

# A Guide for the use of Tablet PCs for Teaching and Learning Activities for in classroom and distance learning in South African Schools

Submitted in fulfilment of the requirements for the degree of

MASTER OF COMMERCE

IN

INFORMATION SYSTEMS

FACULTY OF COMMERCE

**RHODES UNIVERSITY**

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JUNE 2021



# A Guide for the use of Tablet PCs for Teaching and Learning Activities for in classroom and distance learning in South African Schools

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**DEGREE: MASTER OF COMMERCE**

## **ABSTRACT**

Education in South Africa is said to be in crisis in recent years as many learners cannot pass standardised tests at the correct grade level. This has encouraged the South African Government and the Department of Basic Education (DBE) to introduce technology, specifically Tablet PCs, into education to improve learning outcomes in South African government schools. Furthermore, because of the coronavirus pandemic that started in 2020, educators were increasingly expected to find alternative, digital, online methods to continue teaching learners. Thus, the need for remote or distance education suddenly became an important factor in creating a need for online, remote learning. Against this backdrop this study aimed to determine how and in what ways educators could be supported to promote effective use of Tablet PCs both in the classroom and for distance learning. This study used Action Design Research to develop a guide based on both theory and the results gathered from the educator participants at a local secondary government school in Makhanda, South Africa. The finalised guide presents recommendations to educators, principals, and the DBE to promote

acceptance and adoption of technology in the classroom and for distance learning. These recommendations include the provision of data, technological training and pedagogical support, a functioning community of practice, an online learning community of practice, and support from the DBE. Other enrichment factors were also recommended.

**KEYWORDS:**      **TPACK**      **Tablet PCs**      **Blended Learning**

## ***Declaration***

I declare that the Dissertation entitled, “A Guide for the Use of Tablet PCs for Teaching and Learning Activities for in classroom and distance learning in South African Schools”, which I hereby submit for the degree, Master of Commerce at Rhodes University, is my own work. I also declare that this dissertation has not previously been submitted by me for a degree at this or any other tertiary institution and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

A handwritten signature in black ink, appearing to read 'K Theunissen', written over a horizontal line.

Kristen Theunissen (*signed*)

## ***Acknowledgements***

Foremost all praise should be to God as He deserves all the praise and glory for the work of my hands. This dissertation is ultimately written for His glory as He has created me to worship and glorify Him through all things. My heart will be forever thankful for His guiding hand in my life and the opportunity He has presented for me to complete this dissertation.

To my supervisor, Dr Ingrid Siebörger, for providing me with the opportunity to complete this dissertation. Thank you for your continued guidance and support. Thank you for being patient and gracious with me during the past two and a half years. I thank God that you were my supervisor during this project.

To my parents, for not only their financial support during this master's project but also for their emotional support. For being available to chat when I needed a comforting word and being patient with me when this project got extended. Thank you for allowing me to follow my own course and being supportive throughout my journey.

Finally, to my grandmother, for her prayers and constant encouragement. Thank you for always expecting the best and never wavering in your belief that I can accomplish anything.

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# **1 Introduction**

## **1.1 Background/ Context**

The South African education system is said to be in crisis in recent years (Spaull, 2017). Standardised testing across South Africa paints a bleak picture as many learners do not have the required knowledge and understanding to pass standardised tests at the correct grade level (Badat and Sayed, 2014; Spaull, 2013). Consequently, the South African Government and the Department of Basic Education (DBE) have attempted to introduce technology, specifically Tablet PCs, into basic education (primary and secondary education). This introduction seeks to improve education through access to technology, reducing the digital divide, and nurturing engaged learners (Department of Education, 2004). During the State of the Nation address in 2020, President Cyril Ramaphosa stated that Tablet PCs would be provided to matric learners across South Africa in an attempt to improve education (President Cyril Ramaphosa, 2020). Although, how the introduction of Tablet PCs will improve learning outcomes in South African schools remains unclear.

Despite Tablet PCs being introduced into schools, there is often a lack of training for educators concerning integrating Tablet PCs into their existing pedagogy. Many studies in South Africa have highlighted that educators are often not trained in the effective use of technology in the classroom for teaching and learning activities (Adukaite, van Zyl and Cantoni, 2016; Herselman and Botha, 2014; Nkula and Krauss, 2014). This lack of training results in educators feeling reluctant to use technology in the classroom and therefore are not motivated to use technology for teaching and learning activities.

During this study, a worldwide health crisis developed, namely the Coronavirus pandemic. In South Africa, a national state of disaster was declared, and the country was placed into a full lockdown where most businesses and all schools were closed (Zuma, 2020). A consequence of the lockdown and the closing of schools was that teachers were forced to find new and creative ways of facilitating learning and providing learning materials to learners while they were away from school. When schools were allowed to reopen, coronavirus guidelines only allowed classrooms to be at 50% capacity as social distancing was required (Department of Basic Education, 2020). As such, learners attended school less frequently and were required to continue their studies at home. This increased the need for the use of technology to ensure

the continuation of learning throughout the coronavirus pandemic via online and distance learning mechanisms.

## **1.2 Problem Statement and Research Goal**

Given the previously described context, the following problem statement was identified:

"The South African government and Department of Basic Education are introducing Tablet PCs into education as a means of improving and facilitating the continuation of education in government basic education (primary and secondary level) schools. The perceived need for Tablet PCs in basic education has become more urgent because of the coronavirus pandemic and the need for online, distant teaching and learning during the pandemic.

Although Tablet PCs are being introduced into classrooms and for distance learning, educators remain unsure and, in some instances, unwilling to adopt and use technology in the classroom or for distance learning. As such, the focus of this study is on the educators' willingness to adopt and use technology both in the classroom and for distance learning.

The purpose of this study is then to investigate what conditions/factors need to be in place or addressed to facilitate increased adoption of technology by basic education educators. To this end, the study seeks to create a set of guidelines to facilitate and support the successful adoption of technology by educators for teaching and learning activities, both in the classroom and for distance learning."

## **1.3 Research Questions**

Following on from the problem statement and research's intended goal, the main research question was developed. In addition, four sub-questions were posed to help address the main research question. Each of which can be seen in the subsections that follow.

### **1.3.1 Main Research Question**

How and in what ways can educators be supported to promote increased integration and acceptance of technology for use in teaching and learning activities in basic education level schools in South Africa?

### **1.3.2 Sub-questions**

- What factors facilitate increased acceptance of technology by educators?
- What factors facilitate increased adoption of technology by educators?
- How can tablet PCs be utilised to support teaching and learning activities?
- How do Tablet PCs support the continuation of learning, specifically during the coronavirus pandemic?

## **1.4 Methodology Summary**

This study aims to develop a practical guide to support basic education educators in making use of Tablet PCs in the classroom (for teaching and learning activities) and for distance learning. As such, this study is a pragmatic study that employs Action Design Research (ADR) to design the final artefact; a guide to support educators, principals, and the DBE in fostering the use of Tablet PCs in teaching and learning activities, both in the classroom and for distance learning. ADR was chosen as it combines creating a practical solution to a given problem while still considering the organisational needs of the school in the study. The research participants in this study are educators at a previously disadvantaged school in Makhanda in the Eastern Cape. Ethical clearance for this study was received from the Rhodes University Ethics Board (0842), and data were collected through semi-structured interviews and analysed using Thematic Analysis.

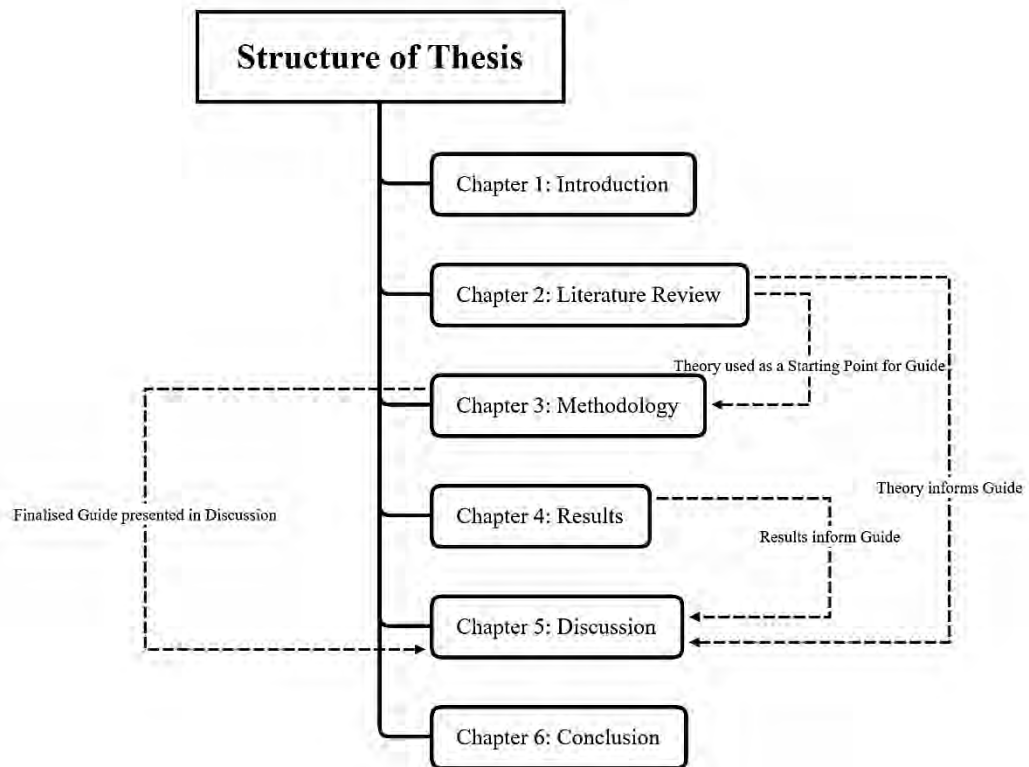
## **1.5 Structure of Thesis**

This thesis comprises six chapters, namely the Introduction, Literature Review, Methodology, Results, Discussion and Conclusion. Each of these chapters plays a role in creating an argument for both the problem and the artefact presented in Chapter 5. The breakdown of chapters can be seen in Figure 1-1, which depicts the links between each chapter. Each of the chapters is briefly described as:

- Chapter 2 presents the literature and theory used to understand the context of the educators and the problems they face when introducing Tablet PCs into their classrooms and for distance learning. Chapter 2 also presents the theories from which one can draw when seeking to understand the requirements of educator training and acceptance of technology, as well as the necessary bodies of knowledge that educators

should possess to teach with technology. These theories are used together with the research findings to direct the development of a guide introduced in Chapter 3 and finalised in Chapter 5.

- Chapter 3 outlines the methodology followed in this study, namely ADR. The research process, research participants, data collection, and data analysis methods are described. This Chapter also presents the initial guide developed for this study.
- Chapter 4 presents the results from the data collected during interviews with participating educators. The results reflect the educators' perspectives on the use of Tablet PCs in education and their insights into how technology could be effectively integrated into teaching and learning activities. These results are used to inform the finalised guide presented in Chapter 5.
- Chapter 5 links the theory and previous research findings from Chapter 2 to the results in Chapter 4 analyses the data in relation to literature and theory to gain a deeper understanding of the intricacies of introducing Tablet PCs into the classroom and for distance learning. It is out of that understanding that the final guide was developed and presented in Chapter 5.
- Chapter 6 summarises the thesis and answers the research questions presented in Chapter 1. Future work and recommendations are also discussed in Chapter 6.



*Figure 1-1: Breakdown of Structure of Thesis*



## **2 Literature Review**

This chapter uses current literature to provide a background to the education system, in general and specifically in South Africa, and how the addition of technology into an educational system influences educators. As such, this chapter interrogates the notion of education as a system and uses Bronfenbrenner's Ecological Systems Theory (BEST) (section 2.2) to understand the educator's role in the use of technology in the classroom. This chapter then goes on to decompose the educator's context (sections 2.3, 2.4, 2.5 and 2.6) to understand how each subsystem in the educator's context affects their use of technology in the classroom. Furthermore, this chapter explains how the personal characteristics of the educator (section 2.7) such as skill level and technology acceptance, affect their use of technology in the classroom. This theory will be used to build the initial guide presented in Chapter 3 and used alongside the results in Chapter 4 to create the finalised guide presented in Chapter 5.

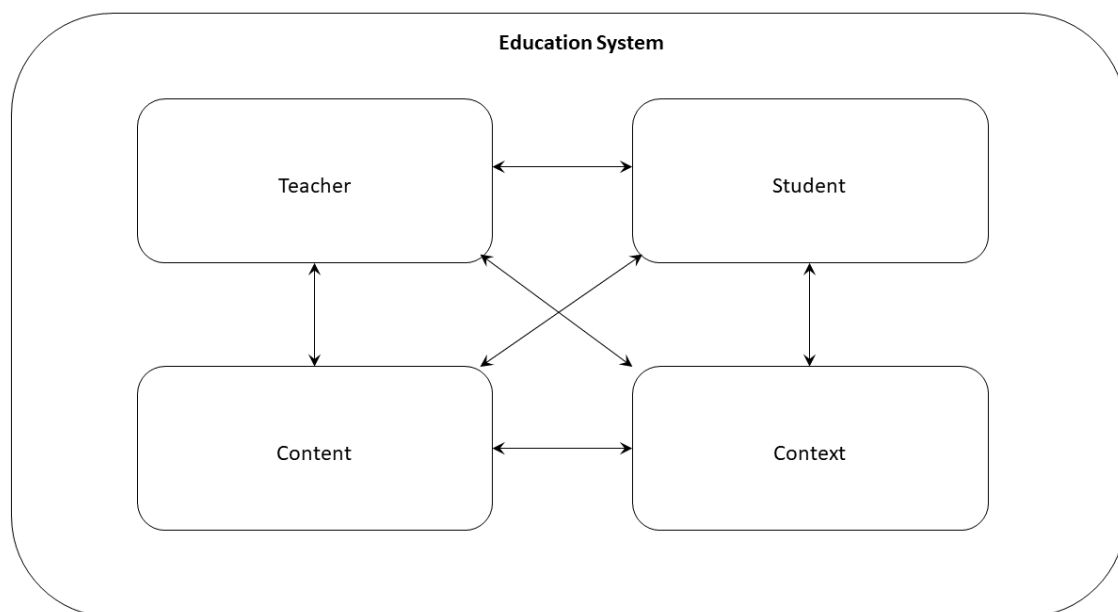
### **2.1 Education as a System**

General Systems Theory was first posited in the 1950s and is an attempt to understand the workings of the natural and man-made world in terms of systems (Boulding, 1956). A system can be referred to as a set of related parts working together to bring about a desired goal (Ackoff, 1971). It is influenced by the organisational structure in which the system exists (the context) as well as the people who are designing the system and operating the system (Cabrera, Colosi and Lobdell, 2008).

As such, an education system can be defined as a set of subsystems, namely, educators, learners, context and content, working together to accomplish the goal of learning (Frick, 1991). This system is considered an intentional system and is guided by the educator. The learner's role is to learn the given content within the given context (Frick, 1991). The relationships between these subsystems are shown in Figure 2-1. Overall, the education system has not changed over the years but the need for online, remote learning (as discussed in section 2.4.1), and the introduction of technology into education (section 2.4.2) has had the greatest effect on the context of the education system and how content is delivered (Frick, 2020). The need for a change to pedagogical practices and therefore content delivery is discussed in section 2.6.2.

The introduction of technology into an education system affects the relationships between all other subsystems. It affects the educator's relationship with the learners; the learner's

relationship with the content and the given context affects people's ability to use technology (Oliver, 2016). As such, technology affects how educators teach and how educational content is delivered in a digital era (Oliver, 2016). The educator plays a vital role in the use and adoption of technology when it is introduced into an education system (Alharbi and Lally, 2017; Altuna and Lareki, 2015; Farid et al., 2015; Herselman et al., 2018; Omare, Mwalw'a and Mutisya, 2018). A study by Gil-Flores, Rodríguez-Santero and Torres-Gordillo (2017) highlighted that an educator's personal characteristics such as technical training, perceived self-efficacy, and pedagogical practices affect their adoption and use of technology in the classroom. Gil-Flores, Rodríguez-Santero and Torres-Gordillo (2017) also highlighted contextual factors such as relationships with other educators also affect their use of technology. Additional contextual factors that may affect educators use of technology include government decisions on policies, relationships with learners, and connections with community members (Herselman et al., 2018).



*Figure 2-1: An Education System (Frick, 1991)*

## 2.2 Bronfenbrenner's Ecological Systems Theory

Since contextual and personal characteristics influence an educator's use of technology in the classroom, there is a need to unpack these characteristics to better understand them and how they affect the educator (Tang and Patrick, 2018). As such, Bronfenbrenner's Ecological Systems Theory (BEST) is used to decompose these factors and how they influence the

educator. BEST is a theory of human development, meaning the theory focuses on people and focuses on the interactions of an individual within their environment (Bronfenbrenner, 1979). Studies in many countries such as Pakistan, Saudi Arabia, Spain, Kenya and South Africa highlight that the educator plays an important role in the adoption and use of technology in the classroom (Alharbi and Lally, 2017; Altuna and Lareki, 2015; Farid et al., 2015; Herselman et al., 2018; Omare, Mwalw'a and Mutisya, 2018). Technology is considered a non-human aspect and affects the interactions of individuals within their context and can promote behaviour that previously had not existed (Boison and Dzidonu, 2017).

BEST is designed to focus on a person and states that human development occurs when people interact with different factors within their environment (Bronfenbrenner, 1979). These interactions are called processes, and through processes, learning takes place. Specifically, development occurs when the following four concepts interact: proximal process, person, context and time (Bronfenbrenner, 1979; Tudge et al., 2009, 2017).

The person, at the centre of the system, undertakes the proximal processes that bring about learning (Darling, 2007). The proximal process refers to the interaction of a person with their environment or context (Tudge et al., 2009, 2017), where person refers to the personal characteristics of a person in a system (Tudge et al., 2009, 2017). A person's individual characteristics, such as personality, gender, race, education level, play a role in how the person interacts within the system and their environment (Bronfenbrenner, 1979). Some of the individual's characteristics are fixed, but others, such as personality and education level, may change and influence how the person interacts within their environment (Bronfenbrenner, 1979). The interaction between a person and their environment is reciprocal; the environment influences the person while the person is influencing the environment. It is during this interaction where the learning process takes place.

Learning also has the effect of changing processes, and therefore processes change over time as learning takes place. Thus, Time refers to the fact that the environment and the person change over time, influencing how they interact with their environment, affecting their learning processes (Tudge et al., 2009, 2017). Further, the person's context affects them over time and influences their proximal processes (Tudge et al., 2017). The final concept is that of context, which is broken down into five subsystems: the chronosystem, macrosystems, exosystems, mesosystems, and microsystems (Tudge et al., 2009, 2017). These systems either play a direct or indirect role in influencing the person.

The macrosystem, exosystem, mesosystem, and microsystems fall within the chronosystem. The chronosystem refers to the time element that all systems and people experience. This system highlights that nothing remains the same forever and that change is inevitable as the person grows and interacts with the other systems (Härkönen, 2007). As such, the educators gain experience as they teach and interact within their environment (Herselman et al., 2018). Macrosystems are the overarching belief and cultural settings that influence all other subsystems. There is no direct influence on the person themselves, but the influence is felt through the influence of other systems (Härkönen, 2007). The macrosystem of an educator could be school belief systems, external pressures from the government to obtain specific results, and other external pressures from their community (Herselman et al., 2018; Rosenberg and Koehler, 2015). Exosystems are systems that the person does not directly influence but through which they are influenced (Bronfenbrenner, 1979; Härkönen, 2007; Tudge et al., 2017). The exosystem for the educator refers to things like the South African education system and national education policies. The educator as a person has little impact on what happens at the national level, but they must adhere to the decisions made at that level and implement them at a microsystem level (Herselman et al., 2018; Rosenberg and Koehler, 2015).

The mesosystem refers to the interaction of an educator's microsystems. Mesosystems are systems where the interaction between microsystems takes place. They are outside of the persons control but still influence them (Guy-Evans, 2020; Härkönen, 2007). The people within an educator's microsystem, such as learners, fellow educators, parents, and other community members, not only interact with the educator but also other individuals within their community. These interactions create changes in the relationships between individuals that the educator has no control over but can indirectly affect the educator (Härkönen, 2007; Herselman et al., 2018; Liu, 2018; Rosenberg and Koehler, 2015). Microsystems are systems where direct relationships with other individuals take place. These systems are the most influential on a person as the relationships within microsystems are bidirectional (Bronfenbrenner, 1979; Guy-Evans, 2020; Härkönen, 2007). The microsystem of an educator includes direct, bidirectional relationships between learners, fellow educators, and parents. The microsystem becomes the most meaningful system to the educator as they directly influence the people in their microsystem and vice versa (Herselman et al., 2018; Liu, 2018; Rosenberg and Koehler, 2015). Ultimately, the context of a person has an inward effect on the person, and the person has an outward effect on their context over time (Manning, 2017).

Bronfenbrenner's ecological system has been used in several studies. It has been used to describe how context affects the occupational well-being of educators (Liu, 2018). It has also been used to understand the relationship between context and additional language education in isiXhosa speaking learners (Kotzé, Westhuizen and Barnard, 2017). Furthermore, it has been used to help explain the gender gap in STEM subjects (Michell et al., 2018; Stipanovic and Woo, 2017); interrogate how disabled learners regard access to technology in the classroom (Ruppar, Allcock and Gonsier-Gerdin, 2017); and how the context of an educator affects their adoption and eventual use of technology in the classroom (Herselman et al., 2018).

These studies used BEST to understand the effect an individual's environment had on their development (Liu, 2018). The studies highlighted that each layer of an educator's environment needs to be understood to provide holistic insight into the environment of an educator (Kotzé, Westhuizen and Barnard, 2017; Liu, 2018) to better support the use of technology in the classroom. An educator's environmental factors can lead to barriers to adoption by educators. Thus, the context needs to be understood to better assist educators with adopting and using technology in the classroom and for distance teaching and learning (Herselman et al., 2018; Ruppar, Allcock and Gonsier-Gerdin, 2017).

Further research has also highlighted that existing environmental factors that fall outside of the educator's control also need to be addressed as these can also create adoption barriers (Kotzé, Westhuizen and Barnard, 2017; Michell et al., 2018; Stipanovic and Woo, 2017). Many studies have been criticised over the years for wrongly placing emphasis on the context of the study and not on the other aspects of BEST. Tudge et al. (2017) states that the four components of BEST (Proximal processes, person, context, and time) need to be unpacked to understand and correctly describe the system entirely. It is essential to know how the educator is affected by their context while understanding how their own personal characteristics and education levels affect their interaction within their context.

This literature review attempts to decompose the factors within each subsystem that influences the educator and their use of technology within the classroom. The literature aims to better understand the context an educator in South Africa finds themselves in and how this context potentially affects their adoption and use of technology. Firstly, this literature review focuses on an individual's environment and how this affects their use of technology. Secondly, it focuses on the educator's individual characteristics that potentially affect their use of technology. Figure 2-2 reflects a breakdown of the aspects that affects an educator's

environment and personal characteristics. Figure 2-2: BEST in Context also reflects the breakdown of this chapter and which aspects of an educator's environment fall into which system in BEST.

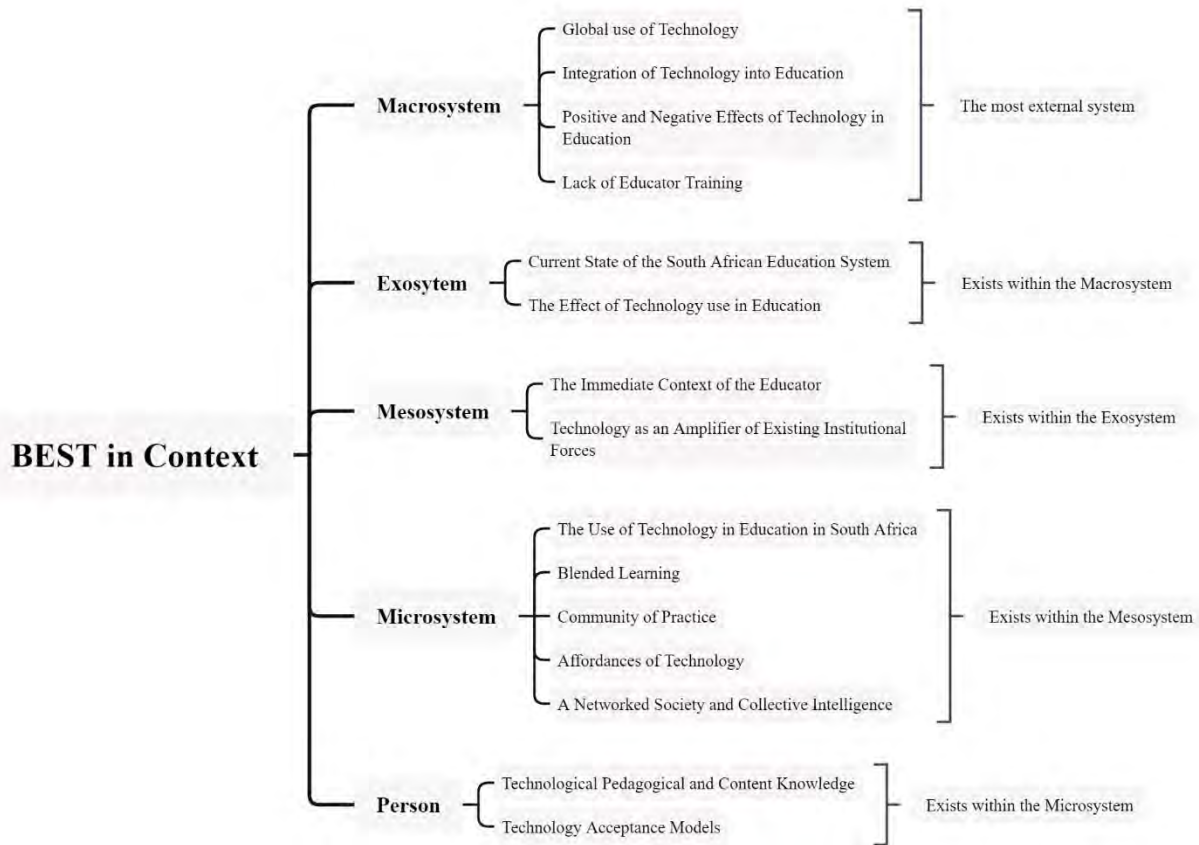


Figure 2-2: BEST in Context. Based on the work by Bronfenbrenner (1979) and Herselman et al. (2018).

## 2.3 Macrosystem

The macrosystem refers to the overarching belief systems that exist within a context, but external factors influence these overarching beliefs. In South Africa, they are influenced by what is happening in the rest of the world concerning the use of technology in education. These trends in use influence how the South African government and Department of Basic Education (DBE) understand the need for the use of technology in the classroom and how they might intend to implement technology in the classroom (Herselman et al., 2018). This section outlines global trends in technology use and unpacks how the introduction of technology has influenced the classroom environment in international studies. Firstly, by looking at the global use of technology to try and better understand why technology is being introduced into education and how the coronavirus pandemic has affected education. Secondly, this section

focuses on the integration of technology into teaching and learning activities and why it is important for technology to be effectively used in education. Thirdly, this section focuses on the positive and negative aspects of technology in education. Finally, it focuses on the need for educator training for the use of technology for teaching and learning.

### **2.3.1 Global Use of Technology in Education**

Many countries worldwide have started integrating technology into education (Zhang et al., 2016) with the intended goal of improving education (Tamim et al., 2015). Many of these countries have introduced national policies for education to support the adoption and integration of technology in teaching and learning (Khan et al., 2015). The introduction of technology can be seen in developed and developing countries (Zhang et al., 2016). In developed countries, the goal of introducing technology is to try and improve the learning experience of learners; allow for personalised learning environments (Kearney et al., 2012); provide equity in education, and improve academic success (Moran, Hawkes and El Gayar, 2010). It also allows learners to regulate their own studies and partake in realistic tasks (Kearney et al., 2012).

In developing countries, the goals of introducing technology into education are different. These goals include providing access to worldwide information and e-learning content and promoting greater collaboration (Maina et al., 2015). Technology is also being used to help empower students (Tamim et al., 2015), reduce inequalities (Ferrer, Belvís and Pàmies, 2011), and provide educational reform (Pamuk et al., 2013). Furthermore, there is a belief that learners with technological skills have a greater chance of finding employment (Wims and Lawler, 2007). Internationally, technology is being used to provide positive change to education. Therefore, it is vital to understand how technology influences education.

The coronavirus pandemic, which started at the end of 2019, also affected education globally. The need for isolation and social distancing, meant that teaching and learning would be safer online for many countries (Edeh, 2020). In developed countries, this shift from classroom to online learning did not place much strain on the education system as many learners had access to devices they could use for distance and online learning and connectivity for synchronous learning with educators (Sun, Tang and Zuo, 2020). Unfortunately, in developing countries the coronavirus pandemic widened the digital divide that already existed within those countries (Khlaif et al., 2021). As learners who had access to technology could continue with their

studies, but those who did have access were unable to continue their education. As such, the inequalities already felt in those countries were deepened due the pandemic (Khlaif et al., 2021).

### **2.3.2 Integration of Technology in Education**

Studies by Ferrer, Belvís and Pàmies (2011); Maina et al. (2015); Pamuk et al. (2013) and Wims and Lawler (2007) have shown that the use of technology can improve learning outcomes but only through the effective use of technology in education. Effective use of technology refers to integrating technology into the educator's pedagogy to ensure that learning takes place with or through the use of technology (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017). The effective use of technology requires the change of pedagogical practices and requires educators to be effectively trained in integrating technology into their pedagogical practices (Kamal and Diksha, 2019). Whereas ineffective use is when technology is used as an add-on in classrooms; only used for basic tasks like administration or content presentation, and they do not influence learning outcomes (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017). An example of this took place in Sierra Leone, where the government tried to implement technology in education by providing access to technology and observing what happened without providing any policies or frameworks to encourage effective use (Samarakoon, Christiansen and Munro, 2017). The outcomes highlighted that technology could not improve teaching and learning without educators being trained to use technology effectively in the classroom. This study also highlighted that educators needed more than technical training to ensure integration into pedagogical practices but also a better understanding of how to integrate technology into their existing pedagogical practices (Samarakoon, Christiansen and Munro, 2017).

There is a lack of understanding amongst policy makers regarding the context into which technology is being introduced and how this might affect the use of technology in the classroom (Samarakoon, Christiansen and Munro, 2017). Studies by Gil-Flores, Rodríguez-Santero and Torres-Gordillo (2017) and Rubagiza, Were and Sutherland (2011), undertaken in Spain and Rwanda respectively, have highlighted that having access to technology does not automatically make the use of technology effective in the classroom and that only through educator training and development can educators start to use technology effectively. Many of the studies that have occurred globally have highlighted that educators' acceptance and adoption of technology



play a pivotal role in integrating technology into teaching and learning activities (Albugami and Ahmed, 2015; Hatlevik, 2017).

The most common ICT introduced into education is the Tablet PC (Haßler, Major and Hennessy, 2016). This is because they are lightweight and portable. They are more cost-effective than other technologies such as laptops and desktops, and they have longer battery life spans than other mobile devices (Haßler, Major and Hennessy, 2016). Furthermore, they are larger than the average mobile phone making them easier to use for the purpose of learning (Fokides and Atsikpasi, 2017). That said, the typical shortfall of introducing tablet PCs into education contexts is that there is often no integration of the technology into educators' teaching and learning activities.

### **2.3.3 Positive and Negative Effects of Technology in Education**

Technology in education can positively affect inquiry-based learning, raising motivation and improving knowledge acquisition (Haßler, Major and Hennessy, 2016). This is due to technology in the classroom affecting what is being learned, how learning takes place, and how teaching occurs (Oliver, 2016). The goal of introducing technology is to promote learning in new and creative ways and help encourage self-efficacy of learning among the learners (Anshari et al., 2017).

Additionally, there are negative effects to using technology in the classroom. Studies have shown that mobile devices enable cyber-bullying to take place (Li et al., 2016). Cyber-bullying refers to when one or more persons, using technology, cause emotional harm or social embarrassment to another individual. This can be a more severe type of bullying as the victim cannot escape their bully as they carry their mobile device everywhere they go (Li et al., 2016). The use of technology can also be distracting within the classroom. This occurs when learners use their mobile devices for non-school related tasks during lessons. This can distract both the learners and the educators in the classroom (McCoy, 2016; Santos, Boheco and Habak, 2018). Learners can also become dependent on technology. The use of technology can reduce hand-eye coordination, and it can reduce the amount of time learners spend interacting with other learners and educators (Anshari et al., 2017). Learners can also use technology in a morally questionable way, such as watching pornography or illegally streaming movies, if the technology is not monitored appropriately (Dibaba, 2017).

### **2.3.4 Lack of Educator Training**

Across numerous countries, such as Brazil, Rwanda, Croatia, Iceland, Norway, and Turkey, the most commonly reported factor that hinders the adoption of technology in the classroom is the lack of educator training (Farias et al., 2013; Pamuk et al., 2013; Rubagiza, Were and Sutherland, 2011; Wastiau et al., 2013). Training needs to be more than IT competency training and should enable educators to integrate technology into their pedagogy effectively (Drent and Meelissen, 2008; Pamuk et al., 2013). Without ‘ICT integration in education’ training, educators lack the confidence to adopt and use technology in the classroom (Albugami and Ahmed, 2015). Furthermore, educators' perceived usefulness and ease of use of technology also affect their use of technology, which can hinder adoption and use. This will be discussed further in section 2.7.2 (Albugami and Ahmed, 2015; Kim, Choi and Lee, 2019; Howley, Wood and Hough, 2011).

## **2.4 Exosystem**

The exosystem refers to the outermost system that directly influences the educator. In the case of a South African educator, the DBE makes decisions concerning curriculum and national education policies. Even though technology can negatively influence learners in the classroom, the South African government is encouraging the deployment and use of tablet PCs and other technologies in the classroom. The motivation to include the use of technology in teaching and learning within schools is the perceived potential for improvement of learning outcomes in South African schools and that more learners will hopefully complete their schooling in South Africa (Department of Education, 2004; Phiri, Foko and Mahwai, 2014). This section gives an account of the current state of the South African Education System (section 2.4.1) and why this is driving the DBE to introduce Tablet PCs into education especially during the coronavirus pandemic. This section also looks at the effect that the introduction of technology has in the classroom specifically in South Africa (section 2.4.2).

### **2.4.1 Current State of the South African Education System**

The South African basic education system (thus not including Higher Education) is composed of two sections, namely, the General Education and Training (GET) band and the Further Education and Training (FET) band. GET comprises Grade R (0) to Grade Nine, and FET comprises Grade 10 to Grade 12 (Matric). The GET band is considered compulsory education,

and all children in South Africa are expected to complete the GET band of education. The FET band is not compulsory, and learners are not required to complete this level of education.

The South African education system has been experiencing a crisis in recent years (Spaull, 2017); of the learners who enter grade one, only half of them will reach grade 12 in the correct amount of time (Modisaotsile, 2012). Further, results from the Annual National Assessments (ANAs) revealed that in 2011 only 35% of Grade 6 learners could read (Modisaotsile, 2012; Spaull, 2013). When decomposing the results to a provincial level, we see a bleaker picture with greater disparities between provinces; 15% of grade 6 learners could read in Mpumalanga, while 49% could read in the Western Cape. This indicates a possible disparity in the quality of education being offered across the country (Modisaotsile, 2012).

The three main international tests that are used to test literacy and numeracy levels are:

- the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ),
- Trends in International Mathematics and Science Study (TIMSS), and
- Performance in International Literacy Study (PIRLS).

These standardised tests are administered worldwide and describe how South Africa is performing in relation to other countries. SACMEQ highlighted that in 2007, 27% of grade 6 learners could not read for comprehension (Spaull, 2013). TIMSS revealed that in 2011, South African grade 9 learners placed last out of 44 countries tested in mathematics and science literacy (Badat and Sayed, 2014) and that 76% of grade 9 learners did not have a basic knowledge of concepts such as whole numbers and graphs. These results are considered especially poor because South African grade 9 learners were tested, but in all other countries grade 8 learners were tested (Spaull, 2013). PIRLS was last administered in 2016 and highlighted that 76% of Grade 4 learners in South Africa could not read for comprehension; South Africa was placed last out of 50 countries tested (Spaull, 2017). These tests can be used to show the disparities among learners in South Africa, they need to be considered in context by policy makers to ensure that effective steps are taken to improve learning outcomes (Govender and Hugo, 2020). Although standardised testing shows a bleak picture of education in South Africa, annual testing in schools has shown a steady improvement to educational quality in South Africa with expected continued improvement in years to come (Gustafsson and Nuga, 2020).

A lack of grade specific knowledge does not only fall on the side of the learners as it has been highlighted that South African educators do not attend school regularly and that 20% of educators are absent on Mondays and Fridays (Modisaotsile, 2012). It has also been found that many Mathematics educators in South Africa have a below average content knowledge of mathematics and cannot answer questions their learners are expected to answer (Spaull, 2013). In 2015, it was found that 19% of educators in South Africa were unqualified and that there is a high rate of turnover of qualified educators resulting in an increase in the hiring of unqualified educators (Hofmeyer, 2015). Due to the lack of trained educators, the DBE has instituted that educators are required to write matric papers. It is hoped that doing so would ensure that educators can identify gaps in their knowledge areas and help the DBE identify unqualified educators in schools (Jourdan, 2019).

Consequently, the South African DBE is driving the introduction of ICTs in education. With the focus being on the use of Tablet PCs within education. The goal of introducing technology is to provide increased access to technology, improve equity, and provide redress (Department of Education, 2004). Further, it is hoped that access to technology can reduce the digital divide (Hart and Laher, 2015) and produce lifelong learners and engaged citizens (Department of Education, 2004). In addition, technology is expected to improve first-year retention in universities and increase learner throughput in schools while reducing learner dropout rates (Ng'ambi, 2013). The White Paper on Science, Technology and Innovation released by the Department of Science and Technology has also stated that ICTs play a pivotal role in education and need to be exploited to provide open-access, ubiquitous learning for learners across South Africa (Department of Science and Technology, 2019).

This drive to introduce ICTs into education has also been hastened by the coronavirus pandemic. In South Africa, the DBE closed schools to reduce the spread of the coronavirus. This led to educators and schools having to find new ways of disseminating knowledge and continuing education despite the school closures. When schools were allowed to reopen, classrooms could not exceed 50% capacity to ensure social distancing could be maintained (Department of Basic Education, 2020). As such, there has been a greater need for distance learning in South Africa to ensure continuation of learning and reduce the learning loss expected from school closures (Gustafsson and Nuga, 2020). This has meant that schools have received government issued Tablet PCs to promote distance and online learning as mentioned by President Cyril Ramaphosa in his State of the Nation address in 2020 (President Cyril Ramaphosa, 2020).

### **2.4.2 The Effect of Technology use in Education**

Given the interest from governments worldwide in introducing the use of Tablet PCs in education, it is important to understand its effect on education. Studies in countries such as Thailand (Pruet, Ang and Farzin, 2016) and Pakistan (Arain et al., 2018) showed that the use of technology in education contributed to a significant improvement to learners' learning outcomes. This is because technology enables greater collaboration when learning and ease of learning material creation (Cheng and Chau, 2016). In the study by Arain et al. (2018), the use of traditional teaching methods also brought about an improvement in learning outcomes; consequently, the authors suggested that e-learning should be used alongside traditional teaching methods. Technology for teaching and learning can also positively affect learners' motivation to learn as they have access to more resources, enhanced communication, greater feedback from a wider audience, and are more engaged when using technology (McKnight et al., 2016). Furthermore, learners need to be able to understand the intrinsic value of using technology for learning. If learners consider there to be too much effort in using technology or they expect there to be a greater workload than before, they will be unwilling to adopt and use technology for learning (Ifenthaler and Schweinbenz, 2016).

The DBE, in their white paper on e-education, stated the need for training and support of educators using technology in the classroom (Department of Education, 2004). Unfortunately, this is often not a reality in schools across the country. There is often little support for technology use in the classroom from both policy makers outside the school and stakeholders inside the school (Dlamini et al., 2017; Msila, 2015). Typically, there appears to be a focus on the physical access to technology as sufficient to bring about a change to learning outcomes (Hart and Laher, 2015). However, technology on its own is neither a force for good nor bad (Toyama, 2011). Only the effective use of technology can improve the learning outcomes of learners (Hart and Laher, 2015; Herselman, 2003). Technology can only be used effectively if educators are trained to integrate technology into the teaching and learning activities. Their pedagogy needs to be adapted to produce improved learning outcomes (Herselman and Botha, 2014).

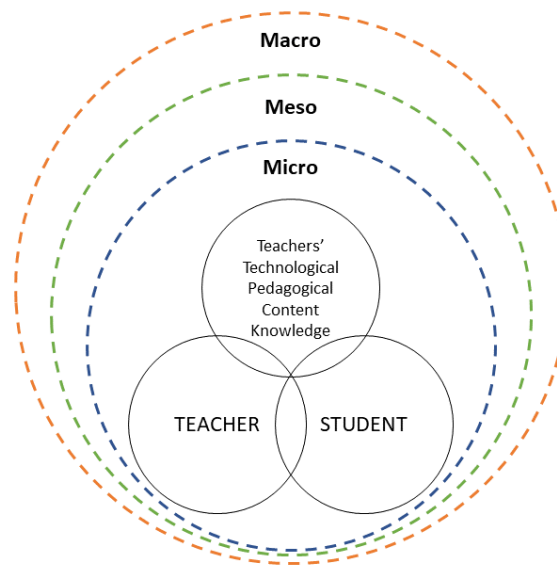
## **2.5 Mesosystem**

As previously stated, the mesosystem refers to the interaction of an educator's microsystems (Härkönen, 2007). The people within an educator's microsystem, such as learners, fellow educators, parents, and other community members, interact with the educator and other individuals within their community. These interactions create changes in the relationships between individuals that the educator has no control over but can indirectly affect the educator (Härkönen, 2007; Herselman et al., 2018; Liu, 2018; Rosenberg and Koehler, 2015). This means that an educator is not the only person learning and changing within a given context (Cherner and Smith, 2017). The changes in an educator's mesosystem have ramifications in the way an educator needs to teach within their specific context. This section attempts to unpack aspects that educators need to be aware of in their classroom such as how their context plays a role in how they teach (section 2.5.1) and how the capacity, motivation to use technology and access to technology of the people they interact with plays a role in how they teach (section 2.5.2).

### **2.5.1 The Immediate Context of an Educator**

The TPACK framework considers how the context of an educator affects their teaching practices. This refers to the classroom environment of the educator and the environment of other individuals such as learners, fellow teachers, and parents. TPACK falls within the personal characteristics of the individual teachers, which is discussed in section 2.7.1, but its practice in the classroom is affected by how the learners react to the lessons and how fellow educators teach in their classrooms (Rosenberg and Koehler, 2015). Context is a vital component in the TPACK framework, but it is often misunderstood or ignored (Rosenberg and Koehler, 2015).

The context that the educator plays a role in affects their interactions with the learners in their classroom and affects their Pedagogical Knowledge (PK), Technological Knowledge (TK), and Content Knowledge (CK). As was highlighted in section 2.2, an educator's interaction within their environment promotes development and can also create barriers to adoption. Therefore, it is important to understand an educator's immediate environment, in this case, the learner's, fellow educators, and the physical environment being taught in, to better understand how an educator may teach with technology in that classroom.



*Figure 2-3: TPACK considering context (Rosenburg and Koehler, 2015)*

### **2.5.2 Technology as an Amplifier of Existing Institutional Forces**

Another theory that explains how individuals within the educator's mesosystem interact is Technology as an Amplifier of Existing Institutional forces. Kentaro Toyama posited this theory in 2011 (Toyama, 2011). He states that technology only amplifies the existing state of technological use in an institution or a community. This amplification broadens the digital divide between those who can effectively use technology and those that cannot. The study defined three areas where amplification can occur, namely differential access, differential capacity, and differential motivation (Toyama, 2011).

Differential access refers to the various technologies to which people have access. This differs depending on the individual, and so the educator needs to understand who in her classroom and community has access to technology specifically for learning (Toyama, 2011). Differential capacity refers to having technological literacy to use technology effectively. This may come in the form of training or previous use of technology. Without the capacity to use technology, technology cannot be used effectively in the learning process (Toyama, 2011). Differential motivation refers to a person's willingness to use technology to improve their life. A person's motivation to use technology can only improve once they understand how technology can improve their current situation (Toyama, 2011). These three areas affect the educator within the mesosystem as they need to understand how technology is used daily by learners and how

they can effectively teach their learners while using technology. This will help the educator better guide the use of technology in the classroom and make the use of technology in the classroom relevant to the learners.

The educator is also affected by differential access (discussed in section 2.6), differential capacity (discussed in section 2.7.1), and differential motivation (discussed in section 2.7.2). If they do not have access to technology, the capacity to use the technology or the motivation to use the technology in the classroom then technology will never be used effectively in the classroom. As stated previously in section 2.4.2, technology will amplify the inequalities that already exist within the classroom (Rodríguez, Nussbaum and Dombrovskaja, 2012). Technology can only positively amplify the pedagogy of educators who are motivated to effectively use technology and have the training to effectively use technology for teaching and learning (DiMaria, 2016). Capacity and motivation need to be considered as only an educator who is both motivated and trained to use technology can positively amplify their pedagogical practices using technology (DiMaria, 2016).

## **2.6 Microsystem**

The introduction of technology in the classroom affects the microsystem of the educator more than any other contextual system. This is because educators are the ones that must attempt to integrate the technology into their teaching and learning practices. It is generally left to the educator to decide on the most effective way to use technology in the classroom. The introduction of technology into the classroom changes the nature of relationships within the classroom. Technology influences the relationship between the educator and the learners and the educator and the administration (Spires, Oliver and Corn, 2012). This change in relationship means that there also needs to be a change in instructional practices to ensure that these relationships are used to enhance the learners' learning experience (Spires, Oliver and Corn, 2012). This section looks at studies in South Africa that have introduced technology into classrooms to try and understand South Africa's specific barriers to the effective use of technology in the classroom (section 2.6.1). Next, teaching techniques, such as blended learning (section 2.6.2), how Community of Practices could improve the technical knowledge of educators (section 2.6.3), and the role connectivity plays in education (section 2.6.4) are all unpacked.



### **2.6.1 The Use of Technology in Education in South Africa**

Studies in South Africa, such as the ICT4RED programme that introduced Tablet PCs into 27 schools in the Eastern Cape (Herselman and Botha, 2014) and a study by Hart and Laher (2015) conducted in the Johannesburg area, highlighted that buy-in from educators is vitally important to ensure technology is used effectively in the classroom. If the educators are unwilling to use technology in the classroom, then technology use will not be implemented. There also needs to be buy-in from other stakeholders, such as the principal of a school (Herselman and Botha, 2014). This ensures that educators feel supported by stakeholders and do not feel that they are the only ones who see the importance of technology (Herselman and Botha, 2014). The ICT4RED program highlighted that the most common barriers to the adoption and integration of technology in the classroom in South Africa are a lack of access to resources, a lack of professional development or teacher training, and negative educator attitudes and beliefs about technology (Nkula and Krauss, 2014). Similar barriers were found by Adukaite, van Zyl and Cantoni (2016). These barriers align with Toyama's technology amplifiers (discussed in section 2.5.2) as there is a lack of access, a lack of capacity, and consequentially a lack of motivation.

A South African study undertaken in Cape Town in the Western Cape showed that educators in under-resourced schools were willing to adopt technology, but they felt they lacked the skills required to use technology effectively in the classroom (Bladergroen et al., 2012). Additionally, a study by Lupondwana and Coleman (2019), which took place in the Johannesburg area, showed that there needed to be subject-specific training for the use of technology in the classroom. However, it is important to note that the use of technology did improve learner involvement and independent learning (Lupondwana and Coleman, 2019). Further, a study in the Johannesburg area showed that educators have positive attitudes towards using technology but that a lack of instructional software creates barriers that reduce the willingness to adopt technology (Batchelor and Olakanmi, 2015).

These five studies all found the need for the professional development of educators; professional development attempts to reduce some of the barriers to adoption. These barriers include a lack of knowledge or confidence in the use of technology. Although there is now access to Tablet PCs that the DBE provides, there is still a need to train educators to use technology in the classroom effectively. This training would reduce some of the educator's reluctance to use technology in the classroom, thereby potentially increasing their motivation. As such, these studies all highlight the problem identified in the Problem Statement in Chapter

1; educators do not have sufficient training to effectively use technology in the classroom and are therefore unable and unwilling to use technology in the classroom.

### **2.6.2 Blended Learning**

Adu and Galloway (2015) showed that educators' instructional practices need to change to effectively use technology for teaching and learning and that training is required to make this change in instructional practices effective (Adu and Galloway, 2015). Blended learning techniques are the most common realisation of changes to instructional practices, attempting to integrate technology into education (Nazarenko, 2015). Blended learning refers to the use of technology so that the traditional educational processes are blended with new technological advances to bring about a new and exciting learning experience (Nazarenko, 2015). This learning process brings together both synchronous and asynchronous learning to provide a holistic learning experience for learners (Garrison and Kanuka, 2004). This is different from traditional teaching methods, where all teaching takes place in the classroom with no technological help. It is also different from e-learning, where all learning takes place online (Thai, De Wever and Valcke, 2017). Blended learning is considered an important change in education as the need for digital competencies is high in the 21<sup>st</sup> century (Kostaris et al., 2017). The focus of teaching has shifted in recent years. Previously, teaching was considered an instructivist process where the educator provided the knowledge. Now, teaching is considered a constructivist process where learners are expected to construct their own knowledge and understanding (Nkula and Krauss, 2014). The introduction of technology into the classroom further drives this change as technology can only be used effectively in a learner-centred classroom (constructivist) (Kostaris et al., 2017). Blended learning is considered a more learner-centred approach to teaching and learning and supports the current changes in pedagogical approaches taken by teachers in the classroom (Kostaris et al., 2017).

Studies by Tang and Chaw (2016), Tseng and Walsh (2016) and, Kintu, Zhu and Kagambe (2017) found that blended learning courses improved learner motivation and satisfaction in the classroom. It also helped them improve the learners' knowledge construction (Kintu and Zhu, 2016). Interestingly, however, blended learning has been shown to have mixed effects on the learning outcomes of learners, some studies recording significant improvements to learning outcomes (Saritepeci and Cakir, 2015; Thai, De Wever and Valcke, 2017), while others recorded no change to learning outcomes (Kintu, Zhu and Kagambe, 2017) but positive effects

on other aspects such as engagement with content (Tang and Chaw, 2016) and learner self-regulation of their studies (Tseng and Walsh, 2016).

Blended learning can be broken into six major models. These models are Rotation (most popular being the “flipped-classroom”), Flex, Self-blend, Face-to-Face Driver, Online Driver, and Online Lab. The different aspects of these models are shown in Table 2-1. The online driver, online lab, and flex model involve minimal educator-learner interaction and do not work in a traditional classroom environment. The self-blend model does not involve the teacher and takes place outside of the classroom. These four models do not work in a traditional teacher-learner classroom environment (Pandit, 2015). The blended learning models that work best in a traditional classroom environment are face-to-face drivers and rotation models. These models can be blended to best aid the educator's learning goals and teaching methods (Pandit, 2015).

*Table 2-1: Blended learning models*

Rotation	Flex	Self-Blend
<ul style="list-style-type: none"> <li>• Students rotate through different stations where some are technology enhanced (Staker, 2011).</li> <li>• Four types of rotation: Station Rotation, Lab Rotation, Flipped Classroom, Individual Rotation (Walne, 2012).</li> </ul>	<ul style="list-style-type: none"> <li>• Learners learn through self-paced online curriculum.</li> <li>• Educators and personnel offer assistance as needed by the learners (Staker, 2011).</li> </ul>	<ul style="list-style-type: none"> <li>• Learners are able to take courses that supplement their own learning.</li> <li>• These courses are generally done remotely (Staker, 2011).</li> </ul>
Face-to-Face Driver	Online Driver	Online Lab

<ul style="list-style-type: none"> <li>• Classroom activities drive technology use.</li> <li>• Technology is used to enhance what is being learned in the classroom (Staker, 2011).</li> </ul>	<ul style="list-style-type: none"> <li>• Learners learn predominantly online but have physical classes once a week for support.</li> <li>• This model is considered remote learning (Staker, 2011).</li> </ul>	<ul style="list-style-type: none"> <li>• One physical location in a lab environment.</li> <li>• All instruction is delivered online (Staker, 2011).</li> </ul>
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Of the four types of rotation models, the flipped classroom is considered the most popular and the most successful in a traditional classroom environment (Thai, De Wever and Valcke, 2017). The “flipped classroom” is a blended learning method of teaching where the classroom dynamic is “flipped,” meaning that the learners become the primary acquirers of knowledge and do not solely rely on the educators for knowledge. It is no longer the educator imparting knowledge to the learners but the learners acquiring the knowledge first-hand and reporting back to the educator (Hwang, Lai and Wang, 2015). The educator acts as a facilitator in the classroom. A study by Thai, De Wever and Valcke (2017) compared traditional teaching methods, e-learning, and the flipped classroom. Their study found that the use of e-learning by itself had no significant difference in learning outcomes than traditional teaching methods. Instead, they found that the flipped classroom method is the most effective method of improving learning outcomes (Thai, De Wever and Valcke, 2017). The flipped classroom is said to help with communication skills, increase collaboration, improve critical thinking skills and help improve complex problem-solving skills (Hwang, Lai and Wang, 2015). This is because the flipped classroom promotes higher order thinking because learners must do their own knowledge acquisition and construction. They also have access to a much larger body of knowledge provided by having access to the Internet (Hwang, Lai and Wang, 2015).

Blended learning models do not have to be used in isolation, and aspects from different models can be combined to complement teaching and learning activities both in the classroom and for distance learning (Kaur, 2013). Educators can combine models to ensure teaching and learning can continue to be effective given the current context. As such, the self-blend or self-paced

model can also be used in conjunction with the “flipped-classroom” and the Face-to-Face Driver model. The Self-Blend model enables learners to continue their own studies outside of the classroom, complete work at their own pace, and gauge their progress through self-assessment (Kaur, 2013). Although, the self-blend model enables learners to have more control over what they learn and how they learn, the need for self-regulation and motivation to continue their studies is important as learners may fall behind if they are not motivated to complete their studies in a timely manner (Hwang et al., 2019).

The use of blended learning methods does place extra pressure on the educators as they are expected to evolve their pedagogical knowledge and educational practices (McKnight et al., 2016; Nazarenko, 2015). This can influence their willingness to use technology in the classroom (Nazarenko, 2015). Some learning areas are more open to the use of technology than others. In the case of the tourism learning area, for example, the National Curriculum Standard (NCS) of South Africa says that tourism educators need access to the Internet to ensure that learners can access current tourism opportunities, such as game drives and holiday destinations, and explore general trends in tourism (Department of Basic Education, 2011). This need for technology has also been highlighted in a study by Adukaite, van Zyl and Cantoni (2016), which specifically focused on using technology in tourism education in South Africa. Tourism also lends itself well to blended learning. Learners are encouraged to do their own investigation into tourism opportunities in South Africa, developing their knowledge in the learning area while carefully guided by their educator.

### **2.6.3 Community of Practice**

Another aspect important to the microsystem of an educator is that of Community of Practice (COP). A COP can be defined as “a group of people who share an interest in a domain of human endeavour and engage in the process of collective learning that creates bonds between them” (Wenger, 2002). They can further be defined as self-organising systems of informal learning that focus on a shared interest; learn through interaction, discussions, and sharing knowledge; and have a shared collection of experiences and problem-solving techniques (Gray, 2004). COPs are important amongst educators as they are a space where they can learn from fellow educators and develop best practices that can be used to improve their teaching practices through problem-solving and knowledge sharing (Trust and Horrocks, 2017). COPs bring together educators of differing levels of expertise to share their knowledge and learn from one

another (Lave and Wenger, 1991), providing professional development through ongoing learning experiences (Brooks, 2010). COPs generally take time to develop as participants require shared knowledge and connected practices but can be promoted through encouragement and support from stakeholders (Goodyear and Casey, 2015).

It can be argued that a COP also exists within the classroom as many of the same goals of a COP are expressed in the classroom. The educators and learners focus on a shared interest, learn through interacting, and have a shared collection of experiences. These COPs can be fostered by allowing interaction amongst learners and educators (Brown, 2007; Olitsky, 2007). COPs can be extended beyond the classroom through blended COPs. Blended COPs combine face-to-face interaction with online learning communities to further enhance the learning achieved in traditional COPs. These COPs can be set up for informal and formal learning to provide learning opportunities from various sources (Trust and Horrocks, 2017). As such, Blended COPs can be defined as a group of individuals who participate in informal and formal learning in a face-to-face setting or online (Allan, Hunter and Lewis, 2006). Blended COPs are supported by technology. Learning is a collaborative process, and Blended COPs supported by technology use, such as Tablet PCs, can extend the already existing learning community to outside the classroom. Thus, positively influencing the learning outcomes of the learners (Trust and Horrocks, 2019).

#### **2.6.4 The Networked Society and Collective Intelligence**

Another aspect of an educator's microsystem is connectivity. Society is increasingly considered to be a networked society because of communications technology allowing for increased connectivity and being online. Previously, connections were made linearly, with information flowing in one direction (such as from educator to learner) (Cornu, 2004). Since the invention of the Internet, connections are no longer linear but rather interconnected in complex ways. This has led to information being shared in non-linear ways, new connections being formed, and new ways to communicate. Cornu (2004) argues that education should change to include the use of these connections to ensure learners learn how to access knowledge and information from digital, online sources. One could argue that not only do they need to learn to access the information and knowledge, but that they also need to learn how to discern accurate information and knowledge, from opinion and hearsay. "Therefore, schools must use

the networks, be part of the networks and teach the networks” to ensure continued learning in schools (Cornu, 2004).

The introduction of communication technology has enabled new networks, new ways of accessing and storing knowledge, and novel communication methods. Thus, creating a new form of collective intelligence (Cornu, 2004). Therefore, the need for communication technology to be included in education becomes necessary to ensure that learners are connected and can participate in the collective intelligence. Collective intelligence refers to individuals acting together with favourable outcomes for the whole group (Kong and Yu, 2016). Learning should no longer be considered an individual task but a collective task that can be promoted through collective tasks and activities and should include technologies that promote collective intelligence such as the Internet and ICTs (Cornu, 2004).

## **2.7 Person**

Since the educator plays a vital role in the classroom, it is important to note and understand how their personal characteristics affect their use of technology in the classroom. This section focuses on the capacity and motivation of the educator, as discussed in section 2.5.2. The educator's capacity refers to their skill level; as such, this section first focuses on the Technological, Pedagogical, and Content Knowledge (TPACK) of the educator and how the development of this knowledge will affect their use of technology in the classroom (section 2.7.1). The motivation of an educator refers to their willingness to use technology in the classroom. This is discussed using Technology Acceptance Models in section 2.7.2 to better understand why educators may have a negative attitude towards technology and how these attitudes may be improved.

### **2.7.1 Technological, Pedagogical, and Content Knowledge Framework**

Koehler and Mishra (2009) designed the Technological, Pedagogical, and Content Knowledge Framework (TPACK). This framework defined the perfect educator who could teach with technology as someone who possessed:

- pedagogical knowledge, the knowledge of how to teach;
- content knowledge, the knowledge of what to teach; and

- technological knowledge, the knowledge of how to use technology (Koehler and Mishra, 2009).

A perfect educator who uses technology should first have good content and pedagogical knowledge before attempting to integrate technology into their teaching and learning activities (Koehler and Mishra, 2009). As stated in section 2.5.2, technology amplifies the existing pedagogical problems and does not automatically improve poor teaching practices.

Figure 2-4 shows the framework as defined by Koehler and Mishra (2009). It describes how effective teaching with technology takes place at the intersection of the three knowledge areas. The Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK) intersections (where two of the three knowledge areas intersect) are as important as the main intersection (where all three knowledge areas intersect) TPACK (Graham, 2011). TPK refers to an educator's knowledge of teaching with technology (Graham, 2011). TCK refers to how educators use technology to find and provide content for their teaching activities. PCK refers to how educators teach the content they are required to cover (Graham, 2011). The intersection of all three of these areas is known as their technological, pedagogical, and content knowledge (TPACK) (Archambault and Barnett, 2010).

An educator's TPK impacts their ability to integrate tablet PCs into their teaching and learning activities. Educators often have technological knowledge and pedagogical knowledge, but they have not been taught how to integrate these two knowledge areas to effectively use technology in the classroom. This can be seen both in South African studies (Herselman and Botha, 2014; Hart and Laher, 2015; Msila, 2015; Nkula and Krauss, 2014) and in international studies (Drent and Meelissen, 2008; Maina et al., 2015; Pamuk et al., 2013; Wastiau et al., 2013). Studies conducted in South Africa that specifically focused on developing the TPACK of educators found that educators lacked the necessary technological knowledge to integrate technology into their pedagogical practices (Hernawati and Jailani, 2019; Mdingi and Chigona, 2021). These studies highlight those educators who cannot integrate their technological knowledge and pedagogical knowledge battle to integrate technology effectively into teaching and learning activities and cannot teach effectively with technology.



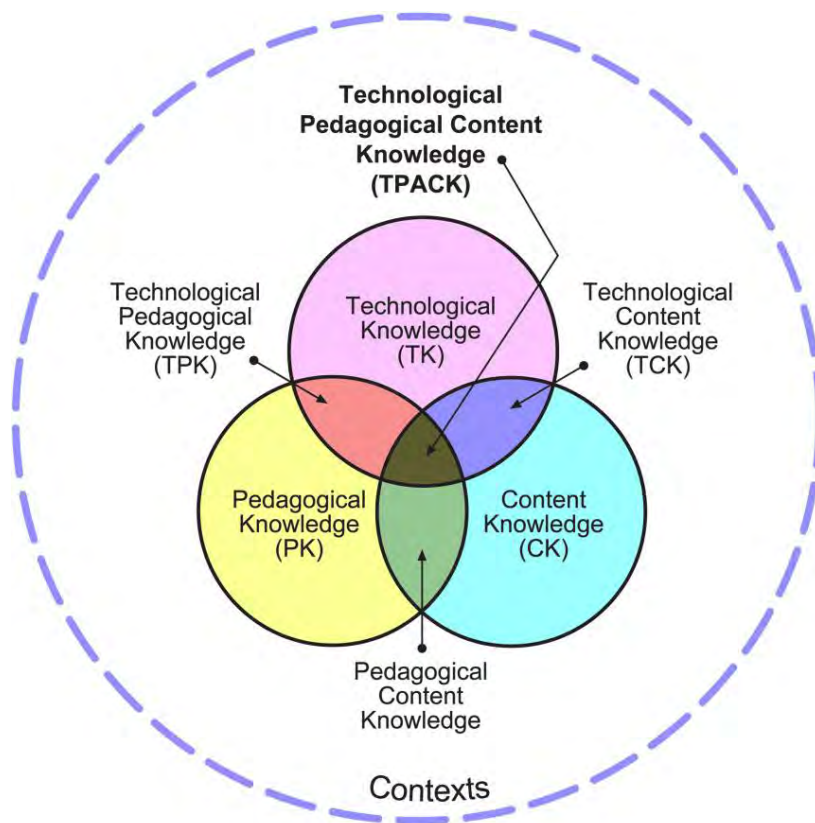


Figure 2-4: TPACK Framework (Koehler and Mishra, 2009)

TPACK has been used in studies to analyse educators' use of technology (Sickel, 2019; Srisawasdi, Pondee and Bunterm, 2018) and design training that specifically focuses on building the TPACK of educators (Admiraal et al., 2017; Alemdag, Cevikbas and Baran, 2019). These studies highlighted that introducing technology into the classroom should change instructional practices (Sickel, 2019). As such, there is a need to create training that provides educators with practical examples of using technology in the classroom. These practical examples can potentially enable educators to integrate their knowledge areas (Alemdag, Cevikbas and Baran, 2019; Roussinos and Jimoyiannis, 2019).

It is also important to understand how to measure an educator's TPACK. One of the most common ways of measuring TPACK is through questionnaires (Schmidt et al., 2009). Unfortunately, questionnaires involve self-reported data, leading to a positive bias towards the educators' abilities (Bustamante, 2019). As such, Harris, Grandgenett and Hofer (2010) state that researchers should examine the educator's understanding of their own TPACK and how they plan their technologically enhanced lessons, their instructional actions within the

classroom, how they interact with learners and their reflections on their actions. These different areas can be analysed through tools such as TPACK observation protocols (Kafyulilo et al., 2015), TPACK lesson plan instruments (Harris, Grandgenett and Hofer, 2010), and reflective journals kept by the educator (Bustamante, 2019).

Additionally, it is important to understand how educators can develop their TPACK knowledge to better prepare them for using technology in the classroom. Studies by Admiraal et al. (2017) and Alemdag, Cevikbas and Baran (2019) highlighted that educators could improve their TPACK knowledge by practicing technology-enhanced teaching through creating technology-enhanced lesson plans and networking with other educators from whom they could learn. This can be done through initiatives within schools where educators are given safe spaces outside of the classroom to practice and understand how they can use technology in the classroom. An educator's TPACK is not the only thing that affects their use of technology in the classroom. Other factors such as context (discussed in section 2.5.1) and willingness to use technology (discussed in section 2.7.2) also play a vital role (Roussinos and Jimoyiannis, 2019). These need to be considered alongside TPACK to truly understand how an educator might integrate technology into their teaching and learning practices (Roussinos and Jimoyiannis, 2019; Sickel, 2019).

### **2.7.2 Technology Acceptance Models**

Educators' use of technology in the classroom is affected by their acceptance of technology (Hart and Laher, 2015; Howley, Wood and Hough, 2011). Technology acceptance affects a person's motivation to use technology, as discussed in section 2.5.2. One of the most common and accepted technology acceptance models is the Technology Acceptance Model (TAM). This model was first posited in 1989 by F. D. Davis and is based on the Theory of Reasoned Action (Smarkola, 2007). Since then, TAM has been used in a variety of settings to try and understand how a person's acceptance of technology affects their use of technology (Šumak, Heričko and Pušnik, 2011), this includes educational settings; specifically trying to understand e-learning acceptance (Šumak, Heričko and Pušnik, 2011).

TAM (shown in Figure 2-5) states that a person's perceived usefulness of technology and their perceived ease of use of technology affects their attitude towards technology and their eventual use of technology (Legris, Ingham and Colletette, 2003). In other words, if a person can see

that technology is useful and easy to use, they are more likely to use the technology in their daily lives (Legris, Ingham and Colletette, 2003).

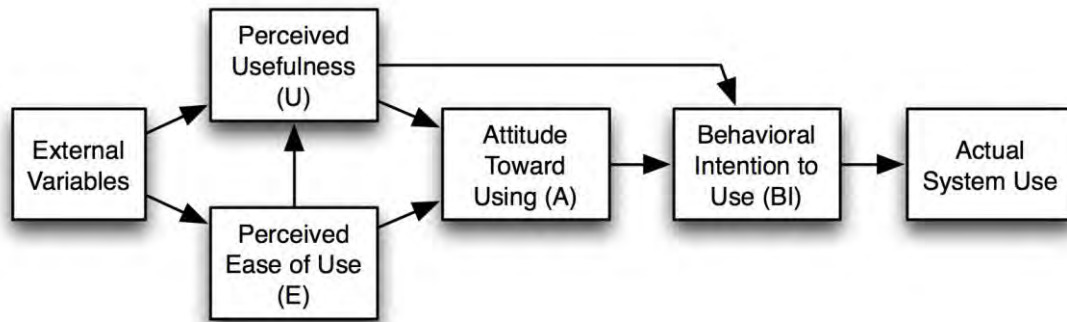


Figure 2-5: Technology Acceptance Model (Legris, Ingham and Colletette, 2003)

Studies have used TAM to understand how educators view technology (Ibrahim et al., 2017), and how learners view technology (Çakıroğlu, Gökoğlu and Öztürk, 2017; Ifenthaler and Schweinbenz, 2016). These studies have often extended TAM to include external variables such as self-efficacy and resistance to change (Ibrahim et al., 2017; Sánchez-Prieto, Olmos-Migueláñez and García-Peñalvo, 2016). Self-efficacy affects perceived ease of use as there needs to be a drive from the individual to use technology (Ibrahim et al., 2017). Resistance to change can also play a role in an educators' perceived usefulness of technology (Sánchez-Prieto, Olmos-Migueláñez and García-Peñalvo, 2016).

Unfortunately, TAM cannot explain every aspect of the adoption of technology by educators. Their knowledge, intention, and context (section 2.2) need to be considered when investigating their technology adoption (Scherer, Siddiq and Tondeur, 2019). This is because many context-specific factors are not considered when analysing TAM (Ma, Andersson and Streith, 2005). Due to this lack of consideration, TAM is only able to account for 50% of the variance in technology use (Holden and Rada, 2011). This has led to the production of the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT was constructed by Venkatesh et al. (2003) and is the unification of eight different acceptance models and can predict up to 70% of the variance in technology acceptance. This model (represented graphically in Figure 2-6) states that four aspects affect the acceptance and use of technology, namely:

- performance expectancy, how much the person perceives that the technology will improve their work performance,
- effort expectancy, how easy the person thinks the technology is to use,
- social influence, the person's perceptions of outside pressure for the use of the technology,
- and facilitating conditions, a person's perceptions of resource and support available to aid technology use (Attuquayefio and Addo, 2014).

These four aspects provide an understanding of an individual's ability to use technology and contextual factors that may influence their adoption and use of technology. UTAUT gives a more holistic understanding of technology adoption (Testa and Tawfik, 2017) and is an important acceptance model to use, especially in developing areas where contextual factors outside of the individual's control directly influence their technology use (Mosunmola et al., 2018). These factors include access to the Internet, electricity supply, and the general lack of available computing and physical facilities for the effective use of technology.

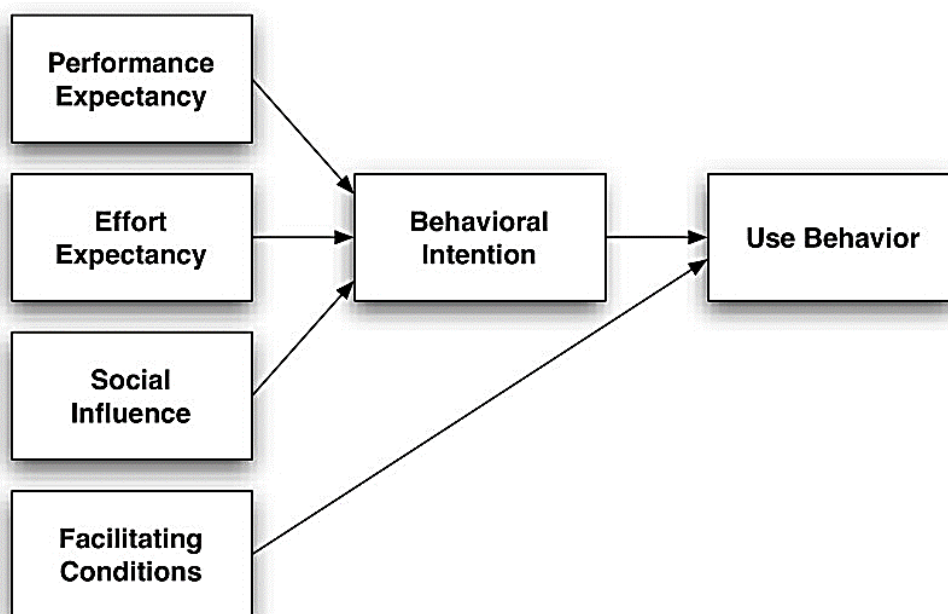


Figure 2-6: Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003)

## 2.8 Building the Initial Guide

As depicted in Figure 1-1, the theory presented in this Chapter was used to inform the initial guide that is presented in Chapter 3, section 3.4.1.1. The initial guide presents four aspects that

need to be considered when introducing Tablet PCs into the classroom. These aspects are infrastructure, technological training, pedagogical changes, and support. The need for Infrastructure (Devices and Connectivity) was further highlighted by the coronavirus pandemic and the need for distance and online learning, as discussed in section 2.4.1. The need for technological training has been found in other South African studies (section 2.6.1) and is necessary for effective teaching with technology as discussed by the TPACK framework (section 2.7.1). Educators can only begin to integrate their knowledge areas once all of them are fully developed. Pedagogical changes also need to occur when technology is introduced into the classroom as highlighted by other South African studies (section 2.6.1) and by the need for an educator's knowledge areas to be integrated to ensure effective teaching with technology (section 2.7.1). Finally, support from the DBE was included in the initial guide. The need for support was underscored in other South African studies (section 2.6.1) and is an important part of technology acceptance (section 2.7.2). As such, these four aspects were used in the initial guide as a starting point when considering the introduction of Tablet PCs into teaching and learning activities.

The introduction of technology into teaching and learning activities affects the context of the educator (section 2.4.2) and their pedagogical practices (section 2.6.2). The introduction of Tablet PCs influences educators' relationships with their learners (section 2.5), changes their pedagogical practices (section 2.6.2), and requires training and skills development to use Tablet PCs effectively for teaching and learning activities (section 2.7.1). As such, the introduction of Tablet PCs affects the mesosystem (relationships), microsystem (pedagogical practices) and personal characteristics of the educators (training and skills development). Therefore, the initial guide presents recommendations for developing educators' skills for using technology and how to integrate that technology into their pedagogical practices. Providing recommendations to ensure that educators can adapt to their changing context due to the introduction of Tablet PCs for classroom and distance learning.

## **2.9 Summary**

The introduction of technology into education influences multiple aspects both within the classroom and outside the classroom as educators and learners need to skills and motivation to use the technology that has been introduced. Technology acceptance is improved by ensuring technological training is provided to educators and they have the necessary knowledge to use

the devices that have been provided. Pedagogical changes also need to take place to ensure Tablet PCs are integrated into the pedagogy of the educators. Aspects such as connectivity and support also play a role in technology acceptance and use and should be considered when technology is introduced. As such, these aspects were included in the initial guide presented in Chapter 3.

### **3 Methodology**

The philosophical approach, research process, and research strategy were chosen based on the complex nature of technology in education, as shown in Chapter 2. The introduction of technology into education affects the pedagogy of educators as they need to learn how to integrate technology into their teaching and learning activities. As such, it is important to understand how educators may be supported to ensure technology is accepted and adopted by educators. This study uses Action Design Research (ADR) to develop a guide to provide practical recommendations to help support educators use of technology for teaching and learning. This guide is developed based on existing theory and shaped by the interviews held with the educator participants in this study.

This Chapter begins by explaining the philosophical paradigm used as a lens through which this study was conducted (section 3.1). The research process of ADR is then described (section 3.2). The four processes involved in ADR, namely Problem formulation (section 3.3); Building, Intervention, and Evaluation (section 3.4); Reflection and Learning (section 3.5), and Formalisation of Learning (section 3.6), are unpacked and each step described in detail.

#### **3.1 Philosophical Paradigm**

A research paradigm is the overarching beliefs of the researcher that guide and define their actions (Kaushik and Walsh, 2019). A paradigm is philosophical in nature and concerns the following five elements:

- Axiology – the role of morals in research,
- Ontology – beliefs about the nature of reality,
- Epistemology – beliefs around how we create and understand knowledge,
- Methodology – the way one goes about finding knowledge,
- Rhetoric – the language in which this knowledge is conveyed (Creswell, 2009).

In the study, the research paradigm chosen is that of pragmatism. Pragmatism focuses on identifying a socially significant problem and developing a practical solution to that problem (Kaushik and Walsh, 2019). This is done through focusing on actions, and these actions having direct consequences. This means that changes are the direct results of actions from an individual. These actions are guided by purpose and knowledge to bring about an expected change (Goldkuhl, 2012). This knowledge is also changed by human action. The goal of

pragmatic research is to translate knowledge into practice to attempt to change human action to produce positive changes in an organisational structure (Goldkuhl, 2011). Pragmatism not only focuses on 'what is' but also focuses on 'what might be.' The goal is to change the 'what is' to the eventual 'what might be.' Pragmatism embraces pluralism and is generally used in mixed-method research. The idea is that the methods used should be appropriate to solve the problem (Kaushik and Walsh, 2019).

Therefore, this study is a pragmatic study as an artefact was developed from the data gained from the educator participants of this study. This artefact is a guide that provides a breakdown of the facilitating conditions required when introducing Tablet PCs for teaching and learning.

### **3.2 Research Process**

This study uses Action Design Research (ADR), otherwise known as Participatory Action Design Research, to structure this research procedure. ADR focuses not only on building a solution but enabling the organisational context to affect the solution. ADR blends the design science research methodology (DSRM) and action research methodology (AR) into one. DSRM focuses on producing prescriptive technology solutions to given problems and evaluating whether the technology solution solves the problem. DSRM focuses on building and then evaluating a solution (Sein et al., 2011). DSRM is said to focus on artificial phenomena rather than natural phenomena. It is mostly focused on the solution's utility and not on individuals' behaviour within an organisation (Cole et al., 2005). This does not always allow for organisational specific needs to be focused on and addressed throughout the build and evaluate process. Due to this need for organisational specific needs being addressed, there has been impetus to adapt the DSRM to better address the needs of an organisation. This has led to researchers blending DSRM with AR.

AR refers to linking theory and intervention to attempt to solve immediate organisational problems. It is an iterative approach that refines the solution over repeated cycles of inquiry (Sein et al., 2011). It is participatory as the concerns and needs of the organisation are taken into account when designing the artefact or solution (Bilandzic and Venable, 2011).

ADR, therefore, attempts to combine design elements and contextual factors to produce context-specific solutions to given problems within an organisation. The final artefact emerges from the interaction of design and use. ADR is a methodology that focuses on the building, intervention, and evaluation of an artefact that is developed by the researcher using existing

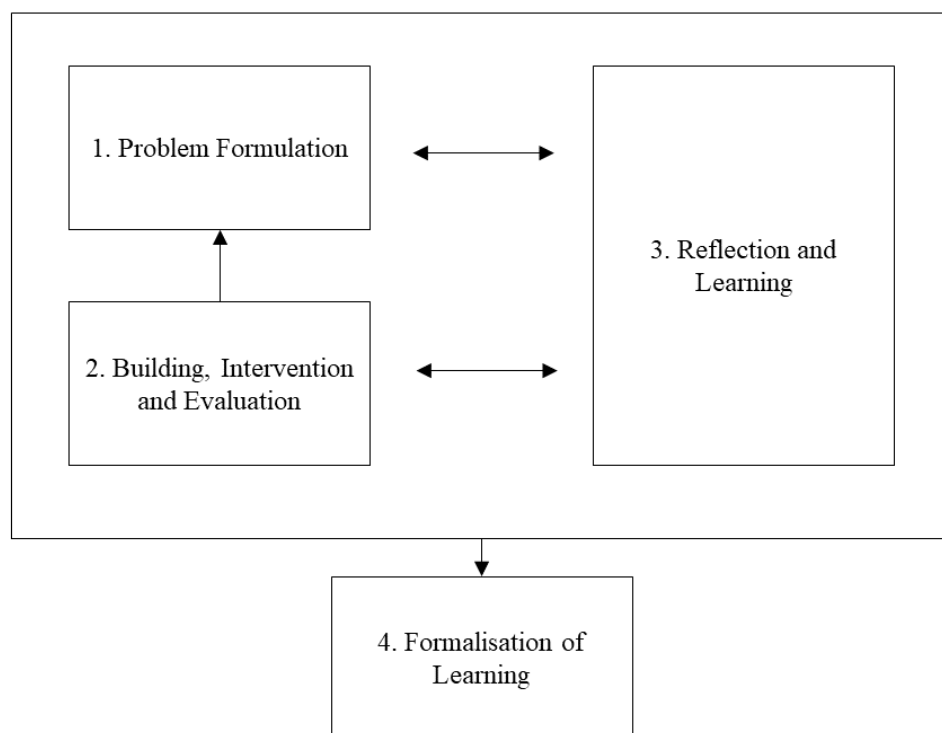


theory to be implemented in an organisational context (Sein et al., 2011). It is an important research process when dealing with socio-technical problems where the focus is on providing a technical solution and reducing some of the external social problems faced by an organisation (Bilandzic and Venable, 2011). This fits with pragmatism as the main goal is to provide a solution to a given problem, as discussed in section 3.1.

ADR has four main stages (depicted in Figure 3-1), namely:

1. Problem formulation
2. Building, Intervention, and Evaluation
3. Reflection and Learning
4. Formalisation of Learning (Sein et al., 2011).

The remainder of the chapter addresses each of these four stages in turn.



*Figure 3-1: Action Design Research Diagram (Sein et al., 2011)*

### **3.3 Problem Formulation**

This section seeks to unpack the identified problem of this study and understand how this influences the design of the proposed guidelines and the overall design of the research process.

This stage is informed by two principles, namely: Practice-inspired research and Theory-Ingrained Artefact (Sein et al., 2011). Practice-inspired research refers to the need to understand real-world problems as knowledge creation opportunities. This leads to the creation of organisational specific solutions (Sein et al., 2011). This is described in detail in section 3.3.1 by defining this study's problem definition and research questions. While, Theory-ingrained Artefact refers to the need to use theories to inform the starting point of the artefact (Sein et al., 2011). This is discussed in section 3.3.2 by defining the theoretical bases that the solution was based on.

### **3.3.1 Problem Definition and Research Questions**

As previously discussed in section 2.6.1, there have been several initiatives by the South African Government to introduce Tablet PCs into classrooms in an attempt to improve the academic outcomes of learners (Adukaite, van Zyl and Cantoni, 2016; Hart and Laher, 2015; Herselman and Botha, 2014; Nkula and Krauss, 2014). However, the introduction of Tablet PCs has typically not been accompanied by sufficient training to ensure that educators can use Tablet PCs effectively in the classroom (Hart and Laher, 2015). Acceptance and adoption of technology is also multi-faceted (Venkatesh et al., 2003) and needs to be understood in the context to ensure that educators are willing and able to use technology effectively in the classroom (Testa and Tawfik, 2017). There has also been a need for distance teaching and learning due to the coronavirus pandemic as learners attended school fewer times during the week to implement social distancing measures within government (public) schools. This means that educators need to know how to use Tablet PCs effectively for both in the classroom and distance teaching and learning.

As such, the following main research question and sub-questions have been identified:

*How and in what ways can educators be supported in order to promote increased integration and acceptance of technology for use in teaching and learning activities in basic education level schools in South Africa?*

- *What factors facilitate increased acceptance of technology by educators?*
- *What factors facilitate increased adoption of technology by educators?*
- *How can tablet PCs be utilized to support teaching and learning activities?*

- *How do Tablet PCs support the continuation of learning, specifically during the coronavirus pandemic?*

### **3.3.2 Theoretical Bases**

This study uses multiple theories to help support educators use of technology in the classroom and distance learning. The TPACK framework (section 2.7.1) and blended learning techniques (section 2.6.2) were used to understand how educators' knowledge affected their ability to integrate Tablet PCs into their pedagogical practices and support changes to their pedagogical practices. Community of Practices (section 2.6.3) were also considered as they could potentially improve educators technological and pedagogical knowledge.

UTAUT (section 2.7.2) was used to understand educator's acceptance of technology and what factors could potentially improve technology acceptance and adoption amongst educators. Toyama's Amplifiers (section 2.5.2) was also used to determine factors that influenced both the educators and learners use of technology.

## **3.4 Building, Intervention, and Evaluation**

This section focuses on the research strategy of the study. It uses the problem and the given theoretical starting point stated in section 3.3 and attempts to design an initial artefact. This artefact is then shaped by its introduction into the organisation (the intervention) and its subsequent evaluation (Sein et al., 2011). This section is divided into three main areas: Building, Intervention, and Evaluation. Each of these is discussed in detail in turn.

### **3.4.1 Building**

Due to the multi-faceted nature of technology acceptance and adoption, the artefact is a guide that provides recommendation for conditions that attempt to support and prepare educators for the use of Tablet PCs in the classroom and distance learning. According to Roblin et al. (2018), practical considerations play the most vital role in Tablet PC adoption by educators. These considerations are infrastructure, support from the DBE, and educators' knowledge of teaching with Tablet PCs.

### 3.4.1.1 Initial Guide

The initial guide is developed based on previous studies findings. These studies implemented Tablet PCs into school environments and determined multiple barriers to adoption and acceptance of technology (section 2.6.1). As such, this guide uses these barriers as a starting point for aspects that need to be considered when implementing Tablet PCs into teaching and learning activities in schools. Table 3-1 shows the initial guide with factors that should be the starting point for consideration when Tablet PCs are implemented into schools. These factors will then be expanded based on data collected from educator participants during interviews.

*Table 3-1: Initial Guide for the Use of Tablet PCs for classroom and distance learning*

<b>Initial Guide for the Use of Tablet PCs for classroom and distance learning</b>		
Factor	Recommendation	Reference
Infrastructure (Device and Connectivity)	Due to the coronavirus pandemic, distance learning has become necessary during the study. As such, the need for devices and connectivity is necessary for the continuation of learning.	Section 2.4.1.
Technological Training	Technological Training should be provided to educators when Tablet PCs are implemented to ensure they have the required skills to use the Tablet PCs.	Adukaite, van Zyl and Cantoni, (2016), Batchelor and Olakanmi (2015), Herselman and Botha (2014), Lupondwana and Coleman (2019), and Nkula and Krauss (2014). Section 2.6.1. Section 2.7.1.
Pedagogical Changes	Pedagogical changes need to take place to ensure educators can integrate	Herselman and Botha (2014). Section 2.6.1.

	Tablet PCs into their pedagogy.	Section 2.7.1.
Support from the DBE	The DBE should support the introduction of Tablet PCs into education by providing resources and training to educators.	(Batchelor and Olakanmi, 2015; Lupondwana and Coleman, 2019). Section 2.6.1. Section 2.7.2.

### ***3.4.1.2 Answering the Research Questions***

This section addresses which tools will be used to answer each research question and how the data collected would inform and answer the proposed research questions.

- What factors facilitate increased acceptance of technology by educators?
  - Interviews were held with the educator participants to determine what factors or conditions needed to be in place to ensure increased acceptance of technology.
- What factors facilitate increased adoption of technology by educators?
  - Interviews were held with the educator participants to understand what factors or conditions needed to be in place to ensure increased technology adoption.
- How can tablet PCs be utilized to support teaching and learning activities?
  - Educators were provided with some initial ideas of how technology could be utilised for teaching and learning activities during a workshop held with the educator participants. During the interviews, the educator participants were able to provide feedback as to how they were utilising the Tablet PCs for teaching and learning activities.
- How do Tablet PCs support the continuation of learning, specifically during the coronavirus pandemic?

- Interviews were held with the educators to understand if Tablet PCs enabled the continuation of learning during distance learning.

### **3.4.2 Intervention**

Intervention refers to using the artefact in a given environment to evaluate if it is effective in solving the problem identified in section 3.3.1 (Sein et al., 2011). The problem in this research study, identified in Chapter 1, is that technology is being introduced into schools and educators are often unwilling or unable to adopt and use the technology due to factors such as a lack of technological and pedagogical knowledge, and a lack of support. This section outlines the environment where this study takes place by discussing the research strategy carried out during this study, the participants involved in this study, and the ethical considerations of this study.

#### **3.4.2.1 Research Strategy**

This research project uses a single case study for the intervention. Case studies are a type of inductive reasoning. They are used when a phenomenon needs to be studied in its natural context to understand the unique dynamics of the problem (Darke, Shanks and Broadbent, 1998). This enables researchers to understand the complexities within a given situation and how to change those complexities (Mueller and Urbach, 2017). This information is then used to develop theoretical knowledge from practice. This theoretical knowledge is highly contextualised and explains a given phenomenon within a given context. This theoretical knowledge can then be extended or modified to explain phenomena in new contexts, thus informing others who may continue with this research (Mueller and Urbach, 2017). Case studies are important in areas where people and actions need to be understood when solving a problem (Darke, Shanks and Broadbent, 1998). This makes it a good choice for ADR research which focuses on producing context-specific solutions, as discussed in section 3.2.

#### **3.4.2.2 Participants**

Participants were drawn from a school (referred to as School X throughout this thesis) in Makhanda, Eastern Cape, South Africa using purposive sampling. The case includes three educators from School X. School X is considered a previously disadvantaged school. Previously disadvantaged schools are poor schools that have been disadvantaged from their time as former Department of Education schools during Apartheid. They are typified as having

poor infrastructure, poor sanitation, and unkempt premises (Xaba and Malindi, 2010). Although these features are true for many of schools, previously disadvantaged schools can still function effectively and produce quality education (Xaba and Malindi, 2010). That is why School X can be referred to as a functioning previously disadvantaged school as it continues to provide quality education despite the challenges faced.

This study took place during the Coronavirus pandemic in 2020. This pandemic meant that schools were closed when a hard lockdown was implemented on the 15<sup>th</sup> of March 2020 (Zuma, 2020). Schools were then reopened in a staggered approach from the end of July 2020 (South African Government News Agency, 2020). This meant that many learners would continue their studies from home with the aid of technology for some learners or with printed packs provided by their schools. President Ramaphosa, in the State of the Nation address, had stated that learners would be provided with Tablet PCs to help improve education in South Africa (President Cyril Ramaphosa, 2020). The coronavirus pandemic sped up the provision of Tablet PCs to Grade 12 learners as the Department of Basic Education started providing Tablet PCs to them to support the completion of their studies by the end of the academic year (2020). As such, educators are having to learn to use Tablet PCs for the purpose of teaching and learning to ensure the continuation of education (especially for Grade 12 learners).

The educator participants completed initial questionnaires to determine their initial perceived technological knowledge and willingness to adopt and use technology for teaching and learning activities. These questionnaires are discussed in section 3.4.3.3. Based on these questionnaires, the educator participants find technology relatively easy to learn but did not feel they had sufficient technological knowledge to teach with technology or integrate technology into their current pedagogical practices. The educators also did not find technology particularly helpful in the classroom or made their teaching more effective.

### ***3.4.2.3 Ethical Considerations***

Ethics is an important aspect of research as it protects the participants of any given study. Following a well-structured ethical procedure can reduce the risk to the participants and produce reputable findings (Bain, 2017). This makes ethics a vital part of any research study. As such, following the ethical procedure of Rhodes University, an ethical application was submitted to the Rhodes University Ethics Board (Ethical Clearance Number 0842) outlining the intended research process and participant group. After the board had accepted the

application and granted ethics approval for the study, gatekeeper permission was requested from the Eastern Cape Department of Basic Education. This study did not focus on any learners, and no observations of the learners were recorded. The research was conducted with the educators only; they were asked to give informed consent, their participation in the study was voluntary, and all participant personal identifying details have been kept anonymous. Member checking was also used on all interviews and workshops to ensure the educators felt comfortable with the information they had provided and what had been captured by the researcher.

### **3.4.3 Evaluation**

Evaluation refers to determining if the artefact in its given state has met the expected goals of the solution and whether the artefact needs to be adjusted and implemented again (Sein et al., 2011). As stated in Chapter 2, educators' use of technology for teaching and learning is multifaceted. Their skill level, instructional actions, interactions with learners in the classroom and for distance learning, and reflections on their own actions need to be considered (Harris, Grandgenett and Hofer, 2010). As such, multiple data collection tools were used in the evaluation of this study. Evaluation in this study occurred through interviews and workshops. Classroom observations would have also been a good source of data, but unfortunately, due to the coronavirus pandemic, they were impossible to carry out. Instead, interviews were held with the educators to better understand their attitude towards using technology in the classroom and for distance learning. This tool is explained in detail in section 3.4.3.1. A workshop was also held with the educator participants to understand the educators' initial feelings towards using Tablet PCs and concerns about using Tablet PCs for teaching and learning. This tool is explained in detail in section 3.4.3.2. The educators also completed questionnaires to understand their initial perceived ability and willingness to use technology for teaching and learning. These tools are explained in detail in section 3.4.3.3.

#### ***3.4.3.1 Semi-Structured Interviews***

Interviews are used to gain insight into an area of interest of the researcher (Rowley, 2012). There are three types of interviews: structured (closed), semi-structured, and narrative (open). Structured interviews have a set of questions that are asked, and only those questions are discussed. Narrative interviews are interviews with no set of questions where the interview is



a conversation held with a person (Stuckey, 2013). In this study, semi-structured interviews were used to drill down into anything of interest seen in the observations and questionnaires. These are interviews where there is a set of questions, but the interviewer has the freedom to ask questions outside of this set (Stuckey, 2013). Semi-structured interviews are beneficial as they are versatile and flexible. It allows for a specific direction within the interview but allows for some freedom to divert into interesting sub-points. Semi-structured interviews are also important when the next question is based on the previous answer (Kallio et al., 2016). This helped the researcher gain insight into why an educator might have performed a particular action with the Tablet PCs or used the Tablet PCs in a particular way for teaching and learning. This also helped educators reflect on their use of Tablet PCs.

Initial interviews were held with the educator participants. All educators were asked the same questions during the initial interview to determine the educators' initial thoughts on using Tablet PCs for teaching and learning. The interview schedule for the initial interviews can be found in Appendix A. Follow-up interviews were then conducted approximately 3 months after the initial interviews. These interviews focused on areas highlighted in the initial interviews to determine whether the educators' opinions had changed over time and whether they had become more comfortable with using the Tablet PCs for teaching and learning. The interview schedules for the follow-up interviews can be found in Appendix B, Appendix C, and Appendix D. All interviews conducted during this study were used to inform areas of the guide by providing insight into areas that may hinder or aid the use of Tablet PCs in the classroom and for distance learning. The interviews were recorded and transcribed by the researcher. An example of a transcription can be found in Appendix E. Member checking was used in this study so that the educators always felt in control of the data they were sharing.

#### **3.4.3.2 Workshops**

A workshop was held with the educators at the beginning of the study. Workshops are used as collaborative spaces for individuals to develop solutions to given problems or create a shared knowledge base for a given problem (Soini and Pirinen, 2005). The workshop in this study helped the educators bounce ideas off each other and enabled the researchers to develop an idea of how technology could be implemented into teaching and learning activities. The workshop also gave insight into some of the concerns the educators might have and support the educators might require to use technology effectively. Based on the information gathered

during the workshop, some technological training was provided to the educators (through instructional videos) as a starting point to help them use the Tablet PCs effectively for teaching and learning.

#### **3.4.3.3 Questionnaires**

Questionnaires are a set of questions used to understand the current level of understanding of an individual. They are generally quantitative in nature and allow for a snapshot of the current situation of the individual (Rowley, 2014). There were two questionnaires used in this study. The first questionnaire was adapted from a questionnaire created by Schmidt et al. (2009). This questionnaire focused on understanding an educators TPACK knowledge from the perspective of the educator. This was used to show how the educator perceived their own TPACK as a starting point to understand their perceived technological knowledge prior to intervention. The TPACK questionnaire can be found in Appendix F. The second questionnaire was based on a UTAUT questionnaire created by Venkatesh, Thong and Xu (2012). This questionnaire was used to get a better understanding of the educator's willingness to use Tablet PCs in the classroom. This questionnaire also showed whether training and support improved an educator's willingness to use Tablet PCs in the classroom. This questionnaire can be found in Appendix G.

#### **3.4.3.4 Data Analysis**

The goal of ADR is to iteratively produce an artefact that solves a problem in a given context. The data analysis measures in this study aim to use the data collected to make changes and adapt the guide to ensure it is a guide to facilitate the use of Tablet PCs for teaching and learning activities both in the classroom and as a distance learning tool. The questionnaires provided a snapshot of the educator's perceived technological knowledge and willingness to adopt technology and was used to understand the participants prior to intervention.

The interviews were analysed using Thematic Analysis (TA). TA is one of the most common ways of analysing qualitative data. It is a method of analysing content and identifying common themes within that data (Castleberry and Nolen, 2018). These themes were then used to make changes to the guide. Both Top-Down and Bottom-Up TA were conducted on the interviews transcribed in this study. The Top-Down analysis looked for theoretical themes present in the data and used them to understand how the existing theory plays a role in educators using

technology for teaching and learning. Bottom-Up TA focused on themes that do not exist in theory but rather emerged as important themes raised by the research participants during the interviews. These themes were then used to provide a more holistic view of the problem and the solution created from this data.

### **3.5 Reflection and Learning**

This section hopes to learn from the findings of this research study and reflect on how the organisational context specifically changed the outcome (Sein et al., 2011). As such, the guided emergence of the artefact will be discussed. Guided emergence refers to the need for changes to occur to the initial artefact (section 3.4.1.1) given the organisational context (Sein et al., 2011). These changes reflect the complex nature of organisational structures and the ever-changing nature of problems in an environment. As such, the proposed artefact changed over time due to the data collected from the educator participants. In this study, the original guide did not consider any enrichment factors that could be used to promote and support the long-term use of Tablet PCs in the classroom and distance learning. The initial guide was also designed to be used in a classroom environment, with classroom observations providing some of the data used to build the guide. Unfortunately, due to the coronavirus pandemic, all data collection took place remotely through interviews. The guide is based on the educator participants' thoughts and expectations when introducing Tablet PCs into classrooms and for distance learning. The finalised guide is presented in Chapter 5 in section 5.2.

### **3.6 Formalisation of Learning**

This section aims to formalise the outcomes of the results to be disseminated. It focuses on abstracting the learning in the projects to be used in a greater class of field problems. Sharing the outcomes with other practitioners (Sein et al., 2011). As such, the guide presented in Chapter 5 can be used in a broader context to help educators, principals, and the DBE introduce Tablet PCs into schools for the teaching and learning and help promote the effective use of those devices when introduced. This guide was designed predominately for a previously disadvantaged school and considered the more specific needs of that environment, but the guide can provide recommendations to other schools who have similar needs or as a starting point for their own unique environment. Other generalisations can be found in section 5.2.5.

### **3.7 Summary**

This study is a pragmatic study that uses Action Design Research as the research process to develop a guide to promote the effective use of technology for teaching and learning. This study uses a single case study with educator participants from a previously disadvantaged school in Makhanda in the Eastern Cape. Ethical clearance was received from the Rhodes University Ethics board. Data was collected through semi-structured interviews and analysed using Top-Down and Bottom-Up Thematic Analysis. Data collected was used to inform and make changes to the finalised guide presented in Chapter 5.

## **4 Results**

This chapter aims to unpack the emerging themes from the qualitative data collected during interviews with the educator participants. These themes were found using both Top-Down and Bottom-Up thematic analysis. Top-Down thematic analysis was used to identify themes present in the data based on already existing theory; allowing for a growing understanding of how existing theory plays a role in the use of Tablet PCs for teaching and learning activities within School X. Bottom-Up thematic analysis, on the other hand, found new and different emerging themes from the data that did not necessarily fit in a theoretical lens, as discussed in Chapter 2. These results were used to refine the initial guide presented in Chapter 3 (section 3.4.1.1) and shape the finalised guide in Chapter 5 (section 5.2).

### **4.1 Top-Down Findings for the First Set of Interviews**

Top-down analysis is a form of thematic analysis that looks for theoretical themes that exist within the data. These themes are then coded and collated to extract meaning from the data. This is a deductive approach to the data analysis. The theoretical bases used to analyse the interviews in this study were: Blended learning concepts such as asynchronous and synchronous learning and blended learning models, UTAUT, Toyama's Amplifiers of Institutional forces, and TPACK. The breakdown of this analysis is shown in Figure 4-1. This figure depicts how often the concept was discussed in the interviews and whether the educators negatively or positively viewed that concept.

#### **4.1.1 Blended Learning**

The educators included in the study explained that, in the classroom, they had continued to teach the way they had previously taught, but that they were using technology to enrich and enhance their teaching. They were using technology to enhance their traditional teaching practices by adding videos to their lesson plans and providing additional resources for the learners such as access to online learning materials and textbooks available on the Tablet PCs. Blended learning was not always seen in a positive light, as shown in Figure 4-1. Teacher A found that knowledge sharing on devices was passive, and many of the learners were not interacting with the material as they would in a classroom setting. This, she stated, was because learners did not want to learn in isolation and preferred learning with educator in the classroom. There were also positive aspects to using the Tablet PCs, as they enabled both asynchronous

and synchronous learning to occur as learners had access to more resources away from school. As shown in Figure 4-1, there were positive aspects to distance learning alongside classroom interaction as the educators could set tasks outside of the classroom for the learners to complete, such as watching a video or completing a quiz. Although the educators positively viewed asynchronous learning, Teacher B commented that the learners found having to learn away from their educator and classmates demotivating and more difficult than learning in the classroom. Teacher B also alluded to having a Face-to-Face driver model of blended learning (section 2.6.2) as the starting point for using Tablet PCs for distance and classroom learning.



Figure 4-1: Mind Map for Top-Down Analysis of the First Set of Interviews with all Three Educators

#### 4.1.2 UTAUT

In terms of technology acceptance, the educators found that using Tablet PCs for teaching and learning activities required more preparation than teaching without technology. This results in a greater effort expectancy for the educators as they must put more effort into using the Tablet

PCs within teaching and learning activities compared with no use of technology. There has been some social influence promoting the use of Tablet PCs for teaching and learning as the need to continue learning during the Coronavirus pandemic has placed pressure on the educators to continue teaching using new formats with technology. There has also been some influence from the Department of Basic Education as they provided Tablet PCs to Grade 12 learners at the school to continue learning despite the lockdown and pandemic restrictions. Although this social influence is seen in a positive light by the educators, there are negative aspects, too, as the educators feel forced to use the Tablet PCs even when they cannot use them to their full potential. The educators also highlighted facilitating conditions that both negatively and positively affect technology use. One of these facilitating conditions was the need for a localised web server to distribute learning materials to students' Tablet PCs or other mobile devices utilized at the school. This was considered a great need as many of the learners did not have access or money to buy data; educators clearly stated that data and Wi-Fi access were the greatest hindrances to technology use inside and outside of the classroom.

#### **4.1.3 Amplifiers of Institutional Forces**

All three of the Amplifiers of Institutional forces were highlighted during the initial interviews. None of them were in a positive light, as shown in Figure 4-1. The most detrimental of these was differential access. Many of the learners in School X are from low socio-economic households. Teacher B noted that she thought that data is not considered to be a necessity in these households. Many of the learners at School X cannot access online learning material/resources inside or outside of the classroom. This is compounded by poor mobile network coverage in the peri-urban area in which School X is situated, as stated by Teacher B, so even if they have the data, they may not be able to access the Internet if the coverage is poor. This makes online learning near impossible within this low socio-economic community. Although this limits the extent to which learners can continue learning outside of the classroom, Teacher C commented that the learners had access to many free-access websites, although she did not know if they were using these sites.

Differential capacity was discussed entirely from the educators' point of view as many of the educators in the school have poor technical knowledge and struggle to technology such as desktop computer and mobile devices. The educators also shy away from technology in general and use it only when necessary, as many of the educators *"to a large extent are feeling as*

*overwhelmed*” as highlighted by Teacher C. Teacher A commented that many of the educators at School X did not use technology in any form, even for distance learning. Due to the differential capacity of the educators, they lack the motivation to use technology for teaching and learning activities. Differential motivation also affected learner’s willingness to learn. All three of the educators stated that many of the learners were feeling demoralised and depressed due to the pandemic and the consequential lack of an appropriate learning environment, which had led to many of them not engaging with their online or remote learning. This also encourages the learners to rather use the Tablet PCs for non-learning activities such as playing games and listening to music. Despite the lack of motivation in some learners, Teacher A commented that there were some learners who were motivated to access material on or using their Tablet PCs.

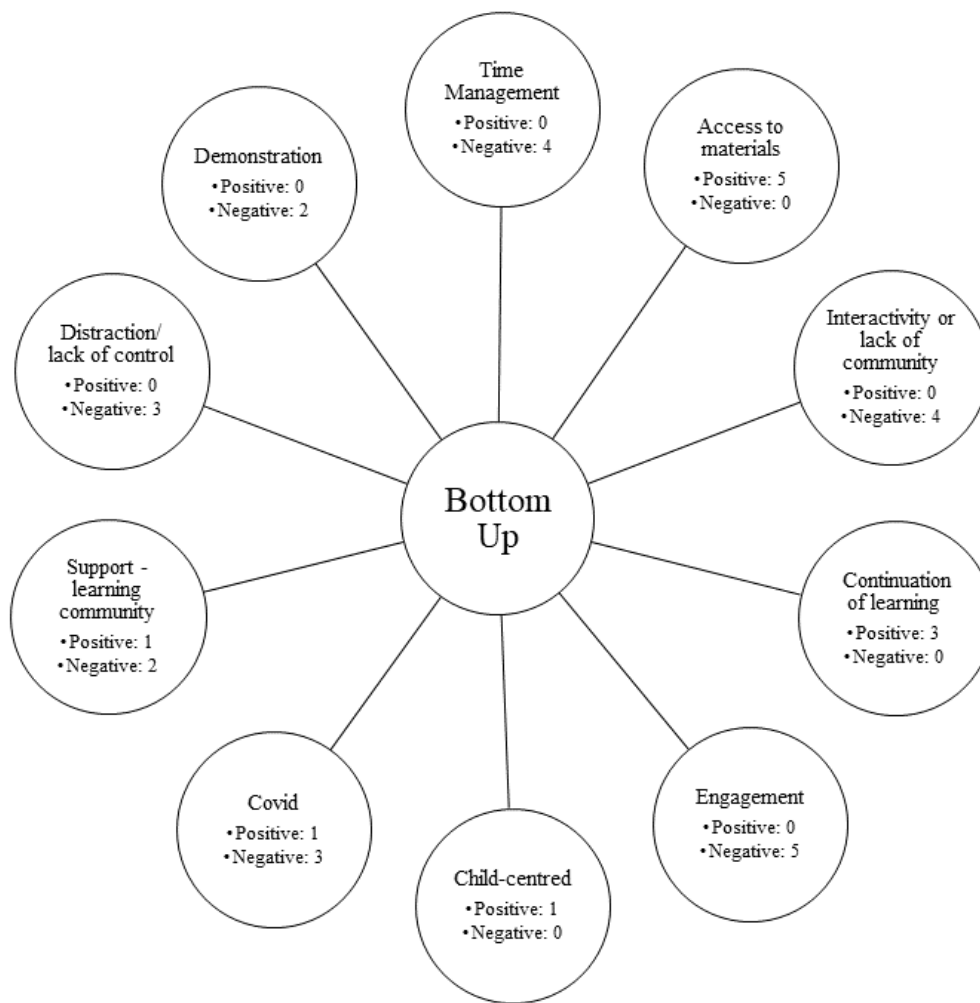
#### **4.1.4 TPACK**

The teachers in the study commented on the technological knowledge of other educators in the school. They stated that many of their colleagues did not have good technological knowledge, and they shied away from using most forms of technology. The educators felt teaching with the technology required more preparation, that technology was a distraction in the classroom and did not allow for interactivity between learners, educators, and fellow learners as learners were spending more time on their devices than focusing on the lesson.

## **4.2 Bottom-Up Findings for the First Set of Interviews**

Bottom-up thematic analysis or “in vivo” focuses on themes that do not link to any theory but rather the themes that emerge from the data. These are the themes that emerge from the data and are a form of inductive thematic analysis; from the expressed opinions or perceptions of the educators interviewed. The themes are then coded and collated to understand emerging themes from the data. Thus, providing a more holistic view of introducing Tablet PCs into education and how educators could be supported to promote effective use of Tablet PCs for teaching and learning. The breakdown of this analysis is shown in Figure 4-2. This figure depicts how often the concept was discussed during the initial interviews and whether the educators had a negative or positive view on each concept. The themes from this analysis are discussed in greater detail in the subsections that follow.





*Figure 4-2: Mind Map of Bottom-Up Analysis of the First Set of Interviews with all Three Educators*

#### **4.2.1 Time Management**

The educators in the study stated that time was one of the biggest factors hindering their use of Tablet PCs. There was an overall negative sentiment towards time management when using Tablet PCs, as shown in Figure 4-2. Firstly, the educator had to create new online material for their learners. They stated that this took more time than creating non-technology-based learning materials and was a learning curve that they had to overcome. Secondly, due to the pandemic, there were more expectations from the Department of Basic Education. Teacher C stated that she had to attend more meetings and conform to the Coronavirus guidelines outlined by the Department of Basic Education. Thirdly, due to the coronavirus pandemic and the lockdown, there was less time to complete the curriculum. The educators felt they had too little

time to navigate the learning curve and attempt to use the Tablet PCs for teaching and learning activities and distance learning.

#### **4.2.2 Access to materials and digital resources**

A positive sentiment that the educators expressed with respect to having access to Tablet PCs was access to digital resources such as websites and documents provided on the Tablet PCs. All three educators stated that their learners could access more resources outside of the classroom as a consequence of having been given Tablet PCs by the DBE. The digital materials included the text documents given to them by educators, any online resources such as websites, provided they had the necessary mobile data to access them, and learning materials made available by Stellenbosch University, which the educators could access and distribute to their learners' digital devices.

#### **4.2.3 Interactivity or lack of community**

Some of the educators felt that the Tablet PCs hindered the classroom interaction they normally had by drawing the learners' attention away from the educator and the lesson they were teaching and rather focused on their Tablet PCs. They felt that using Tablet PCs in the classroom was a private interaction and did not necessarily include other people such as the educator or other learners. This has led the educators to be hesitant in using the Tablet PCs in the classroom as they felt a classroom should be a community of learning, and not an environment in which people learning privately (on their own).

Furthermore, with respect to distance learning, the educators stated that the learners were missing out on the interactive aspect of learning from their peers. Due to the pandemic, the learners were isolated from their peers, which has led to a lack of interactivity between the learners and the educators, while the limited access to data prevented interaction from taking place in a virtual environment online.

#### **4.2.4 Continuation of Learning**

The educators stated that the Tablet PCs did allow for the continuation of learning as the learners had access to more materials at home. But Teacher B also noted that unless the Tablet

PCs were used effectively and as a learning tool and not just for games or music, there would be very little learning taking place outside the classroom.

#### **4.2.5 Child-centred**

Teacher A was the only educator to describe the Tablet PC as being a child-centred learning tool. She explained that the Tablet PCs enabled learners to continue their learning in any manner that they wanted. This, she commented, made the Tablet PCs a valuable tool for teaching and learning.

#### **4.2.6 Engagement**

All three of the educators expressed the need to keep track of who had accessed the materials they were sharing online. This need was expressed because they were worried that many of the learners were not accessing and engaging with the material that the educators had made available to them. There were suggestions that some form of log could be kept to see which learners had accessed the materials and which had not.

Teacher B also expressed that she missed engaging with the learners in face-to-face classroom settings and stated that remote learning reduced her engagement with her learners.

#### **4.2.7 Coronavirus pandemic**

The educators expressed both negative and positive aspects to teaching during the pandemic and especially using technology for teaching and learning during the pandemic, as is shown in Figure 4-2. Teacher A stated that the positive aspect of the pandemic was the motivation to use Tablet PCs for teaching and learning. She expressed that they would not have felt the need to use the Tablet PCs as much as they have without the pandemic and resulting restrictions as a motivator.

There were some negative aspects expressed as well. Teacher B stated that the learners were missing out on peer-to-peer learning because they were isolated and had limited access to mobile data. This hindered learning as they could not ask a friend if they did not understand something. In addition, there was a lot of emotional stress for the learners, caused by the pandemic. Many of the learners felt demoralised and depressed because they were isolated and

learning in a new way. This led to many learners dropping out of school and not engaging with their learning activities.

#### **4.2.8 Support**

The educators expressed two aspects of support being required for the use of Tablet PCs for teaching and learning activities. The first was the need for in-class demonstrations of the Tablet PCs. The educators felt that they had no prior knowledge of teaching with Tablet PCs. This meant that they were hesitant to use them in the classroom. This is a negative aspect reflected in Figure 4-2. The second type of support expressed was the need for a learning community inside and outside the school. This learning community would consist of like-minded educators of similar technical knowledge. In this community, they could discuss how to use the Tablet PCs effectively and share their knowledge to improve everyone's skills. This was expressed as a positive sentiment (Figure 4-2) as Teacher A stated that if a community of practice was in place, then the Tablet PCs would be used more by the educators for teaching and learning activities.

#### **4.2.9 Distraction or lack of control**

Due to the pandemic and the need for social distancing in the classroom, the educators could not be in physical close proximity to their learners. This meant the educators felt they had very little control over what the learners were doing on their devices. Another issue expressed was the distraction caused by the devices; the educators felt that by bringing Tablet PCs into the classroom, the learners would be unable to focus on the lesson provided by the educator.

### **4.3 Top-Down Findings for the Second Set of Interviews**

After a period of three months of access to Tablet PCs and support resources, follow-up interviews were conducted with the educators about their use of the technology in order to support classroom and remote teaching and learning of the learners. Using the existing theoretical frameworks discussed in Chapter 2, the interviews were analysed, coded, and collated to extract meaning from the data. The following themes were used to analyse the interviews: Blended learning concepts such as asynchronous and synchronous learning and blended learning models, UTAUT, Toyama's Amplifiers of Institutional Forces, and TPACK.

Community of Practice was also included as one of these themes as the educators commented on the importance of a COP during the first set of interviews. As such, it was included in the follow-up interviews and findings are included in this section.

#### **4.3.1 Blended Learning**

During these interviews, Teacher B and C gave examples of how they used the Tablet PCs in the classroom to enhance and enrich their lessons and promote interaction. They highlighted that the Tablet PCs needed to be used as a tool for learning and not to replace the educator in the classroom. Their examples of tasks included watching a video and then discussing it with the class, having a lesson and then doing a quiz on the Tablet PCs, and using the Tablet PCs for homework that could then be discussed in the classroom. Both educators highlighted that the role of the educator had to become that of a facilitator in the classroom who guides the use of Tablet PCs for learning. Teacher B also highlighted that the Tablet PCs could not be used for live virtual teaching when learners were away from school but rather had to be asynchronous and created ahead of time; Teacher B commented that the learning material had to be *“something that was pre-stitched together and then stuck onto the server for the kids to then download.”* According to Teacher B, the educators do not want to force the learners to have to buy data and cause additional stress or financial burden. Teacher A highlighted that although data would be an issue, sending home more resources for the learners is an amazing opportunity for the learners and educators. Teacher A also commented that the Tablet PCs allowed for asynchronous learning and marking through learners submitting video presentations which she could mark when not teaching, which increased teaching time in class.

#### **4.3.2 UTAUT**

As a consequence of the coronavirus pandemic, the Department of Basic Education has instituted guidelines for educators and learner interaction as well as how many learners may be in a classroom at a time. This social influence has led to School X having to amend its timetable to accommodate these new guidelines. Teacher B highlighted that these guidelines have meant that classes must be halved, and thereby doubling the number of lessons delivered per grade per day. The learners also do not attend school every day, which has reduced the number of face-to-face lessons that the learners attend per week or term. Due to this change in the timetable, Teacher B stated that the use of technology by educators was going to become *“more*

*urgent and more sort of forced on people*” to ensure educators continue their teaching. Teacher C also highlighted that the influence from the subject advisors had changed, and they were more adamant that the educators needed to use technology to continue teaching and learning.

Teacher A and B also highlighted that the webserver that was installed for the project is a facilitating condition that is vital for the continuation of learning. The webserver would reduce the learners' reliance on mobile data and reduce some of the additional financial costs associated with distance and online learning.

#### **4.3.3 Amplifiers of Institutional Forces**

All three amplifiers of institutional forces were discussed in the follow-up interviews. Differential access was discussed by Teacher B, who highlighted that due to data costs, the learners at School X could not participate in live online (virtual synchronous) teaching such as Zoom or Google Meet sessions. The cost of data also influenced online interaction through platforms such as WhatsApp and Facebook as both platforms also require access to mobile data. Teacher B stated that the lack of data for the learners would always be a “*handbrake*” that the educators would have to work around. Teacher B commented that there needed to be a zero-rated option for learners in previously disadvantaged schools. Teacher A shared the same concerns about mobile data for the learners.

Teacher B also highlighted differential capacity of the learners. She stated that the learners at previously disadvantaged schools did not have the same level of computer literacy skills as learners at more privileged schools. This hindered the learners' ability to use their Tablet PCs for tasks such as typing notes or uploading documents.

Differential motivation was again highlighted by Teacher B. She stated that some of the educators who had been teaching for longer were more set in their ways and reluctant to use Tablet PCs and change their teaching practices. Teacher B also highlighted that some of the educators could not understand the benefit that both the local (to the school) webserver and Tablet PCs could provide in the classroom and distance learning. Teacher B also mentioned that the learners were not motivated as they preferred classroom learning to self-study as learners found learning by themselves more difficult and less successful than learning with their educator.

#### **4.3.4 TPACK**

Teacher B highlighted that many of the educators at School X had poor technological literacy and struggled to use most forms of technology, including Tablet PCs. Teacher C stated that the coronavirus pandemic highlighted this struggle to use technology as many educators were forced to use technology to complete their work. Teacher B also highlighted that although the educators were being forced to use technology, they were reluctant to learn how to use technology because they expected things to return to normal, traditional, face-to-face teaching and learning activities in the classroom and therefore, the reliance on technology to decrease.

Teacher B highlighted that there had to be some pedagogical changes due to online, asynchronous learning as educators learn over time how best to use tools to help with teaching and learning. One aspect she struggled with during distance learning was that she could no longer gauge from her class who were struggling and who understood as she could not see their faces as they completed their work. As such, she struggled to determine who was falling behind in their lessons. Although the educators found distance teaching and learning a struggle, the educators in the study were able to integrate technology into their pedagogical practices in the classroom and gave examples of how the Tablet PCs could be used. These examples included setting online quizzes and watching videos, discussed in section 4.3.1.

#### **4.3.5 Community of Practice**

In the initial interviews, Teacher A highlighted the need for a community of practice (COP) for the educators to learn together and support one another to improve their use of technology for teaching and learning. Teacher A expanded on this idea of a COP for educators during the follow-up interview. She expressed the need for COP to be established where educators can learn through task-driven exercises. The goal of the COP would be to better equip educators to use technology in the classroom and should be promoted by the DBE.

The idea of a community of practice could be extended to the learners as well to produce a learning community where the learners and educators support one another to promote learning with technology. All three educators could understand the benefit of having an online learning community and highlighted WhatsApp groups and Facebook groups already set up for the learners. They also noted factors that may hinder the interaction in this community. Firstly, Teacher B highlighted that all interaction would have to be asynchronous as many learners would not have the data for live sessions. Even using WhatsApp groups or Facebook groups,

some learners may not receive the message as these platforms also require data. Finally, Teacher B commented that zero-rated sites might be the only way to facilitate online learning communities for learners at previously disadvantaged schools. Teacher A commented that similar task-driven exercises could be constructed for the learners to help them use the Tablet PCs more effectively.

#### **4.4 Bottom-Up Findings for the Second Set of Interviews**

The themes that emerged from the data in the second round of interviews were: Time management, Interactivity, Engagement, Decreased Teaching Time, Support, Lack of Rapport, Training and Genesis Theory.

##### **4.4.1 Time Management**

Both Teacher B and C highlighted that using Tablet PCs required more of their time to produce learning materials. Teacher C commented that using Tablet PCs required more time because it was a new technology that she was still learning how to use. Teacher B highlighted that the preparation time increased because she had to produce PowerPoint presentations that covered large amounts of material that she would normally present to her class without the aid of a presentation. Teacher A commented that the time limitations of the coronavirus pandemic had hindered her ability to be creative with how she would use the Tablet PCs in the classroom. Overall, because the technology is new, and the educators have not produced online learning materials before, and the time limitations caused by the coronavirus pandemic, all resulted in the educators feeling that the Tablet PCs required more of a time commitment than classroom teaching.

##### **4.4.2 Interactivity**

Although Teacher B and C did not feel that the Tablet PCs decreased interactivity in the classroom, as discussed in section 4.3.1, they did highlight that distance learning reduced interactivity. Due to the problems mentioned in section 4.3.4, such as a lack of data, the learners could not interact with the educators and fellow learners remotely, this limited *“sharing ideas, interaction, not just with themselves but also with the teacher”* which reduced the amount of interaction that was achievable in a virtual space using technology.



#### **4.4.3 Lack of Rapport**

Since the learners were partaking in distance learning and reduced face-to-face classroom learning opportunities, Teacher B highlighted a lack of rapport between her and her learners. She said this reduced interaction as the learners had not learned to trust her in the classroom.

#### **4.4.4 Engagement**

Teacher B highlighted that there was no way of knowing if the learners were engaging with the pre-recorded lessons or presentations provided by the educators. Her reasoning was that she was not able to see the learners or receive questions from them to ensure that they understood the material provided.

#### **4.4.5 Decreased Teaching Time**

Due to the need to implement social distancing in the classrooms and the resulting increased number of lessons that needed to be delivered, most learners at School X cannot attend school every day; it simply cannot be accommodated. The Grade 12's are the only learners that attend school at the school premises every day. The other learners attend two to three days a week. Teacher B stated that this timetable would be in place for most of the 2021 academic year, and learners would be required to undertake online, remote learning when not at school. Teacher A commented that because there was reduced classroom time, she did not want to reduce human interaction by relying on Tablet PCs in the classroom. As such, she was reluctant to use the Tablet PCs in the classroom for teaching and learning activities.

#### **4.4.6 Support**

During the interviews, the educators were asked what support they required from the DBE to effectively use the Tablet PCs. Teacher B highlighted the need for the DBE to provide PowerPoint presentations, workbooks and other learning digital material that can be uploaded to the Tablet PCs for the learners to use. Teacher B highlighted that this would reduce some of the stress on the educators who had to produce their own materials. Teacher C stated that the DBE needed to encourage the educators to use the Tablet PCs and improve the confidence of the educators. Both Teacher B and C highlighted that providing Tablet PCs is not enough,

and their provision needs to be accompanied by adequate learning materials and support for the educators.

#### **4.4.7 Training**

During the interviews, all three educators highlighted training that would be helpful for the use of Tablet PCs in the classroom. Teacher B's comments focussed on the training of new educators at a university level. She highlighted that the *"new teachers coming through need to be innovative."* She highlighted the need for teaching with technology to be included in university programmes to ensure that new educators are well equipped to use technology in the classroom and for distance teaching and learning. Teacher B also highlighted that new educators needed more than just technological literacy but needed to know how to incorporate technology into their lessons. Teacher A commented that some form of gamification could be used for educators to learn technological knowledge and use Tablet PCs, which could be extended to the learners.

Teacher B and C also highlighted the need for technological literacy for the learners. According to Teacher B, the learners struggle with typing, saving documents and any other tasks outside of sending and receiving messages. Teacher C also stated that she would like to sit in on the training sessions with the learners to be aware of what the learners have been taught.

#### **4.4.8 Genesis Theory**

During the follow-up interview, Teacher A commented on two papers that she had read before the interview. The papers used Genesis Theory to understand how educators used technology in the classroom. She highlighted several points from these papers that she found helpful. Firstly, that technology needs to be used as an extension of a person's thoughts and practices. It needs to be integrated into the daily tasks of an individual (Pargman, Nouri and Milrad, 2018). Secondly, new tools need to be appropriated and become part of an individual's "cognitive-cultural schema", their knowledge base and life experience to be used effectively in the classroom (Ritella and Hakkarainen, 2012). Finally, Teacher A commented that the transformation of an individual's "cognitive-cultural schema" takes time. She was comforted by the idea that she needed time to better use the Tablet PCs in the classroom. Teacher A commented that she had not yet appropriated the Tablet PCs into her "cognitive-cultural

schema”, which was why she struggled to use them effectively in the classroom. She commented that this appropriation could be aided through a Community of Practice.

#### **4.5 Summary**

The data collected during this study was analysed using both Top-Down and Bottom-Up thematic analysis. The educators highlighted the need for training to be supplied along with the Tablet PCs and to be given to educators currently being trained. There is a need for connectivity to be provided to the learners especially when learners are from low socio-economic backgrounds. A Community of Practice could help educators changes their pedagogy and improve their technological knowledge. The Tablet PCs provided an opportunity for the continuation of learning during the coronavirus pandemic. Acceptance and use of Tablet PCs by educators will take time but can be hastened with adequate support and training from the DBE.

## **5 Discussion**

This chapter relates and discusses the theory presented in Chapter 2 and the results in Chapter 4 to understand the intricacies of the introduction and use of Tablet PCs for both classroom and remote teaching and learning activities. In so doing, a guide to help educators, principals, and the Department of Basic Education (DBE) better utilise Tablet PCs in the classroom and for distance learning is extended and refined from the initial guide proposed in chapter 3.

This Chapter is divided into two sections; firstly, facilitating conditions are discussed. These conditions refer to those factors that should be met prior to introducing Tablet PCs in the classroom. Secondly, the guide is presented. This is the finalised version of the guide presented in Chapter 3 (section 3.4.1.1) and builds on those aspects identified in literature to present a more holistic, organisational specific guide to support principals and educators in creating the right kinds of conditions in their schools and classrooms to promote the successful adoption of Tablet PCs for teaching and learning activities in both the classroom and for distance learning. This guide is the final product of the ADR research process described in Chapter 3. Figure 5-1 depicts the outline of the discussion, and the interdependency of the various facilitating conditions are highlighted using arrows. The facilitating condition at the tail of an arrow cannot occur without the facilitating condition at the arrow's head already being in place.

### **5.1 Facilitating Conditions**

As discussed in section 2.7.2, facilitating conditions are an important aspect of technology use in the classroom. These conditions refer to more than just the physical infrastructure available in the classroom and include resources and support provided to ensure the effective use of technology (Attuquayefio and Addo, 2014). If facilitating conditions are not considered and met, then introducing technology into the classroom will not be effective. As such, it is important for schools, principals, educators, and the DBE to consider these factors when introducing technology into classrooms and for distance learning to support educators so that they could potentially use technology more effectively for teaching and learning activities.

This section is composed of five subsections. These subsections are Infrastructure or Preconditions; Technological Pedagogical Training which is subdivided into Technological Training and Pedagogical Changes; Community of Practice; Online Community of Learning; and Support.

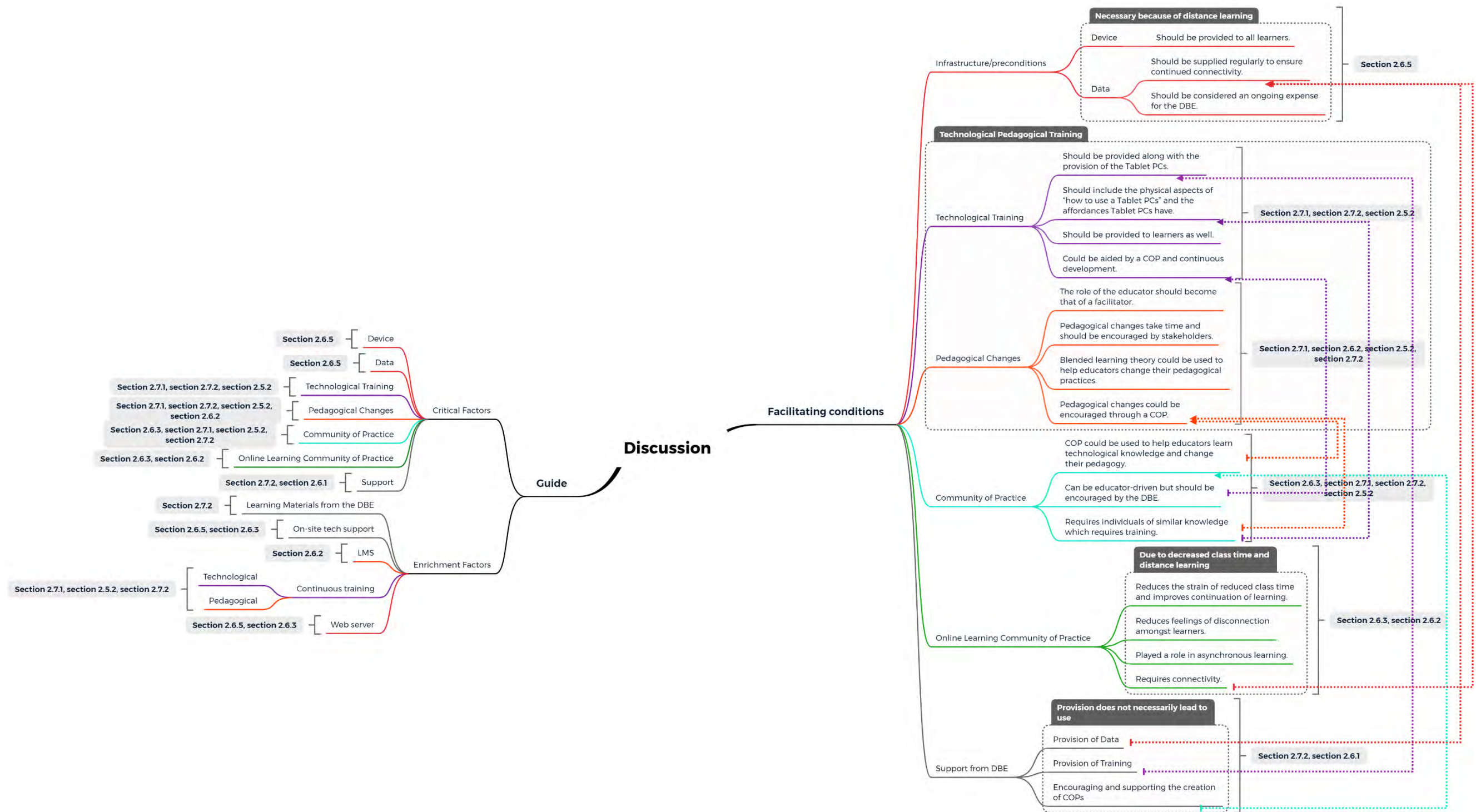


Figure 5-1: Discussion Outline

### **5.1.1 Infrastructure or Preconditions**

Infrastructure or preconditions refer to the technical and physical aspects that need to be in place when technology is introduced into the classroom and distance learning. These include a physical device such as a Tablet PC or mobile phone and some form of connectivity. This connectivity can be provided through data provision. In his State of the Nation address at the beginning of 2020, President Cyril Ramaphosa stated that Tablet PCs were being provided to Matric learners across South Africa to improve education (President Cyril Ramaphosa, 2020).

The introduction of Tablet PCs into education is said to improve the continuation of learning as learners have access to a greater body of knowledge through the Internet and other learning materials provided by the school and stored on the device (Hwang, Lai and Wang, 2015; Nazarenko, 2015). This means that learners can continue working on projects and study for assessments outside of the school grounds. The need for learners to have access to devices became critical because of the coronavirus pandemic and the pandemic's impact on the time allotted to learners in the classroom, as discussed in section 4.4.5. As a result, School X received Tablet PCs from the DBE during 2020; distributed to Grade 12 learners. The provision of the Tablet PCs was considered necessary for the continuation of learning given the decreased class time as previously discussed. Thus, the provision of devices to every learner is necessary to promote the continuation of learning outside of the classroom and school environment. Unfortunately, the provision of devices to learners and educators is not sufficient to bring about the effective use of the provided devices, which has been found by numerous South African studies (Bladergroen et al., 2012; Hart and Laher, 2015; Herselman and Botha, 2014), (see section 2.6.1). As such, it is important that training should be provided alongside the provision of devices to ensure effective use and acceptance of technology. This training is discussed in greater detail in section 5.1.2.

The devices provided to grade 12 learners across South Africa, were expected to be returned by learners and reused for the next cohort of grade 12 learners. Unfortunately, the DBE has struggled to reclaim these devices (Dayimani, 2021; Govender, 2021), and this would mean having to purchase more devices to supply the current grade 12 learners. As such, the provision of Tablet PCs should be considered an ongoing expense to replace those devices not returned and provide repairs when necessary.

The Tablet PCs provided to the Grade 12 learners of School X came with a limited data package/bundle. As such, the learners depleted their provided data bundles quickly and were

unable to purchase additional data for financial reasons, as highlighted in section 4.1.3. This limited the ability of the learners to connect with their peers and educators using their newly acquired ICTs (section 4.3.3) and constrained the opportunities for the learners to continue learning while away from school.

The importance of readily accessible connectivity in education is not new and was argued for by Cornu (2004) as a vital component of education (section 2.6.4). Cornu argued that our society had become more connected due to the introduction of the Internet and ICTs. This should have an impact on education by creating new ways of acquiring and disseminating knowledge. These new connections are evident in the Internet of Things (IoT) which increases our networking capabilities through more connected devices. Devices include mobile phones, Tablet PCs, smart devices, and wearable technology (Al-Emran, Malik and Al-Kabi, 2020). The introduction of the Internet and ICTs into education also changes how educators and learners can communicate and acquire knowledge, thus creating a new form of collective intelligence where learning is no longer considered an individual activity but a collective task that takes place through communication. As such, a lack of connectivity can hinder learning by reducing communication between learners and educators and reducing access to the collective intelligence developed inside a classroom environment (section 2.6.4) from the outside (namely, when the learners are working/learning from home).

During this research project, data constraints prevented learners from connecting to their peers or communicating with their educators outside of the classroom and attempting to continue learning from home. Therefore, data provision cannot be a once-off intervention; data bundles need to be supplied monthly to learners who do not have the financial means to obtain their own. Consequently, data provision would be an ongoing expense for the DBE for which there needs to be an ongoing operational budget to facilitate continued access to the Internet, learning materials, educators, and peers for learners when learning from home.

In order to assist School X with data constraints experienced by the learners and reduce the financial burden on learners, a web server was configured on one of School X's available computers, together with a WiFi access point. The web server does not enable real-time teaching or synchronous learning but does provide learners with access to digital resources without the need for mobile data, allowing learners to take digital resources home with them to continue their learning asynchronously. If used, the educators believed that it might reduce some of the data constraints of the learners and allow for the continuation of learning outside

the classroom. The web server could potentially reduce some of the constraints experienced because of a lack of data. It could be continued to be used in conjunction with the provision of regular data packages to learners to support ongoing learning by the learners.

### **5.1.2 Technological Pedagogical Knowledge**

As discussed in section 2.6.1, training needs to accompany the provision of Tablet PCs to ensure educators can use technology effectively in the classroom. A lack of professional development of educators is considered one of the biggest barriers to adoption in South Africa as educators often lack the skills needed to effectively use technology in the classroom or for distance learning (Adukaite, van Zyl and Cantoni, 2016; Hart and Laher, 2015; Herselman and Botha, 2014; Lupondwana and Coleman, 2019; Nkula and Krauss, 2014). The lack of professional development also reduces the motivation of educators to use technology for teaching and learning, thus reducing adoption amongst educators (Bladergroen et al., 2012; Batchelor and Olakanmi, 2015).

As such, this section discusses the training required by the educators to ensure the effective use of Tablet PCs. The need for training was expressed as the need for both technological training that helps the educators use the Tablet PCs and pedagogical changes that need to take place to ensure effective use of the Tablet PCs for teaching and learning activities. This section discusses each of these aspects separately.

#### **5.1.2.1 Technological Training**

The TPACK framework, as discussed in section 2.7.1, states that an educator can only use technology effectively in the classroom if all three knowledge areas of the educator are developed. The UTAUT model (section 2.7.2) has been used to show that poor technological knowledge can result in a lack of motivation to use technology by educators. This lack of motivation is also presented in Toyama's Amplifiers (section 2.5.2) as differential motivation and is affected by an individual's ability to use the technology that they have been provided. The current coronavirus pandemic is creating an external source of motivation for educators to use technology to support them in attempting to ensure the continuation of learning for the learners. Educators are also being affected by social influence (section 2.7.2), as principals and the DBE are expecting educators to continue teaching even when learners are away from school (section 4.1.2 and section 4.3.2). Although educators are now expected to use



technology, they still lack technological knowledge (section 4.3.4) to do so. As such, educators' technological knowledge needs to be developed to ensure effective use and increased motivation to use Tablet PCs for classroom teaching and learning and distance learning.

Other South African studies (section 2.6.1) highlighted that there is often a lack of technological training provided for educators in South Africa, which reduces their ability to use technology effectively. The educators' lack of technological training and knowledge was highlighted by the educator participants in this study (section 4.1.4 and section 4.3.4). They also commented on the lack of training provided by the DBE (section 4.2.8), which they noted would reduce some of the anxiety experienced by themselves and their colleagues when confronted with new technology (section 4.4.8).

Consequently, the educators suggested that training should be ongoing and start during an educator's university education (section 4.4.7) to better prepare newly qualified educators for using technology for teaching and learning. This training should increase educator motivation to accept and use technology in the classroom, as technology can amplify an educator's pedagogy who is motivated to use technology in the classroom and for distance learning (DiMaria, 2016). Technological training should include aspects on how to use the Tablet PCs. This training should reduce the anxiety experienced with using new technology and ensure greater motivation to use technology in the classroom and distance learning. Training reduces the effort expectancy of educators (Attuquayefio and Addo, 2014), discussed in UTAUT (section 2.7.2), enabling educators to accept and use technology more easily. Appropriate training could also potentially ensure that all three knowledge areas discussed in TPACK would be more fully developed, thereby promoting technology integration into the educators' pedagogical practices. Thus, enabling educators to use technology more effectively.

As stated by Toyama (2011), unless an individual has the capacity to use technology, they will be unable to use technology effectively in the learning process (section 2.5.2). As such, the need for technical literacy training for the learners was also raised by the educator participants (section 4.4.7) as learners would need to use technology outside of the classroom and outside of direct support from educators. This training will help promote the continuation of learning as learners would have the capacity to use technology, increasing their motivation to use technology for their own learning.

Educators in the study highlighted that technological training could be assisted by an educator-driven Community of Practice (COP) to develop the educators' technological knowledge through task-driven exercises (section 4.3.5). COPs will be discussed in greater detail in section 5.1.3.

#### ***5.1.2.2 Pedagogical Changes***

Technological training increases the motivation for educators to use technology in the classroom and for distance learning, but pedagogical changes need to take place for the effective use of technology for teaching and learning activities, as discussed in section 2.6.2 and highlighted by South African studies by Hart and Laher, (2015) and Herselman and Botha, (2014). The TPACK framework (section 2.7.1) refers to the integration of pedagogical knowledge and technological knowledge as technological pedagogical knowledge, which are the pedagogical changes that should occur when technology is introduced into teaching and learning activities both in the classroom and for distance learning. Educators often struggle to integrate these knowledge areas (Hart and Laher, 2015; Msila, 2015; Maina et al., 2015) as effective integration can only occur if both knowledge areas are developed. As such, pedagogical training needs to include how to integrate Tablet PCs into teaching and learning activities to ensure the effective use of Tablet PCs for classroom and distance learning (Adu and Galloway, 2015).

Section 2.6.2 highlights that the introduction of Tablet PCs into a classroom should change the pedagogical practices of the educator. During the study, as a consequence of the coronavirus pandemic, a change in pedagogical practices was also needed. This was imperative as learners were only allowed to attend school a limited number of days of the week (section 5.1.1). Consequently, there was a need for distance and asynchronous learning and a more blended approach to learning when learners were in the classroom. Blended learning (section 2.6.2) combines synchronous and asynchronous learning to provide a more holistic approach to teaching with technology.

The most common models used in a traditional classroom are Face-to-Face driver and the “flipped classroom” (section 2.6.2). These are not the only models that could be employed in schools and other models such as the self-blend model could also be employed particularly for when the learners are having to learn remotely, from home (section 2.6.2). Educators can blend these models to aid teaching and learning. Unfortunately, the “flipped-classroom” and self-

blend model rely on the self-efficacy of learners to complete the work assigned to them. During the study, the educators commented that the learners were very reliant on the educators to guide their learning and struggled when left to complete their tasks by themselves (section 4.1.1). As such, models such as the “flipped-classroom” and self-blend model may not work in School X’s environment. Furthermore, these two learning models might be less effective with school going learners in other places too because it relies on a level of maturity and self-confidence in the learner. During the study, the educator participants described using a Face-to-Face driver approach, but that learning was hindered by the limited connectivity of the learners (section 4.1.1).

The introduction of blended learning does place extra pressure on educators as they have to evolve their pedagogical practices (McKnight et al., 2016; Nazarenko, 2015), this may affect educators effort expectancy (section 2.7.2) because not only do they have to learn how to use a new technology they also have to learn how to teach with that technology. This places extra time pressure on educators and thus increases the perceived effort required to use the new technology for teaching and learning. An increase in effort expectancy decreases the motivation of educators to use technology for teaching and learning. During this study educators also experienced time constraints due to the coronavirus pandemic (section 4.2.1 and section 4.4.1) which also increased effort expectancy and decreased motivation to use technology (section 4.1.2).

The educators in the study commented that because of the introduction of Tablet PCs into the classroom, their role had become that of a facilitator. This meant ensuring that the technology was used as a tool to enhance their pedagogical practices (section 4.3.1) through providing additional resources, such as textbooks and online resources, and affordances for in-classroom use, such as watching videos and taking quizzes. Unfortunately, due to the data constraints highlighted in section 5.1.1, the educator participants’ use of the Tablet PCs for synchronous, distance teaching and learning activities was severely limited.

The change to pedagogical practices takes time and support such as continuous development and this should be encouraged and supported by school principals, the DBE, and fellow educators (section 4.4.1). Buy-in from principals, the DBE and educators is considered an important aspect of technology acceptance and use in South African schools (Herselman and Botha, 2014; Hart and Laher, 2015) and affects the social influence of educators (discussed in UTAUT, section 2.7.2) and increases their motivation to use technology. This change cannot

happen without the technological training discussed in section 5.1.2.1, which should be provided as a starting point for educators to build on during their continuous development. Furthermore, a COP (see section 5.1.3) can potentially aid continuous development and create a supportive environment for educators.

During the interviews, the educators' expressed the need to monitor the level of engagement of their learners, discussed in section 4.2.6. This could be facilitated by introducing a Learning Management System (LMS) that uses metrics to keep track of which learner had accessed resources and completed tasks, providing feedback to educators on learner progress. An LMS can be implemented without Internet access, but if learners are expected to access resources while away from school, then learners would need Internet connectivity, as discussed in section 5.1.1.

### **5.1.3 Community of Practice**

A COP, as discussed in section 2.6.3, can be used to promote the continuous development of educators and improve pedagogical practices (Brooks, 2010; Trust and Horrocks, 2017) to support in working towards effective use of technology in the classroom and for distance learning. This continuous development is accomplished through problem-solving, sharing knowledge and determining best practices that can be used to improve participating educators' pedagogy (Trust and Horrocks, 2017). As such, a COP can improve the technological and pedagogical knowledge of an educator, detailed in the TPACK framework (section 2.7.1), by enabling them to share their experiences of using technology in the classroom and for distance learning (Admiraal et al., 2017; Alemdag, Cevikbas and Baran, 2019). This sharing of experiences could also further promote the integration of these two knowledge areas to ensure increasing efficacy of integration of technology into teaching and learning activities. Continuous development works to improve the educators' capacity to use technology which should improve the motivation of the educator to use technology, as argued by Toyama (2011) (section 2.5.2). COPs also create a support structure for educators where they can share their knowledge with people of similar knowledge and backgrounds (Goodyear and Casey, 2015). This support structure has the potential to create a positive social influence to improve educator's willingness to accept and use technology for teaching and learning activities. Both support and social influence are considered aspects of technology acceptance in UTAUT (section 2.7.2). COPs also foster a collective intelligence (section 2.6.4) among participants,

as a COP is a group of individuals acting together to ensure favourable outcomes for the whole group (Kong and Yu, 2016) which promotes learning through connections with other individuals. Thus, if educators are supported and experience positive social influences through connections with other educators, they will hopefully be more willing to accept and use technology in the classroom and for distance learning. Unsurprisingly, a functioning COP was described by participating educators in this study as an important aspect of learning to use technology for teaching and learning (section 4.2.8 and section 4.3.5).

COPs (section 2.6.3) take time to develop and require individuals of similar knowledge areas to share connected practices (Goodyear and Casey, 2015). Therefore, the necessary technological training for educators should be provided to all educators to ensure that everyone in the COP has a similar knowledge base. As discussed in section 2.6.3, the development of COPs should be encouraged and supported by individuals, such as school principals and fellow educators, as well as the DBE (section 4.3.5), ensuring that continuous development is promoted and supported among educators. The need for a COP was not highlighted by other South African studies but can help reduce some of the barriers highlighted by other South African studies (section 2.6.1), such as a lack of confidence and knowledge to use technology effectively for teaching and learning, while increasing access to support and a supportive environment.

#### **5.1.4 Online Learning Community of Practice**

As discussed in section 2.6.3, COPs can be extended to a classroom environment, creating a COP between educators and learners as many of the same goals are expressed. These goals include a shared interest amongst educators and learners, and learning takes place through interaction between educators and learners (Brown, 2007; Olitsky, 2007). COPs can use technology to extend the existing classroom community to include an online learning community, referred to as a blended COP. A blended COP combines a synchronous in-classroom environment with an online community to extend the existing classroom environment (Allan, Hunter and Lewis, 2006; Trust and Horrocks, 2017). A blended COP can promote blended learning (section 2.6.2) as an existing online community can support the asynchronous learning that takes place outside of the classroom. Both blended COPs and blended learning improve the learning outcomes of learners by providing greater access to resources (Hwang, Lai and Wang, 2015) and continued support (Trust and Horrocks, 2017) to

promote the continuation of learning. It is up to the educator as to how they would like to combine their synchronous and asynchronous teaching and learning activities, but the blended learning models best suited for in-classroom and asynchronous learning are that of the Face-to-Face driver and the “flipped classroom” (as noted in section 5.1.2.2). These models combine continued online work outside of the classroom with work completed during in-classroom teaching (section 2.6.2). The Self-Blend Model can also be employed during distance learning for learners to continue their studies while away from class. This model does require learners to self-regulate their own work and be motivated to complete their work (section 2.6.2). During the study, the educator participants commented on the learners feeling isolated and demotivated when learning away from fellow learners and educators (section 4.2.3). An Online Learning Community of Practice could promote increased motivation amongst learners to continue with their studies while away from school by providing easy communication between learners and educators. As a result of decreased face-to-face teaching time due to the coronavirus pandemic, a need for an online learning community was expressed by the educator participants (section 4.4.5).

Unfortunately, an online learning community can only be effective if all learners are connected and have sufficient data to ensure continued connectivity. The necessity of data provision highlighted in section 5.1.1 would help support an effective online learning community. Providing connectivity to the learners could also reduce feelings of isolation and disconnection caused by the coronavirus pandemic (section 4.2.3) as they can communicate more easily and readily with their educators and fellow learners; always on connectivity would allow learners and educators to continue to foster the community of learning while away from the classroom and learning remotely.

### **5.1.5 Support**

As discussed in section 2.4.2, the introduction of Tablet PCs into the classroom does not necessarily lead to effective use. As highlighted in numerous South African studies, discussed in section 2.6.1, support is required to ensure educators feel willing to use technology in the classroom (Adukaite, van Zyl and Cantoni, 2016; Herselman and Botha, 2014; Nkula and Krauss, 2014). UTAUT also highlights that support is an important aspect with respect to the acceptance of technology (section 2.7.2). Therefore, the introduction of Tablet PCs needs to be accompanied by support from the DBE. Educators in this study suggested that one manner

of support that they would appreciate from the DBE was in the form of the provision of resources such as learning materials, mobile data and ensuring training is provided to help educators use technology effectively for teaching and learning activities. As such, this support would be multi-faceted, and each of the following aspects of support should be met when introducing Tablet PCs into schools.

Firstly, data should be provided monthly to ensure continued connectivity for learners (section 5.1.1). This will support educators and learners with synchronous learning and afford and support the creation and sustainability of online learning communities. In so doing, promoting the continuation of learning by maintaining the social aspects of learning for both the learners and the educators.

Secondly, the provision of learning materials would reduce some of the strain experienced by the educators in making their own learning materials. Thus, decreasing the time constraints when creating online learning materials that the educators highlighted during the interviews (section 4.2.1 and section 4.4.1). The access to learning materials could reduce the effort expectancy of using the Tablet PCs and increase the motivation of educators to use the Tablet PCs for teaching and learning. The learning materials provided by the DBE could also be used as an example of how to create lesson plans that make use of the Tablet PCs in the classroom.

Thirdly, training should be provided (possibly by the DBE) to promote the effective use of Tablet PCs in the classroom. This training should be both technological and pedagogical, as discussed in section 5.1.2 and should be offered continuously to grow the knowledge and confidence of educators when using technology, thereby working to ensure educators remain willing and able to use Tablet PCs for teaching and learning activities in the classroom and distance learning.

Fourthly, the DBE should promote the establishment and longevity of COPs, discussed in section 5.1.3. These will aid in the continued development of educators and promote effective use of technology for teaching and learning activities, both in the classroom and for distance learning, by fostering a community of support and learning among educators. Finally, onsite support through a local technician would reduce the anxiety felt by educators when using technology as they would have easy access to support. This person could also be on-site support for the COP at the school.

## 5.2 Guide

Given the importance of the facilitating conditions being met, a guide is proposed to provide guidelines to principals, educators, and the DBE (stakeholders) to promote the effective use of Tablet PCs for teaching and learning activities both in the classroom and for distance learning. A guide, as defined by the Oxford English Dictionary, is used to “lead or direct in a course of action” and to guide “in the formation of opinions” (OED Online, 2021). As such, this guide provides practical recommendations for stakeholders when introducing Tablet PCs into classrooms and for the support of continued remote learning outside of the classroom and is the finalised version of the guide presented in Chapter 3, section 3.4.1.1.

The guide depicted in Table 5-1 is split into two sections: Critical Factors (section 5.2.1) and Enrichment Factors (section 5.2.2). Critical Factors refer to those factors that, if not implemented, will in all likelihood result in the failed adoption of Tablet PCs by educators for teaching and learning activities. This is because educators will not have the necessary resources or skills required to use technology effectively in the classroom and for distance learning. Enrichment factors refer to those factors that can be implemented once the critical factors are in place and would support the sustained use of Tablet PCs for teaching and learning activities. If the enrichment factors are not implemented, the use of Tablet PCs will not be adversely hindered; the introduction of these factors could be considered once Tablet PCs are effectively integrated into teaching and learning activities.

*Table 5-1: Guide for the use of Tablet PCs in the classroom and for distance learning*

<b>Guide for the Use of Tablet PCs for classroom and distance learning</b>			
	<u>Summary</u>	<u>Theory</u>	<u>Related Section</u>
<b>5.2.1 Critical Factors</b>			
Device	<ul style="list-style-type: none"><li>• Should be provided to all learners.</li></ul>	The Networked Society and Collective Intelligence (section 2.6.4)	Section 5.1.1



Data	<ul style="list-style-type: none"> <li>• Should be supplied regularly to ensure continued connectivity.</li> <li>• Should be considered an ongoing expense for the DBE.</li> </ul>	The Networked Society and Collective Intelligence (section 2.6.4)	Section 5.1.1
Technological Training	<ul style="list-style-type: none"> <li>• Should be provided along with the provision of the Tablet PCs.</li> <li>• Should include the physical aspects of “how to use a Tablet PCs”.</li> <li>• Should be provided to learners as well.</li> <li>• Could be aided by a COP and continuous development.</li> </ul>	TPACK (section 2.7.1) UTAUT (section 2.7.2) Toyama (section 2.5.2)	Section 5.1.2.1
Pedagogical Changes	<ul style="list-style-type: none"> <li>• The role of the educator should become that of a facilitator.</li> <li>• Pedagogical changes take time and should be encouraged by stakeholders.</li> <li>• Blended learning theory could be used to help educators change their pedagogical practices.</li> <li>• Pedagogical changes could be encouraged through a COP.</li> </ul>	TPACK (section 2.7.1) UTAUT (section 2.7.2) Toyama (section 2.5.2) Blended Learning (section 2.6.2)	Section 5.1.2.2
Community of Practice	<ul style="list-style-type: none"> <li>• COP could be used to help educators learn technological knowledge and change their pedagogy.</li> <li>• Provides support and positive social influence amongst educators.</li> <li>• Can be educator-driven but should be encouraged by the DBE.</li> <li>• Requires individuals of similar knowledge, which requires training.</li> </ul>	Community of Practice (section 2.6.3) TPACK (section 2.7.1) Toyama (section 2.5.2) UTAUT (section 2.7.2)	Section 5.1.3
Online Learning Community of Practice	<ul style="list-style-type: none"> <li>• Reduces the strain of reduced class time and improves the continuation of learning.</li> </ul>	Community of Practice (section 2.6.3)	Section 5.1.4

	<ul style="list-style-type: none"> <li>• Reduces feelings of disconnection amongst learners.</li> <li>• Played a role in asynchronous learning.</li> <li>• Requires connectivity.</li> </ul>	Blended Learning (section 2.6.2)	
Support	<ul style="list-style-type: none"> <li>• Provision of Data</li> <li>• Provision of Training</li> <li>• Encouraging and supporting the creation of COPs</li> </ul>	UTAUT (section 2.7.2) Other South African studies (section 2.6.1)	Section 5.1.5
<b>5.2.2 Enrichment Factors</b>			
Learning materials from the DBE	<ul style="list-style-type: none"> <li>• Should be provided alongside the provision of Tablet PCs to reduce some of the time constraints felt by the educators.</li> </ul>	UTAUT (section 2.7.2)	Section 5.1.5
Learning Management System	<ul style="list-style-type: none"> <li>• Can be used to check the engagement of learners and ensure work is being accessed.</li> <li>• Requires connectivity.</li> </ul>	Blended Learning (section 2.6.2)	Section 5.1.2.2
Continuous Training	<ul style="list-style-type: none"> <li>• Training should be offered continuously to ensure the professional development of educators.</li> <li>• Encouraging COPs will also ensure continuous development.</li> </ul>	TPACK (section 2.7.1) Toyama (section 2.5.2) UTAUT (section 2.7.2)	Section 5.1.2
Webserver	<ul style="list-style-type: none"> <li>• Can be provided to reduce some of the data constraints experienced.</li> </ul>	A Networked Society and Collective Intelligence (section 2.6.4) Community of Practice (section 2.6.3)	Section 5.1.1
On-site Support	<ul style="list-style-type: none"> <li>• Could reduce anxiety for educators.</li> </ul>	UTAUT (section 2.7.2)	Section 5.1.5

	<ul style="list-style-type: none"> <li>• Could be the on-site support for the COP.</li> </ul>	Community of Practice (section 2.6.3)	
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### 5.2.3 Concrete Steps for Schools based on the Guide

- Devices provided to learners should have a continued connectivity to ensure effective online learning.
- Technological training should be provided to all educators when Tablet PCs are introduced into a school. This should increase technology adoption and use.
- There should be guidance provided to educators on how to integrate Tablet PCs into their pedagogical practices.
- Educators, through the support of local DBE offices, should be encouraged to create a COP to provide continuous learning and skills development amongst educators.
- Schools, or the DBE, could invest in a Learning Management System which could aid an Online Learning Community of Practice and continued teaching and learning.

### 5.2.4 Tablet PC Guide and Bronfenbrenner's Ecological Systems Theory

Section 2.2 outlined Bronfenbrenner's Ecological System and how different spheres of influence affect an educators use of technology in the classroom. As such, it is important to understand how the guide presented in this Chapter influences an educator and their interaction in these spheres. This guide does not provide recommendations for the macrosystem or exosystem of an educator as these are outside of the direct influence of the educator, but the guide does present recommendations that will affect an educator's mesosystem, microsystem, and their own personal characteristics.

The mesosystem of an educator (section 2.5) includes the other individuals in their sphere of influence and their interaction with those individuals. In this study, these were other educators as well as the learners that the educators interacted with and had influence over. The guide presented recommends improving the interaction between learners and educators during online learning through the provision of an Online Community of Practice (section 5.1.4) to extend the learning community of the classroom to that of the online environment as well. In so doing, improving the ability for learners and educators to interact as well as maintaining the social

aspects of learning and thus the continuation of learning when outside of the classroom environment. This Online Community of Practice should also be accompanied by continuous data provision to promote continued interaction between learners and educators.

The educators also interacted with their fellow educators, and thus, a COP was recommended in the guide to provide support for educators and promote continuous skill development through learning from experiences and knowledge sharing. Furthermore, a COP has the potential to promote knowledge and skill acquisition, which together with the support aspects, can promote technology acceptance among educators.

The microsystem of an educator (section 2.6) refers to the environment in which an educator teaches. This includes both the classroom environment and distance learning. The microsystem is directly influenced by the introduction of the Tablet PCs into that environment as the educator needs to change their pedagogical practices to ensure the technology is used effectively (section 2.6.2). The introduction of Tablet PCs changes the microsystem of the educator and thus can cause educators to be unwilling and unable to use the Tablet PCs that have been provided. As such, the guide recommends that training is provided to ensure educators know how to integrate the Tablet PCs into their existing classroom environment and for distance learning (section 5.1.2). Support from the DBE should also be provided to help educators adapt their pedagogical practices in the classroom and for distance learning (section 5.1.5).

The personal characteristics of the educator (section 2.7), such as skill level and technology acceptance, also need to change to ensure that the Tablet PCs are used effectively in the classroom and for distance learning. As such, the guide provides recommendation for both technological training (section 5.1.2.1) and pedagogical changes (section 5.1.2.2) to take place to ensure that the educator has the necessary skills required to use technology effectively for teaching and learning activities. This training should also improve technology acceptance as their capacity to use technology has been improved through training, and therefore, they should be more motivated to use technology for teaching and learning activities.

### **5.2.5 Generalisability**

This study involved a relatively small sample size of three educators. This small sample size affects the generalisability of the study, but this study and the guide presented can still provide some insight into how previously disadvantaged schools can prepare to introduce Tablet PCs

into teaching and learning activities. This study also focused on the use of Tablet PCs for in classroom and distance learning as Tablet PCs are being provided to schools in South Africa. Although these devices were the focus of this study, many of these factors should be considered when implementing any ICT introduction into a learning environment. Section 2.3.1 highlighted that many countries have started introducing technology into education to improve learning outcomes. In many cases, this is not necessarily Tablet PCs but includes other forms of ICTs such as laptops and digital readers (Tamim et al., 2015). Effective use of any technology requires a change to pedagogical practices, and as such, training needs to be provided to ensure effective use (Kamal and Diksha, 2019). These devices also need to be accompanied by connectivity and support to ensure that educators are willing and able to use technology effectively for teaching and learning activities both in the classroom and for distance learning.

### **5.3 Summary**

The guide in this chapter provides recommendations for facilitating conditions that should be considered and met when introducing Tablet PCs for teaching and learning. The facilitating conditions are Infrastructure or preconditions, Technological Pedagogical Training, Community of Practice, Online Learning Community of Practice and Support. Infrastructure or preconditions promote the continuation of learning outside of the classroom by providing access to resources and connectivity for learners and educators. Technological Pedagogical Training provides educators with the skills and knowledge to integrate Tablet PCs into their pedagogy and increases their motivation by increasing their capacity. A Community of Practice is necessary for continued development, which increases educators' capacity and thereby promotes motivation to use Tablet PCs and technology. A COP also provides support and positive social influence improving educator's technology acceptance. An Online Learning Community of Practice provides an already existing learning community with a virtual space for further online interaction that can help support blended learning and reduce some of the disconnection felt by the learners during distance learning. Support is necessary when Tablet PCs are introduced into schools and should be in the form of data provision, training, and encouraging and supporting COPs. Other factors such as learning materials from the DBE, a Learning Management System, Continuous Training, a Web server, and on-site support could enrich the use of Tablet PCs for teaching and learning activities in the classroom and for distance learning.

## **6 Conclusion**

This chapter provides the concluding arguments for this study. Using the literature, theory, results and proposed guide, this chapter seeks to address the research problem stated in Chapter 1 and answer the research questions. The Chapter starts with an executive summary of the thesis. The research questions are then revisited, and appropriate answers offered based on the research findings. Finally, potential future research work is discussed, and final comments made.

### **6.1 Executive Summary**

Chapter 1 highlighted the current education crisis in South Africa as many learners are unable to pass standardised tests at the correct grade level (Badat and Sayed, 2014; Spaul, 2013). This is one of the factors that has prompted the South African government to introduce Tablet PCs (as well as other technologies) into schools with the hopes of improving education (Department of Education, 2004). The introduction of Tablet PCs for use in teaching and learning is often not accompanied by sufficient training to ensure educators are willing and able to use the Tablet PCs (Adukaite, van Zyl and Cantoni, 2016; Herselman and Botha, 2014; Nkula and Krauss, 2014). The introduction and distribution of Tablet PCs to South African Grade 12 learners was hastened by the coronavirus pandemic and the need for remote distance learning. Consequently, the following problem statement and research goal was posited in Chapter 1:

"The South African government and Department of Basic Education are introducing Tablet PCs into education as a means of improving and facilitating the continuation of education in government basic education (primary and secondary level) schools. The perceived need for Tablet PCs in basic education has become more urgent because of the coronavirus pandemic and the ensuing need for online, distant teaching and learning during the pandemic.

Although Tablet PCs are being introduced into classrooms and for distance learning, educators remain unsure and, in some instances, unwilling to adopt and use technology in the classroom or for distance learning.

The purpose of this study is then to investigate what conditions/factors need to be in place or addressed to facilitate increased adoption of technology by basic education educators. To this end, the study seeks to create a set of guidelines to facilitate and support the successful

adoption of technology by educators for teaching and learning activities, both in the classroom and for distance learning."

The research questions answered in section 6.2 were developed from this problem statement.

Chapter 2 used current theory to provide a background to education as a system and how the system is affected when technology is introduced. Bronfenbrenner's Ecological Systems Theory was used to decompose the factors in an educator's environment that might affect their use of technology. The macrosystem of an educator is influenced by the global use of technology, the need to integrate technology into education, and technology's positive and negative effects on education. There is also a global need for technical training when technology is introduced into the classroom.

The exosystem of an educator is influenced by the current state of education in South Africa, and the effect technology is said to have on education if it is used effectively. The mesosystem of the educator includes the learners that they teach in their classrooms. As such, the educator needs to understand that the learners in their classroom are affected by institutional forces such as differential access, differential capacity, and differential motivation. The microsystem of the educator is influenced by the introduction of technology into that system and how the educator chooses to use the technology. Technology use is influenced by blended learning, the affordances of technology, a community of practice, and the need for connectivity.

Finally, the person refers to the skills that an individual might have to use technology effectively. The person is influenced by their knowledge and their technology acceptance. Chapter 2 decomposes the need for technology in education and the need for factors such as training, connectivity, and support to be provided alongside the introduction of technology to ensure the effective use of technology in education. The theory presented in Chapter 2 was used as a starting point to produce the guide presented in Chapter 3 and finalised in Chapter 5.

Chapter 3 outlines the methodology followed during this study. This study was a pragmatic study that used Action Design Research (ADR) to design the final artefact; a guide to help educators, principals, and the DBE work towards a more effective integration of Tablet PCs into teaching and learning activities in the classroom and for distance learning. This research process was chosen as it combines creating a practical solution to a given problem while still considering the organisational needs of the school in the study. The research participants in this study are educators at a previously disadvantaged school in Makhanda in the Eastern Cape.

Ethical clearance for this study was received from the Rhodes University Ethics Board, and data was collected through semi-structured interviews and analysed using Thematic Analysis.

Chapter 4 highlights the results from the interviews conducted during this study. Analysis was conducted using Thematic Analysis, and both Top-Down and Bottom-Up analysis was conducted on the data. The educators highlighted the need for training to be both about the use of the Tablet PCs and how to integrate the Tablet PCs into their pedagogy. The educators also expressed a need for a Community of Practice to be in place, where educators could develop their knowledge by sharing experiences with fellow educators while being supported by their colleagues. The educators also expressed the need for an online learning community for learners to support them with distance learning and limit feelings of isolation, as well as support from the DBE. The results from the interviews were used to inform the finalised guide presented in Chapter 5.

Chapter 5 highlighted the facilitating conditions that need to be considered and met when introducing Tablet PCs into education. These facilitating conditions are Infrastructure or preconditions, Technological Pedagogical Training, Community of Practice, Online Learning Community of Practice and Support. These conditions were used to develop a guide for educators, principals, and the DBE to support effective use of Tablet PCs when introduced into classrooms and for distance learning. The guide in Chapter 5 is the finalised version of the guide presented in Chapter 3.

## **6.2 Research Questions**

This section attempts to answer the research questions proposed in Chapter 1. Each of the sub-questions will be answered in turn, and finally, the main research question will be addressed.

### **6.2.1 Sub-question 1: What factors facilitate increased acceptance of technology by educators?**

Technology acceptance, discussed in section 2.7.2, refers to an individual's motivation to use technology. Acceptance is affected by external factors that influence an individual's ability to accept and willingness to use technology. Toyama (2011) referred to these factors as differential access and differential capacity, affecting an individual's motivation to use technology (section 2.5.2). Differential access was affected by the provision of data in this



study, and differential capacity was affected by Technological Training (section 5.1.2.1), Pedagogical Changes (section 5.1.2.2), a Community of Practice (section 5.1.3), and Support mechanisms (section 5.1.5). Each of these factors will be discussed in further detail.

Differential access (section 2.5.2) refers to the access individuals have to technology and the resources required to use the technology to which they have access. In this study, the learners at School X were provided Tablet PCs by the DBE but with a limited, once-off mobile data bundle. This limited their ability to use technology outside of the classroom (section 5.1.1). The lack of data also decreased educator acceptance as they were reluctant to force learners to purchase mobile data. As such, it was recommended in the guide (section 5.2) that data provision to the learners should be an ongoing expense for the DBE, which will hopefully improve technology acceptance by educators.

Differential capacity (section 2.5.2) refers to the knowledge an individual possesses to use technology effectively. An individual's capacity affects their ability to use technology, and if they have a greater capacity, they are more motivated to accept and use technology. The first factor that affected differential capacity was Technological Training (section 5.1.2.1). By providing technological training to educators, their knowledge and capacity to use technology increases. Thus, they are more willing to accept and use technology in the classroom and for distance learning. Differential capacity is also affected by the pedagogical changes that need to occur when technology is introduced into a classroom. An educator's pedagogical knowledge needs to be integrated with their technological knowledge to ensure they have the capacity to use technology for teaching and learning activities (section 5.1.2.2). Both technological training and pedagogical changes need to take place to ensure effective use of technology in the classroom and for distance learning. As discussed in section 2.7.1 training influences the personal characteristics of the educator and is necessary to ensure educators are able to utilise Tablet PCs for teaching and learning. The guide presented in section 5.2 provides recommendations for technological training and pedagogical changes to hopefully improve educators' capacity to use technology and improve their technology acceptance and skill level.

A Community of Practice (COP) also affected the differential capacity of the educators. A COP, as discussed in section 2.6.3, provides both continuous training through knowledge sharing and support for educators while learning how to integrate Tablet PCs into their pedagogy. The continuous training provided by the COP has the potential to improve educators' capacity to use technology more effectively for teaching and learning and therefore

improve motivation (section 5.1.3). A COP also creates a positive support structure creating positive social influence to motivate educators to use technology for teaching and learning (section 2.7.2 and section 5.1.3) which improves educators technology acceptance. A COP is formed in the mesosystem of an educator (section 2.5) where educators interact with fellow educators, learning from one another and supporting one another. As discussed in section 2.7.2, technology acceptance is affected by access to support, which a COP can provide. As such, technology acceptance is likely to be improved when a COP is formed. Support also improves acceptance of technology, specifically support from the DBE. Types of support that were found to improve technology acceptance include the provision of data, provision of training and encouraging and supporting the creation of COPs (section 5.1.5). These recommendations were presented in the guide in section 5.2 and will hopefully improve technology acceptance by educators.

### **6.2.2 Sub-question 2: What factors facilitate increased adoption of technology by educators?**

Adoption of technology (section 2.7.2) occurs after an individual accepts technology and attempts to use that technology in their current practices. In this study, adoption refers to educators integrating the use of Tablet PCs into their pedagogical practices. This can only occur if educators have the necessary technological knowledge to effectively integrate their technological and pedagogical knowledge (section 5.1.2.2). As such, technological training needs to take place before the technology can be integrated into pedagogical practices.

Pedagogical changes (section 5.1.2.2) then need to occur, as the introduction of technology into a classroom should change the pedagogical practices of an educator. Pedagogical changes take time and should be supported by school principals, fellow educators, and the DBE. These pedagogical changes can be facilitated through the combination of blended learning techniques such as the "flipped classroom", the Face-to-Face Driver model (section 2.6.2), and the Self-Blend model. Educators can blend these models to support their teaching and learning activities. A functioning COP can also support these pedagogical changes through the sharing of knowledge and experience of how to use the Tablet PCs for teaching and learning activities. These recommendations are made in the guide in section 5.2.

The creation and use of an Online Learning Community of Practice (section 5.1.4) could also promote an increased adoption of technology by educators. The mesosystem of an educator

consists of the learners that they teach (section 2.5). As such, it is important that educators are able to communicate, interact, and support their learners during distant and remote learning. This would create an online space where learners and educators could continue their in-classroom interaction to ensure that learners felt supported and enthusiastic about their learning. The learners being enthusiastic about their studies could potentially improve the educator's adoption as they can see the benefit the learners derive from the Tablet PCs.

### **6.2.3 Sub-question 3: How can tablet PCs be utilised to support teaching and learning activities?**

Technology acceptance and adoption leads to the utilisation of Tablet PCs as educators have the skills and resources to use technology and are therefore more motivated to use technology in the classroom. During the study, distance learning became a necessary aspect of utilising Tablet PCs for teaching and learning activities. This was due to the coronavirus pandemic and the subsequent decreased in classroom time for learners. As such, the Tablet PCs were used for both in the classroom and distance teaching and learning activities. The Tablet PCs were utilised in the classroom to enhance the educators' pedagogical practices (section 5.1.2.2). The Tablet PCs provided access to more resources such as textbooks and online learning materials and provided affordances such as watching videos and taking quizzes.

During distance (remote) learning, the learners had the potential to access resources via the Internet and could potentially communicate with fellow learners and educators. This, unfortunately, was hindered by their lack of access to mobile data, decreasing their ability to go online and connect. Tablet PCs were not used for synchronous learning during the study but rather for asynchronous learning (section 5.1.2.2). Continuous mobile data provision would enable more opportunities for educators to provide synchronous learning when learners cannot attend school and enable educators to utilise the Tablet PCs in new and different ways. This data provision could also promote the Online Learning Community of Practice (section 5.1.4) by enabling educators to more readily sustain the learning community formed in the classroom in an online environment and thus potentially decrease learners' feelings of disconnection and isolation during distance learning.

#### **6.2.4 Sub-question 4: How do Tablet PCs support the continuation of learning, specifically during the coronavirus pandemic?**

The utilisation of Tablet PCs can promote the continuation of learning when outside of the classroom environment by providing access to a greater body of knowledge through access to the Internet and other learning materials provided on or via the device. The devices supplied to School X were to support the continuation of learning due to the decreased classroom time caused by the coronavirus pandemic. These devices need to be accompanied by connectivity as a lack of connectivity can impede learning (section 5.1.1) by reducing the learners' ability to connect to their peers, educators, and the Internet. Cornu (2004) (section 2.6.4 and section 5.1.1) argued that learning is a collective endeavour that takes place through communication both inside and outside the classroom. As such, connectivity is necessary to ensure the continuation of learning when learners are expected to keep learning outside of the classroom or from home.

Continuation of learning could also be promoted through an Online Learning Community of Practice (section 5.1.4). An existing online learning community can support the asynchronous learning that is a part of blended and distance learning. This community also plays a role in ensuring learners are connected to their peers and educators and promotes the collective task of learning as discussed by Cornu (2004) (section 2.6.4).

#### **6.2.5 Main Research Question: How and in what ways can educators be supported in order to promote increased integration and acceptance of technology for use in teaching and learning activities in South Africa?**

Technology acceptance and educator motivation can be improved by improving access and capacity (Toyama, 2011) through the provision of mobile data to learners, providing technological training to educators, supporting pedagogical changes, encouraging COPs, and receiving support from the DBE. These factors discussed in section 6.2.1 improve educators and learner's differential access and capacity to use technology. Differential access and capacity enable users to use technology more effectively by providing the resources and skills required to use technology. As such, when differential capacity and access are improved, it is more likely that educators and learners will be more motivated to use technology as they have the skills and resources required to use the technology. Greater motivation leads to a greater

acceptance of technology (section 2.7.2), and therefore both access and capacity should be improved to ensure technology acceptance.

Technology adoption/integration occurs when educators have sufficient technological knowledge for them to attempt to integrate the Tablet PCs into their pedagogical practices (section 6.2.2). This could be supported by providing technological training to start and followed by training with respect to blended learning techniques to help educators integrate their pedagogical and technological knowledge. Encouraging the establishment of COPs can also support the change to pedagogical practices as COPs provide support for educators and continuous skill development through knowledge sharing and learning through examples.

Technology acceptance and adoption leads to increased utilisation of Tablet PCs as educators have the skills and resources to use technology and are therefore more motivated to use technology in the classroom (section 6.2.1 and section 6.2.3). The Tablet PCs were utilised for both in classroom and distance learning. However, a lack of connectivity (due to limited access to mobile data bundles) significantly impeded distance learning as the learners were not able to access online resources that their teachers could recommend to them, nor engage in live virtual classrooms or synchronous support from educators or peers. Despite the lack of Internet access for the learners, the utilisation of the Tablet PCs promoted the continuation of learning (section 6.2.4) by providing greater access to learning materials stored on the Tablet PCs and potentially allowing those few with the resources to access mobile data to connect with fellow learners and educators using their devices. The guide presented in section 5.2 provides recommendations to facilitate supportive conditions to promote educator acceptance and integration of Tablet PCs into their teaching and learning activities both in the classroom and for distance learning.

The need for technological training, pedagogical changes and support from the DBE were highlighted in other South African studies where Tablet PCs were introduced for teaching and learning (section 2.6.1). These aspects were considered barriers to adoption and use of technology, similar to what was found in this study. This study also found that a COP could be used to improve the knowledge and confidence of educators by providing support and positive social influence amongst educators to improve technology acceptance.

As discussed in section 2.1, education is a system with multiple sub-systems working together to accomplish the goal of learning (Frick, 1991). This system is affected by the introduction of technology as educators need to learn how to integrate the new technology into their current

system (Oliver, 2016). The education system of an educator can be broken down into 5 sub-systems namely macrosystem, exosystem, mesosystem, microsystem, and personal characteristics (section 2.2). All these sub-systems should be considered when technology is introduced into teaching and learning (Kotzé, Westhuizen and Barnard, 2017; Liu, 2018). Globally, in the macrosystem of the educator, many countries have started the introduction of technology into education in an attempt to improve learning outcomes (section 2.3). This has led to the DBE in South Africa, the exosystem of the educator, to encourage and often supply Tablet PCs to schools in an attempt to improve learning outcomes (section 2.4). There are also policies in place such as the White Paper on E-Education released in 2004 (Department of Education, 2004).

Although the macrosystem and exosystem of the educator is considered and policies have been drawn up to promote the use of Tablet PCs, there is often a disconnect in the eventual use and adoption of the Tablet PCs as the provision of devices is often considered sufficient to bring about effective use (Hart and Laher, 2015). An educator's mesosystem, microsystem, and personal characteristics are not considered. The mesosystem of an educator includes the interaction among fellow educators and their learners. During this study, there was a disconnect between learners and educators due to a lack of data provision for learners. As such, learners felt disconnected and isolated during distant and remote learning (section 6.2.3). The need for a COP was also highlighted to promote communication and support amongst educators in an attempt to improve technology acceptance and adoption. The microsystem of an educator refers to the environment in which the educator teaches and the environment in which the technology will be utilised. This study (section 5.1.5) and other South African studies (section 2.6.1) highlighted the need for support from the DBE in the form of training and learning materials to ensure educators are able to integrate the Tablet PCs into their existing teaching environment. This study also highlighted the need for pedagogical changes to be supported through theories such as blended learning (section 5.1.2.2). The personal characteristics of an educator refer to their skill level and technology acceptance. This study (section 5.1.2) and other South African studies (section 2.6.1) highlighted a lack of technological and pedagogical training provided to educators. This led to a lack of motivation to use technology for teaching and learning. The provision of Tablet PCs needs to be considered on a systemic level to ensure educators are supported at all levels to ensure technology acceptance and use by educators for teaching and learning.

### **6.3 Future Work**

This study highlighted the need for a Community of Practice for educators and an Online Learning Community of Practice for educators and learners to facilitate a community of learning. Future studies could investigate how these Community of Practices could be supported and best used to promote the integration of Tablet PCs into an educator's pedagogy.

This study also took place during the coronavirus pandemic and had a classroom and a distance learning focus. Future studies could provide a guide on how to use Tablet PCs specifically for in-classroom use and a guide on how to use Tablet PCs specifically for distance learning.

Future work could also investigate training modules that could be provided to educators alongside Tablet PCs. These training modules could include learning materials that could be a starting point for integrating tablet PCs into their pedagogical practices.

Future work could investigate practical examples of how Tablet PCs could be utilised for in-classroom and distance learning. These practical examples could be provided in the form of a guide that could be utilised by educators to understand how to use technology for teaching and learning.

### **6.4 Final Comments**

The initiative to introduce Tablet PCs into education has highlighted educators' feelings of being ill-prepared and, in some cases, unwilling to use technology in the classroom or for distance learning. There needs to be a systemic change in education to ensure that the introduction of technology is supported at all levels within the education system. Often the support offered at the mesosystem, microsystem and personal level of the educator is lacking and not as well considered as the macrosystem and exosystem levels. This has led to the need for support concerning interaction amongst educators and learners, support for teaching with technology, and skill development for educators. As such, support is multi-faceted, and all factors need to be considered and put in place to promote technology acceptance and use. As such, the guide presented in section 5.2 provides some practical recommendations to principals, educators, and the DBE to hopefully begin to successfully promote technology acceptance and adoption amongst educators in primary and secondary schools.

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## Appendix A: Schedule for Interview 1

Hi, first off, I would like to start by thanking you for agreeing to be interviewed and that the information that you provide me with today will greatly assist in my research.

For the purposes of the recording can I just ask you state your name and the school at which you are a teacher as well as the position that you hold at your school.

1. How have you found using the Tablet PCs in the classroom and for distance learning?
2. Do you feel that the use of Tablet PCs has been successful so far?
  - a. What do you think are some of the benefits of using the Tablet PCs?
  - b. What are some of the drawbacks of using the Tablet PCs?
  - c. Do you feel that they allow for the continuation of learning?
3. How has the use of the Tablet PCs and having to change to distance learning affected the way you teach?
4. With the Department of Basic Education provided Tablet PCs, what are some of the expectations that the DBE has when using the Tablet PCs?
  - a. Have the expectations been realised or been provided for?
5. How have you been sharing resources with your classes?
  - a. How have the learners responded to learning online alongside classroom interaction?
  - b. What are the disadvantages of sharing information with learners online?
6. Have there been any technical issues around using the Tablet PCs for you or your learners?
  - a. Have you been able to mitigate the issues?
7. Do you feel that there is any more training that you would like to be able to better use Tablet PCs for in class and distance learning?
8. What do you feel needs to be in place, or provided to support teachers in integrating the use of tablet PCs meaningfully into teaching and learning activities?

## Appendix B: Schedule for Interview 2 with Teacher A

1. Is there anything new you would like to tell me about using the Tablet PCs in the classroom and for distance learning?
2. Have you been using the web server that Ingrid installed?
  - a. Do you know if any of the learners have been making use of it?
3. The time pressure of teaching and especially teaching with technology came up in the previous interviews. Why, do you feel, the use of technology in the classroom and for distance learning more time consuming?
  - a. What do you feel could be in place to better support the time needed to use Tablet PCs?
4. In the previous interview, you stated that you found the Tablet PCs to be passive in nature. Can you expand on this?
  - a. How does this affect the way you use the Tablet PCs in the classroom?
  - b. How does this affect the way you use the Tablet PCs for distance learning?
5. You also said that you found learning with the Tablet PC a private learning action and hindered interaction in the classroom. Can you unpack this a bit more?
  - a. In your opinion, what is hindering classroom interaction when using the Tablet PCs?
  - b. Can you think of any activities using the Tablet PCs that promote interaction in the classroom?
6. Do you think the learners would be aided by an online learning community with their peers?
  - a. Do you have any thoughts on how you would create a learning community with technology?
7. Can you suggest any practical ways that educators could be encouraged to use technology for teaching and learning activities both in the classroom and for distance learning?
8. Have you found a need for any more support or training since the last time we spoke?

## Appendix C: Schedule for Interview 2 with Teacher B

1. Is there anything new you would like to tell me about using the Tablet PCs in the classroom and for distance learning?
2. Have you been using the web server that Ingrid installed?
  - a. Do you know if any of the learners have been making use of it? If they haven't, why not?
  - b. Has this reduced some of the data issues mentioned in the previous interview?
3. The time pressure of teaching and especially teaching with technology came up in the previous interviews. Why, do you feel, the use of technology in the classroom and for distance learning is more time consuming?
  - a. What do you feel could be in place to better support the time needed to use Tablet PCs?
4. You mentioned in the previous interview that distance learning lacked an interactive element. Can you unpack that more?
  - a. Have you thought of ways to encourage interaction online?
  - b. Do you think the learners would be aided by an online learning community with their peers?
  - c. Do you have any thoughts on how you would create a learning community with technology?
5. Do you feel that the Tablet PCs reduce interaction in the classroom?
  - a. If yes, what is hindering classroom interaction when using the Tablet PCs and how might this be mitigated?
  - b. Can you think of any activities using the Tablet PCs that promote interaction in the classroom?
6. Can you suggest any practical ways that educators could be encouraged to use technology for teaching and learning activities both in the classroom and for distance learning?
7. Have you found a need for any more support or training since the last time we spoke?



## Appendix D: Schedule for Interview 2 with Teacher C

1. Is there anything new you would like to tell me about using the Tablet PCs in the classroom and for distance learning?
2. Have you been using the web server that Ingrid installed?
  - a. Do you know if any of the learners have been making use of it?
3. The time pressure of teaching and especially teaching with technology came up in the previous interviews. Why, do you feel, the use of technology in the classroom and for distance learning more time consuming?
  - a. What do you feel could be in place to better support the time needed to use Tablet PCs?
4. In the previous interview, you said that the students had access to free materials and sites. Are the students aware of these sites?
  - a. Do you know if they're using them? And if they're not using them, why?
5. Do you feel that the Tablet PCs reduce interaction in the classroom?
  - a. If yes, what is hindering classroom interaction when using the Tablet PCs and how might this be mitigated?
  - b. Can you think of any activities using the Tablet PCs that promote interaction in the classroom?
6. Do you think the learners would be aided by an online learning community with their peers?
  - a. Do you have any thoughts on how you would create a learning community with technology?
7. Can you suggest any practical ways that educators could be encouraged to use technology for teaching and learning activities both in the classroom and for distance learning?
8. Have you found a need for any more support or training since the last time we spoke?

## Appendix E: Example of Interview Transcription

### *Key*

Teacher B – Teacher being interviewed.

Teacher A, C - Other teachers involved in the study.

School A – School involved in the study.

### *Start of transcript.*

Interviewer: Did you have a chance to look at the questions beforehand?

Teacher B: I have, and I have written notes, so I have talking points for you for each of them.

Interviewer: Good, good.

Teacher B: Um, OK. Actually, I should have the questions here in front of me as well. Tim, go away. You're playing go, go, go. They're always worried they're not going to be part of the centre of attention. Hang on, let me just pull up the actual questions so they're in front of me as well. OK. So, the first one that you said is "How have you found using the Tablet PCs in the classroom and for distance learning?"

Interviewer: Yes.

Teacher B: Let me just find my little notes. Um, alright so I've said that it's actually a bit of a challenge. Um, because you know with technology the problem is learner's often get distracted, so it becomes a focus of like playing on the Tablet as opposed to using it for its intended purpose is which is as a learning tool.

Interviewer: Yes.

Teacher B: Um, and I have discovered that they have, either the Tablets themselves have come with games preloaded or they have downloaded games onto the Tablets and that has now become a bit of an issue in class because, um, it's difficult to monitor everything that's going on, to be around and see what they're all doing especially with our covid regulations and having to keep our distance. So, they, they are sneaky, so you sort of think they're using the Tablet to look at the work or they're following along on the PowerPoint but actually meanwhile they're playing a game so, that has been, that has been a problem and caused some difficulty. I'm not sure what the solution is there, to that, you know hopefully in the future, I guess, we'll be able

to be more on top of them, you know and we don't have to keep our distance so much we can maybe be closer to them and keep a better eye on what it is that they're doing. They're getting away with murder at the moment so...

Interviewer: Ja. Cool have there been any benefits though. To using them.

Teacher B: I mean ja, I'll go through your questions.

Interviewer: Oh, sorry.

Teacher B: I suppose there's anything else you want to know. That's question 1. Question 2 you said: "Do you feel the use of Tablet PCs has been successful?". "What do you think are some of the benefits? What do you think are some of the drawbacks? Do you feel they allow for the continuity of learning?". So, the answer to has it been successful is yes and no. Benefit is that we can share more resources so, you know in class we can, what we have been able to do mostly is sort of project notes that we create for them on the screen and possibly show some videos and things but, if they miss class, they're absent or whatever and they're not there they don't get to see it. They miss out on those things. So, what's nice about them having these Tablets is that they're, all of that stuff and extra things on top of that, things we might not have time for in class but that require some kind of digital device in order to access or use. We can then send links or, or give them copies of videos or whatever it is we want to or links to certain websites so they can find more information or we found a number of like PowerPoint presentations that other people have created or PDF documents that have been created that have nice visuals included and it's colourful and you know, it brings everything to life a bit more. And that's nice, it's really nice to be able to, to give them access to those things and then they can read through them and it helps them for study purposes. So, that's been on the nice side.

Interviewer: OK.

Teacher B: Drawbacks, obviously not being able to control what content they are actually viewing at any certain time and then the data. Obviously, you know anything that we want to send to them at this point there has to be some kind of Internet connection for them to be able to download that information from somewhere. So, what we've been doing for the most part is WhatsApp, we've been sending things through on a WhatsApp group. So, you know even then, they have to have data to access that information. I have tried once or twice to Bluetooth stuff to kids in class but that is really time consuming because you have to do it individually, one after the other, I haven't been able to figure out if there's like a mass way of Bluetoothing it to

a number of devices at once. Ingrid's shaking her head in the background, so I assume that's a no. So, that's a bit of a problem. So, that becomes, you know, time consuming because you have to send to this one and then you have to connect to the next one and send to that one. So, you can end up losing an entire lesson, trying to get the information to them. Which is where that idea of Ingrid's server would come in handy. If there was somewhere, a place where we could sort of dump all of the information onto it and then the kids in their own time or each individually could connect their machines or their Tablets, you know, to that server and then download the information themselves instead of having to wait for me to transfer each time individually. So, there's that. What else have I said here? Oh, your C question, oh shoot hang on, I've now done something to my phone. "Do you feel they allow for the continuity of learning?". And I've said they certainly, they certainly have the potential for it, like the potential is there for them to be used, if they're used in the correct manner for them to actually be a huge aid in teaching and learning, it's just, it's just making sure they are used for the purpose for which you intend them to be used and unfortunately, you know, kids are resourceful and they're sneaky and they will find ways of sort of subverting your intended use. So, ja, there are teething issues I suppose.

Interviewer: Yes.

Teacher B: Question 3: "How has the use of the Tablet PCs and having change to distance learning affected the way that you teach?". There's a lot more prep involved. Like, a lot more because you have to prepare all the PowerPoints and you know, all of the extra material that you want to use and its incredibly time consuming. You know, before you would walk into a classroom and you'd have an idea in your head of the information you want to bring across and then you can deliver which, that kind of prep takes a lot less time than actually having to take everything you would say and put that in writing. Or even if you're doing voice notes that are attached to you know, a PowerPoint presentation or whatever it takes a lot more prep. And then also, there's an interactive element to teaching, so, when you can see people and you can see how they're reacting to the information you are giving them, you can see whether they understand or not.

Interviewer: Yes.

Teacher B: And based on their facial expression you can be like ok this is not hitting home; I need to change tack and try something different. You don't get that with remote teaching, you know that interaction is not there. So, you've got to hope that the information you've presented

and the way you've presented it is hitting the mark because you don't have that, that immediate feedback telling you, like looking at you with confusion like what are you talking about. So, that's tough and trying to anticipate like potential problem areas that kids might have and trying to sort of compensate for them in advance that's again, it's really difficult. So, the mental load, the mental weight of that is actually huge. Because, you're constantly (lost connection) have I explained it in enough detail or have I made it relevant. Have I, you know have I managed to connect with these kids and not having that immediate feedback of being able to see on their faces that they're with you. I think we take that for granted, we have taken it for granted, we have that immediate sort of recognition of oh, yes I can on their face that they're nodding along, they're with me or they're looking at me like I'm insane and I have no idea what I'm talking about and I need to try something different. So, that's ja. There's that.

Interviewer: OK.

Teacher B: Question 4: "With the department of Education providing Tablet PCs, what are some of the expectations that the department has when using the Tablet PCs?". We have not been told if there are any expectations. None have actually been communicated to us, so I have no idea. They may have expectations but if they do, they have not shared them with us. So, I have no idea if that we're supposed to be achieving some kind of goal or of it's just on their side a ticking of a box like "oh, what have we done to try and help. We've given tablets kind of thing and we have no idea how they're being used but we don't care because we've given them and now that's like our job done". Ja, I'm not sure. They might have them, but they have not told us.

Interviewer: And the teams situation, using Microsoft teams for teaching? Have you heard any more about that?

Teacher B: No, they haven't insisted on it. And I think it's because they know that they'll have to provide the data. And they don't have the money for it, this is one of the biggest drawbacks, one of the biggest problems we are, that we face with technology is the need for Wi-Fi or the need for data and you know, if you can't afford it, you can't afford it. And most of our kids are you know, they come from pretty poor families and underprivileged environments and you know, parents are struggling to put food on the table so data is sort of the last thing that they're actually worried about. Which is why this idea of Ingrid's thing about having this server that they can then connect to without needing Internet they can go, and they can connect to and they can then download information from. You know, that would be a huge help because if we have

to rely on the Internet or on data connectivity, we've got problems. And not just with the pricing, you know the connection out in the townships is terrible. I've got Vodacom on my phone and every time I go out there, I basically lose signal. So, you know, I have to walk around with my phone in the air searching for a place at the school where I can actually connect to something. And it's ridiculous. So, if I'm having problems you can be guaranteed that the kids are having problems, even at home they'll be having problems, having connectivity issues. So, if they can come to school and remotely, via Bluetooth or whatever it is, download information onto their Tablet PCs and then take that home with them and have it there, you know, ready and accessible to them without having to worry about the Internet that would be a huge step in the right direction for us. And probably for most schools in the country, I would imagine because most kids are going to be suffering the same sort of circumstances.

Interviewer: Yes.

Teacher B: So, your question 5 was: "How have you been sharing resources with your class?". As I've said mainly through WhatsApp and then some Bluetooth transfers, we've attempted in class which proved to be very time consuming. So, not a great idea. "How have they responded to learning online alongside classroom interaction?". They don't like it. They don't like it, because it is self-study effectively. And they are not keen on studying by themselves. They say that it is much easier to understand the work when there's someone explaining it to them. Even if the explanation in the notes or in the PowerPoint is exactly what you would have presented in class, again I think it's that sort of interaction that helps them. And the idea that if they don't understand the teacher can see and they can ask questions and you can change tack and you can try and help them understand. But, when they're on their own and they've got the material in front of them, if they don't understand something, you know, there's no one to immediately provide an answer to help them out. And our kids are not terribly independent when it comes to studying, they are very reliant on the information that is presented to them. So, this has been terrible for most of them. They are really demotivated, and they do not want to have to do the work by themselves. They want someone to be in front of them presenting the information to them. Basically, they want to be spoon fed is kind of what it breaks down to, what it boils down to. They don't like this idea of actually being forced into a position where they have to use the information that is given to them and essentially teach it to themselves.

Interviewer: Ja.

Teacher B: Ja. I mean the options are there for them to contact us via WhatsApp, they've got our numbers and they can ask questions but very few of them have actually used that. So, I think that it's basically just a motivation problem you know, they're so demoralised by the entire experience that they're just, it's like overwhelmed them so, they've just sort of thrown their hands in the air and gone "we give up". And I'm not sure, you know that's a covid situation, I think, I don't know if that would necessarily be the case with all online learning. I think if, if we had like a sort of phased in approach, where, you know, they were learning in class but there was also an online or a sort of Tablet-based component to it where maybe they applied what they learned in class by using the technology and working through it like you know, we could potentially put you know, homework or extra activities or whatever online or make them available for them to download that they could then they'd have in class teaching but then they'd be able to use what they have learned and then apply it at home through you know, if it was little quizzes that they could do on the Tablets and then that would provide some feedback afterwards to them based on what they had already learned. Maybe they'd be a little bit more confident about it in that situation but it's sort of been thrust on them, well it's been thrust on all of us really, and so the overwhelming sort of nature of the whole exercise I think has got to most people. And you know, we have to remember that ja they're 18 sometimes even older than 18 but most of these kids like this is, they're kids this is hectic. It's like, "Oh my God, we've never been faced with this before, what is happening, this is terrible". So, at the moment I feel like it's being used more as a toy, the tablet, than actually as a learning tool so, that's something that we're going to need to, to address and work on.

Interviewer: OK.

Teacher B: OK. "What are some of the disadvantages of sharing resources online?". Data. That's the main disadvantage, data, it's expensive. And not being able to keep track of like who has accessed what. So, if you make something available online and obviously it's there but then you don't know who is actually using it or not or who has actually downloaded it or accessed it. So, that, for me, is a bit problematic because I like to know, you know, I keep register when I have normal classes so I know who's been there and who hasn't, I know who missed what lesson, you can keep track of where they're at but with online you're just don't know. We don't have any means at the moment of tracking who has done what. So, it's difficult to know who's really falling behind and who needs maybe a little bit of extra attention of maybe a little bit of extra motivating to catch up to the rest. So, again that's something that we need to look at somehow being able to, to track, you know, at least if there was some sort of central

server that they were maybe downloading things from, if they were logging on maybe we could have like a, a log recording who's logged on and who has downloaded so we know who's accessing and who's not that might help, but it is, ja I feel like it's a problem not knowing who is accessing and who isn't, who's benefitting from the resources and who isn't.

Interviewer: OK.

Teacher B: What else. Oh, and again, that lack of interaction. So, you know, you can't see, if they're accessing it and then they're reading the information then do they understand it, don't they understand it, like you know, you can't see and you can't see what's happening, so that for me is a problem. "Have there been any technical issues around the using of the Tablet PCs for you or your learners?". By technical issues, I'm assuming like problems using the Tablets.

Interviewer: So, any struggles you've had with using either the applications or just in general, connecting to Wi-Fi, sharing information, that sort of stuff.

Teacher B: OK. So, then again, data and just how long it takes if you want to do a Bluetooth transfer. How long it takes individually having to go and transfer from one student to another to another. And then, "Have you been able to mitigate these issues?". Well, we're hoping that Ingrid is going to get her server set up and that will help us so, that's the idea but we'll still have to test that out and see if it works or how well it works.

Interviewer: Ja.

Teacher B: So, question 7. "Do you feel that there is any more training that you would like to be able to better use the Tablet PCs for in class or for distance learning?". I don't know at this point.

Interviewer: OK. That's fine.

Teacher B: I would love to say I'd like to know this, this and this, but I have no idea at this point. I'm still, I'm still trying things out and seeing how they go. I haven't hit a point where I'm like oh I need to learn how to do this. You've provided a lot of training videos already and I'm trying to make use of those and to see how they can fit in with what we're currently doing. We're going into exams now, so we see very little of the kids and actually this would be a good time for them to actually try getting information out. Sort of as, you know, here's a little revision video on this and a little revision video on that. I was actually thinking like for grammar purposes that it might be quite nice to sort of provide a whole bunch of little revision



videos. Not necessarily made by us, there's a ton of stuff on YouTube, really nice stuff on YouTube that shows them how to do a lot of the grammar points. Just making those available to them for those who, who want to brush up and see how it works would be nice. Because they're not coming into class, we can't teach it to them, but at least it would be something for them to access. But then again, data because videos take a lot of data. So, if there was that server that we could download it to that would be awesome.

Interviewer: Yes.

Teacher B: 8. "What do you feel needs to be in place or provided to support teachers integrating the use of Tablet PCs meaningfully into teaching and learning activities?" I think for most of our teachers, how to use the Tablet would be a good start, because a lot of them are not, not really good at using technology or have computer skills at all. In general, like they even struggle with just a regular PC. So, learning how to use those things and then like how to actually create resources. So, all of your little training videos, that's the stuff that they need to be going through. And then obviously, Wi-Fi, you know, if the government could get on that and provide Wi-Fi to schools or Wi-Fi points in schools where kids can download but then again you'd need make sure that they're monitored or supervised in some fashion so that they're not using the Wi-Fi to download games because as I said, they misuse these things. So ja, that is what I have. I don't know if there's something else you want to ask. Based on all the information I've just shovelled at you.

Interviewer: No, I think the biggest thing the is the data thing. So, there's obviously that problem that is going to have to be addressed in some way. But, ja, that was good. I liked the way you went through all the questions. That was really nice. Any last thoughts, anything that you.

Teacher B: Nothing that I can specifically think of at this point. Just that we have with our other grades, we've been making use of Facebook and I kind of wonder if that can't be a better tool, possibly, that we could make use of. Purely because, so many of them are on Facebook, they use it on such a regular basis that we might as well turn it to our advantage. It's the one way that I sort of manage to reach the other grades that only come in maybe once or, in the grade 11's case, twice a week. Our eights, nines, and tens we see only once a week, so we try to do as much as we can in class, but then we send them off with homework. And the only way that we can sort of get feedback to them about the homework and about what they need to do, is via Facebook. So, just today I've uploaded like a whole bunch of answers to homework

questions that were given to the Grade 9's last week Tuesday and it's how we get the sort of information across. It's like OK you were given, you were taught certain skills, reminded, certain skills were revised in class on Tuesday, we went through a few examples, you were given a whole bunch of examples to do for homework. There's no time to check the homework next week because we've got to do the next set of skills, we only see them once a week, so the expectation is that they work on the stuff during the week and then I upload the answers over the weekend and then they can check their answers versus the answers I've provided them with. And it's like the best thing we have available to us at the moment because even those who on free mode, if they then send me a message, I can send the information to them via messenger and then they get access to it. So, that solves a bit of the data issue there, again the only problem though with this, is that we can't monitor who's done it and who's just copying. So, it would be nice if we had like a Google Classroom situation where you could set up an online little activity, homework thing, where they were actually had to fill in answers online and then were able to check those answers against the memo that you've already set up for it. And I've seen how those things work, they look really great but again, comes the problem of connectivity. These kids just don't have the data to do those things, so I could go through and do it and I could set it up and I could make it available to the people but the number of children who would complete the task would be maybe 20 or 30 if I was lucky. So, out of 190, that's the problem, that's the deal that we're sitting with. Because, I will send the rest of this weekend sending the information to kids who don't have data. That's what happens, I post it on Saturday and like right the way though until Monday evening I will still be sending it to kids who are like "Mam, I can't see it, please send it". Like tens of kids who are just like "we have no access". So ja, this is our biggest problem, the resources themselves, there's so many of them and they're so great and we could really make use of them, if our kids could gain access to it. So, I really feel like the money issue, the infrastructure when it comes to Wi-Fi, data that is our biggest stumbling block. Sadly, we need to convince all of these heavy hitters, Vodacom, MTN and all the rest to drop their data charges, because it's, it's just ridiculous.

Interviewer: Yes. Cool. Well thank you very much.

Teacher B: Anything else.

Interviewer: Do you have any, this ones off the top of my head, thoughts about how the covid context has affected technology in teaching?

Teacher B: I mean, I think we're all having to very, very quickly learn how to implement it and how to make use of it in the best way that we can given our circumstances. I think the more wealthy schools have been able to do a whole lot more. You know, they've gone fully online with online classes and kids signing in and teaching classes live. And when you've got the money, when you've got the infrastructure that's great you can do it. But, for those of us who are working for a government school, and specifically I think it's the non-fee paying schools, even your ex-model C schools are far better equipped to have online lessons on the go because their, the majority of their kids are from middle-class families who can actually afford the data or they have Wi-Fi at home so they can actually do the work online. It's our non-fee paying schools with kids who are coming from rural areas or from townships where most of their parents have lost jobs because of covid or didn't even have any to start with because they are the biggest group of unemployed people in the country or they're living off social grants. So, that's their income and it's not enough. You know, it barely covers food for the month, so we're talking about families that can't even provide sanitary pads for their kids, like there's no money for that. That's how bad the situation is so; data is probably the last things that they're going to be thinking about. They're going to hope that their kids gain access in other ways. We spent a lot of time printing out notes, making photocopied bundles of notes to send home to kids and having them come to the school and having them sign for them and fetching them. And that was the best solution we could come up with based on our socio-economic circumstances of our kids, because putting stuff, I mean we did when we couldn't do anything else, we did put stuff online. We created these Facebook groups that the kids could sign up to and then we posted a whole lot of information on there but again it relies on them having data in order to access. So, a lot of them would say they've joined the group and then send me messages saying "I'm on free mode, I can't see it can you please send it to me" and if it's a video or something then I can't. You just can't send that, if it's an image then that's fine, you can send it through, but for any other content, it's just not possible. Even PDF documents, you can't send through on messenger, I've tried. Well, at least it won't let me do it on my phone, maybe it will let me do it on my computer but, I've been mostly doing it from my phone because it's just easier. It's just more convenient, especially if you're moving around. You're not stuck with the computer in front of you. So, there's that. I think that there are huge ramifications though not just academically with covid, but also socially. The lack of interaction with their peers, you know they learn a lot from their friends. Sometimes they won't want to ask a teacher because they don't want to look stupid in class, but they'll talk to a friend about something they haven't understood. And the friend explains it to them, and we're losing out on that kind of

peer-to-peer learning taking place because they're isolated, and they're not allowed to interact with one another. They're separated from one another. So, I feel like that is a problem and it's an emotional impact. So, for our kids, they're teenagers and the most important people in their lives at this point are their friends and those are the people that they are now not allowed to spend time with and not allowed hang out with. So, the emotional toll, a lot of the kids suffer from depression now, there's anxiety, there's depression, there's feelings of just being overwhelmed. We've had, I think our dropout rate is scary because these kids are just so like "we can't cope with this anymore. We can't try come back to school once a week, how are going to get through the year. How are we going to manage?". So, trying to motivate them and to keep them sort of feeling like things are going to be alright, that's tough. And when you're depressed the last thing you're concerned about is your academic performance. So, you've got other issues you're worried about. So ja. We throw technology at things thinking that it's going to solve all of our problems and I don't think that that's the case. I think it's a tool, I think it can be useful, but I think that we have to be careful that we don't think that it's just a solution to everything. It shouldn't be taking the place of learning and teaching, it should be aiding it, it should be a help, a tool for helping. So, there still needs to be, I feel like there's nothing that can really replace face-to-face interaction. And the ideal situation would be like what the private schools have achieved, where they are actually able to, if not be face-to-face, at least have this kind of interaction where they, where it's live and kids are logged in and you can see the teacher and the teacher can see you. The faces are all there. That's the sort of way to best manage without physically being in the classroom, but even that is not the best situation as far as I'm concerned. Because you can't control what a kid's doing on the other side of the computer. You can't make sure that they are actually focused the way you can when you're physically in front of them in a classroom. You can't engage them the way that you can when you're physically in front on them in a classroom. It's so much easier for them to switch off, there's so many more distractions around them. I fear the overreliance on technology, I don't think we should be getting to that point. I don't think we should be thinking that technology at any point is going to replace teaching or that everything can be reduced to a PowerPoint with a voice note or a video. I think that the physical interaction between kids in a classroom and with the teacher physically in front of them is really important for learning. I think they learn far better in that situation when they have that physical presence of the teacher and with each other. So, it's just a matter of integrating tablets or other technology into that sort of space in order to enhance the learning experience. But, that's just my two cents.

Interviewer: Thank you for your two cents.

Teacher B: My philosophical viewpoint.

Interviewer: That's all I have to ask. I'm going to stop the recording quickly.

## Appendix F: TPACK Questionnaire

### TPACK Questionnaire (Adapted from (Schmidt et al., 2009))

Kristen Theunissen

22/01/2020

Strongly Disagree = SD Disagree = D Neither Agree/Disagree = N Agree = A Strongly Agree = SA

- |  |             |
|--|-------------|
| 1. I know how to solve my own technical problems.  | SD D N A SA |
| 2. I can learn technology easily.  | SD D N A SA |
| 3. I keep up with important new technologies.  | SD D N A SA |
| 4. I frequently play around with the technology.   | SD D N A SA |
| 5. I know about a lot of different technologies.   | SD D N A SA |
| 6. I have various ways and strategies of developing and understanding literacy.                            | SD D N A SA |
| 7. I know how to assess student performance in a classroom.  | SD D N A SA |
| 8. I can adapt my teaching based upon what students currently understand or do not understand.             | SD D N A SA |
| 9. I can adapt my teaching style to different learners.  | SD D N A SA |
| 10. I can assess student learning in multiple ways.  | SD D N A SA |
| 11. I can use a wide range of teaching approaches in a classroom setting.                                  | SD D N A SA |
| 12. I am familiar with common student understandings and misconceptions.                                   | SD D N A SA |
| 13. I know how to organize and maintain classroom management.  | SD D N A SA |
| 14. I can select effective teaching approaches to guide student thinking and learning in my given subject. | SD D N A SA |
| 15. I know about technologies that I can use for my given subject.   | SD D N A SA |
| 16. I can choose technologies that enhance the teaching approaches for a lesson.                           | SD D N A SA |
| 17. I can choose technologies that enhance students' learning for a lesson.                                | SD D N A SA |

Strongly Disagree = SD Disagree = D Neither Agree/Disagree = N Agree = A Strongly Agree = SA

- |  |             |
|--|-------------|
| 18. I am thinking critically about how to use technology in my classroom.  | SD D N A SA |
| 19. I can adapt the technologies that I am learning about to different teaching activities.  | SD D N A SA |
| 20. I can teach lessons that appropriately combine content, technologies, and teaching approaches.   | SD D N A SA |
| 21. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.                                | SD D N A SA |
| 22. I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district. | SD D N A SA |
| 23. I can choose technologies that enhance the content for a lesson.   | SD D N A SA |

## Appendix G: UTAUT Questionnaire

### UTAUT Questionnaire (Adapted from (Venkatesh, Thong and Xu, 2012))

Kristen Theunissen

22/01/2020

Strongly Disagree = SD Disagree = D Neither Agree/Disagree = N Agree = A Strongly Agree = SA

- |   |             |
|---|-------------|
| 1. I find Tablet PCs useful in my daily life.                             | SD D N A SA |
| 2. Using Tablet PCs helps me accomplish things more quickly.              | SD D N A SA |
| 3. Using Tablet PCs increases my productivity.                            | SD D N A SA |
| 4. Learning how to use Tablet PCs is easy for me.                         | SD D N A SA |
| 5. My interaction with Tablet PCs is clear and understandable.            | SD D N A SA |
| 6. I find Tablet PCs easy to use.   | SD D N A SA |
| 7. It is easy for me to become skilful at using Tablet PCs.               | SD D N A SA |
| 8. People who are important to me think that I should use Tablet PCs.     | SD D N A SA |
| 9. People who influence my behaviour think that I should use Tablet PCs.  | SD D N A SA |
| 10. People whose opinions that I value prefer that I use Tablet PCs.      | SD D N A SA |
| 11. I have the resources necessary to use Tablet PCs.                     | SD D N A SA |
| 12. I have the knowledge necessary to use Tablet PCs.                     | SD D N A SA |
| 13. Tablet PCs are compatible with other technologies I use.              | SD D N A SA |
| 14. I can get help from others when I have difficulties using Tablet PCs. | SD D N A SA |