expected from the learner. The learner was given the opportunity to ask questions to clear up any uncertainties. While the learner was busy creating the physical artefact, the researcher interviewed the teacher. During this interview the

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interview schedule designed for the actual data collection was followed. When the interview with the teacher was completed, the researcher interviewed the learner, also using the interview schedule designed for the actual data collection. Overall this was a productive exercise as the researcher could make the necessary changes to the interview schedule. In most cases it concerned rephrasing unclear questions. This exercise also assisted the researcher with practical matters, such as creating more space to write on the interview schedule while conducting the interviews. The importance of an audio recorder was also reaffirmed as one is unable to write down everything the participant says. The most beneficial outcome was realising how the learner interpreted the instructions provided by the researcher for the creation of the physical artefact. For this reason the researcher deemed it very necessary to provide clear and concrete guidelines to the learners. These were consequently printed and handed out to each learner. The results of the data collected during the pilot study was not used for interpretation as the context of the school, teacher and learner was completely different to that of the rural school where actual data was collected. The main purpose of the pilot study was to test the data collection instruments. This aim was achieved and the pilot study assisted the researcher in improving upon the data collection instruments. In conclusion, the researcher was able to make changes to the interview schedules with both learners and teachers. An important point that arose from the pilot study is that the researcher realised that it is vital to provide clear instructions to the learners towards the correct execution of the physical artefact. This led to the researcher developing specific guidelines which were handed out to the learners and discussed before they started with the activity. The pilot study also assisted in preparation for the actual data collection as it underlined the importance of a voice recorder as it is difficult to capture everything in writing during an interview. Overall, this was a valuable exercise as the researcher could process the data collected and improve upon the procedure to ensure the best possible outcome of the actual data collection.

4.3.2   SELECTION OF PARTICIPANTS

Participants are *selected* and because it is a choice, it does not represent the wider population and is therefore not a sample (Thomas, 2010). Participants were selected through purposive sampling and, in being intentionally non-random in the selection of data sources, the learners and teachers who could yield the most information about technology-facilitated learning were chosen (Creswell, 2009; Leedy & Ormrod, 2005). The sampling was done with a specific purpose in mind (Maree & Pietersen, 2012) and thus participants with explicit and distinctive attributes were selected making them the containers of the information required for this study

(Nieuwenhuis, 2012c). The participants were learners from a rural school who use tablets in learning, as well as the teachers who use tablets in teaching. These two groups were the sources of information which made it possible to answer the research questions (Nieuwenhuis, 2012c).

As noted in the delineation of the study (*cf* section1.5.2), learners and teachers who had had the most exposure to using the tablets in the classroom to support teaching and learning, were selected. At the time of the study, only Grade 12 learners had used the tablets.

One Grade 12 Science and one Grade 12 Mathematics teacher were selected. These teachers, and the principal, assisted in the selection of eight Grade 8 learners (four male and four female). This selection was made up of low, middle and high achievers, to ensure a representative sample.

The researcher's role was as the "research instrument" (Nieuwenhuis, 2012c) in the data gathering process, acting as interviewer and note-taker. This was made possible by making audio recordings of all sessions.

Table 15 illustrates an overview of data collection, including the selection of participants.

Table 15: DATA COLLECTION OVERVIEW

Data collection strategy	Participants and number of participants	Site & time	Duration	Research instrument	Role of the researcher
1. Physical artefact	8 learners	At school After school	2 hours	Poster and guidelines	Explained requirements and guidelines
2. Interviews	8 learners	At school After school	30 minutes per learner	Interview schedule	Interviewer and note taker
	2 teachers	At school After school	30 minutes per teacher	Interview schedule	Interviewer and note taker
3. Observations	30 learners & 1 teacher	Classroom during periods	2 periods, 80 minutes	Anecdotal records and field notes	Complete observer

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4.3.3   CREATING PHYSICAL ARTEFACTS

Creating the physical artefact was the first process in the actual data collection. Drawings enable creative expression and represents what is important (Rule & John, 2011). It permits the opportunity for information that does not rely on language skills and provides a different perspective than spoken or written texts (Rule & John, 2011). The learners first language is Xhosa and this method can allow one to bridge the language barrier difficulty, it also gives them the opportunity to express what is not easily put in words and provides access to the subconscious (Rule & John, 2011). The individual activity required learners to make a poster of their experience with the tablets which would then serve as a visual representation of their experience. The poster could be made by sketching/drawing, collaging or whatever way they preferred. The aim was to afford the learners freedom of expression. The necessary materials required for the activity were provided. Guidelines and instructions were given to the learners with regards to the physical artefact (*cf* Appendix D). These physical artefacts (posters) were followed by individual interviews with the learners, using the poster/physical artefact for elicitation. This graphic elicitation/visual method is a projective technique (Bagnoli, 2009) which fosters reflection and promotes engagement (Vannini et al., 2013). It relies on other expressive possibilities which represents and allows access to different levels of experience (Bagnoli, 2009). Elicitation also decreases the risk of getting pre-expected answers, which is greater when dealing with teenagers (Vannini et al., 2013). Image based methods are free and provide a powerful extension to observations. It elicits and stimulates responses from participants and this opens up a range of different opportunities (Thomas, 2010). Observations are from the researchers' point of view, but image based methods offer a shared relationship in the gathering of information (Thomas, 2010). It explores the student's voice (Thomas, 2010). The image based method enabled the researcher to analyse the poster before going into the interview which helped to break the ice and get the conversation started (Thomas, 2010). This method invited discussions about their experience and allowed the learners to become aware of their understandings (Rule & John, 2011).

Data collection methods which involve participation from the participants, such as the case with the physical artefact, have some advantages. The advantages these methods provide, which the researcher aimed to foster with the physical artefact, include (Rule & John, 2011):

- Promoting the learners sense of ownership
- Creating a dialogue between the learner and the researcher
- Adding value to the learners' initiative and sense of agency

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- Providing fun and enjoyment for the learners

- Developing skills among the learners

- Shifting power relations between the learner and the researcher

- Including multiple modalities such as oral, written and visual

- Allowing the learners to create and share knowledge

Creswell (2009) agrees that this is an unobtrusive method of data collection through which participants have the opportunity to share their reality directly, and it captures attention visually.

4.3.4   CONDUCTING INTERVIEWS

The second step in the actual data collection involved the conducting of interviews; firstly with the learners, and secondly with the teachers. Semi-structured interviews provide the researcher with a list of topics, possible questions, potential follow-up questions and probes. Interviews which are semi-structured are exactly what it says, not completely structured and not completely unstructured. The structure thus does not have a formal format and the researcher does not have to go through the questions or prompts in a specific order. It also assists the researcher in recalling which important topics to discuss (Thomas, 2010). The semi-structured interviews with the learners followed the individual activity in which they had the opportunity to discuss the physical artefact (poster) in more detail. Questions were asked regarding their emotions and attitudes toward the use of the tablets, as well as the influence of the tablet on motivation in learning. The interview schedule with the questions for the learners can be viewed in Appendix D. Semi-structured interviews with the teachers allowed the researcher to further explore the emotions, attitudes and motivation of the learners. It also focused on how the interaction takes place and how it supports their teaching. See the interview schedule with questions for teachers in Appendix D.

4.3.5   OBSERVING THE CLASSROOM

The third and final step in the actual data collection included observing the classroom milieu in order to define the interaction among the learners, teachers and the tablet. Non-participatory observations (Seabi, 2012), in the classroom during Science periods, afforded an insight into interactions and how the tablet supports learning in Science. Structured observation leads to assumptions about the classroom situation, viewable through a prism which enables the researcher to break down the activities in the classroom into quantifiable elements (Thomas, 2010). The researcher took on the role of complete observer (Nieuwenhuis, 2012c). The

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observations were recorded in the form of anecdotal notes. See the observation notes schedule, *cf* Appendix D.

4.4   DATA ANALYSIS PROCESS

The data collection processes addresses the second part of the figure 34:

Figure 34: RESEARCH METHODOLOGY – DATA ANALYSIS PROCESS
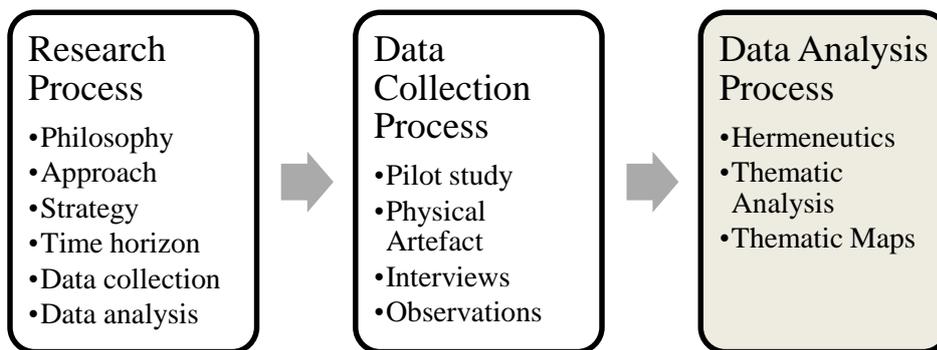
This study is conducted from an interpretivist philosophical perspective and, as an approach to human understanding, it closely relates, supports and is also grounded in hermeneutics (Nieuwenhuis, 2012a). Hermeneutics is defined as a theory or philosophy of understanding and making meaning out of text (Bleicher, 1980; Nieuwenhuis, 2012c). Walsham (1995) also makes the link between hermeneutics and interpretivism by reporting that interpretive researchers strive to consider and evaluate others' interpretations, making it their own, and then providing their version of the events. Interpretivist research also produces an understanding of how the context influences the system and how the system influences the context. Hermeneutics has a circular structure (Myers, 1997) which suggests that the text must be understood, explained and then appropriated.

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4.4.1 HERMENEUTICS

Klein & Myers (1999) recommended a set of principles to assist with the interpretation of data, as underlined in hermeneutics. A description of the principles, an explanation of each principle and how these principles were applied in this study during data analysis follows (*cf* table 16):

Table 16: HERMENEUTIC PRINCIPLES

Principle	Explanation	Application
1. Hermeneutic Circle	Understanding the data by iterating the interdependent meaning of parts of the data and the whole they form. Attempting to understand each sentence which forms part of a larger context.	The data was identified, understood and considered by identifying and considering each learner's emotions, attitudes and motivations and then considering the whole.
2. Contextualisation	This principle requires that the reader is placed in the context of the research setting in order that he/she (the intended audience) becomes aware of *how* the current situation has emerged.	This was applied in section 3.2.4.2 of this chapter by reflecting on the ICT4RED project which this rural school forms part of, as well as the environmental context of the school, as observed by the researcher.
3. Interaction	Reflecting on *how* the data was socially constructed through collaboration between the researcher, learners and teachers to give the reader insight into the life of the learner, teacher, school and environment.	This principle was applied through reflection - *how* was the data collected through the interaction between the researcher, learners and teachers. As discussed in section 3.3 of this chapter, materials collected from the learners involved the creation of the physical artefact by the learner, based on the guidelines provided by the researcher and made in the presence of the researcher. The making of the artefact was followed by individual interviews with each learner and teacher. The final material collected involved classroom observations, with both teacher and learners present.

4. Abstraction and Generalisation	Relating the idiographic details of the interpretation of the data to a theory that describes human understanding and social action in order that the reader can track how the researcher arrived at her theoretical insights.	This was applied in the thematic analysis of the data which is discussed in detail in Chapter 6. More specifically, in the theoretical elaboration (*cf* Section 6.6) which highlights how important concepts, from literature, emerged through data analysis.
5. Dialogical Reasoning	Keeping in mind the possibility of contradictions between the *theory*, which guided the research, and the *real findings*, taking into consideration the original lens of the researcher.	This principle was applied throughout, being constantly cognisant that data analysis is sensitive to the possibility of contradictions arising between the theory and the real findings. This, however, was not the case.
6. Multiple Interpretations	Keeping in mind that it is possible that interpretations among participants may differ from one individual to another.	This was applied by the researcher to seek out and document, as far as possible, multiple learner and teacher viewpoints and the possible reasons for these. These multiple viewpoints were reported in the direct quotations as supplied at the end of each identified theme in Chapter 4 (*cf* section 6.3 to 6.8).
7. Suspicion	Being sensitive to the possibility of discovering biases, distortions and false preconceptions in the data collected from the learners and teachers.	This was applied by the researcher by questioning throughout data analysis whether the teachers and learners actually did do that which they reported upon. A false preconception recognised by the researcher was the expectation that, at times of the classroom observation, the teacher would use the tablet more frequently during the lesson. The tablet was however only used by the teacher in reference to a question paper. The learners, however, used the tablet to access the information, record the discussion, take pictures of the notes on the board and they also used the scientific calculator.

These hermeneutic steps (*cf* table 16) have been applied in the analysis of the study through an understanding of how the data was gathered, explaining what the data means and making it the researcher's own. This was done repeatedly in order to form a network of interpretations (Klein & Myers, 1999), which is discussed in detail in Chapter 6, which also represents the data analysis. The setting of the rural schools has been discussed in the context of the case (*cf* section 4.2.4.2). The data analysis process diagram (*cf* figure 35) depicts *how* the underlying principles of Klein and Myers (1999) were applied throughout the analysis of the data.

The goal of analysis in interpretive studies is to yield an understanding of the text within the context in which interaction occurs (Myers, 1997). The strength of this type of analysis is that the phenomenon is explained based upon the interpretation of the data. The researcher employed two methods of analysis namely *within-case* and *holistic-case* analyses as advocated by Creswell (2007) for case analysis. Through the use of *within-case analysis* the researcher analysed each case for themes and through *holistic-case analysis* the researcher investigated the whole case to provide explanations, themes and interpretations (Creswell, 2007).

4.4.2   THEMATIC ANALYSIS

The data was analysed by making use of a process called *thematic analysis*. Braun and Clarke (2006) suggest that thematic analysis is a foundational method for analysing qualitative data. Thematic analysis is "a method for identifying, analysing and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail" (Braun & Clarke, 2006, p. 79).

Themes, which has been identified through the examination of the data, form the building blocks of the data analysis (Thomas, 2010). A theme encapsulates something significant about the data which relates back to the research question. It should represent a repeated pattern of meaning within the data set (Braun & Clarke, 2006). A theme should be present across the data set, but more instances of the theme does not necessarily mean the theme is more important (Braun & Clarke, 2006). In other words, a theme should occur in a number of instances across the data set and it should also relate to the research questions.

For the purpose of this discussion, the following terms are defined according to Braun and Clarke (2006, p. 79): "Data corpus refers to all the data collected for a particular research project, while data set refers to all the data from the corpus that are being used for a particular analysis. Data item is used to refer to each individual piece of data collected, which together

make up the data set and corpus. Finally, data extract refers to an individual coded chunk of data, which has been identified within, and extracted from, a data item."

The following decisions were made in terms of the thematic analysis (Braun & Clarke, 2006):

– The researcher decided to provide a rich description of the entire data set, instead of providing a distinct explanation of a specific theme or themes within the data. This was done so that the reader could obtain a sense of the significant themes throughout the entire data set.

– The researcher decided on an *inductive* thematic analysis rather than a *theoretical* thematic analysis. This informs upon the researcher's approach towards the research as discussed in the previous section (*cf* section 4.2.3). The analysis approach was *data-driven* meaning that the themes identified were strongly linked to the data itself and the researcher coded the data without trying to force it into a preceding coding frame. Although the researcher did later make links to important theoretical concepts in the theoretical elaboration and analysis of the data, as seen in Chapter 6 (*cf* section 6.6), the approach taken was focussed on an inductive way of analysis.

– The researcher's decision regarding which themes would be identified was *semantic* rather than *latent* in nature. The reason for this is that the researcher attempted to analyse the *surface* of the data. A latent thematic analysis urges the researcher to delve beneath the underlying ideologies of the data.

– Furthermore, the researcher conducted the thematic analysis within the essentialist/realist paradigm, rather than the constructionist paradigm. It was the researcher's intention to identify experiences, meanings, motivations and the reality of participants. With constructionist, the researcher seeks to theorise sociocultural contexts and structural conditions, therefor this approach tends to focus on latent themes.

4.4.3   THEMATIC ANALYSIS PROCESS

The process which was employed was based on a combination of steps for data analysis and it set out in the following paragraphs (Braun & Clarke, 2006; Creswell, 2009; Thomas, 2010):

1. The data was organised and prepared for data analysis. An electronic copy of all the data was made. The verbal data was transcribed into written texts by the researcher herself and this created an excellent opportunity to become familiar with it. The researcher further immersed herself in the data by repeatedly examining and re-reading it. Reading of the data was done in an active way, constantly searching for meanings and patterns. Data was read at least twice

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before the coding process begun and during this phase the researcher made margin notes and marked ideas.

2. The researcher started generating initial codes. This involved identifying interesting features of the data which referred to the most basic elements of the raw data which could be considered *meaningful* regarding the learners' experience of technology-facilitated learning. This coding was done manually and not through a software programme. The researcher worked systematically through the entire data set, giving complete and equal attention to each data item. The researcher then identified interesting features in the data items which formed the basis of repeated patterns across the data set. As this process was done manually, the researcher coded the data by writing notes and using highlighters and coloured pens to identify possible patterns.

3. The researcher then started searching for themes by sorting the codes into *potential themes.* These potential themes were then grouped together and the applicable data extracts, within those themes, were organised together as well. The researcher then considered how codes could be combined to form an *overarching theme*.

4. The themes were then reviewed by developing the set of *possible themes* and then refining them. Some themes collapsed into one another and other themes were broken into separate themes. At this stage the researcher re-read the entire data set to check whether the data extracts matched the themes and also to code any additional data that might have been overlooked during the previous coding stages.

5. When the researcher was satisfied with the themes, the themes were then *named* and *defined* by providing the essence of each theme. During this phase the researcher did not merely paraphrase the content of the data extracts, but instead she *interpreted* the data by *identifying* that which was of particular interest in each theme and also ascertaining *why* it was important.

6. In the write up of the data, presented in Chapter 6, the researcher attempted to tell the story of the data. Consequently she aimed to provide each theme with sufficient evidence and vivid examples of extracts which illustrate the *essence of each theme* in the best possible manner. Appropriate quotations were selected to exemplify the themes (*cf* section 6.3 to 6.8).

A thematic map was developed at the end of the thematic analysis (*cf* section 6.9). This map serves as a complete representation and conceptualisation of the patterns in the data, also illustrating the relationship between the different themes (Braun & Clarke, 2006). The mapping of themes illustrates the *interconnectedness* of the themes as well as which themes communicate with each other (*cf* section 6.9).

A graphical representation of the process followed during data analysis, as discussed previously, is demonstrated figure 35.

Figure 35: DATA ANALYSIS PROCESS DIAGRAM
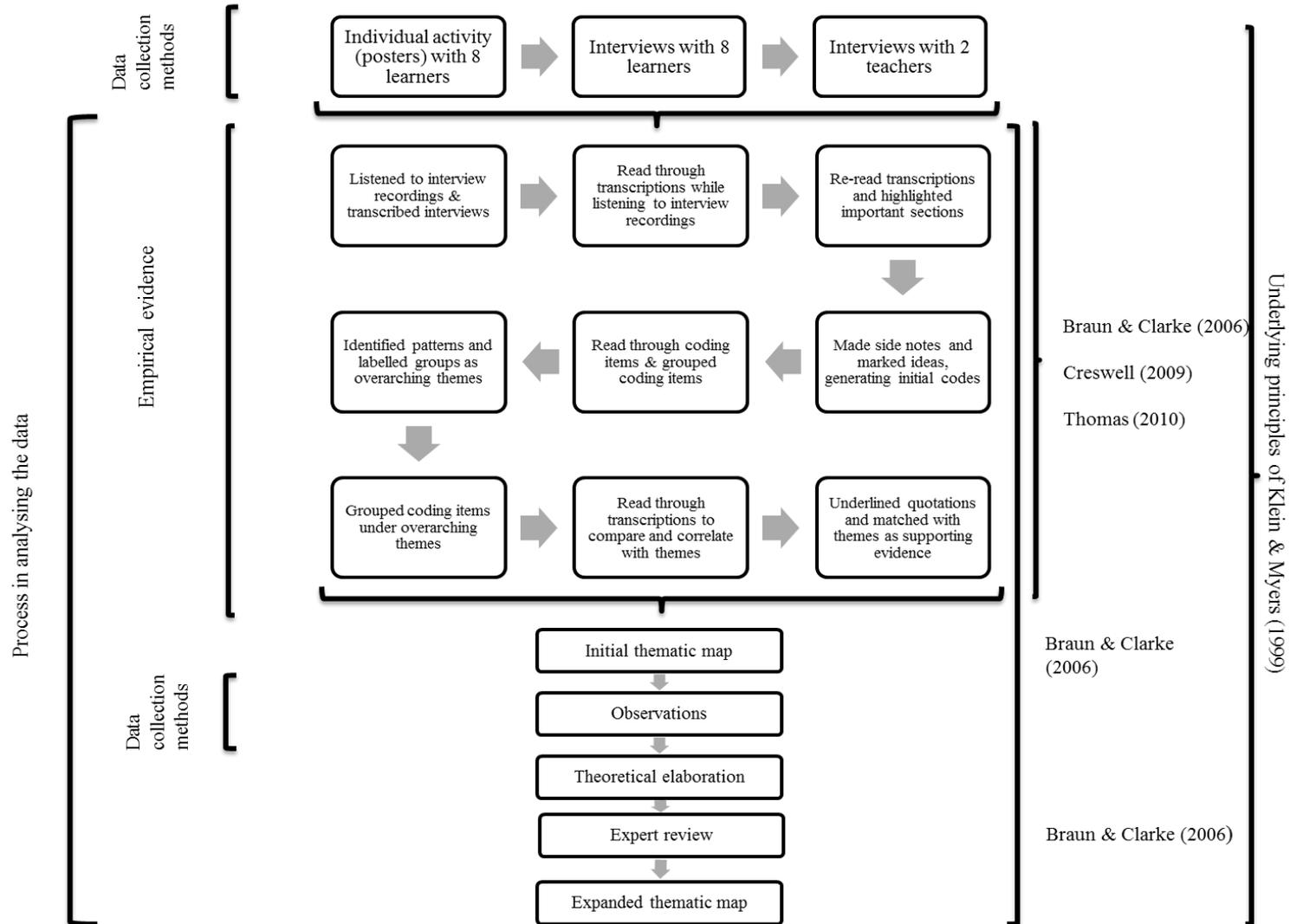
Table 17 provides a 15-point checklist of criteria towards good thematic analysis (Braun & Clarke, 2006, p. 96). According to this checklist, the thematic analysis done in this study can be considered a *good analysis* as all 15 criteria could be ticked off after completion of the process.

Table 17: THEMATIC ANALYSIS CHECKLIST

No.	Process	Criteria	Checklist
1	**Transcription**	The data has been transcribed to an appropriate level of detail, and the transcripts have been checked against the tapes for accuracy.	√
2	**Coding**	Each data item has been given equal attention in the coding process.	√
3		Themes have not been generated from a few vivid examples (an anecdotal approach), but instead the coding process has been thorough, inclusive and comprehensive.	√
4		All relevant extracts for each theme have been collated.	√
5		Themes have been checked against each other and back to the original data set.	√
6		Themes are internally coherent, consistent and distinctive.	√
7	**Analysis**	Data has been analysed – interpreted, made sense of – rather than just paraphrased or described.	√
8		Analysis and data match each other – the extracts illustrate analytic claims.	√
9		Analysis tells a convincing and well-organised story about the data and topic.	√
10		A good balance between analytic narrative and illustrative extracts are provided.	√
11	**Overall**	Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over-lightly.	√
12	**Written report**	The assumptions about, and specific approach to, thematic analysis are clearly explicated.	√
13		There is a good fit between what you claim you do, and what you show you have done – i.e., described method and reported analysis are consistent.	√
14		The language and concepts used in the report are consistent with epistemological position of analysis.	√
15		The researcher is positioned as active in the research process; themes do not just emerge.	√

Adapted from Braun and Clarke (2006)

4.5   TRUSTWORTHINESS

Trustworthiness is the way in which the researcher tests and ensures the quality of the research design (Morse, Barrett, Mayan, Olson & Spiers, 2008). In Morse et al., (2008), Guba and Lincoln (1981) stated that in order to ensure trustworthiness the findings should be credible, transferable, dependable and confirmable. As the researcher was the main instrument of the research, it was important to adapt to changing circumstances and be reactive in such circumstances. The researcher aimed to be sensitive and take a holistic view while maintaining a distance as advised by Guba and Lincoln in Morse et al. (2008). Strategies used, in order attain trustworthiness, (Leedy & Ormrod, 2005; Morse et al., 2008) were *participant validation* in which the findings were related back to the participants (teachers) to determine whether the findings were accurate; and *triangulation* where the researcher engaged in individual activities, interviews and observations to search for common themes. Other strategies included seeking the opinion of the teachers and expert reviewers (educational psychologist) to determine whether they agree or disagree with the interpretations and if they deem that valid conclusions had been drawn from the data. Triangulation is further discussed in Chapter 6 (*cf* section 6.10).

4.6   ETHICS

Ethics involves "the standards of the researcher's behaviour in relation to the rights of those who become the subject of a research project, or who become affected by it" (Saunders et al., 2012, p. 680). When taking ethical issues into consideration, it is deemed necessary that good ethical behaviour must be considered when collecting, analysing and interpreting data and when writing and disseminating the research (Creswell, 2009). A discussion regarding the ethical way in which these different stages were approached follows.

As discussed in Chapter 1 (*cf* section 1.6), permission to conduct research for the ICT4RED project was approved by the Eastern Cape Department of Basic Education (*cf* Appendix C). At the start of the ICT4RED project, the CSIR firstly obtained permission from the Traditional leader of the community to conduct the research and a good relationship with the community was maintained continuously. Ethical clearance was also obtained from the Ethics Committee of the University of Pretoria (*cf* Appendix C). Attention was given to protecting and advancing the best interests of the learners participating in the research. Human rights, including equality, human dignity, freedom, security, privacy and freedom of expression, were protected.

The inclusions of the learners were based on voluntary participation and assent from learners, under the age of 18, was obtained (*cf* Appendix B). Informed consent was obtained from the

learners' parents, guardians or care givers (*cf* Appendix B) and the teachers (*cf* Appendix B). These letters were translated into Xhosa (*cf* Appendix B). The informed consent and assent letters included the identification of the researcher, supervisors and the university. The researcher further indicated *how* participants were selected, the *purpose* of the research, the *benefits* of participating, the level and type of *participant involvement* expected from both learners and teachers, notation of any *risks* to learners and teachers, a guarantee of *confidentiality* to learners and teachers, assurance that learners and teachers could withdraw at any time as well as the names and contact details of the researcher and supervisors if any questions arose. Permission to conduct research and collect data was requested and granted from the principal of the rural school. In this the principal was made aware of all research activities including the purpose, procedures, potential benefits, cost, payment, confidentiality, participation and withdrawal of participants. The participants were learners and teachers from a government senior secondary school and were expected to be competent to participate.

With the non-participatory observations in the classroom during the lessons, there were other learners present in the class but for the purpose of data collection the focus was only on the teacher and the learners who were selected and who agreed to participate. The observations were done in the most discreet way possible and the researcher did her best to remain unnoticed and unobtrusive.

The researcher discussed the process with the participants and gave them the opportunity to ask questions. The researcher did her best to put the participants at ease and to address any uncertainties which the participants might have had. The researcher had no contact, or prior relationship, with any of the teachers and learners at the school.

No risks or harm was done to teachers or learners during data collection. Although the possibility existed that the teachers and learners might feel uncomfortable with the researcher's presence in the classroom, this was not the case. The researcher strived to be alert and aware of any possible discomfort experienced by learners and teachers at all times.

No incentives were used and the letters of informed consent clearly stated that participants would not be paid to participate and that their participation would be free of cost. It was made clear that their participation would contribute to a better use of the tablets and would also afford them the opportunity to voice their opinions.

Only the researcher and supervisors have access to information and data collected.

The participating teachers were asked to comment on drafts of the reports. Anonymity was guaranteed and participants were assured that data would not be linked back to them. The

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names of the teachers, learners and school were not used. Pseudonyms were given to teachers and learners. The names of the teachers and learners would only be known to the researcher. Data obtained during data collection was used to write a dissertation and no information was provided to identify the participants.

In the application for ethical clearance it was stated that findings would be used to write a dissertation and an article and the research and results could possibly also be presented at conferences. Due to this study being part of a larger project the results of the study will be made available to the CSIR and the Eastern Cape Department of Education. The school can also receive a report, if requested. The findings and discussions are stated in Chapters 5, 6 and 7 of the dissertation and are available on request to the school.

Interviews were audio recorded and these recordings are in the possession of the researcher. The transcriptions were done on the researcher's own computer and are available to the supervisors. Observation notes are available on paper and in the possession of the researcher. Posters (physical artefacts) made by learners are on paper and in the possession of the researcher. Digital copies were also made of the posters on the researcher's own computer. These documents are all safely stored in the Science, Mathematics and Technology Education Department in accordance with the storage policy requirements of the university.

The relationship between the researcher and learners was built on trust. They were kept informed of all changes or amendments and the conditions of their participation were continually discussed. They were also provided with the opportunity to discuss their concerns freely and thus a rapport was established with all participants. All research aims and procedures were explained to both the learners and teachers (Mack et al., 2005). The process of the individual activity with the learners was explained and they were provided with guidelines to the activity. The researcher carefully explained these guidelines to the learners, thus ensuring that they understood what was expected of them. Participants were informed that they may withdraw from the study at any time if they chose to do so (Welfer, 2002). No participants were harmed and their wellness was protected.

4.7   SUMMARY

This chapter presented the *motives* and *explanations* for the adoption of a particular research methodology. In the figure 36, the applied research process can be seen, addressing each layer in the research process.

Figure 36: APPLIED RESEARCH ONION
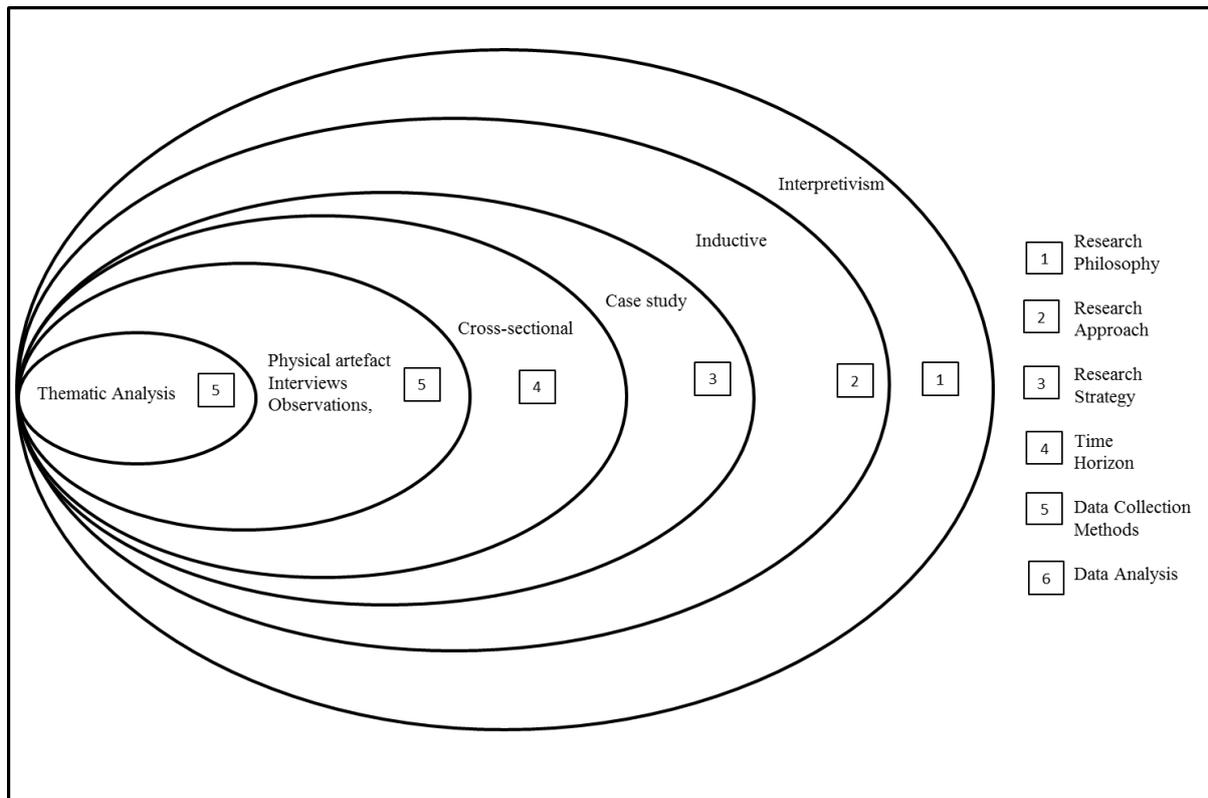
A *cross sectional interpretive* case study was adopted in an effort to fully understand the experience of technology facilitated learning (*cf* figure 36). An *inductive* approach allowed the researcher to explore the data, identify themes and create a conceptual framework (*cf* figure 36). The analysis of the data collected is presented in Chapter 6. A *qualitative analysis* of the data aided insight to the role of emotions, attitudes and the motivations of learners. The method of *triangulation* assisted in supporting findings obtained through the different data sources in relation to the experiences of learners regarding technology-facilitated learning. In the next chapter the analysis of the data, including all themes identified, will be presented.

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CHAPTER 5 – RESEARCH RESULTS
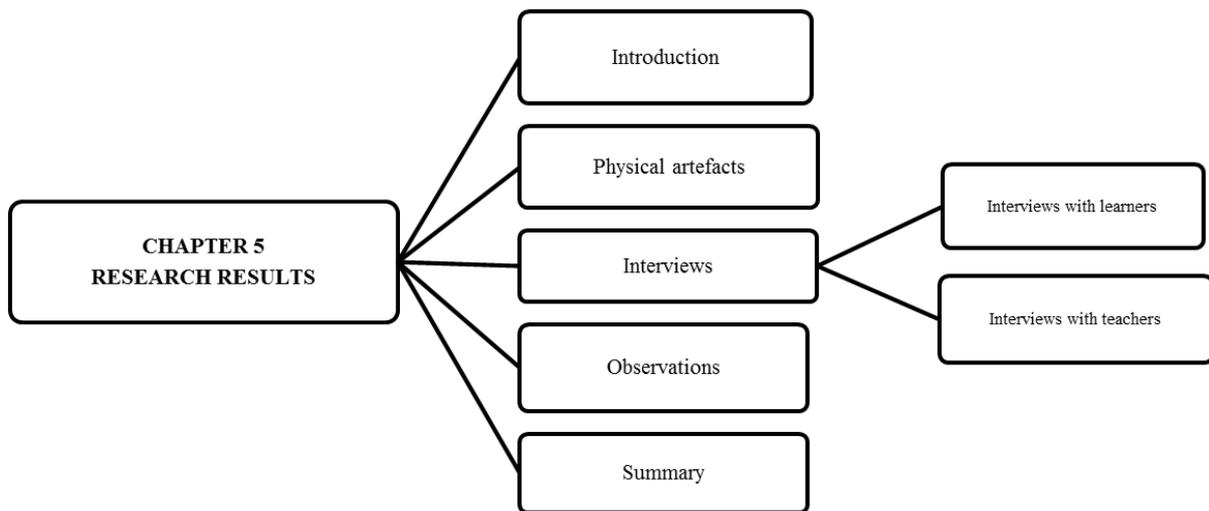
A schematic representation of Chapter 5

5.1 INTRODUCTION

In the previous chapter the methodology which was followed in the study was discussed, explaining how the theory of the research study was carried out. In the methodology chapter the researcher presented the data analysis in terms of decisions made and processes followed during the analysis of the data. In this chapter the researcher will be presenting the actual research results, preceding the analysis of the data (*cf* section 5.2).

The research results are an outcome of the data collection process. The following figure (*cf* figure 37) depicts the data collection process, as discussed in detail in Chapter 4, Research Methodology. The highlighted processes are *physical artefacts* (*cf* section 5.2), *interviews* with learners and teachers (*cf* section 5.3) and *observations* (*cf* section 5.4). The results are merely presented in this chapter and then discussed further in Chapter 6, in the analysis of the data.

Figure 37: DATA COLLECTION PROCESS
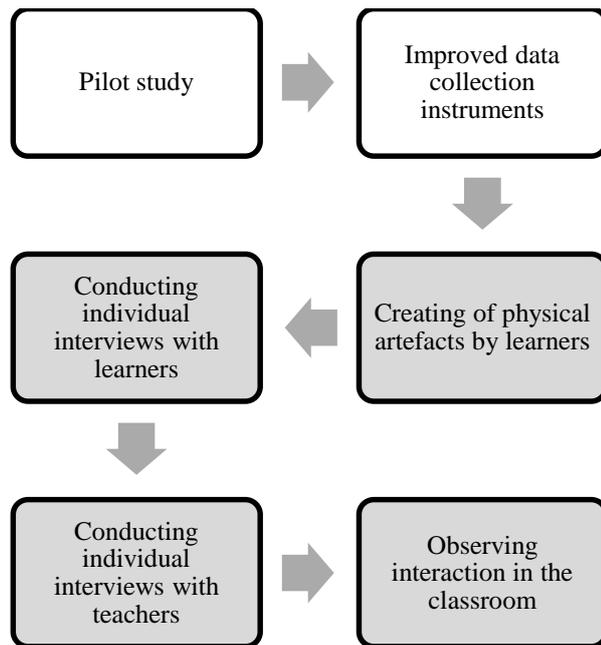
5.2   PHYSICAL ARTEFACTS

The creation of the physical artefact was the first step in the data collection process. The individual activity required learners to create a poster depicting their experience with the tablets which would then serve as a visual representation of their experience. The poster could be made by sketching, drawing, collaging or whatever other way they preferred. The aim was to afford the learners freedom of expression and to get their objective points of view, prior to the interviews. The learners were provided with guidelines as to the individual activity, *cf* Appendix D. All of the necessary materials required for the activity were provided. The learners seemed to enjoy the activity and made use of all the materials provided. These physical artefacts are discussed in the presentation of the themes (*cf* section 6.3). The physical artefacts were used as a starting point in the interview with the learners as they described and discussed their artefacts in the beginning of the interviews. These physical artefacts are further discussed by an educational psychologist in the expert review, *cf* section 6.8. Examples of the individual artefacts follow (*cf* figures 38 to 45).

Figure 38: PHYSICAL ARTEFACT - Learner 1

THE FIRST TIME I RECIEVED IT

* I NEVER KNEW WHAT TO DO WITH IT
* I PLAYED GAMES
* I TOOK PHOTOS

HAPPINESS
ONLY OND JOKES

IT CHANGED
EVRYTHING!

WHEN THEY TOUGHT ME WHAT TO DO WITH IT

* I HAD TO ~~PAY~~ PAY MY ATTENSION

* UNDERSTAND WHA IS IS FOR

* TOOK IT AS MY TEACHER

NO MORE TIMES FOR
JOKES BUT TO BE
SEREOUS

Figure 43: PHYSICAL ARTEFACT – Learner 6

Journey with my tablet

Not knowing the menu

Being thought how to use it

Experiencing
Having a tablet as an educational source

How easy it was after

1. Educational resources
2. Game e.g. chess:
3. Social networks
4. Calculator
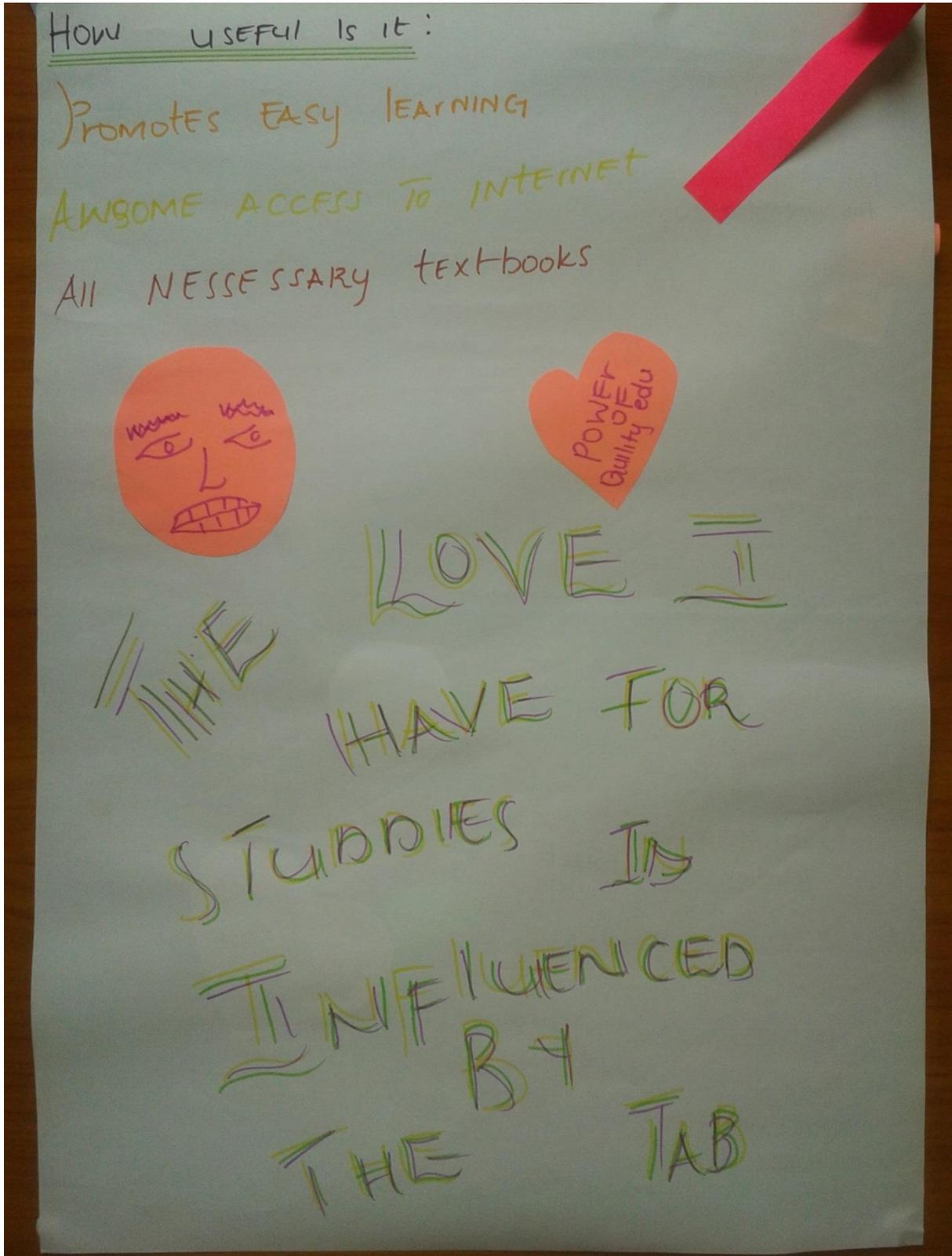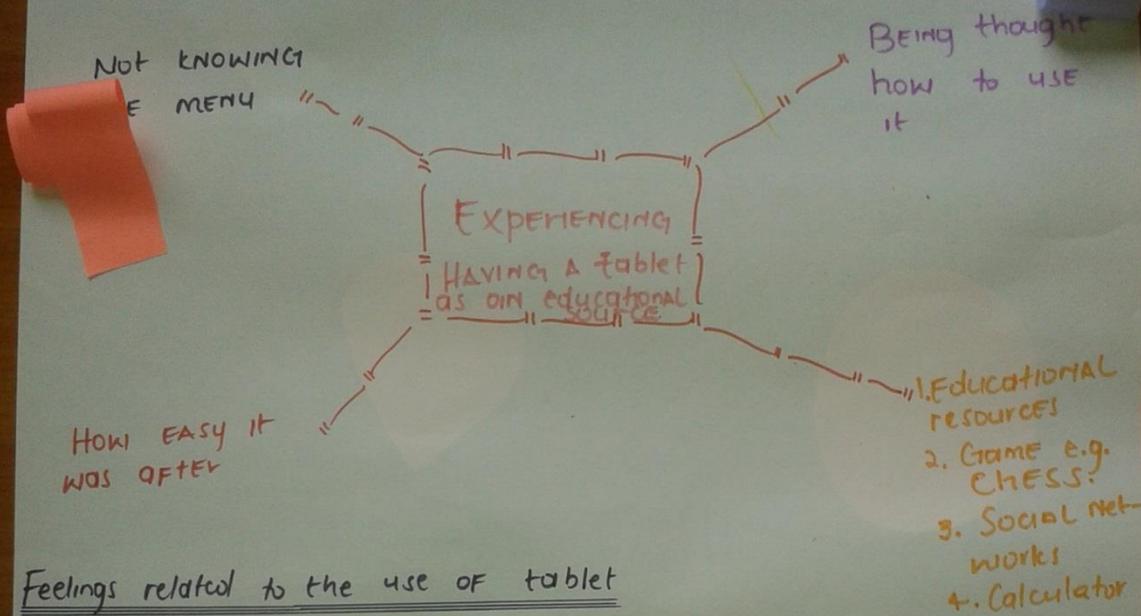
Feelings related to the use of tablet

Happy : Very easy to use
        Teacher in a pocket

Sad : Network problems

Super inlove with my tablet
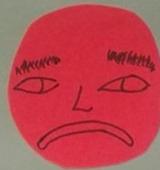
My VIEWS :
SAFE
EASY to use
Problematic Network
Not useful when using at home
1. Net work   2. Wi-fi   Not connecting
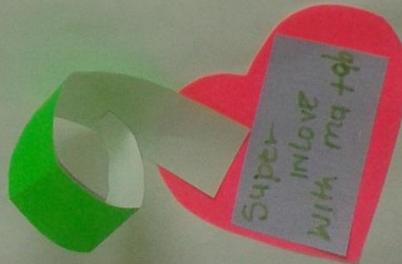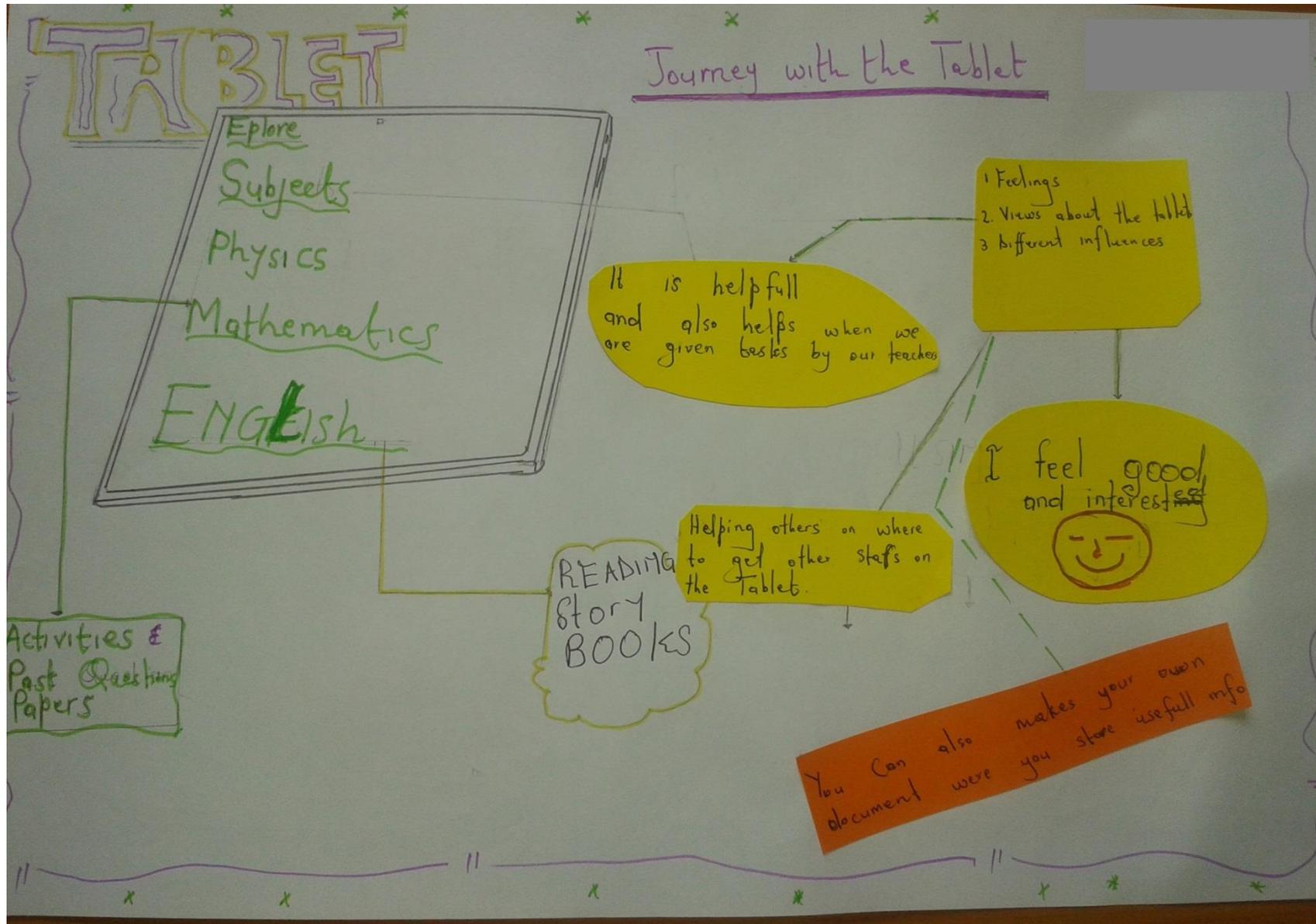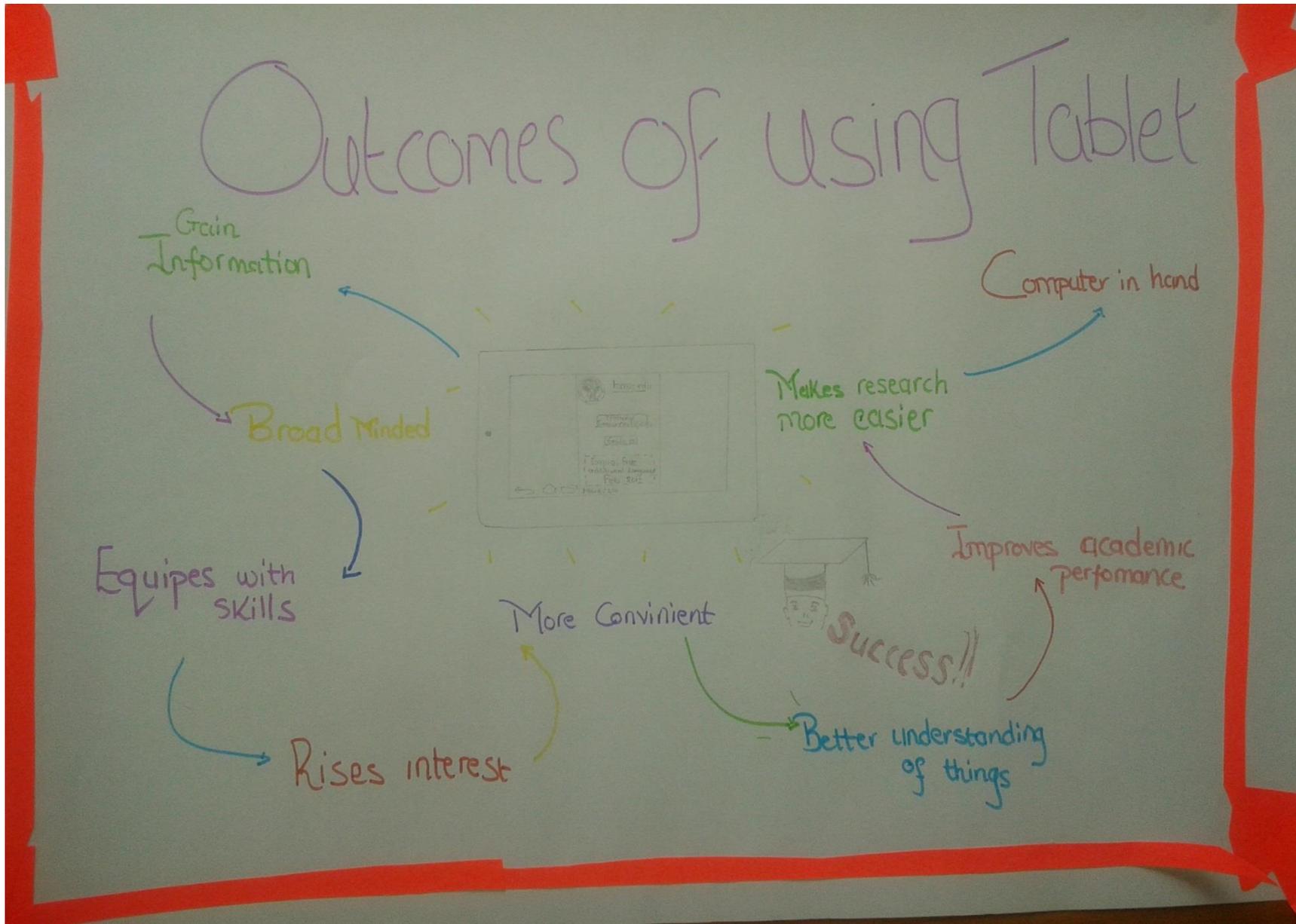
The creation of physical artefacts was discussed as part of the data collection process (*cf* section 4.3.3). The creation of the physical artefacts required learners to make a poster of their experience with the tablets which then served as a visual representation of their experience. The aim was to give learners the freedom of expression. This was important to do as the learners' first language is Xhosa and this projective method allowed for the bridging of the language barrier. The physical artefacts served as a visual evidence and a point of departure in the individual interviews which followed the creation of the physical artefacts.

5.3   INTERVIEWS
Interviews were conducted with both learners and teachers.

5.3.1   INTERVIEWS WITH LEARNERS
The next step in data collection, following the creation of the physical artefact, was the individual interviews with the same learners who participated in the creation of the physical artefacts. The learner interviews, as a data collection method, were discussed in the previous chapter (*cf* section 4.3.4). The presentation of the results, which follows, is based on a summary of the learners' answers to the questions in the interview schedule, *cf* Appendix D.

5.3.1.1 Meaning of the tablet to them?
When asked *what their tablet means to them*, the responses included: the tablet has all the information they need, whenever they need it, wherever they need it and it has everything in one, it means everything to them, it serves as their teacher and it is a teacher in their pocket. The tablet helps them to achieve great things and when they do not know something the tablet can be very useful in helping them find whatever information they are searching for. The tablet is also referred to as a friend or an album in which memories can be stored in the form of pictures. The tablet means that they are not only reliant on a teacher to provide them with information. One learner reported that he is not so 'into' the tablet and only uses it because his teacher requires him to do so. This learner said that he only uses his tablet for games and that the only way which he avoids playing them, is by leaving his tablet at home.

5.3.1.2 What has changed?
When asked *how the tablet has changed their lives* learners indicated that the tablet had indeed changed their lives and that, since using the tablet, they are able to understand things which they previously had not. Learners feel that the fact that they can see *how* things are done, in videos for example, has helped them to understand concepts better. Some learners commented that they do not visit friends as much as they use to because they now keep themselves occupied with the tablet. The tablet has made it possible for them to study after school and in their own

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time. They can, for instance, replay a video at home if they did not understand it during the lesson. Now learners also have access to previous question papers, which was not always the case, and this helps them to prepare for tests and exams. Since having the tablet they state that they are no longer bored and that the tablet has helped them to improve their focus on schoolwork. A learner indicated that the tablet has made her life easier because it facilitates access to information, it is not heavy and she can take it with her wherever she goes. Another learner reported that it has changed his life because he becomes 'perfect' when he uses it 'better and better'. . One of the learners indicated that the tablet has not changed anything for him.

5.3.1.3 What are they able to do now?
When asked *what they could now do with a tablet*, which they could not do before, learners reported that they were able to do revision and see how things are done with the help of videos and recordings made by the teacher to help the learners understand better. One of the learners reported that the tablet has put her into contact with important people at universities who are helping her with her career choice. Learners reported that they are able to take photos of work written on the board and that this saves time. A learner reported that she is able to download educational resources. Learners also indicated that having a memorandum available helps them when they are working at home. One learner stated that, since having a tablet, she reads on the taxi, something she never did when she only had textbooks. She can thus access information wherever she is.

5.3.1.4 Experience with the tablet?
When asked about *their experience with the tablet* some learners struggled to answer the question saying that they did not understand, and in such cases the researcher simply moved on to the next question. However, those learners who answered the question reported that their experience has been awesome, great, good, helpful and that they loved it. Learners stated that they have problems with the battery life of the tablet. Another learner indicated that the tablet causes problems for him as it distracts him from his schoolwork. The *helpfulness* of the tablet relates to learners not having to be instructed only by a teacher but that they have access to information, even if there is no teacher. The tablet also contains information that is not available in a textbook.

5.3.1.5 Feelings towards the tablet?
When asked *how the tablet makes them feel* and to *describe their feelings toward the tablet*, one learner responded that it made her a better person as she now sees herself as someone who is able to understand things. The tablet also makes them feel better and even great because it

provides them with information. Learners reported that they felt excited, blessed, honoured and proud to have a tablet. One learner responded that she cares for her tablet and that it is like her boyfriend. A negative response was that a learner felt that the tablet causes problems for him because he is addicted to games. Other responses included that the tablet has changed their lives, made things easier and that it is helpful in terms of education and social interaction as well. A learner stated that he is no longer on the streets because he does not get bored at home since he has the tablet. Another response was that it makes learners feel important when they receive tablets. Learners responded that they love their tablets and take care of them. A learner described his feelings as *happy* because he has access to information, *good* because he is able to achieve what he want in terms of his studies, and *bad* because some of the learners use their tablets for other non-educational purposes.

5.3.1.6 Changed their lives?

When asked *if and how the tablet has changed their lives* learners replied that the tablet has indeed changed their lives. Learners feel that it has improved their understanding because they are able to see how things are done. The tablet has made things easier for the learners like saving time by taking a photo of work on the board, recording the teacher and being able to do revision at home to prepare for tests. The tablet has enabled them to search for information when they do not understand something, instead of only having the teacher as a source of information. A learner felt strongly that the tablet has changed her life due to the fact that she does not have to carry a heavy schoolbag full of textbooks anymore. Access to question papers, dictionaries and educational videos and books, which they did not have access to before, has changed their lives.

5.3.1.7 Improved schoolwork?

When asked *whether the tablet has improved their schoolwork* all the learners confidently answered that it has indeed improved their schoolwork. Their marks have improved in their subjects because learners feel that they understand better due to the access to information. Another reason for the improvement, according to the learners, is the fact that it is now possible to study in their own time, replay videos and do extra revision at home if they did not understand in class. The ability to carry on with work if a teacher is absent has also helped the learners. A learner responded that the improvement is also due to the fact that she is now working harder because she is more determined and self-motivated to achieve. She wants to work harder since they received the tablets and have used the tablet more efficiently. Another reason given for the improvement in marks was that learners are more interested in schoolwork,

subjects and reading since they received the tablets and this has led to learners doing extra work. A negative reply to this question was that the tablet has not improved the learner's schoolwork, but he did admit that it should in fact improve his schoolwork but due to network problems, there has not been any improvement.

5.3.1.8 More or less motivated?

When asked *whether they feel more or less motivated* since they have been using tablets in school, all learners responded that they feel more motivated. Learners were of the opinion that they were more motivated because they understood better as they had access to information and resources which were previously not available. A learner felt that she was more motivated because she feels proud, blessed and privileged to have a tablet. Another responded that she feels more motivated because since using the tablet and that she feels that she is able to perform and achieve better. One learner's response was negative in that he felt less motivated because he is playing games all the time.

5.3.1.9 Describe your tablet

When asked to *describe their tablet in five words* the responses include: brilliant device, master minded, convenient, more easy to use, smart, helpful, my laptop, stores information, improves schoolwork, useful, intelligent, very clever, exquisite, excellent, superb, influential, saves time, awesome, cool, interesting, good, teacher, source of information, friend, my album, my best friend, lovable, nice, very easy to carry and better way to do my studies. A negative response was that the tablet causes laziness and conflict.

5.3.1.10 Describe your relationship with the tablet

When the learners were asked to describe their relationship with their tablet, the responses included: a close relationship as she always has it in her hand and uses it all the time, a great relationship, a caring relationship, it has all the information the learner needs, a teacher to them, they are like friends, best friends and a person who can assist with information. A learner described his relationship with the tablet as love and that the tablet is more intelligent than anyone else.

5.3.1.11 Overall experience with tablet?

In descriptions of *their overall experience with the tablet,* learners responded that the tablet has made their lives easier, has helped them with their studies and helped them socially, has motivated them, has improved their studies, has given them hope and has made them believe that they could pass their exam. A learner described her experience with the tablet as simply *amazing.*

5.3.1.12 Important when using tablets to learn?

When learners were asked *what they thought was important when using tablets to learn*, they replied that network access, battery life and device memory were important. Other learners emphasised that it is important to record the teacher while teaching, so that they could replay it.

5.3.1.13 Replace teacher?

When learners were asked *if a tablet can replace a teacher* or whether a teacher is still necessary in the class, there were two main responses. Firstly, leaners felt that the tablet could most definitely replace the teacher. Secondly, learners felt that the teacher is still necessary for explaining and assistance.

5.3.2   INTERVIEWS WITH TEACHERS

The third step in data collection involved individual interviews with the teachers. The interviews with teachers, as a data collection method, were discussed in the previous chapter (*cf* section 4.3.4). The presentation of the results is a summary of the responses from the teachers in response to questions posed in the interviews, *cf* Appendix D for the interview schedule with the teachers.

5.3.2.1 Changed the way learners learn?

When teachers were asked *how the tablet has changed the way learners learn*, they responded that it has made things easier and that it saves a lot of time. Summaries in textbooks have also been helpful. Learners are more interested in learning and more willing to work.

5.3.2.2 Observed changes in learners?

Changes teachers have observed in learners since using the tablets include improvement in marks and technology skills. The tablet also encourages group work. Learners' school attendance has improved and school enrolments have increased. Learners are even willing to attend evening and weekend classes.

5.3.2.3 Learners' experience?

Teachers described the *learners' observable experience* as learners working together, explaining concepts and that they enjoy using the tablets. Even if a teacher is absent, learners still have something to do. Another response was that learners are spending much more time on their schoolwork because they have access to a number of resources and information. Learners are using the tablets more and doing schoolwork much more diligently than before.

5.3.2.4 Learners' attitudes?

The *learners' attitudes towards the tablets* were described as very positive, excited and interested in the tablets. No negative response was received. The portability of the device enables the learners to show each other that they have a teacher in their pocket.

5.3.2.5 Learners' emotions?

The learners' expressed emotions while, and since, using the tablets were reported as being happy because they were all engaged and busy and all felt included. A teacher described it as good emotions as learners are working together and assisting one another. Learners' emotions were also described as excited and interested.

5.3.2.6 Influenced motivation to learn?

When asked *how the tablet has influenced the learners' motivation to learn*, the response was that textbooks are perceived as boring and contributes to feelings of laziness and drowsiness but the tablet makes things easier. It was reported that learners are more motivated since using the tablets because they feel that there is not much separating them from private schools now. Learners also feel that they are leading the way in terms of technology in the area. With the help of educational videos and demonstrations, the teacher is able to show the learners how things are done in the rest of the world with technology. This exposure to what is possible further rises the interest of the learners.

Learners' motivation to participate and interact has been influenced by the tablets. Learners are reported to be working together in groups, having discussions in class and helping each other. Teachers received training when they received the tablets. Part of this training involved new teaching methodologies and, through the new teaching methodologies, the learners are interacting much more. The teacher gave an example of how he uses the tablet in Mathematics to divide learners in groups; the groups then solve the problem and share it with the class.

5.3.2.7 Helped in teaching subjects?

The *tablets have helped the teachers to better teach their subjects* in terms of preparation as the tablet makes things easier and quicker. The use of the tablet is more practical and so it facilitates a better and easier planning for the next session. Applications (apps) on the tablets have helped teachers to demonstrate concepts easier and thus ensure that learners really do understand. The teacher explained that it is very useful for learners to see how things are done. The teacher uses a laptop and projector to project apps and demonstrations to learners. One of the teachers mentioned that technology has helped him compensate for his weaknesses. Another teacher responded that the tablet helps learners when they are at home alone because

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in many cases there is no one at home to assist with homework. With the tablet the learner has access to memorandums which guides him/her to better understand how to get to the answer.

Other uses of the tablets include educational resources, apps, videos, power point presentations, emails and banking.

5.3.2.8 Important when incorporating tablets?

When teachers were asked *what is important when incorporating tablets into teaching* to improve learning outcomes, the response was - teacher training on how to use the tablet efficiently and strategies for effective lesson planning. The teacher admits that having a tablet in the class can be chaotic as learners can access the internet for non-educational uses, so planning and monitoring is imperative. Keeping learners engaged instead of a teacher-centred approach is also important.

To help ensure the successful use of tablets in school it is important that learners use the tablet continuously in all the learning areas and also when the teacher is absent. Another response was that it takes a person who is willing and motivated to use the technology because some teachers have been trained to use the tablets, but do not incorporate the technology in the class and are still teaching in the 'old way'.

5.4   OBSERVATIONS

The fourth, and final, step in data collection involved classroom observations of the interaction among the learners, the teachers and the tablet. Observation of the classroom was discussed as a data collection method in the previous chapter (*cf* section 4.3.5). Both classroom lessons observed followed the same procedure. A presentation of a summary of the classroom observations follows:

There were more or less 31 learners in the class, one teacher and 21 tablets. Some learners were sharing tablets; two learners per tablet or in some cases three learners per tablet. The learners' tablets are in leather covers. The teacher was making use of a tablet, textbook and study guide, while the learners were making use of their tablets, textbook and notebooks for writing. The class commenced and the following steps were followed:

- The teacher introduced a new topic.
- She then had a discussion around the new topic in which she explained important concepts and formulas.

- The teacher made notes on the board and the learners copied the notes into their books or some simply took a photo of the notes on the board with their tablet after asking the teacher's permission.

- The teacher then instructed the learners to switch on their tablets in order to see the activity, some tablets had already been switched on.

- Learners were then instructed, step for step, what to click to access the activity.

- The teacher helped the learners who were not at the same place as the others.

- As soon as all the learners were at the correct place, they clicked on the question paper.

- The teacher did the example of the question paper to show the learners, after which the learners moved on to the first question of the question paper and the teacher took a seat at the side of the class.

- The learners were given a time limit by which the activity had to be completed, the teacher kept time and informed the learners when their time was up.

- Some learners used the calculators on the tablet to work out the solution, others used their scientific calculators.

- When the learners had completed the activity, one of the learners went to the front of the class and did the activity on the board; the other learners recorded this learner with their tablets while he explained the activity.

- The other learners then asked questions and the teacher responded.

- When the next activity had been completed, another learner went to the board to explain, other learners helped her and she used her tablet to check her notes.

- The teacher assisted, asked questions and explained to the learners.

- When the teacher asked questions, the learners helped each other by answering and clarifying.

5.5   SUMMARY

This chapter presented the results of the data collection process. It included the physical artefacts made by the learners (*cf* section 5.2), the results of the interviews with the learners and teachers (*cf* section 5.3) and finally the results of the observations (*cf* section 5.4). In the following chapter these research results are analysed to present themes as an outcome.

CHAPTER 6 – DATA ANALYSIS
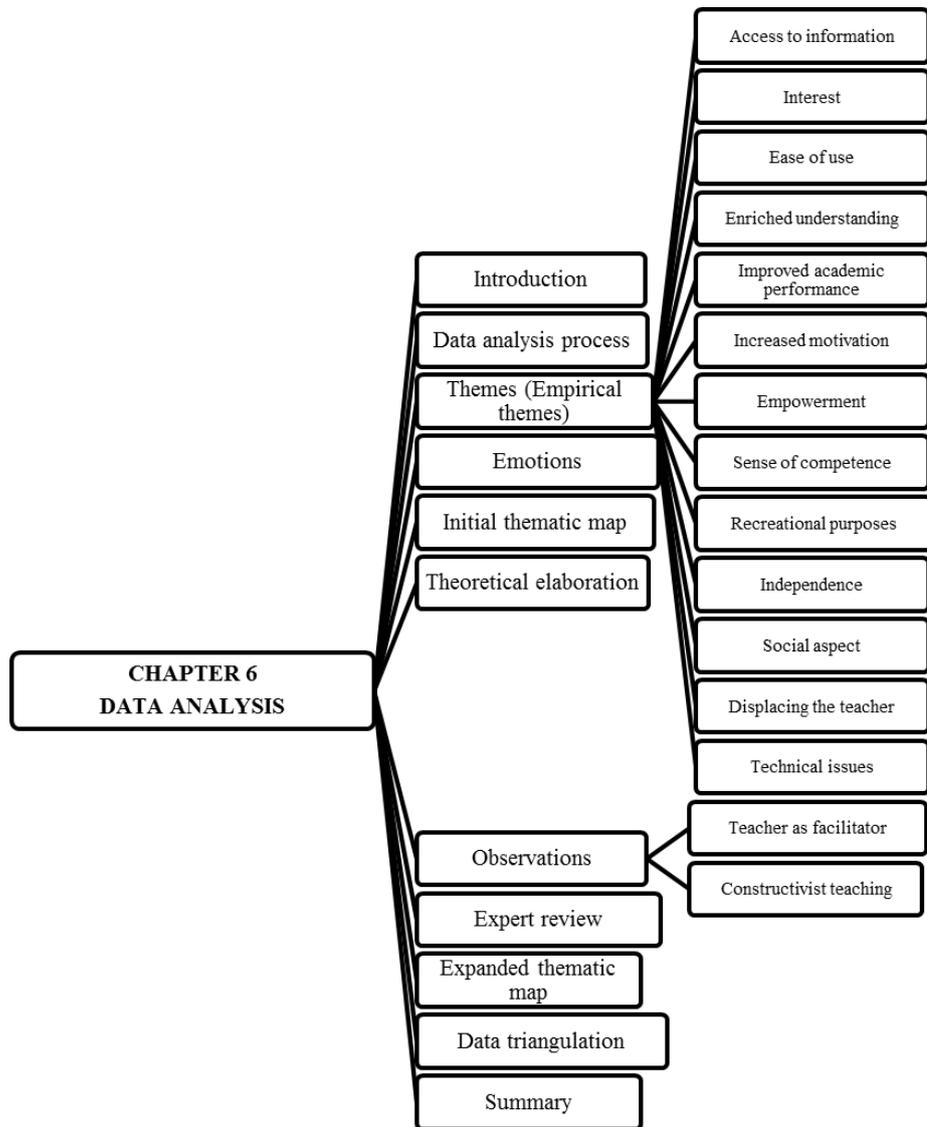
A schematic representation of Chapter 6

6.1   INTRODUCTION

Analysis of data involves making sense of textual or image data by following a process with different phases and steps (Braun & Clarke, 2006; Creswell, 2009; Thomas, 2003). The data needs to be prepared, analysed and then represented so that the reader understands the story the data tells (Braun & Clarke, 2006). It encompasses moving into a deeper understanding of the data and interpreting the data to make sense of the larger meaning of the data (Creswell, 2009).

In Chapter 4 the methodology followed in the study was discussed and the theory of how the research study was carried out was explained. In the methodology chapter the researcher presented the data analysis in terms of decisions made and processes followed during the analysis of the data. In Chapter 5 the actual research results from the data collection process were presented. In this chapter the researcher will be presenting the analysis of the data. This section commences with the process followed in data analysis, discussed in the form of a diagram and description in section 6.2. The empirical themes which emerged from the interviews are presented in section 6.3. The emotions identified during the interviews are reflected upon in section 6.4. An initial thematic map, which serves as a graphical representation of the themes, is presented in section 6.5. Important concepts from the literature which emerged in data analysis are discussed in the theoretical elaboration in section 6.6. Themes which arose during the analysis of the classroom observations are presented in section 6.7. An expert review of the physical artefact of the learners, as conducted by an educational psychologist, is presented in section 6.8. Finally, in section 6.9, the expanded thematic map includes all themes from empirical evidence as well as the expert review. The way in which *data triangulation* was achieved, is discussed in section 6.10. A summary highlighting the essentials underlying the data analysis is presented in section 6.11.

6.2   DATA ANALYSIS PROCESS

The diagram represents the process followed in the analysis of the data (*cf* figure 46). The data collection initiated the process, which involved the individual activity with the learners (physical artefact), followed by interviews with the learners and then interviews with the teachers.

Figure 46: DATA ANALYSIS PROCESS DIAGRAM
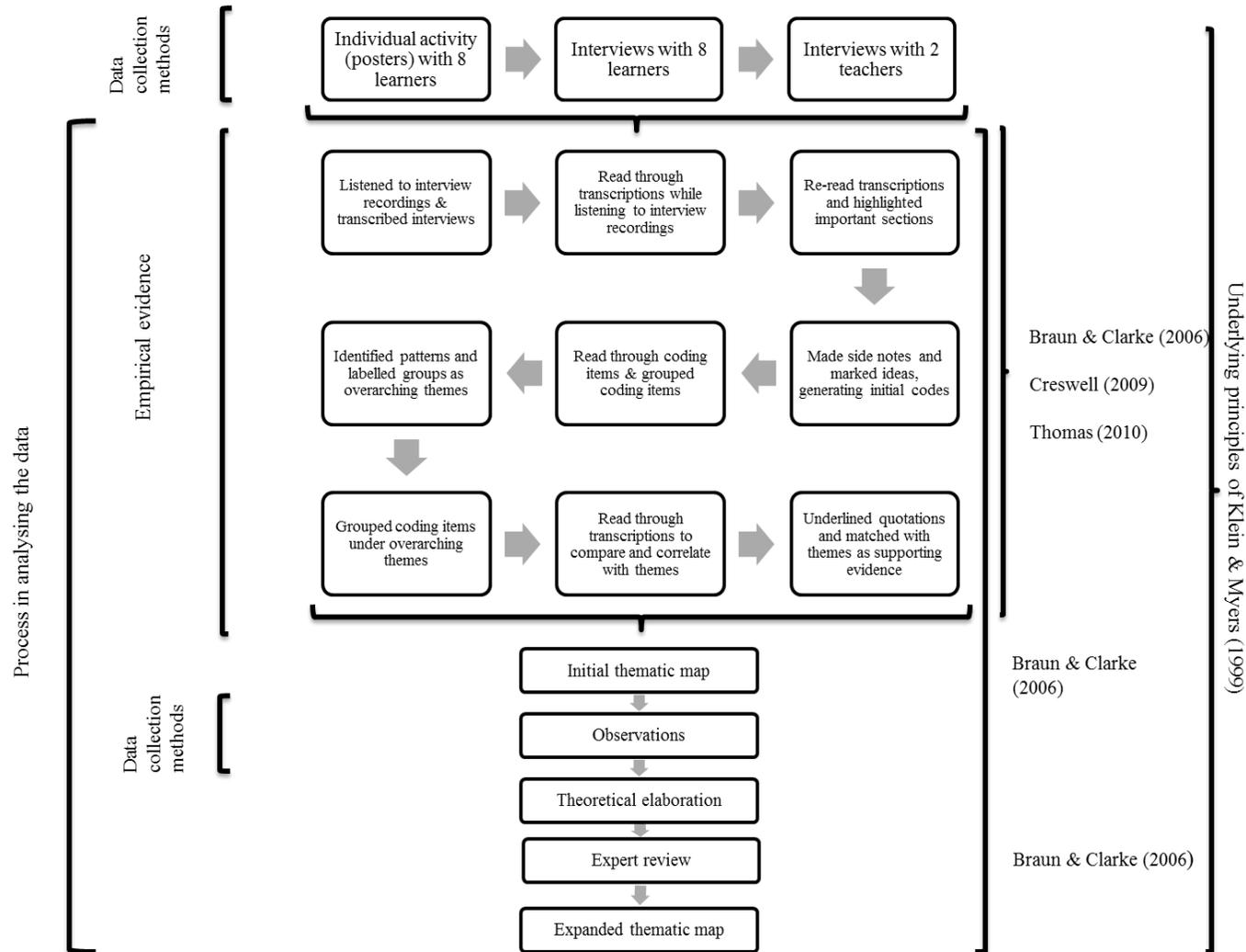
6.2.1   THE PROCESS

As depicted in the diagram (*cf* figure 46) the empirical evidence was made up of the interview recordings which the researcher listened to and then transcribed. These transcriptions were read through whilst listening to the recordings again. The transcriptions were re-read and important sections were highlighted. Margin notes were made and ideas were marked as a process to generate initial codes. The coding items were then read through and the coding items were grouped together.

6.2.2   THEME IDENTIFICATION

Patterns were identified and those groups of patterns were labelled as overarching themes. Coding items were grouped under the overarching themes. The transcriptions were read once again and compared and checked against the themes. Quotations were underlined and matched with themes as supporting evidence. The identified themes were then represented in a thematic map, which also portrayed the interrelatedness of the themes. The observation notes were read through, and the researcher presented a summary of the classroom observations. Important themes were identified from the observation notes and added to the thematic map.

The layout of this chapter follows more or less the same structure as the diagram of the data analysis process (*cf* figure 46).

6.3   THEMES (EMPIRICAL THEMES)

In this section the main themes emerging from the empirical evidence are conveyed and discussed (*cf* section 6.3.1 to 6.3.13). The empirical evidence was presented in Chapter 5. The process of *theme identification* started off with a wide angle and the wide lens was then narrowed down, as explained in the process followed above (*cf* sections 6.2.1 and 6.2.2). Following the thematic analysis, a total of 13 themes (*cf* sections 6.3.1 to 6.3.13) were identified. These themes addressed evidence sprouting from the physical artefact and interviews with learners and teachers. The main themes are reported upon in a discussion which is followed by direct quotations from either learners or teachers, as supporting evidence of each theme. The researcher acknowledges that the teachers' and learners' responses are quoted verbatim and therefor certain language errors are thus unavoidable.

6.3.1   ACCESS TO INFORMATION

One of the most prominent themes, emanating from both the learners and teachers, stated that the tablet provided them with access to information. As a result of a resource constrained

environment as context, this information was inaccessible previously. Although the school has a library, the books are very dated and not relevant. The available resources had no link to the real world context. Resources such as previous question papers, memorandums, quizzes, demonstrations, educational videos and educational games provide such a link and access to these is made possible with the tablet. The school has a content server, to which the teachers and learners have access, which provides them with educational resources at their fingertips.

"...it makes you broad minded because it gives you information..."

"...my tablet is more like I have all the information I need, it's more like everything in one, everything is there, all the information you need is there..."

"...so when I don't know something or when I google a word, I can go to my tablet and google whatever I want, so it is very useful to me..."

"...it means I can get information wherever I am..."

"...it contains information that is not in the textbook..."

6.3.2   INTEREST

The tablet has invoked an interest among the learners to learn. Many learners reported that since having the tablet they have been doing extra, in terms of effort and time towards their studies. Learners refer to textbooks as being boring and making them feel tired and lazy. Teachers concurred by relating textbooks with drowsiness and apathetic learners. The tablet has brought about a focus in their studies and in their general educational experience. Learners are spending more time with their studies, at home and in their free time. Teachers reported a willingness and enthusiasm among the learners to learn.

"...using this tablet makes me to be more confident and also be interested in wanting to learn..."

"...it changed a lot like I no longer get bored..."

"...before we used tablets, I didn't have interest in books but now even when I am everywhere I just put on my tablet and read that book and everything for science, I like reading that book physical science and mathematics, more interested in subjects..."

"...I can read even if I am at town or on a taxi, before I didn't carry a textbook but now I carry a tablet..."

"...these learners they are very much willing to work on the things [tablets] so they are more interested in learning than before..."

6.3.3 EASE OF USE

It was reported that tablets promote *easy learning* as it makes many things easier. Instances in which the tablet makes things easier include taking photos of the teacher's work on the blackboard, quick and effective access to information, recording the teacher in class and it is lighter to carry around than a schoolbag full of heavy books. The learners seem to be impressed with the tablet's convenience and time saving characteristic. It transpired that the tablet creates *the illusion of being easier* because it is less cumbersome and requires less effort.

"...requires less time, unlike textbooks, it is not heavy, it does not take long to find information..."

"...I can't find any information in my textbook I use my tablet to search some things, unlike textbook I don't have to spend much time trying to page every single page, I just click where I want..."

"...at class I don't write a lot I just take photos for example diagrams which I can't draw which waste a lot of my time, I just take a photo of it and I can even record the teacher while teaching..."

"...it has made things a lot easier...it is boring to look at textbooks...not heavy, I can take it wherever I am..."

"...I don't have to carry a schoolbag full of textbooks...there is no such thing like being worried that this thing is going to be heavy for my..."

6.3.4 ENRICHED UNDERSTANDING

The learners' understanding is enhanced and augmented with the use of tablets as it provides the ability to see how things are done through educational videos, examples, demonstrations and memorandums with steps which demonstrate how to get to the answer. The ability to understand better has a direct impact on the learners' self-confidence and capabilities, as discussed in one of the following themes. Another activity which leads to an enriched understanding includes recording the teacher in the class whilst teaching and replaying the video at home. This creates the opportunity for learners to grasp things in their *own time* and at their *own pace*.

The option of practicing and revising old question papers, completing quizzes and having access to memorandums which serve as an example, also contribute to a better understanding. Overall a better understanding of the work adds to the learners feeling 'equipped' to actively participate in their education. The access to quizzes, previous question papers and memorandums serves as a preparation tool which assists the learners in preparing for tests and examinations, which in the long run, prepares them for the future. Both teachers and learners mentioned that with the tablet they have access to summaries of work and this also improves understanding. The continuous building of knowledge also contributes to a better understanding.

"...it makes you broad minded because it gives you information..."

"...I have now understood some of the things which I never understood at first when I wasn't using a tablet..."

"...having the tablet you will be able to see how it is done you know and understand it a bit more..."

"...I never understood them but since I received the tablet I now understand them, now I can improve my results..."

"...and they do not understand, I can just project that app and demonstrate all those things and then they will understand better by seeing it..."

6.3.5   IMPROVED ACADEMIC PERFORMANCE

Learners and teachers all commented on the improvement in learners' academic performance due to the introduction of the tablet. They reported that the tablets have improved schoolwork in terms of better performance. The improvement in performance is due to having access to resources such as textbooks, question papers, memorandums, videos, quizzes etc. The tablet assists learners with their homework and homework plays an important role in achievement. The ability to review recordings made of the teacher in the class at home, in their own time, at their own pace and without any disruptions, contributes to a better understanding which in turns contributes to improved academic performance.

"...my Maths was very poor but since I got my tablets I improved and my Physical Science and my vocab..."

"...we have written test and I have seen some improvements..."

"...it has helped me to improve my studies..."

"...do better because understand better, better marks..."

"...in terms of percentage they have improved...improvement on my subject..."

6.3.6   INCREASED MOTIVATION

Since using the tablet the learners have reported being more motivated than before using the tablets. The teachers supported the learners' statements that motivation has increased. Increased motivation sprouts from being more interested in schoolwork. Learners reflected that since they have been using the tablets they have been working harder, putting in more effort and more time. The want to learn and do extra in terms of their studies is a true reflection of being motivated. Participating in quizzes and practising previous question papers has an impact on motivation as it motivates them to do better every time and to achieve better marks and answer questions correctly.

"...I can say determination, also self-motivation, working harder now..."

"...I want to work hard, use my tablet efficiently..."

"...doing extra, doing more than use to..."

"...more motivated, as I said earlier, I just want to use it..."

"...more motivated because it contains lot of information and it makes me know that technology can help me..."

"...I become perfect when I use it better and better..."

"...they are spending much time doing their schoolwork because there are quite a number of ways they are getting the content..."

"...they are more motivated because now there is not much separating them from model C schools when it comes to technology because even people from Queens College come here to interview them [learners] to find out how things are coming on...they feel like they are the ones leading the way in technology..."

6.3.7   EMPOWERMENT

The way in which the tablet equips learners with skills empowers them. Having the tablet empowers the learners to take control of their own education and therefore their future.

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Learners trust that the tablet will impact upon their future. The learners reported that the tablet empowers them to be successful as it opens doors which were not open before, and the use of the tablet provides them access to opportunities. The tablet also creates an opportunity for change and improvement as it improves decision making regarding their career choices and future.

Having the tablet constructs a sense of responsibility as learners realise that they have some control as regards their learning experiences. They are taking ownership of their education. This sense of ownership is carried further in their use of the word "my" when referring to their tablet.

Coming from a rural area with no library and almost being cut off from the outside world, the learners felt strongly about the tablet's ability to create possibilities and opportunities for them. Having a tablet exposes them to the outside world and serves as a link to reality. Learners also compared themselves to learners in other schools, and this brought about feelings of importance and belonging as they felt they were setting the standards in the community.

"...to me the tablet represents the power of quality education, even in villages..."

"...chat with important people, like people who can help me, like I saw a NMMU website where I can see necessary information about a career I want to choose..."

"...tablet is home for the biggest change..."

"...road to success, then I wrote a brighter future for future generation, this means that through using tablets we can be successful because now we find information easy, more especially we are from rural areas you know we are far from libraries..."

"...these tablets are building our future and they help to build the future for the next generations..."

"...it makes me think that one day I can be a better person, just holding one thing with lot of information..."

6.3.8 SENSE OF COMPETENCE
The use of the tablet has fostered a sense of *self belief* in the learners. Belief in themselves that they are capable of achieving things they thought impossible or things which they considered outside their frame of reference. The ability to do things and be equipped with skills boost

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learners' confidence and their self-worth. Having the tablet provides the learners with skills which increase their capabilities. These capabilities which the learners become aware of create hope, hope in themselves and hope for their futures. In return this hope enforces self-belief. The tablet acts as an *enabler of competence* for the learners and serves as an assurance for the future.

"...using this tablet makes me to be more confident..."

"...It makes me a better person, I see myself as a person now that I have a tablet I see myself as a person who is now able to understand things..."

"...it gives me hope that I can pass when I am writing exam..."

"...I can achieve great things with my tablet..."

"...the only ones who were given the tablets, this makes me feel like I am important..."

"...it gives me hope that one day I can do things, I can know how to put information together in one thing and that one day I can be somewhere because of the tablet..."

"...tablets advantage, to become perfect and pass..."

6.3.9   RECREATIONAL PURPOSES

The learners reported using the tablets for recreational purposes. It emerged that since having the tablets the learners spend their free time more wisely and constructively. The learners use the tablets for educational games, other games and listen to music for relaxation. Learners now have access to games like chess, which they did not have prior to the tablet and such games equip them with problem solving skills. In this manner learning is almost coincidentally stimulated. Some learners reported that having the tablet, which keeps them occupied and stimulated, keeps them out of trouble.

"...I don't go to my friends most of the times, I don't waste my time going to   my friends chilling with friends, now my tablet serves as a friend, so I sit down press my tablet to whatever listen to music, read, do poems and all that..."

"...it has educational games and sometimes when I am free and I don't have any homework or maybe I am done with my homework, I play games maths, physics and chemistry..."

"...it has helped me socially, when I don't feel like studying, I just use it to play music, helps to relax..."

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"...I play chess just to relax..."

"...even at home I don't go hanging with my friends or just hang by the shops, I just play with my tablet, watch videos or as I said earlier answer the past question papers..."

"...when I am bored at home I no longer go on the streets..."

6.3.10 INDEPENDENCE

The tablet fosters independence among the learners. Having a tablet creates circumstances in which a learner is not dependent on a teacher, a classroom or on a school for his/her education to continue, as it is not bound to any of these factors. The tablet creates a learning environment which reaches beyond the classroom walls. The mobility of the device makes it possible to learn *outside* the school building and *outside* school hours. When a teacher is absent, they can commence and continue with schoolwork and activities. It provides them with the prospect of learning at their own pace and in their own time. When they had difficulty grasping some concepts in class, they have the opportunity to study at home at their own pace. With this freedom comes the challenge to act in control of such expectations.

"...if a teacher is to be absent you can download a video and have a lesson when my teacher isn't around..."

"...free extra lessons at home..."

"...recording the teacher while teaching is the most important because when you are at home, if you have forgotten you try to play that video to remember what has been said because sometime we don't manage to keep everything..."

"...we are able to practise without even consulting the teacher..."

"...I am free when there is no teacher I am not scared, I can take my tablet and work..."

"...if I don't understand I check in my textbook and if it doesn't help then I go to my tablet and I click and I find the information it is not like before when we didn't have tablets and we have to ask every time go to the teachers asking them ..."

"...explaining concepts on their own by themselves..."

6.3.11 SOCIAL ASPECT

The use of the tablet brings about a social aspect which was not prevalent before. The learners reportedly work together, helping each other and leveraging on each other's skills. This creates

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a sense of belonging as leaners now have the opportunity, and/or ability to add some value and play their part in bringing some knowledge to the table through showing and assisting each other. It encourages group work and promotes social skills as learners are sharing and interacting. It provides an environment in which learners are engaged and this cultivates inclusivity and knowledge sharing.

The other side of the social aspect is the relationship which the learners have with their tablets. This relationship was described by the learners in terms such as friend, boyfriend, best friend, teacher. The description of their relationship with their tablet indicated the fulfilment of needs. The tablet functions as a companion and mainstay. In the learners' description of their relationship with the tablet feelings seem to be built on trust and faith.

"...help others when they need help..."

"...my friend..." ; "...my best friend..." ; "...my boyfriend..." ; "...my teacher..." ; "...my teacher in my pocket..." ; "...a person who can assist..."

"...it encourages group work...they are working together..."

"...able to show other learners that I have a teacher in my pocket..."

"...all engaged, all busy, all feel included..."

"...they are working together and busy explaining to one another, if a learner didn't understand another learner can help another one..."

"...into groups...then they can interact and share how they have done those problems..."

6.3.12 DISPLACING THE TEACHER

Due to the fact that in many cases learners referred to the tablet as a teacher in their pocket, the question arises whether the tablet can replace the teacher or whether the teacher is still needed in the classroom. Some learners held the view that the tablet can replace the teacher but others felt that the teacher was still needed to provide assistance. This view displaces the role of the teacher and the role of the teacher becomes that of a *facilitator*.

"...I can say my tablet is my teacher because my teacher is in my pocket..."

"...when I am doing maths, I will see the sum and how it is done this way and this way and that way, but then I will also need some assistance..."

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"...we don't have to be told by a teacher only..."

"...it teaches things the teacher didn't teach us, the tablet can teach me..."

6.3.13 TECHNICAL ISSUES

Problems with the network led to feelings of frustration. When the network gives problems and the learners became frustrated, they would relay this feeling as being bored. Problems with the network led to strong negative feelings and this is the only negative feedback among the different themes.

"...angry when flat or because of the network..."

"...I sometimes feel hopeless when I am struggling with network or Wi-Fi, tablet is refusing to download..."

"...disappointed...sometimes obviously when trying to download, the network problems..."

"...struggle to get access to internet..."

"...disappointed with network problems..."

"...I hate that sometimes I want to download a video but it disagree and it don't want to be downloaded and then the internet disagree..."

6.4   EMOTIONS

The following emotions emerged from the interviews with the learners. They are tabulated (*cf* table 18) to demonstrate the *emotion*, the *relation of the emotion to the questions* asked in the interview and the *occurrence* of that emotion among the learners.

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Emotion	Relation of question	Occurrence (out of 8)
Enjoyment	Do you enjoy using the tablet?	8
Hope	Do you have hope in using the tablet?	8
Confidence	Do you feel confident using the tablet?	8
Happiness	Do you feel happy when using the tablet?	8
Pride	Do you feel proud of your tablet?	8
Relief	Do you feel relieved when you are able to achieve something with you tablet?	8
Appreciation	Do you appreciate your tablet?	8
Thankfulness Gratefulness	Do you feel thankful and grateful to have a tablet?	8
Helping of others	Do you help others with their tablets?	8
Love	What do you love about your tablet?	8
Excitement	Do you look forward and get excited when you are going to use the tablet?	7
Sadness	Do you feel sad when you do not achieve something on the tablet?	7
Admiration and Respect	Do you admire and respect how others use their tablets?	7
Hate	What do you hate about your tablet?	7
Satisfaction	Do you feel satisfied when you achieve something on you tablet?	6
Disappointment	Do you feel disappointed when using your tablet?	6
Difficult	Do you sometimes feel that using the tablet is difficult?	5
Boredom	Do you get bored while using the tablet?	3
Anger	Does your tablet make you angry?	3

Stressed	Do you feel stressed about using the tablet?	2
Dislike	Do you dislike how others use their tablet?	2
Hopelessness	Do you sometimes feel hopeless about using the tablet?	1
Worry	Do you feel worried about using the tablet?	1
Shyness	Do you feel shy using your tablet?	1
Annoyance	Does your tablet annoy you?	1
Irritated	Does your tablet irritate you?	1
Disapproval	Do you disapprove of how others use their tablets?	1
Impossible	Do you sometimes feel that using the tablet is impossible?	0
Uselessness	Do you sometimes feel that using the tablet is useless?	0
Anxiousness	Do you feel anxious about using the tablet?	0
Nervousness	Do you feel nervous about using the tablet?	0
Embarrassment	Do you feel embarrassed using your tablet?	0
Ashamed	Do you feel ashamed using your tablet?	0
Jealousy/Envy	Do you feel jealous or envious of others with their tablets?	0
Hate	Do you hate how others use their tablets?	0

To summarise the findings of the previous table (*cf* table 18), the following conclusions can be made from the data:

- **100%** of the learners experience the following emotions: enjoyment, hope, confidence, happiness, pride, relief, appreciation, thankfulness/gratefulness, helping others, love.
- **87,5%** of the learners experience the following emotions using the tablet: excitement, sadness, admiration and respect, hate.
- **75%** of the learners experience satisfaction and disappointment.
- **62,5%** of the learners experience the following emotions using the tablet: difficulty.
- **37,5%** of the learners experience the following emotions using the tablet: boredom, anger.
- **25%** of the learners experience the following emotions using the tablet: stress, dislike.
- **12,5%** of the learners experience the following emotions using the tablet: hopelessness, worry, shyness, annoyance, irritation, disapproval.
- **0%** of the learners experience the following emotions using the tablet: impossible, useless, anxiousness, nervousness, embarrassment, shame, jealousy/envy, hate.

Although the focus of this study is not on whether the emotions experienced are positive or negative, it is interesting that positive emotions were markedly more common, *cf* table 18.

Table 19 presents other emotions, feelings, attitudes and views which were not related to specific questions as in the previous table (*cf* table 18). These emotions and feelings presented themselves throughout the data.

Table 19: OTHER EMOTIONS, FEELINGS, PERCEPTIONS AND VIEWS

	Occurrences
Emotions and feelings	
Interested, interest, interesting	31
Love	23
Hope	23
Happy	17
Motivated, motivation	14
Sad	13
Excited, excitement	12
Proud	12
Confident	11
Enjoy	10
Blessed	2
Honoured	1
Privileged	1
Attitudes and views	
Helpful, help, helps	44
Easy, ease	15
Able	15
Save time, time, quickly	11
Useful	7
Influential	3
Relationship	
My teacher, my teacher in my pocket	10
My friend, my best friend	3

The majority of participants reported that working with the tablets were more interesting than the previous learning process in which tablets were not present. *Teachers and learners* reported that learners are more interested in schoolwork because of the tablets. Another very prominent view was that the tablets help them and is considered *helpful* in terms of schoolwork. Most of these emotions, feelings, attitudes and views have been covered in the discussions of the themes

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(*cf* section 6.3). This table (*cf* table 19) merely serves as an alternative representation to some of the responses.

6.5   INITIAL THEMATIC MAP

Figure 47 represents the themes identified during the first part of data analysis (*cf* section 6.3). These themes were derived from the physical artefacts produced by the learners and interviews with learners and teachers, as previously stated (*cf* section 6.3). The initial thematic map is expanded with additional themes after these had been identified in the analysis of the observation data, *cf* section 6.9.

Figure 47: INITIAL THEMATIC MAP
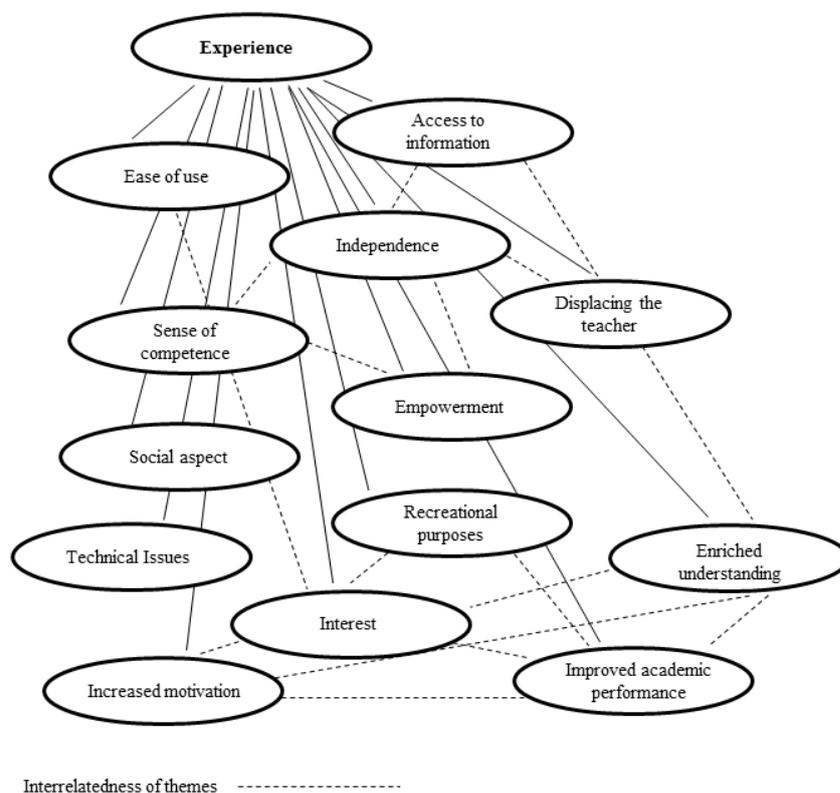
This initial thematic map (*cf* figure 47) illustrates the different themes identified in thematic analysis. The map further illustrates the interrelatedness of the themes, demonstrating the direct influence and relationship which one theme has with another. This interrelatedness of themes was established when the researcher was studying the data.

Interest, as a theme, relates to increased motivation, improved academic performance, enriched understanding, recreational purposes and ease of use. Due to learners being more interested,

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learners' motivation to learn has increased, which in return has improved their academic performance. Due to learners' enriched understanding of the work, their academic performance has also improved. Interest in the tablet has further led to learners using their tablet for recreational purposes. The ease of use of the tablet has made learners more interested in using it.

Access to information relates to enriched understanding and independence. Having access to information has led to an enriched and improved understanding of schoolwork. Access to information has made learners more independent as they do not have to rely on the teacher solely as a source of information.

Independence relates to a sense of competence, empowerment and displacing of the teacher. Being independent has fostered the sense of competence as learners feel they are more able to achieve things. Independence gives rise to feeling empowered as they are able to rely on themselves and learners accept responsibility for their own education. As the learner becomes independent, the role of the teacher becomes displaced.

Displacing the teacher relates to independence and access to information. The fact that learners have access to information, other than the information only provided by the teacher, creates independence among the learners and displaces the role of the teacher.

6.6 THEORETICAL ELABORATION

During the data analysis process of the interviews with learners and teachers, it became evident that apart from the themes identified during the thematic analysis process, there exist links between the data and the literature. The researcher deemed it necessary to discuss this correlation as it links to important underlying psychological concepts from the literature. In the theoretical elaboration (*cf* table 20) key concepts in theory were identified and defined, then quotations from interviews with learners and teachers were identified to support and illustrate the link to the literature. This link between the literature and data is also discussed. These concepts are merely *links* between data and the literature and are not considered themes. As the researcher was analysing the data, the links were noted parenthetically. As this study has a psychological perspective, these concepts are interesting and important to take note of. These concepts are discussed in Chapters 2 and 3. A representation of the links is illustrated in table 20:

Theoretical situation		Empirical situation	
Concepts	**Definition**	**Concepts**	**Discussion**
Motivation Motivation to learn	"An internal state that arouses, directs and maintains behaviour/interest in something" (Woolfolk, 2013, p. 430) - *cf* section 2.3.2 "The tendency to find academic activities meaningful and worthwhile and try to benefit from them" (Woolfolk, 2013, p. 454) - *cf* section 2.3.2	"...more motivated..." "...interesting..." "...motivates me..." "...interest..." "...interested..." "...interested in wanting to learn..." "...helps me..." "...I want to work hard and use my tablet efficiently..." "...I no longer get bored..." "...the learners are very much willing to work..." "...more interested in learning..."	Both learners and teachers reported that learners were more interested to learn and that they are more willing to work. Learners find working on the tablets more interesting and they believe that the tablet helps them educationally and socially. All learners reported that with the tablet they are more motivated because they are performing better due to a better understanding of the work and access to rich information.
Extrinsic motivation	"Motivation created by external factors such as rewards and punishment" (Woolfolk, 2013, p. 431) - *cf* section 2.3.2	"...I use the tablet just because my teacher wants me to use tablets, if everyone was not told to use tablets I was not going to use it..."	This learner is motivated to use the tablet because he fears punishment by the teacher.
Intrinsic motivation	"Motivation associated with activities that are their own reward" (Woolfolk, 2013, p. 431) - *cf* section 2.3.2	"...I can read even if I am in town or on a taxi, before I did not carry a textbook but now I carry a tablet, I can get information wherever I am..."	Learners are motivated and interested outside of school and apart from school duties, to learn and use their tablets. They are also more interested as teachers and

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		“...I can say determination and self-motivation, working harder now...” “...I just want to use it...” “...they are doing schoolwork much more than before...”	learners report that they are doing more than before in terms of school work.
Behaviourist teaching	“Directed instruction - a teaching and learning model based on behavioural theories; learners receive information from teachers and do teacher-directed activities” (Roblyer & Doering, 2013, p. 420) - *cf* section 3.2.1	“...I use the overhead projector so everybody will see and I use a laser but then I noticed that most of the learners are drowsy because it is a teacher centred learning method because it is only me who is talking, the learners are the lookers watching TV all keeping quiet looking this way...”	The teacher reported that behaviourist teaching, a teacher centred approach, did not engage the learners or grab their attention. The learners are passively receiving the information from the teacher.
Constructivist teaching	“Emphasis on the active role of the learner in building understanding and making sense of information” (Woolfolk, 2013, p. G–3) “Learners should generate knowledge through experienced-based activities, rather than being	“...I am now able to see some of the examples of how they are done...” “...watch how things are done...” “...if I don’t understand ...I go to my tablet...I find the information, not like before when we didn’t have tablets and we have to ask every time go to the teachers asking them...”	Most learners reported on the benefit of being able to see how things are done, which is made possible through the tablet. Teachers stated that learners are more actively involved and engaged in the activities. They are sharing knowledge, working in groups and building on each other’s ideas. It became evident that the teacher had a role of a facilitator. Learners are creating own knowledge and understanding the

	taught it by teachers" (Roblyer & Doering, 2013, p. 420) - *cf* section 3.4.3	"...we don't have to be told by a teacher only, there are other things that we can get information from..." "...encourages group work..." "...they are working together..." "...explaining concepts on their own by themselves..." "...all engaged, all busy, all feel included..." "...busy explaining to one another, if one learner didn't understand another learner can help..." "...also the way we are teaching them I am trying to teach them other methods like trying to show them how things are done outside with technology...but having them exposed to that they saw that this is something that is possible..." "...we went through training on how to use tablets in classroom so through those new teaching methodologies learners are interacting..." "...then they interact and share how they have done these problems..." "...I can just project that app and demonstrate all those things and then they will understand better by seeing it..."	information and making sense of it through experiencing real world examples, such as demonstrations.

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		"...so they can play around with that app and investigate the functions..."	
Scaffolding	"Support for learning and problem solving" (Woolfolk, 2013, p. G–9) Support is given temporarily in order for knowledge to be acquired - *cf* section 2.3.5	"...still needs a teacher in the class..." "...need the teacher...and the teacher explains..." "...maybe in the video you understand it better than the teacher standing in front of you..." "...but then I will also need some assistance..." "...the tablet is like a person who can assist me..." "...the tablet can teach me..."	It became apparent that this support for learning can be provided by either the teacher or the tablet. When something is unclear, or a learner is struggling to grasp a concept on the tablet, the teacher can assist and support problem solving. When the teacher is absent the learner can proceed using the tablet. When a learner is at home without any support, the tablet serves as a teacher.
Self-concept	"Learners knowledge and belief about themselves; their ideas, feelings, attitudes and expectations" (Woolfolk, 2013, p. G–10) - *cf* section 2.3.3 "What people believe or think about themselves and their main attributes, as well as the positive or negative value attached to	"...my marks have improved..." "...since I got my tablet I improved and physical science and my vocab..." "...I do better than the way I use to..." "...since I received the tablet I now understand them, now I can improve my results..." "...to become perfect and pass..." "...they feel like they are the ones leading the way in technology..."	Learners believe that they have improved, they further believe that this improvement is due to the tablet and the access to information. Having the tablet has cultivated an expectation and belief that leaners are able to pass. Learners report that since using the tablet they have a better understanding and this has led to improvement in results. These beliefs all contribute to an enhanced self-concept.

	these attributes" (Donald et al., 2002, p. 344) - *cf* section 2.3.3		

6.7 OBSERVATIONS

The purpose of the observations, as stated in Chapter 4 in the research methodology, was merely to convey *how* the interaction takes place among the learners, teachers and the tablet in the classroom.

The main format the lessons took on involved the teacher starting with the discussion, explaining concepts on the black board, using a textbook and a study guide. Learners take photos of teacher's notes on the board. The learners are then instructed to switch on the tablets, where after the teacher provide the learners with step-by step guidance to access the work on the content server necessary for the appropriate lesson. The teacher assists learners who are behind with the navigation. The teacher then continues with an example to illustrate to the learners. The learners are then instructed to do the activity. When learners have been given sufficient time to do the activity, the teacher calls upon a learner to demonstrate the activity on the board. Learners then ask questions and teacher gives other learners the opportunity to answer or she assists with clarification. Some learners record the leaner as he/she is demonstrating on the blackboard, using the tablet.

The observation of the interaction in the classroom indicated that the tablet was used to access information and classwork activities on the server, to take photos of notes on the board, to record the teacher and learner explaining and to use the calculator on the tablet. It seemed as though the tablet does not replace any books as learners were writing in their books completing the activity, some textbooks were also visible on learners' desks.

The significance of the observations is discussed in terms of two additional themes, *teacher as facilitator* (*cf* section 6.7.1) and *constructivist teaching* (*cf* section 6.7.2). A discussion of the themes will now follow.

6.7.1 TEACHER AS FACILITATOR

The teacher took on the role of a facilitator, facilitating interaction among the learners and the tablets, by assisting *when* and *where* learners got stuck. Facilitating interaction among the learners as peers also occurred as they asked and answered questions. The teacher also facilitates the interaction taking place among the learners and the information. This facilitation role is supported in the theme of 'Displacing the teacher' as discussed previously in section 6.3.12. The learners' view that the teacher is still necessary to provide assistance is reinforced by this theme. (This theme further relates to the theoretical concepts of scaffolding and the

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Zone of Proximal Development, *cf* section 2.3.4 and 2.3.5). This means the teacher does not primarily build the learners knowledge but the learners also construct their own knowledge.

6.7.2   CONSTRUCTIVIST TEACHING

Constructivist teaching was apparent in that the learners had an *active role* in the lesson, forming part of the teaching and learning activity. The learners build an understanding and make sense of the information by first doing the exercise on their own and then by demonstrating it to the rest of the class. Learners generate their own knowledge by grasping the activity on their own, instead of being taught by the teacher. As explained above the teacher adopts the role of a facilitator. The learners are given the opportunity to individually discover and make meaning of the information. This interactive approach is learner centred rather than teacher centred as the focus is on the learners rather than on the teacher. Constructivist teaching was discussed as a learning theory in the literature review, *cf* section 3.2.3.

This theme was supported in the interviews with the teachers in which they explained the concept of the learners' active role.

 "... I use the overhead projector so everyone will see and I use a laser but then I noticed that most of the learners are drowsy because it is a teacher centred method because it is only me who is talking the learners are the lookers watching TV all keeping quiet looking this way. I am at the back now this tablet I can use in cooperation in the action with the learners so when I say click here, follow...so keeping them engaged and your class will be managed because they will feel..."

 "...When we received that tablets we went through training on how to use the tablets in the classroom. So through the new teaching methodologies learners are interacting a lot, for example in Maths there is that jigsaw type of teaching where I get the learners into groups. Maybe I have 6 groups, then I give 6 different problems in each group…Then I assist them and when I am sure that everyone has done the specific problem in that group, I will release them to join other members of other groups so that they can share...then they interact and share how they have done those problems..."

6.8   EXPERT REVIEW

The expert review involved an educational psychologist reviewing the posters made by the learners in order to identify significant themes per individual poster (per learner) and overall at the end of review process, in the form of a summary. This included any themes which were interesting, significant and were associated with emotions, attitudes and motivation.

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Learner A - This learner appears to be intrinsically motivated and seems to be positive about the tablet. The learner, however, does not discuss any negative aspects of the tablet. This could be done either deliberately or this learner might be naïve and in general unable to see dangers in time. This could also perhaps be that the learner is open-minded and not easily influenced. The feeling is that this learner will apply and use technology as a tool in a positive way.

Learner B - This learner's interest has most definitely been aroused and he/she can see the value of the tablet. This learner wants to use the tablet in difficult subjects and also access more information, such as the reading of books in English, which was not possible before. This learner seems to be very serious about his academics.

Learner C - This poster and comments occur in a balanced and comprehensive way which is possibly a reflection of how the learner operates. Some signs of frustration are present and this learner is not afraid to voice an opinion. The learner summarises and lists both the advantages and disadvantages of the tablet. A few frustrations with the tablet are pointed out. This learner comes across as having good judgment.

Learner D - This learner appears to be well balanced and is not reluctant to pro-actively state his/her opinion. There exists recognition of the advantages of tablets, but negative aspects are called by its name. This learner shows leadership qualities as he/she suggests a solution to the problem and more specifically thorough training in the use of tablets. It seems as though this learner prefers the traditional way of teaching.

Learner E - This learner shows insight and is able to draw relationships. The learner starts off with the former frustrations and recognises how the tablet has positively altered the learning situation. Although this learner does not discuss negative influences, the learner evades it with words such as 'educational toys' instead of 'adult games'. This learner does, however, show a positive attitude towards academics in general and strives to perform well and achieve regardless of the tools available.

Learner F - This learner has the doing of mind maps under control. This learner does not feel threatened or intimidated by the tablet, but the learner does however seem to be frustrated with technical aspects over which there is no control such as availability of network. This learner has the ability to articulate feelings and is not concerned about the dangers of a tablet. Rather the inability of connecting to the network when necessary does cause excessive frustration and even anxiousness for the learner.

Learner G - This learner immediately realised the advantages of the tablet and tries to apply it. This learner seems to be creative, but does like structure and predictability. The overall feeling is that this learner shows inner strength and intrinsic motivation and will apply technology positively in the future. This learner does, on the other hand, seem to be overwhelmed initially by the new technology. This could possibly be due to the lack of thorough training in the use of the tablet. The learner initially feels happy and excited, but only after the learner has been shown the ropes regarding the use of the tablet, the learner realises the value of the technology. Although the learner indicates the advantages of the tablet, the second face drawn, shows something different. It is almost as though the learner does not feel ready for the responsibility to take up the studies more seriously through the use of the tablet.

Learner H - This learner is excited about the advantages of the tablet, such as access to information and the practising of previous exam papers. This learner also likes the fact that he/she is able to see the content visually. This learner does however feel guilty about the dangers of the tablet such as access to pornography. The learner feels guilty because the other learners apparently apply the tablet in a negative way, but possibly does it himself but does not admit it.

In summary, learners should be trained thoroughly in the use and the value of the tablet but should also be informed of its dangers and shortcomings. There appears to exist a positive value among the learners' posters in general, more specifically the learners who can improve their performance through technology as well as enrich themselves, for free and on their own. The tablet is small, compact, light weighted and a great source of information in schools where there is, for instance, no library. The tablet can be used outside school hours and provides the learner with the freedom and the opportunity to obtain traditional content in many different ways, such as practising previous question papers. The dangers of pornography and lack of proper and thorough training in the use of the tablet, does raise concern. It could possibly be useful to make use of a deterrent such as warning the learners that the supplier is able to view what learners have accessed. Learners should also be informed regarding the use of the tablet to discourage that it is only used for photos and games for instance. Technical support should be provided to help relieve the frustrations associated with technical problems. The presumption exists that learners are overwhelmed by the tablet but this could be due to them only having it at their disposal in Grade 12.

Table 21 presents how the expert review supports themes identified in section 6.3. The theme will be named on the left side of the table with the expert's quote on the right.

Theme	Expert quote
Access to information	"...source of information..." ; "...opportunity to obtain information in many different ways..." ; "...such as access to information and the practising of previous exam papers..." ; "...access more information, such as the reading of books in English, which was not possible before..." ; "...great source of information in schools where there is no library for instance..."
Interest	"...learner's interest has most definitely been aroused..." ; "...learner wants to use the tablet..."
Ease of use	"...tablet is small, compact, light weighted..."
Improved academic performance	"...a positive value among the learners' posters in general, more specifically the learners who can improve their performance through technology..."
Increased motivation	"...this learner shows inner strength and intrinsic motivation and will apply technology positively in the future..." ; "...learner appears to be intrinsically motivated and seems to be positive about the tablet..."
Empowerment	"...improve their performance through technology as well as enrich themselves, for free and on their own..." ; "...provides the learner with freedom..."
Independence	"...tablet can be used outside school hours..." ; "...provides the learner with freedom and the opportunity to obtain traditional content in many different ways..." ; "...on their own..."
Technical issues	"...could possibly be due to the lack of thorough training in the use of the tablet..." ; "...the inability of connecting to the network when necessary does cause excessive frustration and even anxiousness for the learner..." ; "...he suggests a solution to the problem and more specifically thorough training in the use of tablets..." ; "...technical support should be provided to help relieve the frustrations associated with technical problems..."

The expert review further supports emotions identified (*cf* section 6.5), which are experienced as a result of using the tablet such as happiness, excitement, enjoyment (like), frustration and

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anxiety. Additionally, the expert review supports attitudes perceived by learners and teachers such as that the learners value the tablet, they are interested in the tablet and want to use it, they realise the advantages the tablet can provide to their education and in general the learners have a positive attitude towards the tablet.

6.9 EXPANDED THEMATIC MAP

In this expanded thematic map all themes identified in data analysis as a whole are represented (*cf* figure 48). In addition to the initial thematic map, (*cf* section 6.5), this map includes themes identified in the analysis of the observations, including teacher as facilitator and constructivist teaching.

Figure 48: EXPANDED THEMATIC MAP
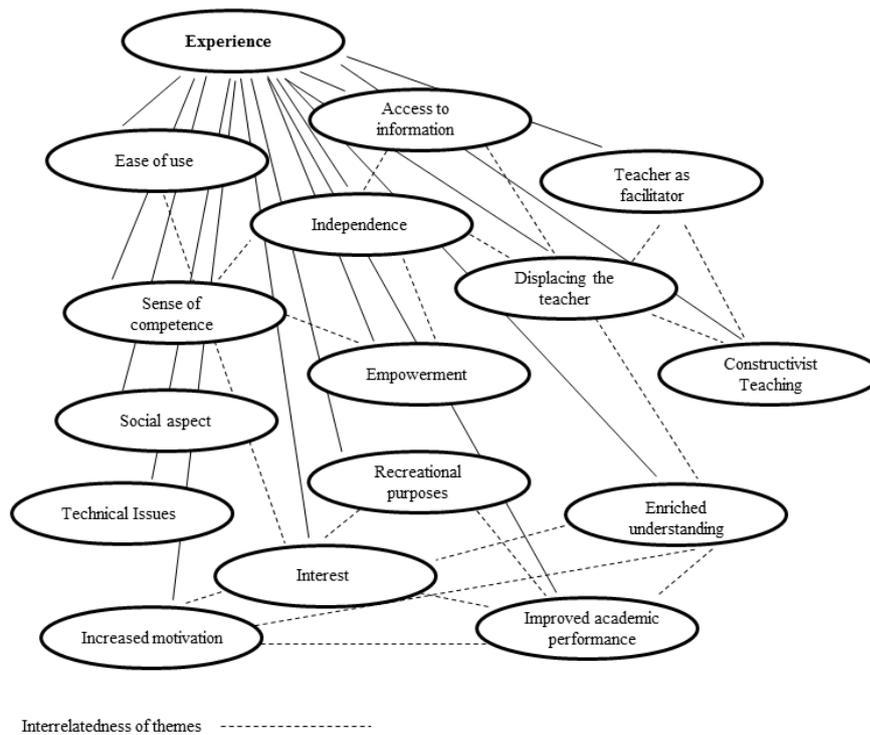
6.10 DATA TRIANGULATION

Triangulation is a strategy to ensure *trustworthiness* of the data (Decrop, 1999; Leedy & Ormrod, 2005; Morse et al., 2008). It entails considering the same research question or same phenomenon from more than one source of data (Decrop, 1999). When information comes from different angels it supports, elaborates and illuminates the research problem (Decrop, 1999). Data was triangulated as it was sourced from the physical artefact, interviews with learners, interviews with teachers and observations. Triangulation of data was achieved by the

researcher engaging in different data collection methods to look for common themes. The expert review of the educational psychologist further ensured the trustworthiness of the data. The initial thematic map (*cf* section 6.5) and expanded thematic map (*cf* section 6.9) represent the common themes found across the data collection through the analysis of the data.

6.11 SUMMARY

This chapter presented the analysis of the data. The section commenced with the process followed in data analysis, which was discussed in the form of a diagram and description in section 6.2. The empirical themes which emerged from the interviews were presented in section 6.3. The emotions identified during the interviews were reflected in section 6.4. An initial thematic map which served as a graphical representation of the themes was presented in section 6.5. Important concepts from the literature, which emerged during the process of data analysis, were discussed in the theoretical elaboration in section 6.6. Themes which arose during the analysis of the classroom observations were presented in section 6.7. An expert review of the physical artefact of the learners, conducted by an educational psychologist, is offered in section 6.8. Finally, in section 6.9, the expanded thematic map, which included all the themes from empirical evidence as well as the expert review, was presented.

CHAPTER 7 – FINDINGS AND CONCLUSION
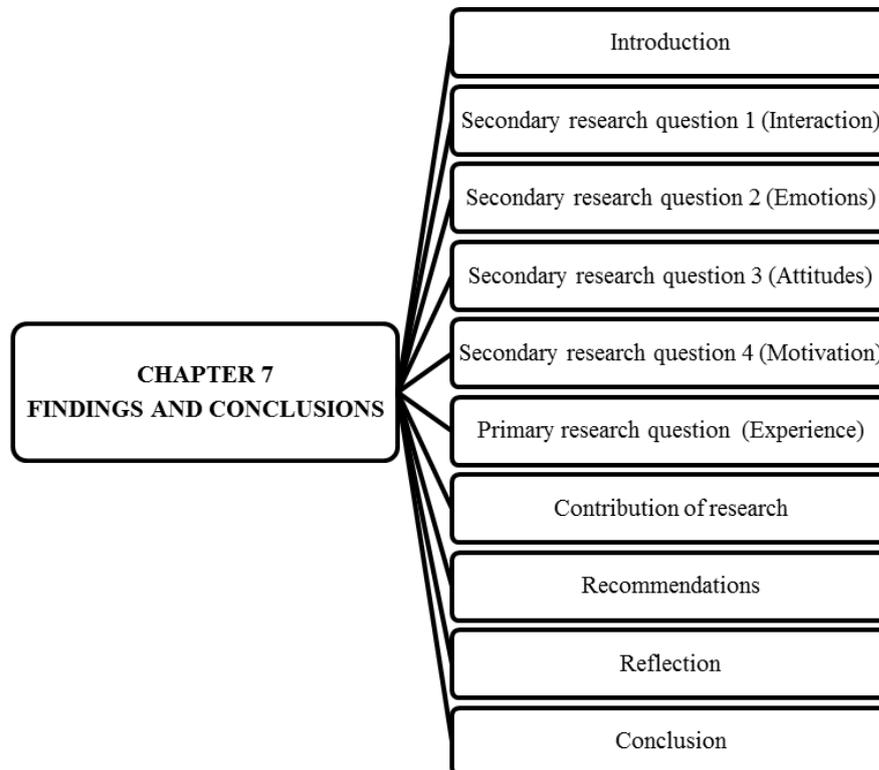
A schematic representation of Chapter 7

7.1 INTRODUCTION

The previous chapters lead up to this, the final chapter of the research study. The *introduction* set the scene and sketched the background for this study. The *literature review* dealt with all important literature, significant in informing the researcher and pivotal in answering the research questions. The *research methodology* included the plan of how the research study was conducted. The *research results* chapter was, in essence, a presentation of the data collected in the study. The collected data was interpreted and an analysis of the data was presented.

This final chapter includes the findings and conclusions derived from the research study. In addition, this chapter addresses the four *secondary* research questions which lead to the answering of the *primary* research question.

As the research study draws to its conclusion, it is important to restate the purpose, objectives and research questions of the study to evaluate whether they have, in fact, been achieved and answered (*cf* sections 1.2.1, 1.2.3 and 1.2.4).

The purpose of this study is to determine how user experiences (emotions, attitudes and motivation) of learners are influenced by the use of tablets in teaching and learning in a rural school in the Eastern Cape Province. As soon as these user experiences of learners with tablets are defined, it can serve as a guide to support teachers in ensuring that the emotions, attitudes and motivations experienced by their learners, contribute to the improvement of the overall teaching and learning environment.

The following objectives were set toward addressing the purpose of this study:

− *Describe* the specific uses and applications of tablets in rural schools.

− *Understand* how tablets are incorporated within the teaching process in senior secondary schools in a rural context.

− *Identify* emotions, attitudes and motivations which arise when learning is mediated by technology (such as tablets) in school.

− *Demonstrate* how to incorporate Activity Theory and User Experiences as a conceptual framework for technology-facilitated learning.

The primary research question is: *how do learners experience technology-facilitated learning in a resource deprived environment?* In order to fully explore the primary research question, the following secondary research questions need to be addressed: How does interaction occur among the tablet, learner and teacher? Which emotions do learners experience when learning is facilitated by technology? What are learners' attitudes toward the use of tablets in school? How does the use of tablets motivate leaners in school?

7.2 SECONDARY RESEARCH QUESTION 1 (INTERACTION)
The first secondary research question is: "How does interaction occur among the learner, the teacher and the tablet?"

The first generation of Activity Theory (*cf* section 2.2.1) involved a subject *acting on* an object using a tool to arrive at an outcome. This generation of Activity Theory can be applied in this study to discuss the interaction with the tablet, as the learner (subject) is acting on learning (object) using a tool (tablet) to arrive at a specific outcome. The focus is on the subject and the object, the learner and learning. When interacting, the learner is continuously learning and

growing as he/she is interpreting and reinterpreting the learning process. As the first generation of Activity Theory did not take into account the environment and the relationship with the individual, Engeström expanded this generation of Activity Theory.

The technology-facilitated learning relationship

For this study of technology-facilitated learning the relationship, according to the Activity Theory (based on Engeström's Activity Theory Model in Hardman, 2008), is as follows:

– *Subject*: the focus of the study and the doer with a purpose which, in this case, refers to the learner (*cf* figure 49, block a).

– *Object:* is the intention which motivates the activity, refers to the problem space that the teachers and learners are working in, in this case it refers to learning (*cf* figure 49, block b).

– *Tool*: helps convert the object into an outcome, refers to the tablet used to facilitate learning in the classroom (*cf* figure 49, block c).

– *Rules*: the rules guide the actions, the rules are the norms, obvious and unspoken customs, standards, agreements and social interactions which are acceptable in the classroom (*cf* figure 49, block d).

– *Community*: the community comprises of the teacher, learner and peers who work together to achieve the outcome and interactions between the different parties (*cf* figure 49, block e).

– *Division of Labour*: involves the way in which the responsibilities and tasks are assigned, both at a horizontal and vertical level. It refers to *who is doing what* in the problem space. On a vertical level it involves the teacher instructing learners on what to do, it also views the teacher as acting in a facilitating capacity. On a horizontal level it involves the learners and peers working together, interacting and engaging with one another and sharing knowledge as learners are demonstrating, reflecting, asking and answering questions among each other. It is important to note that, although technology has been introduced as a mediating artefact, the role of the learner remains to *learn* and the role of the teacher remains to *teach* (*cf* figure 49, block f).

– *Outcome*: the outcome is the end result which is aimed for by the subject, this refers to the learning outcome to be achieved by the learner (*cf* figure 49, block g).

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Figure 49 illustrates the discussed relationship.
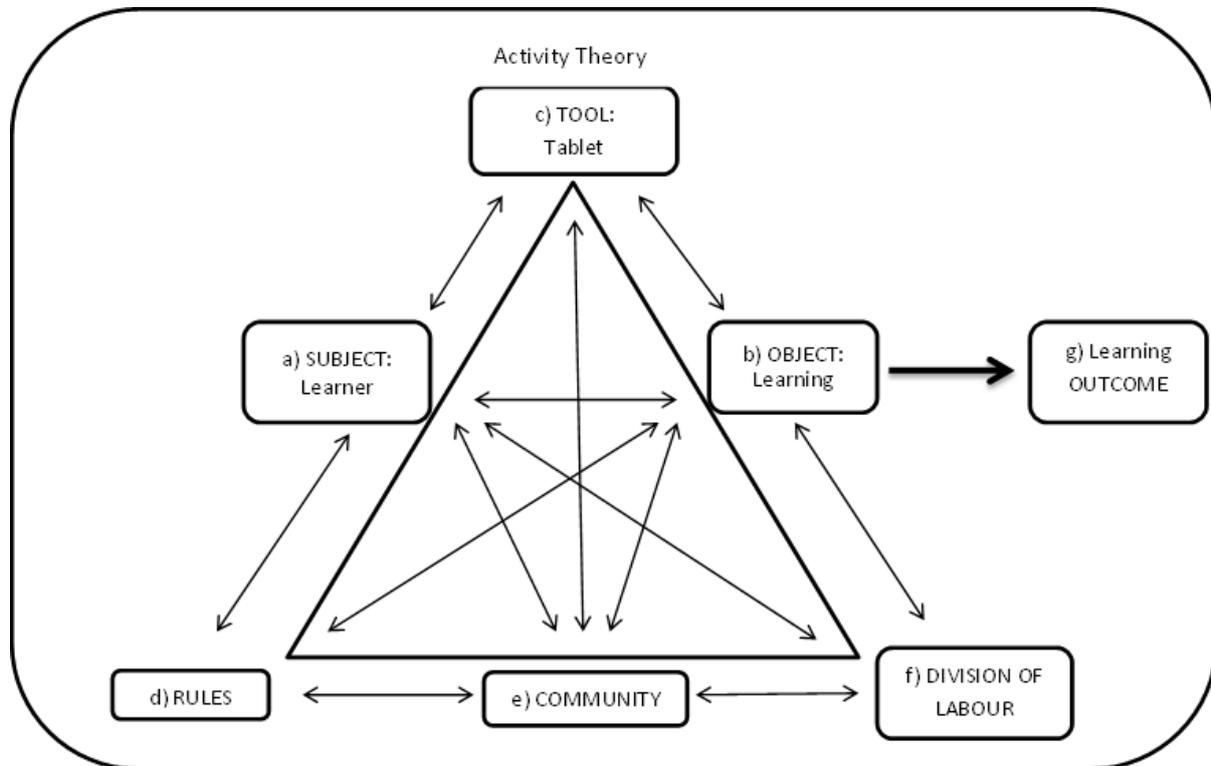
Adapted from Engeström (1987)

The rules, community and division of labour in the classroom produce the *activity context*. This activity context influences the learner, as the subject. The *subject* is the *doer*, in this case the subject refers to *the learner*. The *object* is the *purpose*, in this case the purpose is *learning*. An activity is driven by a motive, this entails that for a learner to engage with and focus on the activity he/she needs to be driven by a motive. This is where the motivation of the learner plays a role. The motivation of the learner, and how it is influenced by the interaction with the tablet, is discussed in detail in the secondary research question regarding motivation, *cf* section 7.5, in this chapter. The *action of the activity* is directed at a goal, the *goal* in this case is to *achieve the learning outcome* of the particular lesson.

In order to determine *how* interaction is influenced by a tool it is important to examine the *types* of activities, identify *who* is engaging in the activities, *what* are the goals of the activity, *what* outcomes result, *what* rules define the activity and *who* is the community involved in the activity.

- **Types of activities?** The types of activities taking place during interaction included the explanation of concepts which form part of the lesson. Explanations include demonstration of work such as definition, formulas and examples provided by teacher on the black board. The learners capture the demonstration provided with the tablet and instruction is provided on how to access the information on the tablet. Guidance is provided by the teacher regarding the navigation of the tablet. The types of activities further included illustration of what learners are required to do, instruction to do the activity within a time limit, and demonstration of activity by learners using their tablets. The learners record the other learner giving the demonstration, the learners and teacher ask questions, the teacher and learners answer questions. The final activity is further clarification by the teacher.

  In summary, the tablet was utilised mainly for four activities:

  1. To capture important information provided by the teacher.
  2. To access information necessary to do the activity.
  3. To report back to class on how learner did the activity.
  4. To record the learner giving the demonstration.

- **Who is engaging in the activities?** The teacher, learner and peers are all engaging in the activities.
- **What are the goals?** The goals are the outcomes which the lesson sets out to achieve, it involves the learner understanding the new concept discussed by the teacher, understanding what is expected, doing the activity, sharing answers and reflecting on what has been learned.
- **What outcomes result?** Outcomes which resulted from the activity include learners grasping the new topic which forms part of the learning outcome which, in turn, is the aimed to be achieved.
- **What rules define the activity?** Rules include that learners must pay attention, follow instructions using the tablet to access the necessary information needed to do the activity, do the activity within the time limit set by the teacher, learners are requested to present their findings where after learners and teacher asks questions for clarification purposes.
- **Community in which the activity occurs?** The community in which the activity occurs includes all the parties participating *in acting on the shared object*, which is learning, to

arrive at the learning outcome. This includes the teacher, the learner and the peers in the classroom.

Themes from data analysis

Themes emerging from the data analysis (*cf* section 6.3), which relate to interaction with the tablet, include independence, recreational purposes, social aspect, displacing the teacher, teacher as facilitator and constructivist teaching. The *interaction with the tablet* fostered *independence* among the learners (*cf* section 6.3.10). The tablet has given them access to a 'teacher' wherever, whenever. Learning takes place beyond the classroom walls, creating an environment for learners to interact with the tablet and to learn in their own time and at their own pace. Interaction with tablet and learning can occur and continue with or without a teacher. Interaction with the tablet included *recreational activities* (*cf* section 6.3.9). This interaction entails that free time was spent more constructively, for instance playing educational games. The *social aspect* (*cf* section 6.3.11) brought about through the interaction with the tablet involved learners engaging in tasks, working together with peers, helping each other and sharing knowledge. Another theme relating to interaction with the tablet involved the *displacement of the teacher* (*cf* section 6.3.12). The interaction with tablet altered the role of the teacher in the classroom. The question arises whether the teacher is still needed in the classroom or whether the tablet can replace the teacher. Interaction with the tablet necessitated that the teacher act in a *facilitating capacity* (*cf* section 6.7.1). This facilitating role goes hand in hand with the theme of constructivist teaching where learners become active participants in the learning process (*cf* section 6.7.2). It furthermore affords learners the opportunity to learn through discovery and to generate their own knowledge.

Supported in literature

Interaction, as a secondary research question, was supported in the literature. Constructivist teaching was made possible through interaction with the tablet as it provided learners with the opportunity to learn through discovery (*cf* section 3.2.3). The interaction observed was *learner-centred*. Learners' knowledge was enhanced and creativity, teamwork and innovation were promoted through the interaction with the tablet.

It was evident that through *scaffolding* learners bridged the gap between the familiar and the unfamiliar by making use of the tablet (*cf* section 2.3.5). Scaffolding refers to support and guidance given by a teacher, peers or technology. With the tablet's mediation the distance

between the leaners' level of *actual development* and their level of *potential development* in their Zone of Proximal Development diminished (*cf* section 2.3.4).

Due to interaction with the tablet, learners cultivated 21st century skills (*cf* section 3.5). Twenty first century skills developed through the interaction with the tablet included collaboration, communication, ICT confidence, creativity, critical thinking and problem solving. Learners' ways of thinking and ways of working were modified. Ways of *thinking* included discovering new ways to learn, being creative and innovative, thinking critically, solving problems and making decisions. Ways of *working* were also modified as learners learned new ways of communicating and learners were working collaboratively with peers and teachers, working in teams and interacting with others. Tools for working, relating to 21st century skills, resulted in learners' *information literacy* being enhanced through having access to information which had not been freely available to them before. ICT literacy was also developed through utilising the tablet as learners learned how to *effectively* apply technological skills, how to *access* information using the tablet and how to *research* and *organise* information. These skills also relate back to constructivism.

In summary

Figure 50 summarises *how* the findings of the secondary research question, regarding interaction, are applied in the triangle of Activity Theory. The triangle of Activity Theory is positioned in the figure of User Experience to illustrate the interaction between the learner and the tablet. Activity Theory and User Experience are joined together and applied as a conceptual framework in the section addressing the primary research question, *cf* section 7.6. This figure exemplifies the themes experienced through interaction with the tablet. It includes independence, recreational purposes, social aspect, displacing of the teacher, constructivist teaching and teacher as facilitator. The figure further illustrates other findings supported in literature including scaffolding, Zone of Proximal Development and the development of 21st century skills. It shows the four main procedures for which the tablet was used for in classroom interaction which are *capturing* of information, *accessing* of information, *reporting* back to class and *recording* of information. It concludes, by summarising the application of Activity Theory, that the learner acts on learning using the tablet in order to transform it to arrive at the learning outcome. The activity context is influenced by the community - the rules and division of labour within that community.

Figure 50: SUMMARY OF INTERACTION

CONTEXT

Resource deprived context

USER

(LEARNER)

USER EXPERIENCE

Interaction

- Themes: independence, recreational purposes, social aspect, displacing the teacher, constructivist teaching, teacher as facilitator
- Scaffolding
- Zone of Proximal Development
- 21st century skills
- Tablet utilised for 4 main activities:
  1. Capture information
  2. Access information
  3. Report back
  4. Record information

The learner acts on learning using the tablet in order to transform it to arrive at learning outcome.
The activity context is determined by the community, the rules and division of labour within the community.

PRODUCT

Tablet

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7.3   SECONDARY RESEARCH QUESTION 2 (EMOTIONS)

The second secondary research question asked: "Which emotions do learners experience when learning is facilitated by technology?"

Themes from data analysis

Learners enjoyed having access to information. The learners were also satisfied with the fact that they had access to many resources. Learners' experienced *anticipatory joy* as the tablet raised their interest to learn. Learners appeared satisfied regarding the ease of use of the tablet and how it made educational tasks easier. The ease of use gave rise to feelings of relief as the tablet was less cumbersome to carry and handle and in general required less effort to navigate and incorporate in their lives. Learners experienced *gratitude* regarding the enriched understanding afforded by the tablet. Improved academic performance has resulted in learners having *hope* for their education, results and future. Improved academic performance has also led to feelings of *satisfaction*. Learners' increased motivation has brought about feelings of pride, hope and satisfaction. *Pride* for they feel that they are on par with other schools and even leading the way in technology within their community. Interest in schoolwork, which has led to increased motivation, has further helped to create hope in terms of improved academic performance. Learners appeared satisfied as they are determined to work harder and invest more time in their schoolwork. The sense of *empowerment* generated by the tablet creates hope in learners, hope for their futures as they nurture the belief that this technology tool can help them to be successful. The sense of *competence* achieved by the use of tablets also creates hope as they become aware of their capabilities and so improve their capabilities. Learners experience *joy* using the tablet for recreational purposes. The independence fostered by the use of the tablet led to feelings of satisfaction, relief and joy as they could now learn at their own pace and in their own time, outside of school. The *social aspect* of the tablet, which emerged in the themes of data analysis, suggested that learners experienced feelings of deep affection towards their tablet describing it as their friend, boyfriend and teacher. Learners were excited and enjoyed the displacement of the teacher as the tablet became *a teacher in their pocket*. Technical issues brought about feelings of frustration and anger. Some learners experienced boredom when faced with technical issues.

The following graphs visually present the emotions experienced by learners during their interaction with the tablet. It includes positive emotions (*cf* figure 51) and negative emotions (*cf* figure 52). It also includes a chart to present the academic emotions experienced (*cf* figure 53).

Positive emotions

The following graph presents all the *positive emotions* experienced by learners as a result of technology-facilitated learning (*cf* figure 51). These emotions were discussed in data analysis (*cf* section 6.4). Positive emotions included joy, hope, confidence, happiness, pride, relief, appreciation, thankfulness, gratitude, helping others, love, excitement, admiration, respect and satisfaction.

Figure 51: POSITIVE EMOTIONS GRAPH
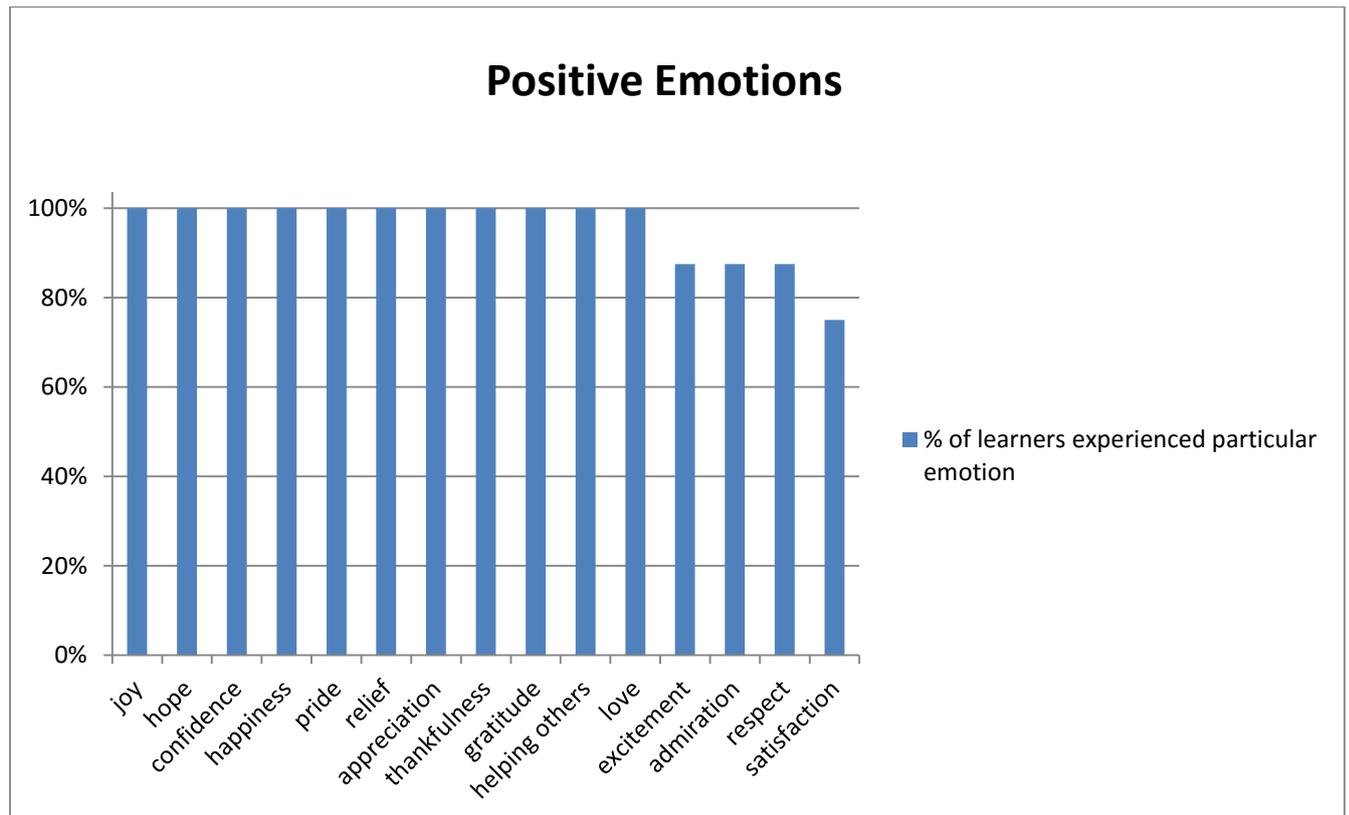
Negative emotions

The following graph presents all the *negative emotions* experienced by learners as a result of technology-facilitated learning (*cf* figure 52). These emotions were discussed in data analysis (*cf* section 6.4). Negative emotions included sadness, hate, disappointment, difficulty, boredom, anger, stress, dislike, hopelessness, worry, shyness, annoyance, irritation, disapproval, impossible, uselessness, anxiousness, nervousness, embarrassment and shame. Interesting to note that learners did not experience the following negative emotions although these emotions were listed: impossible, uselessness, anxiousness, nervousness, embarrassment and shame.

Figure 52: NEGATIVE EMOTIONS GRAPH

Negative Emotions
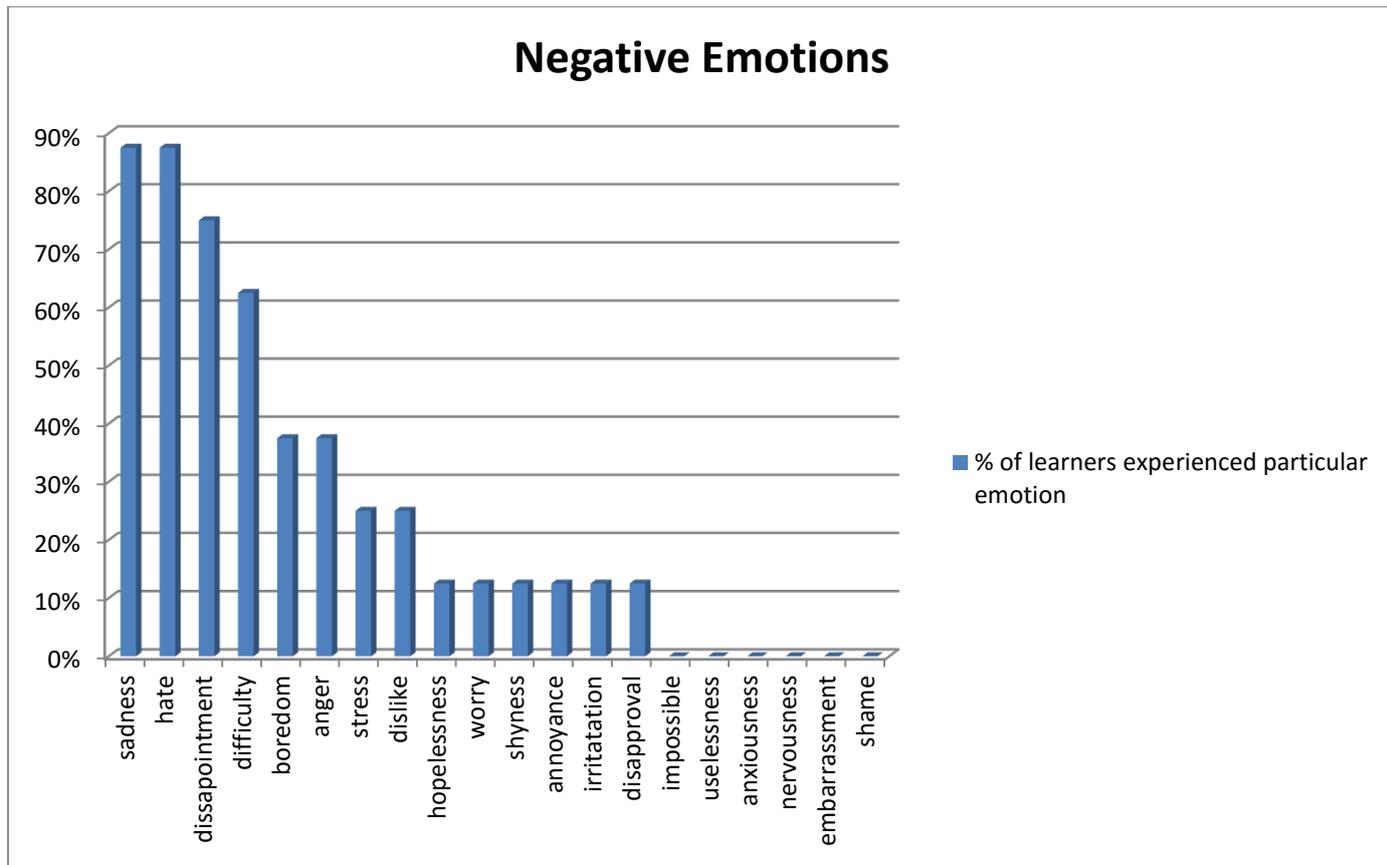
Academic Emotions

The following chart presents the *academic emotions* experienced by learners (*cf* figure 53). Academic emotions were discussed in the literature (*cf* section 2.3.1). Academic emotions experienced as a result of technology-facilitated learning included joy, hope, pride, anger, hopelessness, boredom, satisfaction, relief, gratitude, sadness, and disappointment.

Academic Emotions experienced

Dissapointment 9% — Shame 0% — Enjoyment 12% — Hope 12% — Pride 12% — Anger 5% — Hopelessness 1% — Boredom 5% — Satisfaction 9% — Relief 12% — Gratitude 12% — Sadness 11%

Table 22 shows the main academic emotions experienced by learners. Academic emotions were discussed in the literature (*cf* section 2.3.1).

Table 22: ACADEMIC EMOTIONS EXPERIENCED

Academic Emotion	Experienced
Joy	YES
Hope	YES
Pride	YES
Anger	YES
Shame	YES
Hopelessness	YES
Boredom	YES

The following table (*cf* table 23) is another representation of academic emotions. Academic emotions were discussed in the literature (*cf* section 2.3.1). The table shows which emotions

were experienced by learners. The table differentiates between *task-related*, *self-related* and *social emotions* as discussed in the literature, (*cf* section 2.3.1).

Table 23: ACADEMIC EMOTIONS

Emotions	Positive		Negative	
Task-related and self-related				
− Process	Enjoyment	√	Boredom	√
− Prospective (future)	Anticipatory joy	√	Hopelessness	√
	Hope	√	Anxiety	−
− Retrospective (past)	Joy about success	√	Sadness	√
	Satisfaction	√	Disappointment	√
	Pride	√	Shame and guilt	√
	Relief	√		
Social				
	Gratitude	√	Anger	√
	Empathy	√	Jealously and envy	−
	Admiration	√	Contempt	√
	Sympathy and love	√	Antipathy and hate	√

In summary

Figure 54 summarises *how* the findings of the secondary research question, regarding emotions, are applied to User Experience as theoretical framework. It exemplifies the emotions experienced through the interaction with the tablet. It includes the positive, negative and academic emotions experienced. The figure further illustrates the main findings of data analysis and how these themes impacted on learners' emotions. These themes include access to information, interest, ease of use, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, recreational purposes, independence, social aspect, displacement of teacher and technical issues.

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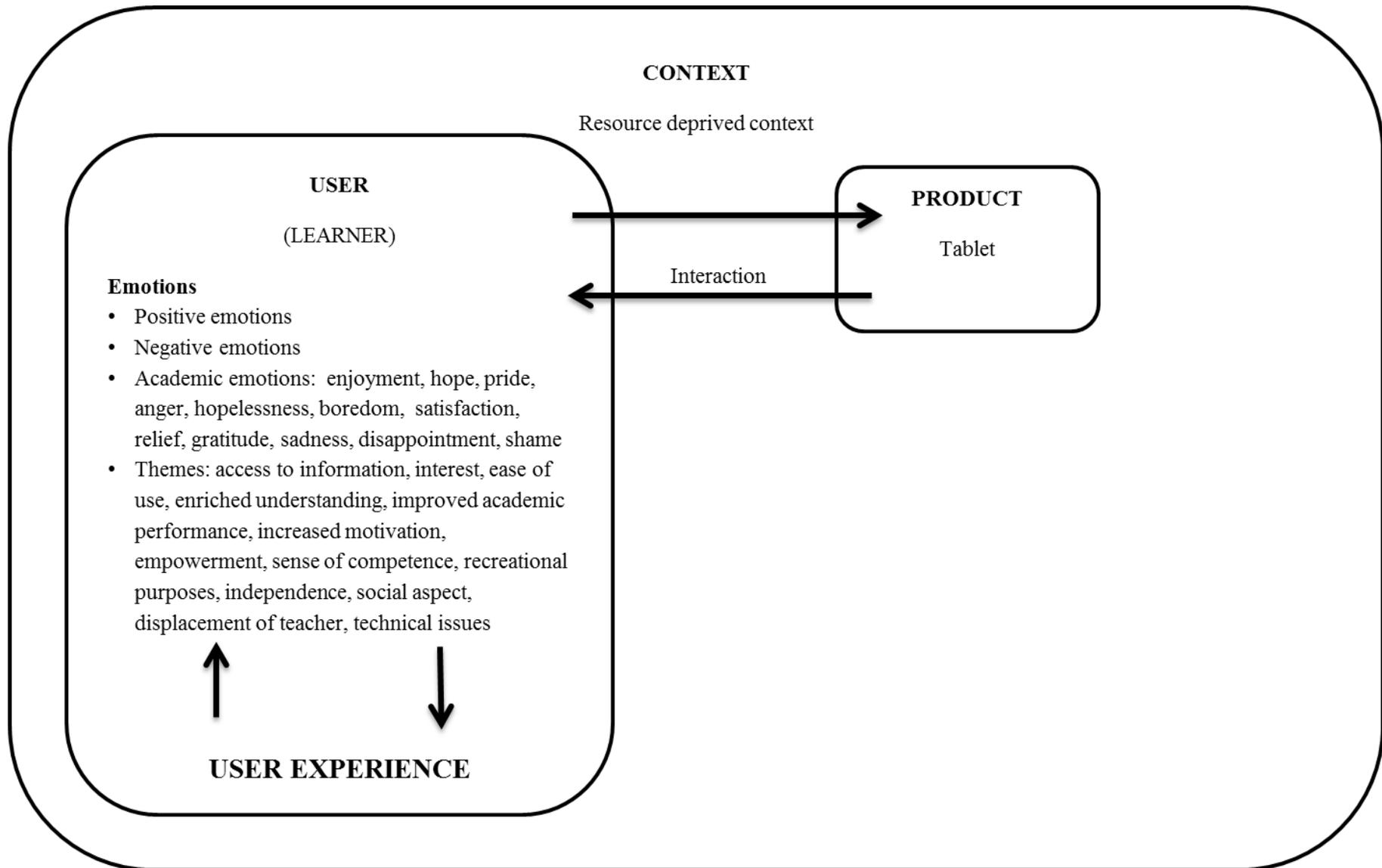
7.4   SECONDARY RESEARCH QUESTION 3 (ATTITUDES)

The third secondary research question was concerned with: "What are learners' attitudes towards using tablets in school?"

Themes from data analysis

Gathered from the data analysis, themes which related to the positive attitudes of learners included: access to information, interest, enriched understanding, ease of use, improved academic performance, increased motivation, empowerment, sense of competence, independence and social aspect. Data found that learners responded positively and even embraced the *access to information* provided by the tablet (*cf* section 6.3.1). Learners enjoyed *relevant real world information* and all resources which were previously unavailable. The learners' attitude towards learning changed from being unresponsive and bored to being more interested, willing and enthusiastic towards learning (*cf* section 6.3.2). Data also found that the tablet promotes easy learning, reporting on the *ease of use characteristic* of the tablet which has a positive impact on learners' attitudes (*cf* section 6.3.3). The ability to understand better has a direct impact on learners' self-confidence and capabilities which, in turn, influences their attitude towards learning (*cf* section 6.3.4). The realisation of the continuous building of knowledge due to access to a variety of resources has modified their attitudes. Improved academic performance serves as a motivation to learn and clearly has an effect on the learners' attitude to learn (*cf* section 6.3.5 and 6.3.6). Data suggested that, since using tablets, their attitudes toward schoolwork has changed as they have become more interested in their schoolwork.

Data proposed that the *sense of empowerment* which the tablet created has changed their attitude towards learning in terms of their future and career (*cf* section 6.3.7). The tablet furthermore modified their attitudes with regards to their responsibility towards their education. As discovered in the data, the tablet fostered a sense of self belief in terms of their capabilities. Feeling equipped by the new skills acquired also boosted learners' self-confidence and self-worth (*cf* section 6.3.8). Independence promoted by the tablet altered their attitude towards learning as their education does not purely depend on the teacher (*cf* section 6.3.10). Their education is in their own hands and it reaches beyond the classroom walls, making it possible to learn at their own pace and in their own time. The social aspect that is brought about by the tablet has modified learners' attitude towards learning. Data found that learners are working together, helping each other and leveraging on each other's skills. Learners are engaged and sharing knowledge (*cf* section 6.3.11).

A theme which related to both positive and negative attitudes of learners included displacing the teacher (*cf* section 6.3.12). This is *positive* in the sense that learners were not dependent on a teacher and could learn in their own time and at their own pace but *negative* in the sense that some learners still required teacher support. Some learners were of the opinion that the tablet can replace the teacher and others held the view that the teacher cannot be replaced and he/she is still necessary.

Themes which related to negative attitudes of learners included those pertaining to technical issues (*cf* section 6.3.13). Learners expressed their frustrations towards network problems and difficulties. Being frustrated with the network impacts negatively on the learner's attitude towards the tablet and its use in learning.

Supported in the literature

The attitudes of learners are supported in the literature in discussions relating to self-concept (*cf* section 2.3.3), self-esteem, self-efficacy and agency (*cf* section 6.6). Learners' self-concept improved with their belief in and knowledge about themselves, their ideas, feelings attitudes and expectations. Data showed learners' felt they improved academically, socially and emotionally due to the tablet and this cultivated the expectation and belief that they could perform well academically. Learners' attached positive values to both their newly found and already existing attributes. Learners' self-esteem was boosted as a result of using the tablet. They placed high value on their own abilities and characteristics. Data found that learners were confident, felt important, improved themselves and were able to understand better. A very prominent finding in the data was regarding learners' self-efficacy in how they believed in their capabilities to do tasks and to perform well in them. The tablet contributed immensely to learners' self-efficacy. The modification of learners' attitudes due to the tablet was also visible in agency. Learners were personally and actively engaged and were taking initiative and control of their education. The tablet enabled learners to make intentional choices regarding their education by choosing educational activities above other activities. Learners, furthermore, designed appropriate courses of action by investing more time and effort in their schoolwork. They motivated and regulated the execution of the plans towards their education in terms of agency by realising that they were working towards an end goal, passing matric, and even planning for possible future careers.

In summary

Figure 55 summarises *how* the findings of the secondary research question, regarding attitudes, are applied to User Experience as theoretical framework. It illustrates the attitudes being

modified through the interaction with the tablet. It includes themes emerging from data analysis which modified learners' attitudes towards learning in a positive way. This included access to information, interest, ease of use, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, independence, social aspect and displacing the teacher. It also includes themes emerging from data analysis relating to negative attitude modification involving technical issues and displacing the teacher. The figure further shows important theoretical concepts which were influenced by technology-facilitated learning, including self-concept, self-esteem, self-efficacy and agency.

CONTEXT

Resource deprived context

USER

(LEARNER)

PRODUCT

Tablet

Interaction

Attitudes

- Positive attitudes: access to information, interest, ease of use, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, independence, social aspect
- Positive & negative attitudes: displacing the teacher
- Negative attitudes: technical issues
- Self-concept, self-efficacy, self esteem and agency

USER EXPERIENCE

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7.5   SECONDARY RESEARCH QUESTION 4 (MOTIVATION)

The fourth secondary research posed: "How does the use of tablets motivate learners in school?"

Themes from data analysis

Themes related to *motivation* found during data analysis included interest, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, independence, social aspect and displacing the teacher. Data suggested that the tablet evoked interest in leaners to focus more on their studies (*cf* section 6.3.3). Learners spent more time and effort on schoolwork and were more willing to learn and more enthusiastic about learning. The tablet acts as a *catalyst* to an enriched understanding (*cf* section 6.3.4), which leads to improved academic performance which in turn motivates learners to learn (*cf* section 6.3.5 and 6.3.6). Data suggested that the increased motivation sprouted from being more interested in schoolwork. Data found that the learners are more motivated as it creates opportunity for change and advance as it improves decision making. The tablet equips learners with skills, which empower them and, in turn, motivate them. The sense of competence cultivated by the use of the tablet boosts learners' self-confidence (*cf* section 6.3.8). The tablet has provided learners with new skills which increased their capabilities and being competent and capable motivate learners to achieve. The tablet fosters independence among learners as they are not dependent solely on the teacher (*cf* section 6.3.10). The opportunity to work in their own time and at their own pace motivates learners. The social aspect that is prevalent due to the tablet creates a sense of belonging among the learners as they are engaged and working together, building on each other's skills and helping each other (*cf* section 6.3.11). The collaboration of peers drives motivation among the learners. Although the teacher is displaced, as learners refer to the tablet as a teacher in their pocket, the tablet motivates them to work independently as it serves as a teacher at hand (*cf* section 6.3.12).

Supported in literature

The theoretical elaboration done, as part of data analysis, indicated that motivation is influenced by the use of the tablet (*cf* section 6.6). Motivation is present in learners as their behaviour and interest is stimulated, directed and maintained towards their learning. Learners are motivated to learn whilst using the tablet as they tend to find academic activities more meaningful than before. Learners also try to benefit from academic activities. Learners were more interested to learn and they were also more willing to work. Learners found working on the tablets more stimulating and they indicated that they believed that the tablet helps them

educationally and socially. All learners reported that, with the tablet, they are more motivated because they are performing better due to a better understanding of the work and access to rich information. Learners were intrinsically motivated by activities which brought their own reward. Learners were motivated and interested, outside school and apart from school duties, to learn and use their tablets. They were also more interested as teachers, and learners themselves, report that they were doing more than before in terms of school work. Extrinsic motivation was also present as learners were motivated by external factors such as rewards and punishment. Intrinsic motivation was significantly more prevalent than extrinsic motivation.

The constructivist principles, as discussed in the literature (*cf* section 2.3.2), were present in data analysis. Learners were challenged with the unfamiliar in their ZPD which led to them being motivated internally. To help the learners to face the challenge, resolve it and adapt, the teacher supported and guided them externally. The activities were connected to the learners' interests and also challenged them, in accordance with a specific stage in their development, and this motivated them further. Learners interacted socially and learned co-operatively with peers, which also resulted in them being more motivated. Based on the fourth principle, learners felt actively engaged and took control of their learning and this motivated them to tackle more challenges. Furthermore, as supported in literature, for learners to be motivated *internally* it is necessary for them to be motivated *externally* by teachers and peer support, guidance, involvement and engagement (*cf* section 2.3.2).

Another theme in the literature, which was found in data, was that of *attribution* (*cf* section 2.3.2). Attribution relates to *how* learners, who are succeeding academically, evaluate and question the situation in order to determine the reason for their success. When learners did this evaluation, many attributed their academic success to the tablet.

When referring to intrinsic motivation, as discussed in the literature, *personal interest* and *situational interest* play a role (*cf* section 2.3.2). Learners showed a personal interest in the tablet which definitely motivated them. Learners reported that they liked and enjoyed using the tablet in the learning process. Situational interest focuses on the features of the learning context, including catch and hold factors. The tablet stimulated learners as it grabbed their attention. The content provided by the tablet empowered learners as they viewed the content as valuable and this also encouraged their further participation in activities.

Expectancy, value and affective components are important in motivation models (*cf* section 2.3.2). *Expectancy* components related to learners' belief in their own ability to perform certain

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tasks and the tablet contributed to this belief. They also believed that it is due to the tablet that they are able to perform. This is supported in the theme of 'Sense of competence' in data analysis (*cf* section 6.3.8). *Value* components relate to learners' belief in the interest, importance and utility of a task. Learners viewed the tablet as useful and important to their education. *Affective* components relate to learners' feelings about themselves and their emotional reactions to the task. Overall, learners responded positively to the tablet. The affective components are addressed in detail in the secondary research question regarding emotions (*cf* section 7.3). Thus, learners' belief in their ability bolstered by the tablet, the usefulness of the device and the feelings evoked when using the tablet all contributed to them being motivated.

To conclude, it was found that if learners are interested, they are motivated and if learners are motivated they learn, and when learners learn they achieve. This supports the assumption made in Chapter 1 (*cf* section 1.1) and Chapter 2 (*cf* section 2.3.2 and *cf* figure 11).

In summary

Figure 56 summarises how the findings of the secondary research question, regarding motivation, is applied to User Experience as a theoretical framework. It illustrates how motivation to learn is influenced when learning is facilitated by a tablet. It includes the themes: interest, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, independence, social aspect and displacing of the teacher. It further highlights significant theoretical concepts supported in the literature which include: intrinsic and extrinsic motivation, constructivist principles, personal and situational interest, attribution, expectancy, value and affective components. In addition, it illustrates the notion that a learner who is interested, is motivated and a learner who is motivated, will learn and if a learner learns, he/she will achieve.

CONTEXT

Resource deprived context

USER

(LEARNER)

PRODUCT

Tablet

Interaction

Motivation

- Themes: interest, enriched understanding, improved academic performance, increased motivation, empowerment, sense of competence, independence, social aspect, displacing of teacher
- Intrinsic and extrinsic motivation
- Constructivist principles
- Personal interest
- Situational interest
- Attribution
- Expectancy, value and affective components

Interested → Motivated → Learn → Achieved

USER EXPERIENCE

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7.6 PRIMARY RESEARCH QUESTION (EXPERIENCE)

The primary research question asks: "How do learners experience technology-facilitated learning?"

It is possible to answer this question based on the elaborations of the secondary research questions. It was found that interaction with the tablet led to different emotions being evoked, attitudes towards learning being modified and finally, an increase in the motivation to learn. This encapsulates the primary research question of how learners experience technology-facilitated learning.

Table 24 illustrates how the themes found in data analysis link to the different secondary research questions.

Table 24: THEMES RELATED TO SECONDARY RESEARCH QUESTIONS

Data Analysis Themes	SRQ 1 Interaction	SRQ 2 Emotions	SRQ 3 Attitudes	SRQ 4 Motivation
Access to information		√	√	
Interest		√	√	√
Ease of use		√	√	
Enriched understanding		√	√	√
Improved academic performance		√	√	√
Increased motivation		√	√	√
Empowerment - future		√	√	√
Sense of competence		√	√	√
Recreational purposes	√	√		
Independence	√	√	√	√
Social aspect	√	√	√	√
Displacing the teacher	√	√	√	√
Technical issues		√	√	
Teacher as facilitator	√			
Constructivist teaching	√			

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Figure 57 joins and incorporates the two theoretical frameworks, Activity Theory and User Experience, to present the *conceptual framework*. This conceptual framework serves as a summary of all the findings of the different *secondary* research questions, to finally address the *primary* research question. This incorporation of Activity Theory and User Experience, applied together to address technology-facilitated learning, is the product of this study.

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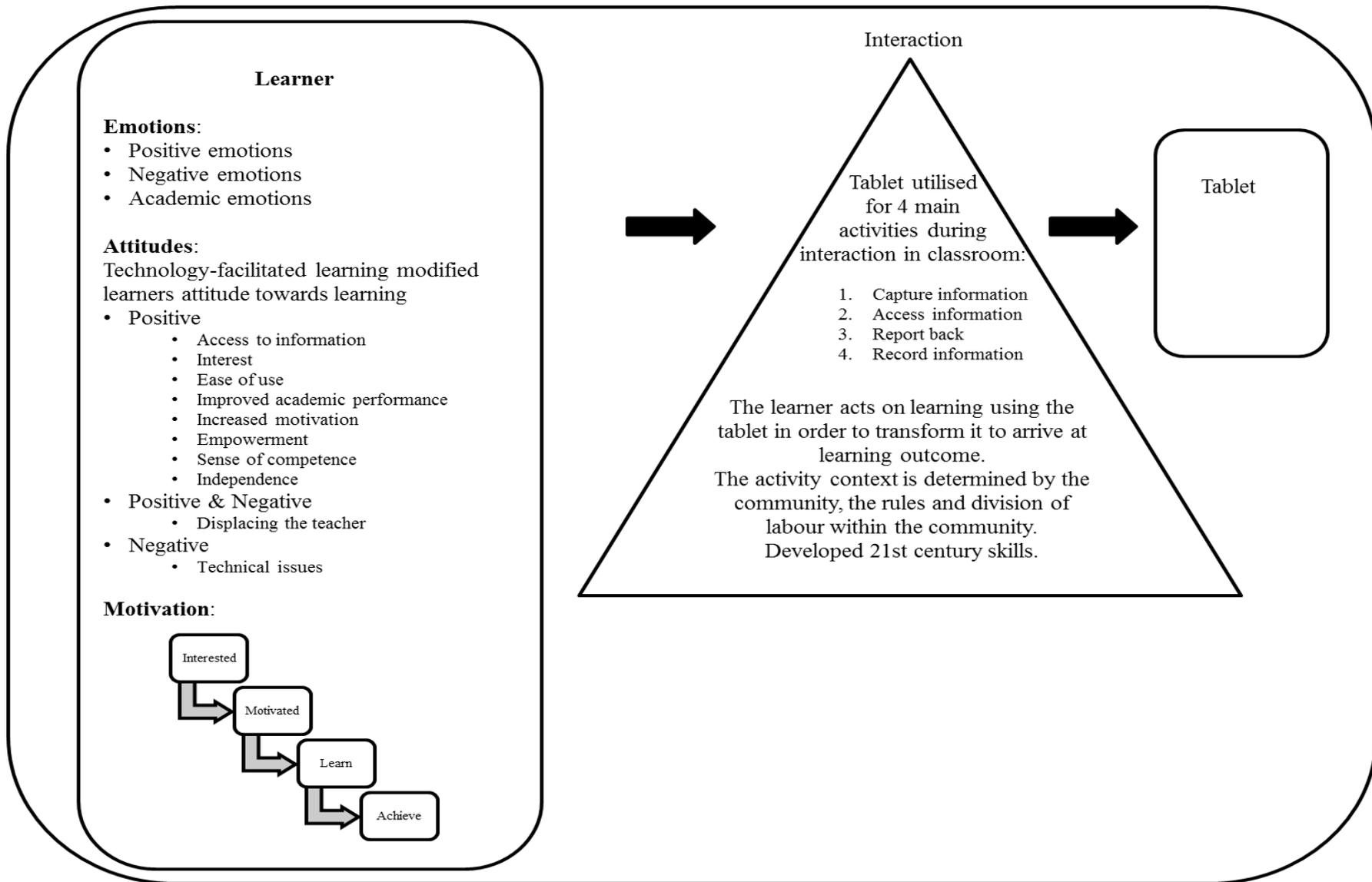
Figure 57 figure represents the experience of technology-facilitated learning. It shows how the *learner* (User Experience) interacts with the *tablet* (Activity Theory). When the learner interacts with the tablet, the learner experiences certain emotions. Furthermore, the learner's attitudes are altered as a result of the interaction with the tablet. And finally, the interaction with the tablet motivates the learner to learn.

7.7   CONTRIBUTION OF RESEARCH

The findings of this study are important to the academic body of knowledge in that:

They offer an understanding of *how* learners experience technology-facilitated learning.

They offer an insight into the important role which learners' *emotions*, *attitudes* and *motivations* play in the learning process.

They offer a perspective on *how* tablets are incorporated, within the learning process, and *how* interaction occurs among the learner, teacher and tablet.

They offer an application of a *conceptual framework* incorporating Activity Theory and User Experience as theoretical frameworks.

The knowledge gained from this study resulted in an improved understanding of the user experience of learners regarding technology-facilitated learning.

7.8   RECOMMENDATIONS FOR FURTHER WORK

The following recommendations for further work can be made:

Guidelines for teachers when learning is facilitated by technology. Take into account concepts such as scaffolding, fading of support, support according to individual needs, motivation etc.

Creative ideas and *instructions* for teachers in the use of tablets in the learning process to maximise this use of the technology.

The impact of technology on *teacher efficiency*.

The impact of technology on *learners' academic performances.*

The correlation between *technology use* and *academic results*.

Implementation plan to ensure *effective adoption* of ICT in rural schools.

How to overcome *technical issues* in the use of technology-facilitated learning.

The *positive* versus the *negative* impact of tablets in learning.

7.9   REFLECTION

It has been a great pleasure and privilege to be part of a project such as the ICT4RED project which has had an immense impact on the lives of rural communities.

Lessons learnt, in terms of the research study, include the importance and worth of a pilot study to refine your data instruments and to envision the data collection situation in preparation thereof. The researcher needs to be prepared for data collection and has to have a plan B and C in mind. The researcher should keep in mind that collecting data from humans is a challenging process and one needs to be flexible and adaptable to varying circumstances and needs. Another lesson learnt is to spend adequate time at the place of data collection and to be present in the environment to witness how things are done and how things work in a setting which is unfamiliar to you. Lastly, remain focussed and always keep the aim of the study in mind as it is easy to become side-tracked.

Limitations of the study, as indicated in the scope and delineation of the study (*cf* section1.5), include the fact that the learners who were selected to participate had already been exposed to the technology. However, this exposure was short term, and at the time of the study learners had been using the tablet for a few months only. This study looked at the interaction which occurs among the tablet, learner and teacher at a specific time and the reported interactions include only observations made in the classrooms, and therefore it does not describe all uses and applications of tablets at the rural school, or in education. The emotions, attitudes and motivation refer to a *specific* point in time only and this may change in time. The emotions reported upon relate to questions asked, however there may be more or other emotions which have not been dealt with. This study did not measure the impact of the technology with regards to academic performance. Only Grade 12 learners and their teachers participated in the data collection methods. Therefore, the claims made in this study cannot be generalised to describe *all* learners in *all* schools.

7.10   CONCLUSION

The purpose of this research (*cf* section 1.2.1) was originally to determine how user experiences (emotions, attitudes and motivation) of learners' are influenced by the use of tablets in teaching and learning in a rural school in the Eastern Cape Province. It was ascertained that learning with the use of a tablet, does exert an influence on learners' emotions, attitudes and motivation. To summarise the research questions (*cf* sections 7.2 to section 7.6), learners experienced both

positive and *negative* emotions as a result of technology-facilitated learning. Attitudes toward learning improved as a result of the interaction with the tablet. Finally, it was found that the technology did indeed influence the learners' motivation to learn.

Objectives set for the study (*cf* section 1.2.3) included determining specific uses and applications of tablets in rural schools. The main uses and applications which were observed included accessing, capturing and recording of information and reporting back to the class. These findings have contributed to an understanding of *how* tablets are incorporated within the teaching process in senior secondary schools in a rural context. Emotions, attitudes and motivations were identified which arise when learners' experiences are mediated by technology (such as tablets) in school. A demonstration of how to incorporate Activity Theory and User Experiences, as a conceptual framework for technology-facilitated learning, was provided in the answering of the primary research question (*cf* section 7.6).

This study was done with a specific problem in mind (*cf* 1.2.2). The stance of the researcher was that the focus of most studies of ICT in education relates to the teacher, implementation and adoption. The researcher aimed to re-orientate the focus to the learners as the receivers of ICT in education. An assumption of the researcher was found to be true (*cf* section 1.1), in that an interested learner will be motivated, a motivated learner will learn and a learner who learns will achieve (*cf* figure 9). The researchers' position holds that internalisation plays an imperative role in children's lives as it results in specific behaviours (*cf* section 2.2.1). Emotions, attitudes and motivation are *internal* processes experienced when *external* activities occur. Internalisation and externalisation impact on one another.

Emerging from an educational psychology background and a life-long passion for children, the researcher has constantly been curious about what makes children tick, why they act the way they do or why they behave in a certain manner. Having been a counsellor at a school for learners with special needs, the researcher always ponders the question: *what has led to the current situation in which a child finds him/herself.*

Being present in the rural school environment evoked this passion for children yet again. It became apparent that this is the right place to start in order to make a difference. Our children are South Africa's future generation. They will grow up to be the doctors, teachers, economists and future leaders of our country. Having said this, the teacher still plays an imperative role in our children's lives. Not only is the teacher the *educator* but he/she is also a *role model* and *parent figure* who instils values and responsibilities to be the best of his/her ability and often

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achieves beyond that which was thought possible. It was a privilege to be involved with this particular rural school and the experience evoked in my a desire to make a difference in the lives of others This experience also made me realise how grateful we should be for the things we often tend to take for granted. Once again, the importance of education has been magnified.

To conclude, our beloved president Nelson Mandela once said:

"Education is the great engine of personal development. It is through education that the daughter of a peasant can become a doctor, that the son of a mine worker can become the head of the mine, and that a child of farmworkers can become the president of a great nation. It is what we make out of what we have, not what we are given, that separates one person from another."

~The Long Walk to Freedom, p.194~

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ADDENDA

Appendix A: Pilot Study

Appendix B: Main Study

Appendix C: Ethics

Appendix D: Schedules