

1:1 Digital devices and preparatory school teachers' classroom practices

by

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Declaration

I, Janine Dumas Kuchling (21038156), declare that this dissertation on *1:1 Digital devices and preparatory school teachers' classroom practices* is submitted for the requirements of a Masters in Education at the University of Pretoria. This is my original work and has not been submitted to any other institution of learning.



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Ethics Statement

The author, whose name also appears on the title page of this thesis, has obtained, for the research described in this work, the applicable research ethics approval. The author declares that she has observed the ethical standards required in terms of the University of Pretoria's *Code of ethics for researchers and the Policy guidelines for responsible research*.



August 2020

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Declaration – Language editing

To Whom It May Concern

This is to confirm that Dr Gerhard Genis (staff number: 91321124) edited the language in the dissertation, *1:1 Digital devices and preparatory school teachers' classroom practices*. I am also the supervisor for this study.

Yours sincerely



Dr Gerhard Genis

Abstract

In this study, the influence of a 1:1 digital device on South African preparatory school teachers' perceptions regarding their classroom practices is described. The focus is on the Chromebook as an 'artifact' of learning. Digital technology is becoming prevalent in all education spheres and, subsequently, interest in this topic is growing. In order to create an environment where optimal learning takes place, teachers and pupils should adapt their learning and teaching methods to embrace the effects of technology. Teachers are at the forefront of education and education trends involving digital devices are becoming a reality across all grades.

Qualitative research was conducted to gain insight into eight teachers' perceptions on using a 1:1 digital device (the Chromebook) for teaching and learning in a private Gauteng school. The major findings were that teachers had to adapt their preparation, facilitation and assessment strategies to accommodate the use of the Chromebook in the classroom. This was mostly done successfully by the participants. The teachers realised that the Chromebook is a useful learning and teaching artifact or learning and teaching support material as a tool in the classroom. It enhances multimodal learning, encourages the inclusion of multiliteracies, and creates a third space of learning, where teachers and pupils cooperate in constructing new knowledge. A concern addressed by the teachers was that digital learning would have a negative impact on writing skills. They also stated that there should be a balance between technology and traditional teaching methods.

The most important recommendations are that teachers should change their attitude and their preparation and implementation of lessons when using the digital device in the classroom. Teachers should realise that pupils whose parents have the financial means and who have access to trending technology, today's digital natives, have instant access to information and this has changed the way learning takes place. Although new to some teachers, the use of digital devices is second nature for many pupils of the 21st century. Teachers should embrace opportunities for professional development so that the digital device can be effectively incorporated in the learning process in the classroom.

Key terms

1:1 Digital devices; Chromebook; learning artifact; classroom practices; third space; multiliteracies; multimodalities; technological, pedagogical, content, knowledge; preparatory school

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List of Abbreviations

BYOD	Bring your own device
G-suites	Google for education
ICT	Information and communication technology
IT	Information technology
ITSI	IT Schools Innovations
LTSM	Learning and teaching support material
OBE	Outcomes-based education
PCK	Pedagogical, content, knowledge
TPCK/TPACK	Technological, pedagogical, content, knowledge
USA	United States of America

Chapter 1: Introduction

1.1 Introduction, background and concepts of the study

The aim of this study was to determine how and why the use of 1:1 digital devices influenced the perceptions held by preparatory school teachers regarding their classroom practices. The focus is on the Chromebook as this is the digital device that is used at the research site of this study. It was also necessary to determine whether the Chromebook as an ‘artifact’ of learning is not merely a commercial trend but an educational tool that has an intrinsic educational value.

According to a White Paper written on quantifying the economic value of Chromebooks for K-12 education, the economic value of Chromebooks has been evident in the classroom, as well as their user-friendly attributes that require less technical support (IDC, 2016). By requiring less technical support, teaching time is maximised. Conversely, another study done by Engels (2016) in the United States of America (USA) shows that teachers, although trained to use technology in their classrooms, were not always doing this to the benefit of student learning. Therefore, teachers need to be assisted with managing the change in teaching pedagogy due to the use of digital technology or else this will impact negatively on teaching and learning (Engels, 2016).

United Kingdom authors, Galloway, John and McTaggart (2015), state that learning using digital technology allows relationships in learning to improve by making learning more student-centred and by increasing the use of collaborative and individual learning skills. By introducing and using 1:1 devices in classrooms, schools generally want to provide pupils with greater access time to information and to add value to their learning. Access time, in this regard, is the time pupils will spend using their digital devices for academic purposes. However, in order to maximise these benefits of 1:1 devices, research conducted in Australia identified skills which teachers require to teach effectively in a digital environment (Baker, 2010). Crucially, teachers should be trained to optimise technology in the classroom.

With the rapid increase in the use of digital technology in classrooms today (Moses & Sibongile, 2019), there is a need to research classroom and teaching practices. While doing this, one can investigate the experience of the teachers using this technology. Many teachers born before 1980, grew up in an era where technology in classrooms was not utilised or even existed, and their learning and training did not involve using technology in the classroom. This has created an opportunity to explore and to research the influence this technology has on the classroom and perceptions of the teachers. As an

educator, digital technology has positively influenced my classroom practice and, thus, my interest lies in exploring other educators' roles and opinions regarding this.

Many digital platforms such as online textbooks, teaching resources and online learning programs, as well as digital devices such as Apple iPads, Tablets and Chromebooks are available today. Many large companies such as Google, Apple and Microsoft have increased their design of educational software and its use for classrooms (Nagel, 2016).

The device used in my study is the Chromebook as this is the device that is used at the research site. Chromebooks are a type of digital device, similar to laptops but have a touchscreen feature. They run on Google OS, which relies on internet connection. Chromebooks are marketed as hardy devices that offer a longer battery life and quick start-up time compared to other laptops (Miller, 2011). Chromebooks have become increasingly popular in education because of their perceived value for money, ease of use in the classroom, and their facilitation of collaboration through educational applications (Bartolo, 2017). Additionally, other big software companies like Microsoft are also continuously looking at ways to increase their popularity and to link their use to education (Bartolo, 2017). Arguably, time remains the most precious commodity to teachers and Google continues to develop digital applications which may assist both teachers in their planning and teaching, and pupils in their learning and acquiring of new knowledge and skills (Mao, 2017).

With the development and progression of digital technology, many pupils who have access to technology are accustomed to Google's capabilities as this technology relates to their generation. Pupils often know how to "Google it" to find answers to questions. Currently, with the increased use of digital technology, pupils are learning in different ways and they require different skills, such as online research and digital citizenship skills, to previous years (Francis, 2017). Subsequently, teachers need to adapt their pedagogy to reach the pupils of the 21st century. Pupils need to learn additional skills to those taught in the past (such as writing skills and rote learning) as they now require digital safety and netiquette skills. Netiquette is 'online etiquette' and it is an approach of defining effectiveness through online communication (Mintu-Wimsatt, Kernek & Lozada, 2010). It joins the words "network" and "etiquette" and the idea is linked to ethics (Mintu-Wimsatt, Kernek & Lozada, 2010). In a classroom setting, netiquette deals with the correct usage of technology in learning. Watanabe-Crockett (2016) and Francis (2017) state that the following skills are needed for a 21st century pupil:

- Problem solving – pupils need to be able to devise solutions to problems in the digital world
- Creativity – with today's pupils being stimulated all the time (using digital technology), they are continuously looking for ways to express themselves digitally

- Analytical thinking – pupils need to be able to analyse and evaluate various digital sources
- Collaboration – pupils need to be able to collaborate both in person and in the digital world
- Communication – although communication has always been an important skill, pupils now need to be able to communicate effectively on a variety of digital platforms and using multiliteracies
- Ethics, Action and Accountability – interactions, both online and offline, should teach pupils about being responsible citizens

Teachers are sometimes hesitant to use new technology in their teaching practice as they do not want to risk failure and, therefore, prefer to utilise older teaching methods that they are more comfortable with. Consequently, at present, the assessment outcomes in schools remain the same – using standardised tests in a written format (Francis, 2017).

Schauffhauser (2015) states that schools need to look at infrastructure first (e.g. internet connection and support from IT) before considering the training or technological capacities of the teachers. Only then should the technology for learning (e.g. software options, device options and platform options) be selected (Schaffhauser, 2015). This will only be possible at schools which have the finances at their disposal. Many schools in South Africa will not be able to focus on the aspects mentioned by Schauffhauser (2015) as their focus will be on learning without the assistance of technology.

At the research site of this study, an affluent, private school in Pretoria, a 1:1 Chromebook initiative took place at the beginning of 2017. My study determines preparatory teachers' perceptions of how and why the Chromebook influenced their classroom practices in teaching the prescribed content. The integration of Google for Education (G-Suites) and IT Schools Innovations (ITSI), which provide digital textbooks, along with 1:1 Chromebook rollout have taken place at the research site and the teachers, therefore, have had sufficient time to form perceptions regarding its use in their classrooms.

When the sample school wanted to select the ideal digital teaching device, internal research regarding the best device for primary school children was conducted in 2015 by the information technology (IT) team as well as the managers (some being teachers) involved in the classroom. The device needed to have the correct specification for running the ITSI system, needed to be user-friendly for younger pupils as well as the teachers, and needed to fit in with the school's existing IT systems. Chromebooks proved to be the best option as it is compatible with the school's IT regulations, is user-friendly and cost effective. In order to decide which system would deliver the best digital textbook solution, several schools in the Pretoria area, which had already used the ITSI system, were consulted. Senior teachers

had undergone training at these schools, after which all teachers received training and were introduced to the system at the research site. This digital learning system seemed most beneficial as a range of textbooks from various publishers are available on this device. The system also allows pupils to use the textbook when not connected to a Wi-Fi/internet connection. Teachers are able to “push” (place/add) additional content and notes onto the system which can aid the pupils’ learning in a flipped classroom environment. The findings of the school’s internal study corresponds with Hess’s (2014) findings which mention several probable benefits of the Chromebook; its price, it is lightweight, its user-friendly capabilities, and its multimedia capability.

Therefore, the influence of the Chromebook on teachers’ classroom practices is considered as this device is used as a teaching aid in the research site. This study indicated the dyadic relationship between the use of the device in the classroom and its influence on classroom practices. In this study, it was necessary to look at the experience of using Chromebooks in other countries such as the USA and to compare it to that of South Africa.

1.2 Rationale

This study is relevant to me, the researcher, as the sample school implemented the 1:1 Chromebooks, and it is a current and trending topic in South Africa. In 2017, in an honours research project, I assessed how the rollout of the Chromebooks affected the academic achievement of pupils. This prompted my interest in delving into the influence it had on teachers’ classroom practices and how they perceived the change in teaching practices. The influence, perceived or real, of the Chromebook on the participating teachers’ methods of instruction, marking, assessing and reporting was analysed in the current study.

Many schools across the world and in South Africa want to use digital devices for teaching and learning and this research assists in informing their decisions with regard to not only which device to choose, but also how to successfully implement the device within their schools. This research should also benefit teachers by giving them strategies and techniques which should make their transition from traditional teaching methods to digital teaching methods easier. While there have been studies on 1:1 programs internationally, there is limited South African literature on studies conducted on Chromebooks, specifically in a 1:1 environment.

This study aims to enrich education by providing insight and support to teachers, not only in South Africa but also worldwide, and by providing information on how to effectively integrate the use of technology in a classroom, specifically where a Chromebook is used. Education is continually evolving

and teachers should stay current with what is available and pedagogically sound in the field. As a researcher, I would like to contribute to scholarly research on how digital devices are linked to teaching and the concomitant choice of classroom practices.

1.3 Specific terminology linked to the study

The following terms are used in this study and therefore need explanation.

1. 1:1 digital device

"1:1" (one to one) Means that every pupil has access to a digital device to support their learning. A digital device is any mobile electronic technology (computer, laptop, tablet, phone) that pupils use to support learning. A 1:1 digital device initiative allows all pupils access to learning at anytime and anywhere (Luo & Murray, 2018).

2. Artifact

In this study, the 'artifact' is the Chromebook which is an object used for learning. The Chromebook is used as an 'artifact' as a tool for learning. According to the Oxford South African Concise Dictionary (2010), an 'artifact' is an object made by people. Artifacts in the context of this study are objects or Learning and Teaching Support Materials (LTSMs) made or used by teachers that can provide proof of learning and teaching practices (Pahl & Rowsell, 2013).

3. The use of 'pupils' instead of learners

At the sample school, the term 'pupil' is used in place of learners or students for all references (in all written documentation, reports and letters). The reason behind this is that the word 'pupil' refers to a minor and a child normally needing supervision. The sample school is a preparatory school (primary school).

1.4 Research question

How and why does the use of a 1:1 digital device influence preparatory school teachers' perceptions regarding their classroom practices?

1.5 Clarification of key concepts

This section highlights important concepts that are used in the study. These concepts are discussed in greater depth in Chapter 2: Literature review.

1.5.1 Digital technology

Schafer (2003) defines digital technology as digitised information which represents text or images. Collins and Halverson (2018) focus on the fact that digital technology includes the use of a device or tool to transform an action, process, or outcome. According to Buzzard, Crittenden and McCarty (2011) digital technology includes all hardware and software which is used directly or indirectly in the acquisition of knowledge and skills. Spiteri and Rundgren (2018) state that digital technology includes the tools we use to process and create information. This enables the change in the way people think, learn and work. In this study, digital technology is conceptualised as the devices used for teaching and learning as well as other sources of digital resources. The use of digital technology in classrooms allows teachers and pupils to engage with a variety of digital media to enhance the learning environment (Ross, 2017).

1.5.2 Chromebooks

Miller (2011) describes Chromebooks as a laptop type computer with a screen and keyboard that operates on the Google Chrome Operating System. In the context of this study, the Chromebook is used as a digital tool for teaching and learning in the classroom. The Chromebook serves as a multimodal resource tool in that it has many functions relating to learning and has the functionality to adapt and serve as a workbook, textbook, and a communication tool (Hutchison & Woodward, 2018; King, 2016). Chromebooks were the chosen device when implementing a 1:1 device at the participating school. Teachers and pupils were required to adapt to use this device both in the classroom and for homework and learning purposes.

1.5.3 Classroom practices

It was established in the literature review in Chapter 2 that there are many different ideas regarding classroom practice (Anthony, 2019; Danielson, 2014; Marzano, 2003). Day, Sammons and Kington (2008) state that it is linked to the learning environment, pupil interactions and the curriculum. Classroom practice refers to teaching and learning occurrences in the classrooms. It is linked to a teacher's teaching and learning philosophy and the learning environment created in the classroom. Classroom practice includes the skills and techniques teachers use to keep their classes organised, attentive, focused, on task and academically productive. In the context of this study, classroom practice involves the activities teachers implement in their classrooms; this ranges from planning and preparation, to the teaching and learning component, to the assessment and the subsequent reflections on lessons.

1.5.4 Multiliteracies

Sujee (2015) describes how literary practices are changing due to technological and social evolution. Sujee (2015) also mentions the need for people to equip themselves with these new literacies in order to effectively interact and communicate in a digital world. Multiliteracies, as formulated by the New London Group, focus on the different channels of communication which have become important in our day-to-day interactions due to the increase in digital technology use for all spheres of life (Cope & Kalantzis, 2000). Multiliteracies are linked to this study in that this concept forms the basis of interaction and communication when using the digital device as a multimodal tool in the classroom setting. Thus, there is a need for teachers and pupils to understand and interact in a multiliterate environment.

1.5.5 Third Space

Soja (1996) mentions that the third space is an area, which is not defined by a physical environment but rather a zone where new knowledge and information is acquired. Webster (2018) further mentions that this is the space to which pupils/colleagues bring their current knowledge and through interaction and communication, new knowledge and ideas are formed. The third space forms an important part of this study as digital devices provide new forms of learning where pupils can expand on their current knowledge using the digital devices. This space is not bound to a classroom but learning can now take place anywhere and at any time.

1.6 Theoretical framework

Figure 1.1 represents the theoretical framework of this study. Constructivism will form the larger lens of the theoretical framework that incorporates multiliteracies and TPCK (Technological Pedagogical Content Knowledge) and, zooming in to the Chromebook as an artifact for learning.

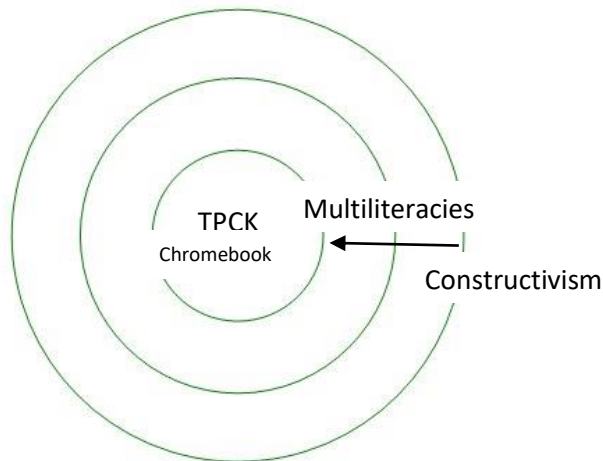


Figure 1.1: The theoretical lens of this study: zooming in from Constructivism, to Multiliteracies, through TPCK to the Chromebook

The researcher looked at how human beings (teachers) integrated the use of digital technology (Chromebooks) in the classroom. Consequently, the ontological assumption of this study is both realist, the use of objective technology, and nominalist, describing and naming subjective human experience. (Maree, 2016). I follow a constructivist stance as I consider human-technology interaction and the way the teacher uses the device for teaching and learning (Maree, 2016). Human-technology interaction relates to how technology is used by people in their environment (Huda, 2019; Norros, Kaasinen, Plomp & Rama, 2003). Norros et al. (2003) state that human-technology interaction enhances the use of technology in any setting. Additionally, Norros et al. (2003) indicate that the advancement of technology is connected to its practical objectives and usefulness for people. Huda (2019) stresses the importance of using technology wisely to ensure its use is optimised.

The overarching theory that guides this study is constructivism as teachers construct their own perceptual knowledge based on their experiences with the Chromebooks. Constructivism is a theory of learning which states that people learn by actively creating their own knowledge (Scholnik, Kol & Abarbanel, 2006). Learning is a process that involves active knowledge formation and is not a passive action (Scholnik, Kol & Abarbanel, 2006). In the 21st century classroom, teachers and pupils are

creating and building on their own learning as digital technology develops and evolves. A constructivist theory of learning, according to Piaget in Ozer (2004), is one where learning is centred on the pupils and they are encouraged to initiate learning and new ideas. Similarly, Vygotsky's social constructivism assists us in understanding the impact of collaborative learning which is implemented in classrooms in the 21st century (Ozer, 2004). The Chromebook allows for opportunities of collaborative learning as pupils may work together on documents and share their knowledge with each other. They form their own knowledge using the Chromebook as an 'artifact'.

Within this larger lens, the multiliteracies approach will be used to zoom in closer on the phenomenon, which is the teachers' perceptions of the use of Chromebooks in the classroom. Multiliteracies emphasise that the teacher and pupil are the designers of their own knowledge and thus their own futures. The New London Group (1996) coined the concept of multiliteracies, which views literacy as dynamic and complementary, and that it improves or transforms established teaching and learning (Rowse et al., 2008). Multiliteracies recognise both the increasing cultural and linguistic diversity in the new globalised culture and the innovative variation of text forms created by multiple communicative technologies (Rowse et al., 2008). In this study, the Chromebook is used in a multiliterate environment where varying forms of technology are combined in learning design.

This process or design principle of learning is embedded in the multiliteracies learning approach, where pupils are encouraged to become active designers of their own social futures (Anstey & Bull, 2006; Anstey & Bull, 2018; Cope & Kalantzis, 2000; Cope & Kalantzis, 2009; Engelbrecht & Genis, 2019; Kalantzis & Cope, 2008; Kosnik & Beck, 2008; O'Byrne & Smith, 2015; Pahl & Rowse, 2013; Rowse, Stein & Newfield, 2006; The New London Group, 1996). The New London Group's multiliteracies conceptualised three design concepts: "Available Designs", "Designing" and "The Redesigned" (Cope & Kalantzis, 2000; Cope & Kalantzis, 2009; Kalantzis & Cope, 2008; The New London Group, 1996). Available Design relates to the knowledge construct that is in existence and the object which the pupils engage with, which in this study is digital technology, and specifically the 1:1 device. Designing is the actual process of cognitive development and meaning construction while engaging with the new knowledge construct by using the object (using the digital device to create meaning). Finally, the concept of Redesigned is the newly created design or knowledge which brings a new view from the pupil's perspective or a transformed practice: this process of designing takes place in the 'third space' or constructivist learning environment wherein the pupils form their own meaning through the use of the 'artifact' or device. Crucially, technology and digital devices serve as the 21st century vehicles for this process of learning design. They are artifacts that allow for constructivist learning within a third space of knowledge construction. This new learning is multimodal, as it includes the visual, audio, tactile, gestural, representational and spatial modes and semiotic systems (Cope & Kalantzis, 2009;

Anstey & Bull, 2018). Embedded within this multiliteracies approach is the pedagogical approach, TPCK.

TPCK is an approach that incorporates the use and understanding of how technology is able to maintain and enrich learning, as well as how to redesign learning content (Unwin, 2007; Sujee, 2019). This approach built on Shulman's formulation of PCK (Pedagogical Content Knowledge) because of the evolution in technology in the education sphere (Unwin, 2007). Teachers need to be able to integrate technology with existing pedagogy and use appropriate learning tools in order to effectively teach pupils. This research assists in critically viewing how technology, the Chromebook implementation in particular, influences the teachers' perceptions of using the digital device.

Teaching with technology may be challenging. The TPCK framework suggests that content, pedagogy, technology, and teaching/learning situations need to be considered both individually and holistically (Koehler & Mishra, 2009). The TPCK framework offers several opportunities for supporting research in teacher education and development, and the teachers' use of technology (Koehler & Mishra, 2009). It offers possibilities for looking at technology in the classroom in a variety of ways. It allows teachers to move beyond generalised methods that use technology as an "add on" and rather focus on the dynamic interplay of technology, content and pedagogy in the classroom (Koehler & Mishra, 2009).

TPCK offers a close-up lens by exploring the pedagogy that the teacher uses in the classroom and how the teacher uses and interacts with digital technology in the classroom to design learning with technology (Unwin, 2007). Teachers are facilitators of content and the use of the Chromebook as a tool or 'artifact' guides the pupils' learning. As seen in this study, the Chromebook allows teachers and pupils the opportunity to collaborate and work with other teachers and pupils whilst they are engaging with the content within this 'third space' of learning. Due to this being a constructivist environment, learning will continue once the pupils leave the classroom.

Subsequently, the Chromebook in this study is viewed as a multimodal artifact that is used in the class as a tool for learning and collaboration. Due to Chromebooks being linked to Google, this artifact is used for learning, enquiry, research and communication.

The findings in this study were interpreted through this theoretical framework. The three-layered lenses of constructivism, multiliteracies and TPCK assisted in sifting the data according to relevant themes that relate to the research question of the study.

1.7 Research design

According to Williams (2007), research is a methodical analysis or study whereby the researcher gathers data and examines the data in an attempt to understand, define and envisage the phenomenon studied. Research is prompted by at least one question about a phenomenon of interest to the researcher (Williams, 2007). According to Yin (2009), research design is the rational structure which connects the perceived facts to the research questions and to the effects of the research.

In this study, a qualitative research approach is followed. Qualitative studies are normally conducted in natural social environments and time is spent with the participants (Maree, 2016). According to Polkinghorne in Maree (2016), qualitative research focuses on words and language and not on numerical data. An advantage of qualitative research is its ability to provide rich descriptions of how participants experience a given research issue or phenomenon (Maree, 2016). In this study, the researcher qualitatively assesses the influence of 1:1 devices or Chromebooks on teachers' classroom practices.

The specific research approach used in this study is a descriptive qualitative study. This is used to study the phenomenon and then describe the phenomenon, i.e. the Chromebook-teacher interaction. The main purpose of this research is to understand how the teachers have adapted their classroom practices and to add value to research in the field (Maree, 2016). Descriptive research helps us to have a better understanding of the phenomenon in a specific social-cultural context.

A qualitative study provides the means for the researcher to study multifaceted phenomena within their specific situations or contexts (Maree, 2016). Therefore, a constructivist research paradigm will be adopted in this study as the focus is on the phenomenon of Chromebook-teacher interaction within a specific context, which is the physical classroom and the conceptual third space. Constructivists state that truth is relative and that it is reliant on the participants and researcher's viewpoint. Knowledge is formed on the principle of a social construction of reality (Searle, 1995) and is therefore interpretivist in nature. Constructivism, according to Vygotsky (1978) and Roberts and Potrac (2014), emphasises the manner in which individuals, through their cultural background and the environment, gain and cultivate their understanding and construct their knowledge. One of the advantages of this approach is the close relationship between the researcher and the participant, which enables participants to share their points of view (Crabtree & Miller, 1999).

There are certain perceived drawbacks to completing a qualitative study. According to Rahman (2016) and Atieno (2009), qualitative research often removes circumstantial issues and focuses on meaning and experiences. Secondly, quantitative studies are often regarded as more reliable as results are

objectively transparent (Atieno, 2009; Rahman, 2016). Another perceived shortcoming is that a smaller sample size in qualitative studies may reduce the generalisability of the results to a larger population or another context (Atieno, 2009; Rahman, 2016). Furthermore, the data interpretation and analysis may be more of a challenge and may be more time consuming (Atieno, 2009; Rahman, 2016;). I addressed these challenges by taking classroom circumstances into consideration and by ensuring that I analysed the findings in an objective manner. I ensured that my sample size was as large as the study allowed to ensure it was applicable to schools not only in South Africa but also internationally. With the data analysis, I was honest in my transcriptions and used the time available to assess the results objectively. I asked the teachers who were interviewed to check my transcriptions for validity.

This section presented the research design selected for this research study. Before incorporating any digital devices in education, it is important to investigate and understand how teachers perceive and experience teaching with digital devices for learning purposes. By doing a qualitative study, I determined how the teachers used 1:1 digital devices and uncovered its influence on their classroom practices.

1.8 Research methodology

Descriptive case study research, which is used in this study, involves looking at a phenomenon from different perspectives and using the different variables to conduct research (Maree, 2016). This study uses qualitative methods to generate the data. Through case study methods, a researcher is able to understand the environment through the participants' qualitatively formed perspectives. Case study research helps explain both the process and outcome of a phenomenon through complete observation, reconstruction and analysis of the cases under investigation (Rule & Vaughn, 2011). Case study is linked to a constructivist view as constructivists believe that reality is dependent on a person's perspective and that humans construct their own meaning depending on their situation. This also links to the interpretivist epistemology that holds that individuals' perceptions are shaped by their social-cultural environment (Maree, 2016).

Case study research is used to study the phenomenon within the given context and answers "how questions". A descriptive case study is the type of case study used to define a phenomenon, which, in this study, is how teachers perceive the influence of 1:1 digital devices on their classroom practice, where the latter is the actual context (Yin, 2003). Therefore, descriptive case study research was chosen for this study as I wanted to explore a phenomenon in a context and various sources of information gathering or research methods were used. In this study, a literature study and interviews

were used to generate findings. Case study research is often used in education as it analyses the data within a context (Yin, 2003). The detailed qualitative data often accumulated in case studies help to describe the data in real-life environments and also assist in explaining the complexities of real-life situations which may not be explained through quantitative methods (Zainal, 2007).

Eight teachers from a private preparatory school in Pretoria form the sample for this study. In case study research, a sample is selected from the bounded context (Maree, 2016). Therefore, I used a purposive sampling technique as the researcher identified participants who were able to contribute meaningfully to this study. There was a specific purpose in mind and therefore purposive sampling was best suited. Consequently, teachers who had taught with the digital device over a period of time (for at least one academic school year) were suitable for selection.

Purposive sampling is part of non-probability sampling and the participants are selected with a purpose in mind. Purposive sampling is most effective when the researcher wants to study a specific group by selecting their own participants (Teddlie & Yu, 2007). I chose eight teachers in the senior preparatory school that includes Grade 4-7 and, therefore, two teachers per grade were interviewed to obtain adequate data.

Individual semi-structured interviews with teachers from various grades and subjects form part of the qualitative study. An advantage of qualitative methods in exploratory research is that they often use open-ended questions which give participants the chance to answer in their own words, rather than making them choose from given responses (Maree, 2016). Open-ended questions were posed to the teachers to gauge their experiences of the use of 1:1 devices.

The researcher used narrative analysis to interpret and analyse the data and provide feedback and interpretations of the findings. Narrative analysis is when the researcher pays special attention to all data and interactions regarding any verbal, written or visual cues which could form part of the data. Narrative analysis involves noting of processes in the data (Maree, 2016). In the case of this study, the researcher described how teachers adapted and changed their perceptions on classroom practices by using 1:1 Chromebooks. Analysis (meaning making) occurs throughout the research process and is not a separate activity which occurs after data collection (Etherington, 2011). The emphasis is on forming a meaning and understanding of what is happening in the environment between the researcher and participants. While being involved in interviews, the researcher analysed what was said and compared it with the researcher's theoretical and conceptual perspectives.

QUESTION	DATA COLLECTION
1. How and why does the use of a 1:1 digital device influence preparatory school teachers' perceptions regarding their classroom practices?	Interviews Literature Review

Documented data in the form of findings (from the interviews) were qualitatively assessed and conclusions were drawn. The findings were analysed through open coding, categorising and identifying naturally and inductively occurring themes as suggested by MacMillan and Schumacher (2010). Other data collection techniques included literature studies and analysing the data for triangulation purposes. By using open coding, thematic relationships in the data were identified for a better understanding of the phenomena in order to view and interpret results (MacMillan & Schumacher, 2010).

By using a descriptive case study and analysing the generated data, a better understanding of the use of digital devices in the classroom was obtained and the teachers' perceptions were revealed. By using qualitative data, the findings reflected an objective conclusion, which could be adapted across the world.

1.9 Ethical and quality assurance

Ethical issues deal with human interaction and the fact that researchers need to remain objective and present data in a truthful manner, which is not detrimental to the subjects studied (Cohen, Manion & Morrison, 2000). The ethical considerations form part of each stage of research from data collection, interaction with participants through to the analysis and reporting (Cohen et al, 2000). Although there are many ethical principles, they are covered by these five guidelines (Check & Schutt, 2012):

- Avoiding harm to the participants,
- Ensuring consent of all the parties involved and participation should remain voluntary,
- Respect the participants' confidentiality or anonymity,
- Researcher should disclose their identity, and
- Advantages of a study should outweigh any unforeseeable risks.

Ethical clearance had been obtained from the University of Pretoria's Ethical Committee before the research was conducted. The consent from the school and relevant teachers was obtained.

Information regarding the study's purpose and aim was transparent and carefully explained to all parties involved. Parents and pupils were informed about the study taking place. Participation in this study was voluntary. Furthermore, participants could withdraw from the study at any time if they felt uncomfortable or had a change of mind.

As stated in Maree (2016), trustworthiness is essential in qualitative research. The four criteria which need to be met are: credibility, transferability, dependability and confirmability. Credibility links the findings of a study to reality in order to demonstrate accuracy in the study's findings (Maree, 2016). This was achieved by ensuring current and relevant literature was consulted and then the findings were linked to this literature. Credibility is often seen as one of the most important criteria because it reveals the truth of the study, therefore the credibility of the findings (Connelly, 2016). Transferability relates to how the findings could be used in other contexts and situations (Maree, 2016). Transferability was achieved by consulting literature from not only a South African context, but looking at global literature. It is vital that a "thick description" is used in order to make the analyses of data transparent (Maree, 2016). Linked to this is the importance of choosing one's sample carefully. Qualitative researchers focus on the participants and their reality and this needs to provide readers with rich information in order to allow research to be transferrable.

Dependability relates to the confirmation of the accuracy of the results of a study (Maree, 2016). Findings are supported by the richness of the data collected (Connelly, 2016). Finally, confirmability verifies that the researcher uses the participants' views, not the researcher's views to predict outcomes (Maree, 2016). Confirmability refers to the neutrality of the findings and that they could be repeated consistently (Connelly, 2016). Member checking was used to enhance confirmability.

1.10 Possible limitations to the study

Due to the research focusing on only a Chromebook, this study may be limited to users of Chromebooks and those interested in using them in education. Due to technology advancing all the time, the use of Chromebooks may not be relevant in education in the near future. Chromebooks also use Google as their provider and therefore it is linked to a brand name. However, the study provided findings which relate to the significance of human-technology interaction in a learning environment.

Classroom practice is also a broad topic and external factors may influence the teaching of pupils using 1:1 Chromebooks. The constant change in personnel at the participating school could also be a limitation as teachers will have different exposure to the use of Chromebooks in the classroom. However, selected participants had access and exposure to the use of technology so the findings are

transferable. The findings also revealed generic aspects of human-technology interaction and how it influenced classroom practices.

1.11 Conclusion

This chapter gave an overview of digital devices and how technology is currently viewed and expected to be used in classrooms, and the influence of technology on a 21st century classroom. The Chromebook was described as being used as an ‘artifact’ and the use of multiliteracies in teaching was explained. The third space was also introduced whereby teachers and pupils are now able to work and connect outside the classroom and collaborate.

Background information regarding the use of digital technology in classrooms (in particular the use of Chromebooks), classroom practice as well as the chosen school were described. My rationale and motivation, research questions and theoretical framework which incorporated constructivism, multiliteracies and TPCK were highlighted.

The qualitative research design and the methodology in terms of a case study were introduced. Ethical considerations were described and limitations to the study were mentioned. The rest of the study explores in depth and describe all these areas in more detail.

This study answered the research question by providing insight to the teachers’ views and perceptions and assessing the changes they need to make in order to effectively implement digital technology in their classes. The participants mentioned that they had to change their preparation, planning, execution of lessons, as well as marking and reflecting.

Chapter 2: Literature Review

Introduction

According to Randolph (2009), a literature review is written in order to determine what information has already been published on a topic, to gain a new perspective on the given topic, and to study the relevant epistemologies and methodologies that have been used in the field. Ridley (2012) agrees with these statements and further states that this is the section where extensive research is undertaken and connections are made between information and the topic. General characteristics of a literature review are (Ridley, 2012):

- Providing a historical background for the research,
- Giving an overview of the current information regarding the topic,
- Discussing the theories and methodologies used in the research,
- Discussing of relevant terminology in order to clarify meanings in the context of one's study,
- Describing relevant research applicable in the field and addressing the gap, and
- Providing evidence for the practical problem or phenomenon being researched.

Academic research is constantly trying to evaluate the impact of technology on teaching and learning (Blair, 2012; DeLoatch, 2015; Erdin, 2020; Herald, 2016; Mukhari, 2016). Despite these efforts, there is limited proof that digital technology directly influences learning, especially with regard to a 1:1 setting (Moseley, 2015; Penuel, 2006).

This chapter reviews published literature relating to technology, specifically digital devices, which is used in classrooms, and how teachers have adapted their classroom practices to the implementation of 1:1 digital devices. Concepts which are relevant to digital devices, in particular Chromebooks, are discussed as well as their application to teaching and learning. The literature review also defines and expands on concepts associated with teaching with 1:1 devices, including the “third space”, multiliteracies and TPCK, and indicate the relationship between these concepts. This chapter is divided into various sections, which explain all the concepts linked to the study.

2.1 Digital technology in classrooms

Digital technology was introduced into classrooms early in the 1980s and this is an ongoing process as technology constantly evolves (Ruggiero & Mong, 2015). Sujee (2019) agrees with this and states that computer technology has been used in classrooms over the past 20 years. It is also true that

technology alone cannot benefit a classroom and, therefore, teachers need to be fully involved in the process and correct implementation of technology.

Arthur (2009) conducted various studies on technology's role in the educational sphere. From his studies, one can deduce that technology is knowledge, classroom practice, applied science, as well as an educational activity. He further explains that technology is a sequence of events that occurs to benefit or better our lives (Arthur, 2009). I agree that technology benefits society but in my view, it is not only linked to knowledge, practice, applied science or an activity. My view is supported by Maritz, Marsh and Hofmeyr (2019), Ng (2018) and Parr, Kubiak, Pambudi and Reilly (2016), all of whom mention that for a society to grow and develop, the integration of technology is key to its development.

Digital technology includes the use of a device or digital tool to transform and enhance an action (Collins & Halverson, 2018). Digital technology is linked to technology in that it involves knowledge, practice, applied science and activities, and the use of a digital tool to develop these actions (Collins & Halverson, 2018). Technology and digital technology form part of LTSMs within the classroom. Anshari, Almunawar, Shahrill, Wicaksono and Huda (2017), who studied the benefits and hindrances of devices in a classroom, found that the benefits of technology, in particular the digital devices, include enhancing a teacher's pedagogical practice, increasing communication (between both pupils and teachers), as well as improving the learning process. The hindrances mentioned were teachers' attitudes and resistance to change and to adapt their teaching habits, as well as insufficient infrastructure (Anshari et al., 2017). However, their study concluded that primary school pupils were more engaged and took more of an interest in the academic subject when digital devices were used and this promoted their learning and understanding. Anshari et al. (2017) state that this allowed teachers in primary schools to use different mediums and modes such as videos, pictures and audio to teach, which appealed to diverse pupil learning styles. Furthermore, it contributed to their understanding of the content. However, Anshari et al. (2017) also found that these devices could serve as a source of distraction, and that some teachers did not use these tools to their full educational potential in lessons. These teachers substituted the textbook for a digital device and did not use the digital devices as a learning tool or artifact.

The literature reveals that teachers use digital technology in the classroom to support their role in providing pupils with knowledge and information, to monitor pupils' progress and to evaluate pupils' academic ability (Eady & Lockyer, 2013; Francis, 2017; Ross, 2017; Sujee, 2019). Teachers remain at the frontline of delivering quality education. Therefore, they need to embed digital technology in their pedagogy and teaching practice, from planning right through to evaluating, as they have to prepare

pupils for a multiliterate world that is driven by digital technology (Sujee, 2019). Power and Thomas (2007) indicate that teachers use digital hand-held devices for both professional and personal purposes and for a variety of creative tasks in the classroom. Many studies have shown how digital devices influence student learning but little has been researched on teachers' perceptions of these devices. A study by Mlambo, Chukwuere and Ndebele (2018) mentioned the importance of the incorporation of technological pedagogy into pre-service teachers' training in order to improve the current perceptions of teachers on the use of digital technology in the classroom.

Digital technology in the classroom is not a new concept but it is evolving and being increasingly integrated into classrooms. Teachers enhance the creativity of lessons and integrate new learning concepts into planning, when new technology is integrated in an efficient manner (Eady & Lockyer, 2013). Medrano (2015) highlights benefits in using digital technology, such as instant access to a wide range of resources and knowledge for both pupils and teachers, teacher support in various forms (access to information and new technology in the classroom), and improved student engagement which in turn motivates the teacher. A study done in Korea in 2008 agrees with Medrano and adds that teachers use technology to adapt to the new generation of teaching and learning (Baek, Jung & Kim, 2008). Other benefits in the use of digital technology for teachers include access to information, not only for planning purposes but also for assessment purposes and monitoring pupils' results. This allows more time for teaching and for reinforcing concepts which need emphasising in the classroom.

Teachers in the 21st century should ensure that pupils have the necessary skills for after-school life (post graduate studies as well the work environment) and integrating technology has become a growing requirement for this (Jacobson-Lundeberg, 2016). The use of digital technology is also becoming an increasingly important skill for teachers to have and employ in their classes (Jacobson-Lundeberg, 2016). Internationally, teachers' lack of knowledge and skills in using digital technology in their classrooms has been seen as a problem in schools, colleges and universities as it affects these institutions reaching their professional goals (Pelgrum & Anderson, 2001). A study done by Voogt and McKenney (2015) and a further study by Cruz and Díaz (2016) agree with Pelgrum and Anderson (2001), and further explain that in many universities, digital technology and teaching with digital technology does not form part of the universities' curriculum. The reason for this may be that when teaching younger pupils, teaching of information and communication technology (ICT) does not form part of the curriculum. In a South African context, Marishane (2013) acknowledges that many schools do not have access to basic needs such as proper furniture and classroom equipment, textbooks and workbooks, thus the prerequisite to prepare teachers for teaching with digital technology is not seen as a priority. Many professional institutions, schools and universities are driven by the prestige of their

academic results and products. If they are not keeping current and engaged with emerging trends, their opportunity to reach their full potential is stunted (Miranda, 2016).

Although the view is held that technology has not yet significantly changed education such as the study by Voogt and McKenney (2015), Anshari et al. (2017) found that technology has changed the access to education. Information is now readily available to everyone in digital format. Globally, there are a variety of online educational programs and learning opportunities – of which some are free (Jacobson-Lundeburg, 2016). These educational programs offer pupils the opportunity to make deeper connections with the content taught; pupils are actively involved with the presented content in being active participants or experimenting with the technology, and these programs include some form of collaboration which is an important skill for pupils to master (Anshari et al., 2017; Harasim, 2000). Haman and Koohang (2007) mention how these educational programs designed for learning enhance the process of meaning making in a constructivist environment, where multimodal learning occurs instead of simply relegating pupils to passively gaining information. Werry (2002) agrees with Haman and Koohang and further adds that the focus of these programs is not necessarily on content but actually on the process of creating the content for learning.

Another benefit technology has brought to education and classrooms is allowing pupils and teachers the ability to communicate and collaborate in a democratic learning space (Dukuzumuremyi & Siklander, 2018). This links closely with multiliteracies (see Section 2.7.2) as people use different methods (involving texts, modalities and technologies) to communicate with others and to express themselves through digital technology. Multiliteracies and the integration of digital technology encourage schools to become communities of learning (NLG, 1994). Within diverse classrooms, technology can be used as a powerful tool to bridge multiculturalism, as well as social gaps which could be part of these classrooms by facilitating communication and encouraging cooperative learning environments (Hollenbeck & Hollenbeck, 2009). Technology offers the opportunity for pupils to have access to information regardless of their academic ability. Pupils who are socially withdrawn have the opportunity to express their thoughts and opinions on a different platform such as creating an avatar for a class presentation or prerecording themselves, instead of doing something live, which may boost their confidence and collaboration (Plowman, Stephen & McPake, 2010). Herold (2016) reiterates this by saying that technology can be used to meet various students' needs. These needs may include the need for learning to be pupil-centred, the need for being actively involved in the learning process, and flexibility within the learning environment (Herold, 2016). This is important to this study since the way teachers teach and use the 1:1 digital devices determined how effectively pupils use technology to learn.

Fullan and Donnelly (2013) who looked at implementing technology in global classrooms, state that there are four areas which must be addressed so that technology can have a positive impact on education:

- Totally engaging for pupils and teachers
- Easy to adapt and manage
- Universal access to technology all day/night
- Immersed in real-life problem solving

The learning value linked to this is that pupils are able to use the digital artifact of learning within a multiliteracies third space to form new knowledge and to enhance learning in their own setting, at their own pace and according to their learning needs (Genis, 2019: 31). They will do this by incorporating various modalities (visual, tactile, verbal, spatial, gestural and aural) and different digital texts in order to cater for different learning styles. Pupils design on the device and are therefore designers of learning by using what they know and what they learn to form new knowledge and skills (Sujee, 2019).

A further study by Fullan and Langworthy (2014) shows that pupils use technology to make connections with new information by gaining knowledge and skills and use these in the wider world. Sujee (2019) focuses on the diversity of South African schools where teachers have had to adapt to different contexts. This is due to multicultural classrooms in South Africa and the fact that teachers teach a diverse group of pupils with differing abilities and backgrounds; this is because South Africa has various African languages and different cultures which complicate the education system as there is no one size fits all learning approach. However, the multimodalities that technology provides cater for the different learning styles which are present in classrooms; all the different cultures of South Africa have a rich multimodal history of learning about their word; these include the San rock art, the *izibongo* tradition in African societies, and the Afrikaner veranda story-telling tradition (Genis, 2019: 23-25). Digital devices provide for such a rich multimodal learning experience which include all the senses: audio, pictures, videos, collaborative documents etc. Subsequently, pupils' individual needs can be met when using digital technologies in classrooms and they may have more confidence and creativity in their work (Fullan & Langworthy, 2014).

In South Africa, using technology in classrooms is often seen as a means of “fixing” what has gone wrong within the education system (Padayachee, 2017). Ndlovu and Lawrence (2012) agree with this statement and further state that current education is also redressing what happened in the past in our country. The apartheid era affected so many spheres of the country and education was among

them. Inequality in education included the unequal treatment by race in unequal educational opportunities for whites and blacks, and educational inadequacy (Vandeyar & Killen, 2007). Schools were divided according to racial groups. Schools for black South Africans did not have the same resources as those for white South Africans. This affected their qualifications, which in turn affected their job prospects and futures, as the quality of education was not the same as that for white schools. The South African government implemented, post-apartheid, the Outcomes-based Education (OBE) curriculum (from 1998 – 2005) to try and amend the errors from the past. OBE was an outcomes-based curriculum which changed the focus from content-based teaching to a learner-based system. The government's aim was to change the way pupils learnt by making learning more pupil-centred, allowing them the same access to resources and encouraging pupils to become critically engaged with information. Unfortunately, as mentioned by Vandeyar and Killen (2007), there were no major changes to education after the implementation of OBE. A factor which affected this was that teachers were not willing to change their assessment methods. This has negatively impacted the incorporation and use of technology in the classrooms, as many teachers have remained stagnant in their teaching due to their disinterest in learning new styles of teaching and learning (Anshari et al., 2017).

Even today, many government schools in South Africa do not have the infrastructure nor the financial resources for the implementation of using digital technology in the classroom (Naidoo & Raju, 2012). Another factor which influences this is how teachers implement the use of digital technology in their classrooms (Naidoo & Raju, 2012). Many teachers are either not trained properly or they lack confidence to change and adapt to the new methods of teaching and learning with technology (Naidoo & Raju, 2012).

Sujee's (2019) study in South African schools found that teachers need to make the change and adapt to the needs of pupils in order for pupils to accept responsibility for their learning and to actively play a role in society. Teachers need to adapt their teaching methods to reach the pupils in front of them (Sujee, 2019). Importantly, technology in the classroom positively affects the management of the class, the learning climate as well as the interaction between the teacher and the pupil (Sujee, 2019).

Tiene and Luft (2001) conducted a study which looked at the extent to which teachers in ten public schools in the USA have the ability to adapt and implement using digital technology. From their study it is evident that teachers need to have efficient training and support, as well as flexibility in their teaching environments to allow for new learning to take place (Tiene & Luft, 2001). In South Africa, where some schools barely have enough desks in their classes (Marishane, 2013), this may not be a priority for the school and even for society.

Classrooms, both internationally and in South Africa, are being equipped with interactive whiteboards, projectors and other technology to enhance teaching and learning. This is dependent on funds available at schools and may differ from school to school. An important factor in using digital devices is the design of the classrooms for efficient use of the technology (Cilliers, 2017). When integrating and increasing the use of technology in the classroom the layout, furniture, space and design need to be addressed. A flexible and open layout works best for 21st-century learning as it encourages collaboration and the creation and sharing of ideas (Cilliers, 2017). Classroom design is linked to the pupils' learning, as it builds on cooperative knowledge construction (Cilliers, 2017).

2.2 1:1 Devices for teaching and learning

1:1 Devices are considered as LTSMs as they enhance the learning opportunities in a classroom (Chu, Hwang & Tseng, 2010). Subsequently, these technological devices also allow for teaching opportunities where current events and real-life problems can be addressed in real time (Chu, Hwang & Tseng, 2010). Hudson (2013) agrees with this and states that using devices for teaching and learning allows teachers to design meaningful and authentic learning experiences within their classes. Meaningful learning experiences consist of lessons which create opportunities for pupils to create and gain real-life knowledge, and according to the multiliteracies' framework, they allow students to be the creators and designers of their own social futures (Engelbrecht & Genis, 2019). Consequently, how teachers present and relay information impacts learning design and reflection during lessons (Hudson, 2013). The design factor links closely to multiliteracies where the insistence of learning as designing leads to transformed practice, or applied learning (Cope & Kalantzis, 2015:4).

2.2.1 International View

Hudson (2013) states that Australia is at the forefront of implementing technology in their primary and high school classrooms and the use of devices has become increasingly important in their curriculum. Positive results have been yielded where technology in the form of 1:1 digital devices has been adequately integrated into the curriculum; these include increased collaboration between teachers and pupils, increased participation by pupils and the enhancement of multimodal teaching methods which has increased the professional development of staff. Hudson (2013) further states that there is a need for technology integration in education in order to prepare pupils for their future roles

in society, such as their social life and in their careers. Multiliteracies further embarks on this by describing how pupils have different social roles which assist them in adapting to the ever changing world.

A further study in Thailand by Hall (2016) also reports that when devices are used in school classrooms for teaching and learning, there is more active participation by pupils and crucial skills are developed, including problem solving. Furthermore, pupils in these primary and high school grades tend to outperform those who are not using digital devices. Hall (2016) states that these pupils, who are digital natives, are accustomed to working with digital devices from a young age, and it is these artifacts which allow them to develop their skills and knowledge. When pupils are more actively involved it assists them in cooperative learning, self-directed learning as well as problem solving.

Prensky (2001) mentions that digital devices improve pupils', across various grades, cognitive competences and states that digital natives think and process information differently than preceding generations who did not grow up using digital devices. A study done by Azar and Nasiri (2014) in Iran found that by using digital devices, pupils in the study improved their reading comprehension and that using digital devices is an innovative way for teaching and learning. The study by Azar& Nasiri (2014) also determined that digital devices can be used anywhere, at any time, which is of benefit to digital natives who are able to multi-task. These devices also allow them to explore different modes of learning, not just text (Pedro, 2007).

Parsons, MacCallum, Schofield, Johnstone and Coulter (2020) refer to the importance of changing the curriculum to incorporate digital technology, not as a separate subject but rather integrated into all subject areas. The focus of their study was how teachers across the world integrated digital skills into their subjects (Parsons et al., 2020). They found that when teachers are actively involved in using technology skills, they are able to implement these in their lessons (Parsons et al., 2020). They stressed the importance of incorporating digital devices to assist individual pupils to achieve in a digitised world (Parsons et al., 2020).

However, a study done in 2012 by Duncan, Hoekstra and Wilcox found that younger primary school pupils who used digital devices underperformed by a symbol (a 10% difference), compared to those who used pen and paper for learning. Duncan, Hoekstra and Wilcox (2012) mentioned the distractibility factor when using digital devices in class as pupils focus on other aspects of the devices instead of their academic value. McCoy (2016) also found in his study in the USA that pupils across grades 4-9 used the digital devices for "non-class related purposes" such as playing games or "Googling" other topics which proved that these devices often serve as a digital distraction.

The international literature therefore indicates that using 1:1 digital devices has both positive and negative influences on classroom practices. Some of the positive aspects mentioned were the increase in participation and collaboration while negative aspects include pupils becoming distracted or teachers not effectively implementing the use of digital technology in their classes.

2.2.2 South African Perspective

Naidoo and Raju (2012) describe the digital divide in South Africa as the gap which exists between pupils who have access to technology and those who do not. Similarly, a study by Mayisela (2013) in South Africa indicates this technological divide. This digital divide impacts on access to technology, the skills required to use technology, as well as the gap in the impact of using technology. Mayisela (2013) also mentions that infrastructure such as accessibility to Wi-Fi and the current education system and available resources in South Africa determine whether devices are used for teaching and learning.

In Mayisela's study (2013), university students who had access to technology noted that it was easier to participate in the learning process when using technology as they received instant feedback and could collaborate with peers. This was due to teachers being able to comment on their work whether they were in class or at home. The students could collaborate with others, even if they were not in the same space. Naidoo and Raju (2012) mention that learning environments, in some instances in South Africa today, are created around web-based technologies, which further emphasise the need for technology to be integrated into all classrooms. This links closely to the reality that digital natives have access to digital devices from a young age and, therefore, this type of stimulation and learning is already embedded in them. However, due to economic restraints in South Africa, there are many digital natives who do not have access to technology and therefore it creates a greater digital divide amongst pupils.

Padayachee (2016) and Nkula and Krauss (2014) found that teachers across both primary and high schools have not effectively integrated the use of digital devices in their classes in South Africa. Padayachee (2016) further mentions that there is a misconception that by implementing digital technology in classrooms, it will resolve issues in the education system. Padayachee (2016) actually found that if not used correctly, the technology actually does more harm than good.

A study done in the Eastern Cape by Chisango, Marongwe, Mtsi and Matyedi (2019) found that teachers were willing and positive regarding the implementation of technology and the use of digital devices, but that they lacked the technical skills. This study further mentions that both teachers and pupils need training on how to use digital devices for teaching and learning purposes (Chisango et al., 2019). Padayachee (2016) writes that the Department of Basic Education in South Africa defined

strategies in 2015 which would assist schools with the roll out of digital technologies in schools. These include:

- establishing a link between the use of ICT in the classroom and learning goals;
- understanding the various types of technologies available;
- establishing collaborations with stakeholders to drive e-education; and
- analysing the status quo of e-education initiatives and their envisioned results.

Based on the literature, it is evident that there are challenges in South Africa regarding the implementation of digital technology and digital devices in the classroom. These challenges include not all pupils having equal access to devices, digital devices not being used to their optimum in the classroom and enhancing the skill set of both teachers and pupils when using these digital devices.

2.2.3 Impact of 1:1 devices on teachers, pupils and schools

Many schools, both locally and internationally, are looking at 1:1 devices for teaching and learning in the classroom. There are various options, where pupils can either BYOD (bring your own device) or schools choose a specific device. Penuel (2006) describes three criteria which are features of a 1:1 initiative. Firstly, the device should be portable with the relevant software loaded. Secondly, the pupils should have access to a form of Wi-Fi in the school/community. And lastly, the device should be used to complete academic work (Penuel, 2006). Penuel (2006) also looked at the goals that schools wish to achieve by using a 1:1 initiative: these include improved academic achievement, equal access to academic information, and transforming the quality of teaching and learning (Penuel, 2006). A study by Harris and Al-Bataineh (2015) proves that 1:1 devices had a positive impact on academic achievement and motivation by incorporating a more hands-on learning environment. Harris and Al-Bataineh (2015) mention the importance of the technological shift and the impact that has on academic achievement while using devices for teaching and learning.

Another important factor relating to 1:1 devices is the ability to work anywhere and at any time. This allows for learning to take place in various places and that it is not classroom bound. The term 'third space' (Soja, 1996) becomes increasingly important here as the digital device is used as an artifact in the third space. The third space is where the pupils' home world and literacies are incorporated into his/her school world and literacies – it is the space where new information and knowledge is acquired and merged with already existing knowledge (Genis 2019:31). This third space also allows for pupils and teachers to learn together and from each other in an environment which is rich with technology; this provides a democratic learning space (Pahl & Rowsell, 2013). The intention of using and

implementing 1:1 devices in schools is to enhance education in general and more specifically, they assist in the development of ‘21st century skills’ such as creativity, critical thinking and communication skills (Islam & Grönlund, 2016). These devices also assist by giving pupils equal opportunities (Moseley, 2015). By implementing digital devices in classrooms, pupils have the same opportunities and access to information and learning can occur to address the pupils’ specific needs; learning can take place anywhere and at any time (Moseley, 2015; Sujee, 2019).

By using 1:1 devices, the roles of teachers have evolved. Islam and Grönlund (2016) discuss that learning has become more student-centred and, subsequently, the more “traditional” forms of teaching pedagogy had to adapt to this shift. Traditional forms of teaching took place at a set time in a set venue, learning was teacher-centred, pupils tended to be passive in learning, and resources were dependant on physical objects such as worksheets or textbooks (Felder & Brent, 2016). Traditional forms of teaching are often known as “chalk and talk” and pupils were provided with the knowledge they were expected to acquire (Felder & Brent, 2016). There was limited application of this knowledge in real-life situations where basic problem solving skills are required (Felder & Brent, 2016; Islam & Grönlund, 2016). Thus, the need arose for teaching and learning both in and out of the classroom to assist in solving real-life problems in an ever-increasing technological world. Therefore, there was a need to create an environment where technology was accepted and where teachers were assisted in changing their attitudes towards the use of technology in a learning setting. Increasing technological development has posed the question whether teachers are needed in the classroom (Kolchenko, 2018). Consequently, teachers have to adapt to the new way of teaching and facilitate pupils to become the creators of content and to be more active in their learning role (Felder & Brent, 2016).

When implementing 1:1 devices, the focus is not on the devices or digital technology itself, but on how teaching and learning incorporates this technology. Various studies done internationally indicate that the implementation and use of 1:1 devices is more common in high schools. However, it is filtering down into primary school level (Moseley, 2015; Sauers & McLeod, 2012). Sauers and McLeod (2012) have also found that a few primary schools have withdrawn their use of 1:1 devices due to the lack of positive results. These findings indicate that the devices are a distraction and cause academic results to decrease instead of increase as the pupils focus on information not related to their curriculum (Sauers & McLeod, 2012). Furthermore, teachers were not satisfied with the level of teaching and learning that occurred as pupils were distracted by the devices (Sauers & McLeod, 2012). In this study, Sauers and McLeod (2012) refer to teachers who have varying views on the use of technology – some positive, others negative. Some teachers are not satisfied with the use of devices because they do not necessarily assist pupils reaching the learning outcomes; other concerns raised are that pupils do not use the devices to their full potential for academic learning, and the teachers’ out-dated pedagogical

stance and lack of knowledge in using these devices in the classroom (Sauers & McLeod, 2012). Sauers and McLeod (2012) mention a benefit of using these devices in that pupils have access to their own devices which gives them equal access to relevant content and information.

For the implementation of 1:1 devices to be successful, effective professional teacher development needs to take place (Islam & Grönlund, 2016; Penuel, 2006; Ruggiero & Mong, 2015). Teachers should have a 'hands-on' approach with the technology and ensure that they interact and understand how it works in the classroom (Hutchison, 2012). Therefore, teachers have to be experienced in their content knowledge to implement 1:1 devices successfully. A major outcome of 1:1 initiatives is to ensure digital technology is effectively used by all pupils and teachers in the school.

Iding, Crosby and Thomas (2002) and Reiser (2002) mention the importance of teachers being open-minded to the implementation of 1:1 technology in their classrooms. In being open-minded, teachers are willing to implement new ways of teaching and learning and to adapt to the implementation of technology. Authors who have done studies on 1:1 device implementation also mention that some teachers believe that there is no benefit to teaching with digital technology and that learning occurs without it (Iding, Crosby, & Thomas, 2002; Reiser, 2002). Furthermore, teachers can become frustrated when technology does not work and they often become negative toward the devices (Hung & Hsu, 2007). When there are challenges such as Wi-Fi connectivity problems, electricity interruptions or hardware malfunctions on devices, teachers tend to revert back to traditional teaching methods which are perceived to require adapting to fewer challenges (Hung & Hsu, 2007). Hung and Hsu (2007) found that teachers who have been teaching for a longer period of time and who started teaching during the pre-digital technology era, took longer to adapt and embrace the technological changes. They found it harder to adapt to this new way of teaching and learning.

If technology is not used correctly, it may not be beneficial to the pupils. Crucially, teachers should be properly trained and adapt their teaching techniques to use technology effectively for the purpose of learning. DeLoatch (2015) states that there are a few challenges regarding the use of 1:1 devices in a classroom. These devices distract some pupils during lessons because they associate devices with gaming and social networking, and not with learning. It may also hinder cooperative learning in class as learners may be more interested in their screens than in interacting with their groups (DeLoatch, 2015). Furthermore, pupils need to be taught to assess the reliability of the digital information they are exposed to as there is information which is inaccurate.

Another concern of using 1:1 devices in the classroom is the pupils' safety. There are websites that are unsuitable for children and which are easily accessible (DeLoatch, 2015). A further study by Luo and Murray (2018) emphasises DeLoatch's argument and states that academic dishonesty is another

way pupils of all ages are misusing 1:1 devices. In the same study, a few of the pupils also reported that they did not use the 1:1 devices for productive or academic studies but for entertainment purposes (Luo & Murray, 2018). A study by Grant, Tamim, Brown, Sweeney, Ferguson and Jones (2015) also looks at device barriers for teachers such as equipment (especially when different devices are used), time (both to prepare and get the pupils started), and lack of technological skills. They also found that the device was a distraction to pupils.

In conclusion, the impact of 1:1 digital devices on teachers and pupils have varying views and teachers need to learn to manage these devices in classrooms and pupils need to take responsibility for using the devices in the correct manner and for educational purposes.

2.3 Digital literacy

Digital literacy is the ability to comprehend and use information in various digital forms and modes such as combinations of written, audio, visual, gestural as well as spatial modes (Gilster, 1997). Kress (2003) notes that digital devices have become the medium for conveying information and knowledge. Koltay (2011) states that digital literacy is essential in education due to the evolution of digital technology. Given the definitions and understanding of digital literacy, one can deduce that digital literacy is the ability to communicate via different digital modes to build knowledge and skills. Digital literacy is essential to this study as both teachers and pupils need digital literacy skills in order to effectively implement it in the classroom.

Erstad, Flewitt, Kümmerling-Meibauer and Pires Pereira (2019) focus on how digital literacy encompasses 'multimodal meaning making' and multisensory spaces. Erstad et al. (2019) mention that a mode, including the visual, aural, tactile, spatial or gestural, is used to communicate and that there are various texts pupils are exposed to such as written, visual and gestural texts. Pupils and teachers alike are engaging in a range of activities where different literacy (in particular digital literacy) is used to make meaning of the information presented. With regard to the multisensory space, which links very closely to the third space, Erstad et al. (2019) consider how different spaces and circumstances contribute to learning in a digital era. The multisensory space links with the third space in that it creates the environment where learning can occur that is based on previous knowledge. Learning is sparked by something in the moment such as an idea through an image. This is linked to the study as traditional teaching spaces need to adapt to accommodate the newer multimodal methods of teaching and learning. A pupil's home and social circumstance also have an impact on how they use technology to learn. The home environment is usually where pupils are first exposed to digital technology.

Digital literacy links closely with multiliteracies as it involves people using technology to make meaning of complex modes in documents, which include signs, sounds and symbols (Martin & Madigan, 2006). Digital literacy offers opportunities to include multiliteracies and provides an understanding of what is happening in digital spaces (Rowse & Walsh, 2011). Both Martin and Madigan (2006) and Rowse and Walsh (2011) emphasise that digital literacies offer opportunities for multimodal communication which teachers need to use effectively to ensure that learning occurs.

Digital literacy, otherwise known as technological literacy, emerged in the 1970s when concerns were raised regarding the probable dangers of digital literacy for the environment and civilisation due to unknown factors; it was feared that the workforce could be affected negatively if people are uninformed regarding digital literacy (Martin & Madigan, 2006). Martin and Madigan (2006) explain these 'dangers' as access to material which is not suitable, such as sites which are not appropriate for pupils. Another danger is access to too much irrelevant and false information, that may be detrimental to learners and learning (Martin & Madigan, 2006).

Olson and Torrance (2009), divide the development or history of digital literacy into three stages:

1. The public interest in digital devices (computers in those days) in the 1980s,
2. The increase in the use of and interest in the internet in the 1990s,
3. And currently, the rise of networked information economies.

The European Commission (2008) identified 'digital competence' as the key foundation of life-long learning which goes beyond the use of basic ICT skills such as understanding and applying a wide range of computer programs and applications. The European Commission (2008) defines digital competence as the ability to understand digital media, which is any content used or accessed in a digital form, and use previous knowledge to comprehend digital information. Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci and Rumble (2012) define digital literacy as the use of digital tools to gain knowledge and information and to critically engage and form new ideas through these tools. Likewise, in the USA (WestEd, 2010), researchers evaluated primary schools where ICT was used and that focused on using digital technology for collaboration, the construction of knowledge and new ideas, and the investigation of problems, while using digital devices. Their findings are favourable and emphasise that the effective use of digital literacy assists younger pupils to form new knowledge and skills, for instance, working together on a project to find a solution to a real-world problem. Binkley et al. (2012) further looked into digital literacy and focused on combining aspects of technological proficiency with those of information and knowledge. Binkley et al. (2012) found that as people became more

proficient in using digital technology, they became more creative in their approach to using new information.

Crucially, digital literacy can be seen as the accessing and use of any form of digital or multimodal technologies that include text, audio, the visual, spatial or a combination of these semiotic systems of information. By using this information, the teacher can consider transforming, using and creating new information and forming knowledge in our pupils (Fraillon, Ainley, Schulz, Friedman & Gebhardt, 2014).

For pupils leaving school and going to university or joining the workforce, the World Economic Forum (Gray, 2016) predicted that by the end of 2020, the skills, which will be needed will include those incorporating digital literacies. Pupils are able to use a range of devices but they need to adapt to them as well. This links to the concept of the life-long learner.

Life-long learning, especially relating to teachers, is an important skill in our current era. According to Gorard and Selwyn (2005), a life-long learner is required in today's society as careers are no longer defined by job descriptions anymore and people need to adapt and learn skills in a variety of spheres in order to build their careers. Gorard and Selwyn (2005) mention the importance of technology in life-long learning due to the easy access to resources and the new opportunities offered at educational institutions, which use online learning, especially due to the COVID-19 outbreak in 2020 (Ting, Carin, Dzau & Wong, 2020). The need to upskill a workforce is also mentioned, and this will also assist with social inclusion when people are using resources to their advantage and developing not only themselves, but also others.

Another form of digital literacy is the pupils' ability to use knowledge and skills to differentiate between credible and unreliable information on the internet (Bhatt & MacKenzie, 2019). If pupils are not able to differentiate between these types of information, they will battle to create their own content which is reliable and valid (Bhatt & MacKenzie, 2019). This type of literacy is linked to critical literacy. Janks (2014) mentions that critical literacy is the ability to examine and identify the various purposes of texts and critically analyse the language that is used. Janks (2014) speaks about the power the reader has to engage critically with the text by focusing on the importance of language in engaging critically with information. Janks (2014) further mentions multiple modes, such as visual or verbal, for making meaning; there can be different forms of language in texts which the reader needs to interpret. Critical literacy is integral when teaching with digital devices and links with this study: when teaching with digital technology both teachers and pupils need to be aware of the information they have access to and be cognisant of how to effectively select and apply that information. This links closely with the four pedagogical acts of multiliteracies in experiencing, conceptualisation, analysing and applying

(Cope & Kalantzis, 2004; Cope & Kalantzis, 2015). Critical literacy specifically links with the multiliteracies pedagogy of ‘analysing’ or ‘critical framing’ where pupils critically analyse the purpose and relevance of information within the framework of their prior knowledge (Cope & Kalantzis, 2004; Cope & Kalantzis, 2015). Pupils then add the selected relevant information to their already existing schemas to form new knowledge (Cope & Kalantzis, 2004; Cope & Kalantzis, 2015).

According to Mohammadyari and Singh (2015), people who have multiple literacies and are able to use digital knowledge, skills and information competently are seen as digitally literate. Tang and Chaw (2016) focused on how digital literacy influenced blended learning. Blended learning incorporates traditional teaching methods with the integration of other forms of learning. This other form of learning could be digital learning, learning in a third space, or learning in a different mode, such as learning by listening to music or using visualisers online. Digital literacy has had an influence on blended learning as learning with technology can occur outside the classroom walls (Tang & Chaw, 2016). Tang and Chaw (2016) focus on the need for pupils to reach a certain level of digital literacy in order to thrive in this new era of education where pupils are no longer consumers but producers of their own work. Blended learning, as mentioned by Bonk and Graham (2006), has become a buzz word in education and is conceptualised as using a blend of instructional modalities in order to deliver knowledge in an interesting way to pupils and which challenges their thinking through non-traditional methods of teaching. Bonk and Graham (2006) also mention the link in blended learning between traditional teaching practices combined with technological aspects. By using blended learning, the third space is once again formed as learning is not confined to a specific space or time.

Linked to digital literacy is digital citizenship which can be described as the qualities required by a person to use digital tools effectively in a digital environment (Searson, Hancock, Soheil & Shepherd, 2015). Farmer (2011) and Ribble (2015) emphasise the importance of using online content responsibly and for the correct purpose e.g. education and research. Koltay (2011) mentions that the integration of digital citizenship in an education setting is reliant on digital literacy where pupils are taught skills to use digital technology effectively. Ribble (2015) further states that education facilities should encourage their pupils to interact responsibly on digital platforms and these facilities should establish codes of conduct to ensure digital technology is used effectively.

2.4 Chromebooks

In the context of this study, the Chromebook is used as a LTSM artifact, which is a digital tool for teaching and learning. It links to being able to learn/work in the third space as pupils are enabled to work collaboratively using their ‘artifact’ without being bound to a desk or classroom. The

Chromebook serves as a multimodal resource tool in that it has many functions relating to learning and has the ability to adapt and serve as a workbook, textbook and a communication tool (Hutchison & Woodward, 2018; King, 2016).

The Chromebook, due to its applications being linked to Google, offers a variety of digital literacies, and multiliteracies where pupils have access to a wide variety of texts that include slides, documents and videos (King, 2016). Pupils using Chromebooks are expected to read, listen and view information independently and collaboratively, and to use this multimodal information to expand on their learning experience (King, 2016).

Chromebooks were designed with the classroom setup in mind as they are created for collaborative use and provide access to educational material involving the G-Suites (O Donnell & Perry, 2013). O Donnell and Perry (2013) also mention the low cost needed to support the device. A 2018 study notes that Chromebooks have outpaced all other technological equipment purchased in the USA (Carter, 2018). Carter (2018) also notes the decline in sales in Microsoft and iOS over the last few years, which has seen a boost in the sales of Chromebooks and the use of the Google platform. This is relevant to the current study as choice of device is of importance when integrating technology into the classroom.

Miller (2011) describes Chromebooks as a laptop type computer with a screen and keyboard that operates off the Google Chrome Operating System. Miller (2011) states that it is lightweight, requires minimum storage, and runs cloud-based applications using the Chrome browser which functions with Google Drive. Chromebooks require users to have a Google account to log in. Bartolo (2017) completed a study in the USA amongst Grade 4-8 teachers and mentioned that Chromebooks are user-friendly in schools as they update automatically and do not need a virus protection. Bartolo (2017) continues by stating that when users have worked on a Chromebook, they are able to access their work from any device due to Google's ability to automatically save documents. Bartolo (2017) found that the free educational suite of applications, G-Suites which include Docs, Sheets and Forms, assists with the educational value of a Chromebook. However, careful consideration must be made when implementing it in the classroom. Chromebooks are managed by a school's Google Admin Console within its own domain which ensures it is safer as it is protected by a firewall and restrictions on sites may apply which protect the user against harmful sites (Bartolo, 2017). This assists when configuration is needed to Wi-Fi and when accessing the schools' websites.

A study in the USA on 1:1 Chromebook initiatives in a primary school shows that these devices proved beneficial to pupils as they were able to use these devices constructively in class (Loescher, 2018). Furthermore, when teachers committed to using these devices for the correct purposes and to developed their skills, their attitudes and skills teaching with Chromebooks improved (Loescher,

2018). Another study in New Zealand states that Chromebooks have been beneficial as pupils in primary and high schools have easy access to textbooks and online education programs (Abella, 2018). However, the study also reveals that teachers need to integrate this device into their classroom practices in order to ensure the best learning experiences for the pupils (Abella, 2018). Teaching should not descend into edutainment but the device's use should be supported by sound pedagogy (Abella, 2018).

A study by Kulow (2014) in the USA emphasises the greater awareness of primary school student engagement when using the Chromebook. Additionally, it had a positive effect on learning as students had instant access to information. Importantly, when facilitated correctly, students remained engaged and produced positive learning results (Kulow, 2014). Cox (2014) affirmed Kulow's findings and emphasises that the Chromebook increases collaboration between pupils, teachers and administrators. The Chromebook adds the element of student empowerment and the ease to physically connect for learning, not only with their peers and teachers, but also with people around the world (Cox, 2014).

Chromebooks were rolled out by Acer in 2011 and their use has continued to grow through the enhancement of their technological capabilities making them a viable option in the educational sphere according to Pullen (2016) and Kulow (2014). Kulow (2014) highlights that Chromebooks have the ability to run a number of applications which are free and to update these automatically which benefits classroom practices.

Sahin, Top and Delen (2016) completed a study of Grade 6-12 teachers in America where concerns regarding Chromebooks were addressed. These include the inability to print directly to a printer, the amount of time the technical department takes to repair Chromebooks, and certain non-educational websites being blocked. Teachers who formed part of this study also commented that pupils were distracted due to what they have access to on the Chromebook such as non-educational applications (such as games) and access to the internet (Sahin et al., 2016). Pupils also accessed content on other sites or games which was not relevant to the lesson presented (Sahin et al., 2016). Leary, Severance, Penuel, Quigley, Sumner and Devaul (2016) had similar findings to that of Sahin et al. and further recommend proper technical support and setup regarding the Chromebooks. This technical support should come from the IT department which should ensure proper Wi-Fi and setup of the devices.

Chromebooks are reliant on internet access due to their link to Google. Because pupils are accustomed to working with web-based applications (Conole, De Laat, Dillon & Darby, 2008), they may access educational information more readily by using a Chromebook. Information is often paperless and, therefore, pupils have access to this information at any time. A study done by Yockel (2017) found

that high school pupils in America have access to information even when they are absent from school as most work is “pushed” or added to the pages in digital format to the pupils. This also creates a third space of learning incorporating multiliteracies as the pupils can use their Chromebooks outside the classroom to learn through a variety of multimodal texts.

The graph on the following page conceptualises the researcher’s understanding of the Chromebook as an ‘artifact’ of learning in the classroom:

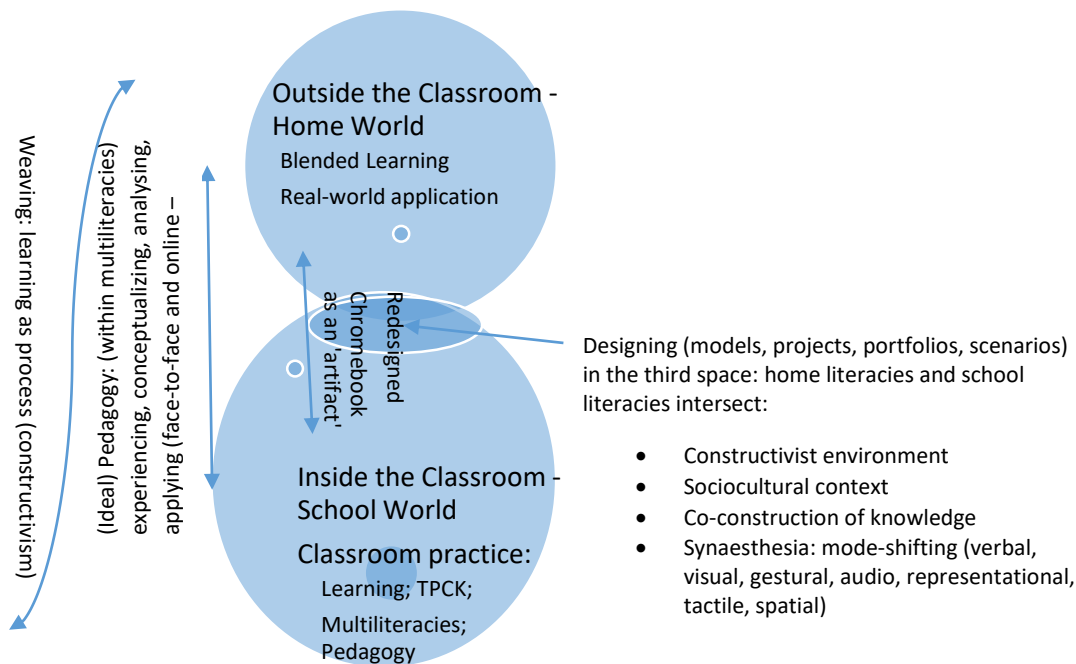


Figure 2.1: Conceptual framework for the Chromebook as ‘artifact’ in a third space of learning

(Source: Adapted from Engelbrecht, A., & Genis, G. (eds) 2019. *Multiliteracies in education: South African perspectives*. Pretoria: Van Schaik: 34)

Figure 2.1 displays the relationship between all the different aspects relating to the study. The weaving refers to how and where learning takes place: it is a process within the classroom and home environments. Pedagogy is related to how knowledge and skills are acquired in the 21st century of learning. Designing of learning occurs when teachers and pupils meet to construct knowledge using digital technology as a tool for learning. This learning environment is known as a third space. The multimodal learning which the digital device (artifact) offers, creates a constructivist third space for knowledge construction. This is where the use of digital technology influences teachers’ classroom practices.

2.5 Third space and multimodal learning

The third space, as mentioned by Soja (1996) is a “space” which is not necessarily physical but an environment where new learning and discovery takes place. Webster (2018) also speaks about this space as the area where there is no boundaries as learning is not restricted to textbook work. Webster (2018) states that the third space is an interactively created environment in which learning outcomes are achieved. Gutiérrez (2008) commented on the multiple layers within a classroom; these being the transformation of class spaces that creates this third space for learning and interaction. Gutiérrez (2008) also mentions how interaction plays a role in the third space due to pupils thriving on bringing the known or their home literacies into the learning space and merging these with the unknown or school literacies. Crucially, the third space is seen as an environment, not defined by a building or four walls, where opportunities for learning occur, where the pupils bring their existing knowledge and combine it with what is taught. In this way, pupils are the creators of their own knowledge.

With the use of digital technology both in and out of classrooms, there is a need for learning to take place beyond the classroom environment. Wegner (2011) focuses on this and mentions the importance of working collaboratively outdoors or in different group settings in order to empower pupils to learn in a non-conventional setting.

Currently, trained teachers across the world who have access to sufficient technical equipment and logistics are using collaboration in their classrooms, which is a suitable environment in which to create a third space for learning. A study by McCollum, Morsch, Pinder, Ripley, Skagen and Wentzel (2019) shows that trust is built by empowering knowledge sharing between pupils, teachers and colleagues when there is an opportunity for teaching and learning in the third space. Teachers who become familiar with setting work for outside the classroom allow pupils to become exploratory learners (McCollum et al., 2019). This links closely with a flipped classroom approach. A flipped classroom allows pupils to view work outside the classroom walls, as well as allowing pupils the time to prepare for a lesson so they come to class with relevant knowledge (Carrier, Damerow & Bailey, 2017). The aim of a flipped classroom is to allow for more meaningful teacher-pupil contact time in class, where pupils use time at home to complete work which does not necessarily need teacher interaction or support (Carrier, Damerow & Bailey, 2017). With the use of digital devices, the flipped classroom is viewed as a preferred method of teaching and learning as the use of digital devices offers work to be loaded on a variety of platforms giving access to pupils anywhere.

The third space occurs in the classroom where pupils have the opportunity to form their own opinions and ideas. Gutiérrez (2010) mentions that social interaction can form a third space where learning

occurs in the production of ideas in a collaborative manner. By having access to digital devices/artifacts, the opportunities for creating a third space for teaching and learning is now more prevalent than ever. Teachers and pupils with devices have the ability to connect, not only with each other, but with knowledge systems and information from around the world, for instance connecting on blogs, having access to information published by others and collaborating with other societies in a learning environment (Herald, 2016).

Pupils of the 21st century are digital natives who grew up immersed in technology and can use it for both personal and educational use. They are used to third spaces within social media sites, including gaming platforms and social interaction spaces such as Facebook. The third space allows for a balance between the known and unknown, the personal and the professional, and the building of relationships through working with others. The third space also allows for the ‘weaving’ of learning. This ‘weaving’ of learning is a multiliteracies concept which links the knowledge which is known (brought from previous experiences) and the new knowledge (Serafini & Gee, 2017). This process of ‘weaving’ includes the selection of various texts – live, digital, paper-based – and multimodalities in designing new knowledge constructs (Genis, 2019).

The ‘third space’ is, therefore, a socio-constructivist environment in which learning will continue once the teachers and pupils leave the classroom (Herald, 2016). This will happen as teachers and pupils form their own learning in their own environments and link it to what they have been taught in class and at university. Constructivists believe that people learn through their own experiences and technology offers this flexibility and adaptability for self-directed learning even from a young age (Ford & Lott, n.d; Erdin, 2020). Rüschoff and Ritter (2001) indicate that a major principle of constructivism is that learning is “process-based”. Thus, it is a process of collecting information and processing the new knowledge (Rüschoff & Ritter, 2001). Such a “process of the interaction between knowledge previously acquired and new information gathered leads to the acquisition and even to the production of new knowledge” (Rüschoff & Ritter, 2001: 225). “Process-based” learning connects with the “Designs of meaning” project of multiliteracies: Available Designs are Redesigned by the pupil to form a new knowledge construct (Cope & Kalantzis, 2000:211-217).

The third space links directly with classroom practice as both relate to the pedagogy used and the interpersonal relations within a classroom (Li & Oliviera, 2015; Pahl & Rowsell, 2013). Teachers should strive to move from the traditional methods of instruction to new ways of teaching to transform education (Li & Oliviera, 2015).

Literature regarding digital devices, how devices are used in the classroom as an ‘artifact’ and using multiliteracies in teaching creating a third space is important to 21st century pupils. As Prensky (2005)

mentions, these digital natives will continue to evolve so quickly that educators need to adapt their practices to suit the digital natives they are teaching.

The third space also offers a multimodal learning environment. Due to the third space not being confined to the classroom with restrictive boundaries and set traditional learning standards, opportunities for incorporating different modes of teaching and learning are offered (Skerrett, 2010). Skerrett (2010) mentions that visual modes can be digitally distributed and incorporated into learning, and that tactile modes provide pupils the opportunity for a hands-on experience in digital designing and programming.

Jewitt and Kress (2003) describe multimodality as ways in which to understand the meaning making of knowledge by using various modes (visual, audio, physical) in the learning process. Jewitt and Kress (2003) further explain that the modal choice of using visuals or linguistics adds to the multiliterate texts and assists in developing ideas and new knowledge in education. Kress and Leeuwen (2001) emphasise that multimodality should be incorporated into educational resources to create meaning, where pupils are able to relate to the resource.

Farías and Véliz (2019) mention the importance of evolving technology and the need to understand and interpret information, which is portrayed in multiple modes such as visuals, audios, videos and through the gestural. Farías and Véliz (2019) further mention the increase in webinars, blogs, slideshows and cloud computing which are used frequently as communication and information tools. Therefore, there is a need to incorporate multimodality into teaching and learning to prepare learners for the digital world of work.

A study by Tan and Guo (2009) among the youth in Singapore found that there was a discrepancy between what was presented in the school curriculum and the knowledge and skills that the pupils bring into the classrooms. Abraham and Farías (2017) also completed a study with adolescent English language pupils and found that schools need to analyse critically the texts and resources they are presenting to the pupils. These should have academic value and not be used for the wrong purpose or as a quick-fix insert for the pupils.

However, education for the younger years, pre-school in particular, has supported and incorporated multimodality in that it fosters and creates opportunities for multisensory and multi-semiotic play-based learning (Lotherington, 2017). With the increasing use of digital devices in education, there is a need to adopt this multimodal and multiliterate approach in learning and teaching (Farías & Véliz, 2019).

2.6 Teaching and classroom practices involving digital technology

Teaching practice is viewed in many different ways and experts do not always agree on its classification (Anthony, 2019). However, Danielson (2014) identifies areas of teaching practice and compartmentalised them into: planning and preparation, the classroom environment, instruction, and professional responsibilities. Marzano (2003) looked at three levels of teaching practice that include instructional strategies, classroom management, and classroom curriculum design. Furthermore, Hattie (2018) acknowledges Marzano's levels and adds a number of constituents and other elements to these three levels. More specifically, the following constituents are increasingly important in classrooms: "setting instructional outcomes, designing coherent instruction, designing student assessments, creating an environment of respect and rapport, establishing a culture for learning, managing classroom procedures, communicating with students, engaging students in learning, using assessment in instruction, demonstrating flexibility and responsiveness, and using questioning and discussion techniques" (Hattie, 2018 p.28). Therefore, teaching practice links closely with classroom practice.

Classroom practice is a broad concept but for this study, it includes the integration of digital technology, in particular 1:1 Chromebooks in the classroom. A teachers' pedagogy and training may influence their classroom practice. This needs to be taken into account when research is conducted.

Technology should be seen as a tool used for teaching and learning due to its integration and use in the classroom (Uers, Volman & Kral, 2018). Institutions, both schools and universities, should see technology as an addition to the training of teachers. However, many tertiary education institutions do not adequately train teachers to implement technology in the classroom to make the pedagogical shift that is required when teaching with technology (Griva, Thanopoulos & Armakolas, 2019). Many teachers who have been teaching for many years feel that they do not have the adequate knowledge to integrate technology into their lessons (Papadakis, 2018).

As far back as 2003, literature is present where authors mention the importance of incorporating technology into teaching practices (Kirschner & Davis, 2003). Unfortunately, technology in education is still mainly used for administrative purposes (Tondeur, van Braak, Siddiq & Scherer, 2016). Hinostroza, Ibieta, Claro and Labbe (2016) agree that technology is mainly utilised for administrative purposes. They add that there are implications for incorporating technology in the classroom, for instance the improved understanding of learning with ICT in the class for teaching and learning. The implications have an effect on both teaching and learning. There are, however, studies that look at how teachers are incorporating technology in the classroom (Hanover Research Council, 2014; Project

Tomorrow, 2008; Smolin & Lawless, 2011). These studies reveal that teachers who incorporate technology use it for assessments, to generate additional academic notes or worksheets for pupils, to present their lessons, and for collaboration between pupils (Hanover Research Council, 2014; Project Tomorrow, 2008; Smolin & Lawless, 2011).

Digital technology allows for exploratory learning which provides pupils with the opportunity to engage and explore the content before instruction takes place, thus linking it to the flipped classroom approach (Derkson & DeCaro, 2020; Newman & DeCaro, 2018). This type of learning offers time for pupils to engage and form their own understanding of the content and includes an exploration phase where knowledge gaps are uncovered (Derkson & DeCaro, 2020). In Derkson and DeCaro's study (2020), university students were exposed to a topic, which they could explore and investigate before being taught. This approach yielded positive results with regard to overall learning, which were linked to the participants' improved academic achievement. Newman and DeCaro (2018) state that it is important for pupils to receive feedback during this type of exploratory constructivist exploration because if not scaffolded, pupils may continue to develop incorrect solutions to problems. This study by Newman and DeCaro (2018) reveals positive results with regard to the application of explorative learning and the intake of new knowledge, which makes this a positive learning style to consider.

Herold (2015) comments on how numerous case studies in the USA have indicated that the minority of teachers embrace the use of ICT and in particular, digital devices, in their classrooms; conversely, the majority make slight, if any, changes to their teaching methods and do not embrace the integration of technology in the classroom. Many of these studies have shown that teachers are cautious of the unknown, i.e. new technology, and are not always willing to adapt and transform their practice in education. Therefore, some teachers have their own perceptions and prejudice about using technology in the classrooms which affect their instructional planning. Celik and Yesilyurt (2013) refer to teachers' attitudes, confidence and competence of using ICT in the classroom which affect how and for what they use technology. ICT links to digital technology in that it allows for communication and the creation of knowledge, as well as the dissemination, storage and management of information (Herold, 2015).

Machado and Chung (2015) mention that in the USA, many studies have been completed on the role of professional development and the implementation of ICT in the classroom. It was found that a teacher's view on the integration of technology in the classroom affects her/his instructional preparation. Other findings of these studies include the need for teachers to build confidence in adequately using technology. Machado and Chung (2015) mention that teachers should be continuously mentored on their pedagogy when using digital devices in classrooms. Research shows

a connection between the value of professional development and the adequate integration of technology (Machado & Chung, 2015). This links closely with the current study in that teachers' practice is influenced by the amount of continuous professional development that they are offered. The participants mentioned that the quality and what is offered during professional development sessions influenced their classroom practices.

Professional development is an important factor in shaping teaching practices when using digital technology. If teachers are not trained properly on a specific device, they will not be able to implement it successfully in their lessons. Ongoing support is also needed as digital technology evolves and new tools keep emerging (Engelbrecht & Ankiewicz, 2016; Howard & Thompson, 2016; Kajander & Mason, 2007). This also links to the TPCK framework where technology is as important as the pedagogy used and the content taught. The TPCK framework (discussed in detail in Section 2.8) which incorporates technology, pedagogy, content and knowledge, is often used by researchers to analyse teaching practice which incorporates the use of technology.

It is imperative that teachers evolve and keep current in order to reach the pupils in their classrooms (Medrano, 2015). Baek, Jung and Kim (2008) studied the effect of the level of experience in teachers and the findings show that teachers with more experience reluctantly use technology in their classrooms while younger teachers with less experience are more willing to adapt and to introduce technology in their teaching. It appears that the younger generation is more inclined to use the available technology in the classroom. Crucially, teachers are preparing pupils for a world where technology will have evolved even more and, therefore, both teachers and pupils need to keep up to date and embrace these changes.

In the 21st century, teachers are no longer viewed as the bearers of all knowledge but pupils are encouraged to seek knowledge and form their own understanding of the world (Kivunja, 2014). Teachers are, therefore, facilitators of learning. If integrated pedagogically with classroom practice, the Chromebook is reported in the above-mentioned sources to assist in this process as it allows for a socio-constructivist tool for learning in the classroom where pupils learn from teachers and teachers learn from pupils. The Chromebook, as a learning tool and if used correctly, facilitates collaboration between teachers and pupils whilst they are engaging with the content. This provides for a 'third space' (Pahl & Rowsell, 2013) where teachers and pupils meet in the construction of new knowledge. Soja (1996) states that the third space could be a physical or mental space or environment. Soja (1996) focuses on how these physical and mental spaces work together to create a new environment specifically linked to the journey of discovery. Pahl and Rowsell (2013) have applied this term specifically to the context of school spaces and classroom practice. They indicated that within this

school space, 'artifacts' or objects of learning, which link home and school literacies, should be incorporated in the learning process. The school environment is a safe-place, where teachers and pupils 'co-construct' knowledge (Rowse, Kosnik & Beck, 2008). Crucially, the Chromebook, if utilised correctly, becomes an 'artifact' (Pahl & Rowse, 2013) or a 'third space' that serves both as a learning object and learning environment that link home and school literacies within the classroom. These views are based on the New Literacy Studies and multiliteracies, which are closely aligned.

Furthermore, studies by Sangra (2010), Sabzian and Gilakjani (2013) and Mukhari (2016) have concluded that teachers' attitudes and beliefs toward technology's usability for teaching and their technological skill levels, influence the types of activities for which they use technology and how often they integrate technology into the curriculum. Overall, the introduction and use of technology in the class have an effect on both teaching strategies and the quality of pupil-teacher relations (Mukhari, 2016). Frequently cited obstacles to technology integration with classroom practice include lack of preparation and practice time, equipment problems, and insufficient professional development regarding the use of technology (Mukhari, 2016; Sabzian & Gilakjani, 2013; Sangra, 2010).

2.7 Pupils of the 21st century

Prensky (2001) describes digital natives as people who grow up in the digital environment with digital technology being implemented into their daily lives. Palfrey and Gasser (2008) add to the definition of digital natives as people who were born after 1980 and who have had contact with technology from a young age, possess technological skills, and feel at ease when using technology. Most of the existing literature has described digital natives in a positive manner (Lei, 2009). They are often labelled as the "millennial generation" that is "socially connected, digitally literate, shows strengths in multitasking and collaboration, and values immediacy" (McMahon & Pospisil, 2005: 422). Sarkar, Ford and Manzo (2017) describe digital natives as those who have the following characteristics: work well in a technology-infused environment, like instant feedback, thrive on collaboration, have a short attention span, and enjoy a more flexible schedule. They live in a global digital setting and are the native speakers of the digital language (Prensky, 2001).

In order to keep these pupils interested in lessons and to ensure that they engage with the content taught, teachers need to ensure that they include resources and tools, which today's pupils are interested in. Many of these learners are digital natives, and as a generation, is generally interested and fluent in modern technology: the so called Generation Z (Kivunja, 2014). Prensky (2005), who coined the term 'digital natives', defines these pupils as spokespersons of technology and indicates that they are fluent in the language of computers, digital games and the internet.

Opposing Prensky's view of digital natives are authors who state that this concept is more of a stereotype (Judd, 2018; Koumachi, 2019; Smith, Kahlke & Judd, 2020). Smith, Kahlke and Judd (2020) further state that teachers should consider the skills needed as well as digital literacies when teaching pupils who are considered to be digital natives. Smith, Kahlke and Judd (2020) also emphasise the importance of supporting pupils by teaching in a way that will equip them with the necessary skills and knowledge by building on what they know. This prior knowledge may exclude digital literacy.

Teachers are preparing pupils for the digital future and it is recommended by sources such as Spitzer & Rundgren (2018) and Mc Farlane (2019) that digital technology should be used and integrated into lessons from a young age. Young children are inquisitive by nature and are navigating different forms of technology from early on. Subsequently, children should be encouraged to become creators and designers of their work (Cope & Kalantzis, 2009). Pupils are also now creating work for a wider audience. Instead of just the teacher seeing their work, they are creating blogs, sharing on-line documents and gathering information from a variety of sources (Anstey & Bull, 2006; Blair, 2012; Engelbrecht & Genis 2019). Pupils should be exposed to a range of digital tools and they need to be equipped with problem-solving skills to use in their formation of knowledge within a digitised world.

According to Wagner (2008), there are certain skills which pupils of the 21st century need to acquire and master. These are:

- Critical thinking;
- Collaboration;
- Communication;
- Creativity and innovation;
- Self-directed learning and independence;
- Global connections; and
- Using technology as a learning tool.

Shear, Novais, Means, Gallagher and Langworthy (2010) agree with this and further state that research has been conducted on each of these skills and, if implemented correctly, should lead to positive results for pupils and their development. Their findings (Shear et al., 2010) revealed that when teachers engaged and implemented innovative teaching practices by using technology, pupils were able to master the 21st century skills mentioned above: critical thinking, collaboration, communication, creativity and innovation, self-directed learning and independence, forming global connections and using technology as a learning tool. The previous generation, the digital immigrants, focused on a

knowledge-based curriculum while pupils of the 21st century should focus on skills which prepare them for the future workforce (Ronchi, 2019).

Pupils of the 21st-century are innovators and creators of their own knowledge and require more input into their learning (Hernandez-de-Menendez, Escobar Díaz, & Morales-Menendez, 2020). By applying knowledge from their own world, including digital knowledge, and then considering what is presented to them in the curriculum, pupils use the third space to form new knowledge and use what is readily available to them such as online content, information presented by peers or creative ideas (Carrier, Damerow & Bailey, 2017; Hernandez-de-Menendez et al., 2020). The mind-set of 21st-century pupils has changed, as they are exposed to different stimuli, digital and multimodal, than those of pupils of 10-20 years ago (Hernandez-de-Menendez et al., 2020). Teachers, who may be from Generation X (or even Baby boomers), need to adapt to the new era of teaching and learning where pupils are actively involved in the way they gain knowledge (Papadakis, 2018). Generation X are people who were born between 1966 and 1980 and are viewed as being independent and self-sufficient (Balc & Bozkurt, 2013). Due to digital technology not being available in schools when Generation X was schooled/growing up, they may not have the frame of reference to implement effectively this in their own teaching.

Due to today's pupils having instant access to knowledge, their need to be immediately satisfied has also become a factor, which teachers need to take into consideration (Papadakis, 2018). Teachers should ensure that pupils of the 21st century are stimulated in a way which captures their attention and which equips them for their future (Papadakis, 2018).

Pupils of the 21st century are also exposed to different stimuli than those of the past. Gani (2016) mentioned that young people have been exposed to television, computers and video games for extensive periods and this affects their cognitive development. It affects the way they absorb information as they become distracted easily which affects their attention span. Rothman (2016) states that the brains of pupils born in the 21st century are structurally different due to the external environment; their brains are required to adapt and respond to their multi-sensory environment in acquiring new information. In Cilliers (2017) study, which focused on the challenge of teaching this generation of pupils, it was found that teachers need to adapt to create environments, which are conducive to critical thinking and creativity. Pupils are expecting an environment, which is as stimulating to them as their virtual environment and teachers should create opportunities for interaction and visual teaching and learning (Cilliers, 2017).

According to Blair (2012), Hashemi, Azizinezhad, Najafi and Nesari (2011), Hess (2014), Schaffhauser (2015) and Sujee (2019), there are proven benefits for pupils using their own technological devices for

learning. Pupils learn more efficiently by being actively involved in learning through navigating their own knowledge devices and by being able to complete digital assessments with rapid teacher or device feedback (Schaffhauser, 2015; Sujee, 2019). Pupils have the opportunity to learn more fully and with mastery as they have the opportunity to extend their learning or review and reflect on their learning so that they can put it into practice. Hashemi et al. (2011) also state that using technological devices in education enables better interaction and communication in a classroom, as pupils feel more confident to present ideas through a medium that they feel more adept with. Hashemi et al. (2011) also emphasise the importance of collaborative learning when using devices, which is advantageous for pupils as this is a skill needed more in the workforce today. Real-world learning is now happening in the classroom as the outside world is brought into the classroom via information networks like Google Scholar, and with the use of technology and devices, pupils have access to this information anywhere. This process of breaking down the boundaries of learning is called 'Connectivism'. This is a constructivist concept that refers to the process of networking and connection-making between and among pupils (Abdullah & Mtsweni, 2014).

From these discussions, it is evident that the literature is linked to the theoretical framework of this study, which encompasses constructivism, multiliteracies and TPCK. With all the knowledge on the evolving digital world and the impact it has in education, it is essential that the way teachers are teaching encompasses these theories and approaches to learning. Digital technology offers learning tools in an environment where constructivism, multiliteracies as well as TPCK should be considered and implemented.

2.8 Theoretical framework

According to Dickson, Emad and Adu-Agyem (2018), a theoretical framework is used to describe the course the research will take. This makes the findings and conclusions of the research more theoretically sound and allows the findings to be relevant to a wider epistemological milieu. Dickson, Emad and Adu-Agyem (2018) stress the importance of applying the correct theoretical framework to one's study in order to strengthen the objectivity of findings. It also assists with establishing the academic position of the researcher and at the same time, that of the readers. The theoretical framework is based on existing theories and, therefore, when new findings emerge within a framework, they add to the generalisation of the framework.

The theoretical framework used in this study is a combination of constructivism, multiliteracies and the TPCK model.

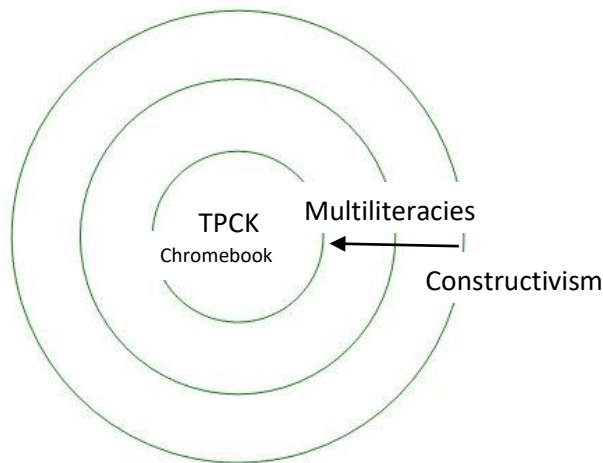


Figure 2.2: The theoretical lens of this study: zooming in from constructivism, to multiliteracies, through TPCK to the Chromebook.

2.8.1 Constructivism

Mvududu and Thiel-Burgess (2012) state that constructivism is an approach where a child's level of understanding is viewed and how this understanding changes as a child learns. Therefore, it is linked to how a child thinks and in turn learns. Constructivism describes the way a pupil can use information to make sense of it and how this information can be taught effectively (Mvudududu & Thiel-Burgess, 2012). Mvudududu and Thiel-Burgess (2012) indicate that pupils select the knowledge they acquire from the content to validate and support their understanding. Constructivism, initially conceptualised in the works of Piaget (1970), Bruner (1979), and Vygotsky (1978) looks at how an individual behaves and interacts with their environment to form their own knowledge. Constructivism according to these works (Piaget, 1970; Bruner, 1979; and Vygotsky, 1978) implies that learning occurs in certain contexts, and that pupils create their own meaning from the experiences in various situations by interacting with knowledgeable others.

Constructivism is closely linked to educational settings as well as the changes, which occur in the educational environment (Krahenbuhl, 2016). Constructivism theory affects both the pupil as well as the teacher as the teacher communicates certain ideas, knowledge or skills they would like pupils to attain and grasp; and the pupil forms their own knowledge from these prompts (Krahenbuhl, 2016). This theory is relevant in today's teaching environment, as teachers need to adapt their teaching style to capture the pupils' attention by relating content and LTSMs to the pupils' world.

An important consideration in constructivism is that teachers cannot merely transmit knowledge to pupils, as pupils need to take an active role in this construction of knowledge (Mvududu & Thiel-Burgess, 2012). A digital device allows for opportunities of active and collaborative learning as pupils

may work together on documents and share their knowledge with each other. They often form their own knowledge using the digital device as an 'artifact' (Mitchell & Turner, 2018). The digital device links to constructivism in that the device focuses on the learning environment and active collaboration (Ah-Nam & Osman, 2017). The digital device offers opportunities for learning to occur as it serves as a tool, where new knowledge and content can be acquired by the pupil (Ah-Nam & Osman, 2017). This can be attained by research or by collaboration and the sharing of knowledge (Ah-Nam & Osman, 2017).

Active and collaborative learning creates a third space for learning. In the third space the pupils use a constructivist approach in order to build on their current knowledge and in so doing, form new knowledge. Varellas and Pappas (2006) conducted a study in the USA where primary school pupils brought prior knowledge into the classroom and teachers provided a constructivist environment. Their finding was that pupils interacted the classroom in a collaborative manner, where they had opportunities to work with each other and then form new knowledge by building on their prior knowledge and by learning new concepts. Within this context, the digital device offers not only a learning tool for a constructivist environment, but the ability to work in the third space as it creates a new environment for learning.

Bhabha (1994) mentions the skills needed to work in both a constructivist and third space environment. These fourth industrial revolution skills include critical thinking, complex problem solving and cooperating with others. It is important as educators to allow for these learning opportunities.

Constructivism is a suitable theoretical framework for this study because it is important for teachers to be aware of the way in which pupils learn and to allow the pupils to use this knowledge in practical situations. Teachers should be aware of what pupils know and then build on this in a collaborative manner.

Linking constructivism to the human-technology interaction is increasingly important as the skills that people need today are critical for human-technology engagement (Ah-Nam & Osman, 2017; Huang & Liaw, 2018; Yadav, 2016). Pupils should be given opportunities to apply relevant skills by using digital technology (Ah-Nam & Osman, 2017; Huang & Liaw, 2018; Yadav, 2016). It is important that while pupils engage with technology, they are improving and accumulating skills, which will benefit them in the future. The constructivist environment allows pupils to use digital devices and technology in interactive learning spaces; this develops their current knowledge base and simultaneously allows them to engage with real-life experiences (Huang & Liaw, 2018).

By using constructivism as a lens in this study, the researcher was able to analyse and interpret the data by looking for evidence of teachers giving pupils opportunities to use digital devices and digital technology in forming their own knowledge. This allowed the researcher to explain what occurred in the context of the current school system. Using constructivism as part of the theoretical framework, allowed the researcher to describe the practices of digital technology and the teachers' perceptions of these practices in their classrooms.

2.8.2 Multiliteracies

The New London Group (1996) conceptualised multiliteracies as an approach in which they envisioned empowering classrooms for teaching and learning to become more representative of cultural, linguistic, multimodal, textual, creative and technological diversity. Multiliteracies allow pupils to explore knowledge presented to them through various texts and in different modes, by using different senses such as hearing, sight and touch to make meaning of the information in live, paper-based, face-to-face and digital communication forms (Genis, 2019; Anstey & Bull, 2018). Haggerty and Mitchell (2010) added to the conceptualisation of multiliteracies by stating that it is beneficial to extend various approaches to learning amongst school pupils, their teachers and families, and to make significant connections between the home, school and wider community. Many teachers view home as the first place of learning where the child acquires his basic language and skills (Hall, Larson & Marsh, 2003). Therefore, home literacies influence and link to school literacies as the pupil's background (home) knowledge forms the foundation on which to build the school knowledge (Hall, Larson & Marsh, 2003; New London Group, 1996). This pedagogy takes into consideration the different ways pupils learn and make sense of information and, therefore, ties in with constructivism and TPCK.

In essence, multiliteracies focus on two important aspects. Firstly, the multiple ways of designing forms of communication, which include the different kinds of texts (live, digital, paper-based, face-to-face) and the available multimodal media: multimodality includes different meaning modes or modalities that include written and spoken, visual, audio, tactile, gestural, spatial and representational. Secondly, multiliteracies incorporate the development of social and linguistic diversity, which is evolving (Cope & Kalantzis, 2000). Cope and Kalantzis (2000) further mentioned that there are evolving communal, organisational and international societies which need to be taken into account. Multiliteracies are, therefore, not only linked with language but have further applications to everyday social, economic and cultural life, including educational settings. This is prevalent, even more so today, with the speed that technology is evolving and becoming an increasing important tool or "artifact" in schools.

Kalantzis and Cope (2008) discuss the three components which encompass multiliteracies competencies. These are the Available Design, Designing and the Redesigned (Kalantzis & Cope, 2008; 2009). The Available Design can be described as the resources and tools that are available in the world and which make meanings specific and situate meaning concepts in context (Kalantzis & Cope, 2008). The Designing is the process of forming meaning using the available resources of the Available Design component (Kalantzis & Cope, 2008). The Redesigned can be seen as the product of the Designing process and is formed once new meaning is made from the resources in the Available Design component (Kalantzis & Cope, 2008). Using the Available Design in the Designing process in order to create the Redesigned allows one to create one's own understanding and knowledge.

The concept of multiliteracies further delves into not only traditional versions of literacy, such as written language, but also how people make meaning from different forms of text or modes (Serafini & Gee, 2017). Antsey and Bull (2018) further mention the semiotic systems that include the linguistic, visual, auditory, gestural and spatial domains, which are incorporated into multiliterate environments. Multimodality is closely linked with multiliteracies in that it represents all the different forms of communication. According to Kress (2005), Jewitt (2009), and Haggerty and Mitchell (2010) multimodality includes the type of communication which occurs due to the mode of transmitting information. Kress (2005), Jewitt (2009), and Haggerty and Mitchell (2010) consider the importance of multimodality in teaching in the 21st century, where pupils have to learn to navigate multiple forms of literacies in order to prosper. With this said, it is important that teachers adapt and allow pupils to be exposed to a broader view of literacies and ways of communicating in this collaborative world.

Boyd and Brock (2015) investigated how digital devices have offered a platform for multiliteracies where pupils have the opportunity to collaborate and design their own knowledge by using digital tools. Boyd and Brock (2015) also mention the importance of pupils being able to design knowledge using a digital device across cultural and cognitive contexts. Multiliteracies, by incorporating digital devices as artifacts, create a wider platform for pupils to engage in various forms of texts and modalities that include linguistic, visual, audio, tactile and combinations of these. This allows them to design and construct their own knowledge. Rowland, Canning, Faulhaber, Lingle and Redgrave (2014) also considered how digital devices within a multiliteracies framework enhance the building of knowledge through experience. They found that the design process is important to build new knowledge. Multiliteracies encourage the use of various forms of literacies (digital, visual, textual, audio and spatial); the digital device offers a platform or third space and tool on which different forms and modes of literacy are available to the pupils. The digital device enhances visual and textual literacy in the form of pictures and text. Additionally, it improves digital literacy as the pupils constructively engage and use digital devices for designing purposes. Crucially, the digital device offers pupils the

opportunity to combine various literacies such as audio, textual and visual in order to create new knowledge (Boyd & Brock, 2015).

Teaching in South Africa currently requires that teachers are able to teach pupils from different socio-economic backgrounds, different cultures and pupils who have different needs. By implementing teaching using multiliteracies, there is more chance of meeting the needs of this diverse pupil population (Purnell, Ali, Begum & Carter, 2007). Due to the exposure pupils get to digital technology from a young age, multiliteracies offer opportunities for rich, meaningful academic experiences in and out of the classroom. Haggerty and Mitchell (2010) completed a study which reveals that it is beneficial to introduce multiliteracies from a young age, and for teachers to include families in order to make connections between the home and school world. This New Zealand study found that young pupils in primary school are able to adapt their understanding when exposed to multiple literacies; these also improve their language skills and ability to learn; finally, with the support of parents, teachers can support the pupils' favoured modes of learning (Haggerty & Mitchell, 2010). These findings relate to my study as they affect the way the teacher uses digital devices in a multiliterate world.

Boyd and Tochelli (2014) looked at how teachers use multiliteracies in their classrooms and emphasise the importance of presenting different modes of teaching. It is important to present different modes of teaching as the pupils we are currently teaching are exposed to digital technology far more than previous years; therefore, they thrive in an environment where they are academically challenged. They are interested in digital technology and using the latter in the classroom to present work interests them (Boyd & Tochelli, 2014). They also mentioned how a digital device or artifact could enhance multiliteracies as it offers a platform for a variety of texts (Boyd & Tochelli, 2014).

Studies by Miller and McVee (2012), Leander and Boldt (2013) and Jacobs (2012) considered how multiliteracies has developed within the teaching and learning environment; their findings reveal the increased use of applications and the integration of digital devices in education. Using a digital device within the multiliteracies domain creates opportunities to presents texts on the same device in multimodal ways (visuals, audio and spatial); it also provides a platform where learners are the creators of their own multiliterate forms of learning.

Closely linked to the designing principle of Multiliteracies is Multiliteracies pedagogy. These include *experiencing, conceptualising, analysing* and *applying* (Cope & Kalantzis 2009; 2015) that encourage learning through designing when using a digital device. By *experiencing*, pupils can engage with what they know and form new knowledge (often taking place in the third space as they explore new information). When a new topic is introduced pupils use their background knowledge and home literacies on the topic and build on this in the classroom through various multimodal experiences that

are offered by the digital device. This learning through experiencing often occurs without pupils even realising it is taking place (Cope & Kalantzis, 2004; 2009; 2015). By *conceptualising* using a digital device, pupils learn and give names to what they learn. Pupils make a connection with the digital information and can identify with the topic and information. In learning new terms, they are able to generalise this produced information and use it in various settings (Cope & Kalantzis, 2004). By exploring using digital devices, pupils *analyse* the content, which they have to learn. *Analysing* links closely with Janks' critical literacy (2014) in that it encourages pupils to make connections, conduct research, explore various texts and practices, and consider the effect these texts and practices may have on society. Finally, pupils apply all the knowledge they have gained through *experiencing*, *conceptualising* and *analysing*. Pupils play an active role in applying what they have learnt to their own situations (Cope & Kalantzis, 2004). In this phase, pupils are physically involved in the "doing" and designing part of learning, for example, they are actively involved in research and creating a slideshow. Figure 2.3 demonstrates how multiliteracies incorporate multimodal styles for learning, the culture of the pupils and teachers as well as how these are all integrated for teaching and learning purposes.

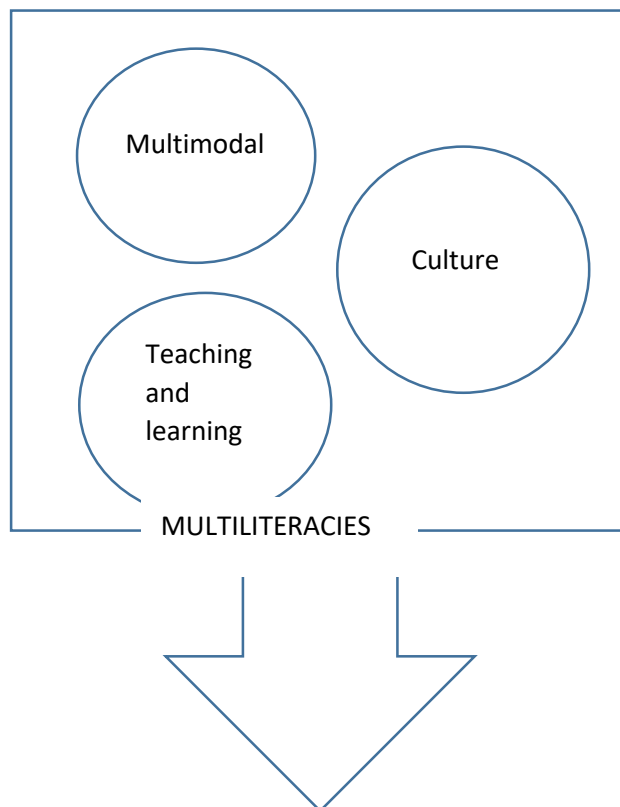


FIGURE 2.3 Influences on multiliteracies

2.8.3 TPCK

The TPCK framework, as mentioned in Chapter 1, is used to assist teachers with the implementation and integration of technology within their classroom practices and pedagogies. Although technology is a LTSM and tool that teachers are expected to implement in their classrooms, the technology, pedagogy, content and knowledge application has not kept up with this expectation of integration (Erduran & Ince, 2018; Hofer & Grandgenett, 2012). The use of digital technology, especially 1:1 devices, is seen as a motivating tool and is used to cater for 21st century teaching and learning. When technological devices are used to change or redefine the way knowledge is taught and learnt, the learning situation should be revised as traditional teaching and learning methods need to be aligned with their use. Due to the ever-evolving nature of technology, teachers have to be willing to adapt to and continue learning from the evolution of technology. The TPCK model incorporates the technological pedagogical framework of this study.

TPCK stands for technological, pedagogical, content knowledge and is based on Shulman's (1986) initial framework of PCK, which includes the concepts pedagogy, content and knowledge. This framework is often used by researchers to analyse teaching practice. When PCK was introduced, there was little integration of technology in classrooms so there was no need to incorporate this into his framework. Due to the advancement in educational technology, TPCK was conceptualised by Koehler and Mishra (2009) to integrate technology for effective teaching and learning.

TPCK requires an understanding of the relevant concepts so that technology is successfully incorporated into the pedagogical techniques and classroom practices. TPCK provides a framework for maximising the use of technology to assist pupils with academic challenges. TPCK explores how technology can build on current knowledge to cultivate innovative epistemologies or reinforce existing ones (Koehler & Mishra, 2009). In Koehler and Mishra's (2009) formative structure, they discuss the technological pedagogical content knowledge with the acronym TPCK. They have since revised it to TPACK, as referenced in Hutchison, Beschorner and Schmidt-Crawford (2012) as well as Hutchison and Woodward (2014). Mishra and Koehler (2006) focused on the increase of technology that is used in schools and how to address the lack of knowledge of its effective use for educational purposes.

The TPACK framework suggests that content, pedagogy, technology, and teaching/learning situations influence each other in individual or group settings. Teaching effectively with technology means looking at continually producing, maintaining and finding a balance between all the components mentioned (Koehler & Mishra, 2009). TPACK strives to assist teachers in understanding the different

types of knowledge required in order for them to integrate technology effectively in their lessons (Koehler & Mishra, 2009).

Research done by Hofer and Grandgenett (2012) with pre-service teachers as well as Ling Koh, Chai and Tay (2014) in their Singaporean study of teachers examined how teachers use TPACK as a professional tool to integrate technology. Both mentioned studies found that during the planning and contextual stages, digital technology can be incorporated successfully by using TPACK. Both studies encouraged the use of this framework in the planning stage to enhance learning by creating environments conducive to information and skill gaining.

The individual components of the TPACK model are meaningful on their own, and the relations between the components are just as important (Koehler & Mishra, 2009). By using the TPACK model, teachers can identify the different levels of technological incorporation that can occur by linking it to pedagogy, content and knowledge (Morris, 2018). As teachers develop professionally and become more confident in implementing new approaches, their improved perception of the integration of technology assists in the understanding of the other TPACK components. The focus should, therefore, not be on the digital device but on how pedagogy is reinforced by technology (Donovan, Green & Hansen, 2012).

TPACK enhances multimodal learning as it links to the digital device in the third space where pupils are creators of their own knowledge. A digital device offers opportunities for teachers to work 'multimodally' by incorporating different modes of communication, which include images, speech/audio, music, writing, gestures and videos. Pupils who have access to these different modes have, therefore, more of an opportunity to work in a third space where they can contribute their own creations of knowledge. The different modalities also accommodate the different learning styles. An example of this is how the different learning styles link with the different modalities, e.g. musical-aural learners prefer auditory learning and verbal learners prefer a linguistic modality.

By integrating this framework, the hope is for an active-learning perspective to take place in classes.

Conclusion

This chapter focused on information, which has been published and relates to the use of technology (particularly 1:1 devices) in teaching and learning, the teaching practices involved in teaching 21st-century pupils, the TPACK framework, as well as the relevance of the third space in relation to the use of digital devices in today's classroom. Many sources were consulted to inform and build on prior knowledge in order to further explain the terms used in this thesis.

By using constructivism, multiliteracies and TPACK, the researcher uses a qualitative research design to explore teachers' perceptions on the use of 1:1 digital devices in the classroom. It is important to understand how 1:1 digital devices affect teaching and learning to enhance the learning experience. The following chapter focuses on the research design, the participants and the methodology used in the study.

Chapter 3: Methodology

Introduction

This chapter focuses on descriptive case study research, qualitative research, the data collection methods used for this research, as well as the theoretical framework used in this study. The theoretical framework (as explained in Chapter 2) includes constructivism as the wider lens, multiliteracies as an inner lens, and the TPACK model as a micro-lens through which to interpret the findings.

As mentioned in Chapter 1, the research question is:

How and why does the use of a 1:1 digital device influence preparatory school teachers' perceptions regarding their classroom practices?

3. 1 Theoretical framework

In Chapter 2, the theoretical framework was unpacked in detail. Figure 2.2 represents the relationship between constructivism, multiliteracies and TPACK. The researcher is able to link with these concepts as she is involved in the implementation of using technology in the classroom (TPACK), she is currently teaching so is actively involved in pupils' learning and the formation of knowledge (constructivism), and is also constantly looking at different ways in which information is presented and perceived by pupils (multiliteracies).

The theoretical framework of this study encapsulates interpretivism and the qualitative approach as these epistemologies and approaches consider individual experiences within specific social-cultural contexts (O'Donoghue, 2019). Interpretivism stresses the importance of human interaction and hence "has to be interpreted and understood within the context of social practices" (Usher, 1996:18). Maree (2016) defines the concept of interpretivism by emphasising the importance of considering the context when interpreting the experiences of individuals or societies. Interpretivism as described by Maree (2016) includes focusing on the participant's subjective experiences and taking into account that human beings interact and are social beings so their contexts are important for the research. By choosing interpretivism as the research paradigm, the researcher is concerned with revealing individual perspectives through social interaction, in particular with regard to digital devices in the classroom.

3.2 Qualitative research

The qualitative research approach was chosen for this study because the participants were teachers at a preparatory school. This links to qualitative research wherein participants' perceptions of a phenomenon are described within a specific real-life context (Maree, 2016).

As stated in Maree (2016), qualitative research involves words and data which are collected and which are descriptive in nature. This means that the data are explained and describe the characteristics of the phenomenon. Qualitative research also involves doing research in a naturalistic setting where participants are actively involved in a classroom setting (Maree, 2016). The findings are valid if the data which are collected are a reflection of what the participants are actually experiencing. This relates to a strength of qualitative research where research is done in a real-life context. According to Bogdan and Biklen (2007), qualitative research is the study of a particular phenomenon which takes place in a specific setting and research needs to be conducted in this context where the researcher is able to accurately capture information.

A qualitative research study often uses open-ended questions, and images or linguistic data to generate detailed data (Creswell, 2013). Qualitative research often focuses on social phenomena and descriptions which answer "how" and "why" questions. Qualitative research can also be informative by providing information to the public which will be of value to other studies (Cresswell, 2013).

A small sample size is used in qualitative research because the researcher cannot interview the whole population; the sample size is chosen as it is representative in nature. The nature of this study is to understand the participants' perceptions of 1:1 digital technology as this field is relatively new and a growing research field in education in South Africa.

Qualitative research is, therefore, suitable for this study to gather data from teachers about how and why they adapted their teaching when the implementation of 1:1 digital devices occurred. As noted by Hancock (2009), qualitative research involves a person's thoughts, approaches and experiences. This further supports the reason for using a qualitative study for this research as individual teachers provided their perceptions on how they adapted their classroom practices to the use of 1:1 digital devices.

The researcher used open-ended questions, which allowed for dialogue and understanding between the researcher and the participants. Open-ended questions are often used to get both facts and opinions from the participants (Dikko, 2016). Open-ended questions are often used when the researcher has some knowledge on the topic and by using open-ended questioning, the researcher can use follow-up questioning and prompts to assist the participants in exploring their perceptions in

depth (Dikko, 2016). The participants in this study answered questions, which related to their own experiences and perceptions of how teaching with 1:1 devices affected their classroom practices.

Borgdan and Biklen (2007) mention some limitations of a qualitative study. They indicate that the researcher might collect too much data, which in turn could become too time consuming which may have an impact on the reliability of the study. There is also the possibility of the researcher being biased, as the researcher is currently in the classroom using 1:1 devices. Therefore, as a researcher certain measures have been put in place to ensure this does not occur. The researcher has been guided by reading up on qualitative research on the choice of data collection. To ensure triangulation and authenticity during interviews, the researcher allowed the participants to reread the data transcription before it was analysed. Regular supervision meetings were held with the supervisor to ensure the researcher was on the right track by voicing the research steps taken and asking for guidance where needed.

3.3 Descriptive case study research

An advantage of using case study research is that it gives the researcher the opportunity to focus on a specific situation or phenomenon and to understand the processes involved in shaping this phenomenon in a particular context (Rae, 2017). Maree (2016) mentions the following types of case studies:

- Explanatory case studies;
- Exploratory case studies;
- Descriptive case studies;
- Multiple case studies;
- Intrinsic case studies; and
- Instrumental case studies.

Yin (2009,) however, focuses only on explanatory, exploratory and descriptive case studies. Table 3.1 describes these categories and provides examples of the contexts in which they could be used.

Table 3.1: Description of different case studies

Type of Case Study	Description	Example of where it could be used
Explanatory	Deals with causal studies (normally looking at sequence of events to build generalisations) by analysing data both at surface and deeper level (Zainal, 2007).	Complex cases, e.g. do students use strategies when completing work online? If so, what strategies. (This study wants to delve further into the subject).
Exploratory	Deals with exploring a phenomenon in which the researcher shows interest (Zainal, 2007).	Pilot study, e.g. a campaign promoting recycling.
Descriptive	Deals with describing the natural experience of participants, which occurs within the data being collected (Zainal, 2007).	Journal description, e.g. scandal in government reported by reporters.

The chosen design for this specific study is the descriptive case study. Descriptive case studies provide awareness of a specific topic and describe a regular socio-cultural occurrence within a natural setting and specific context (Zainal, 2007). One of the goals of descriptive case study research is to report what the participants have perceived and experienced regarding a phenomenon or phenomena within their specific socio-cultural context (Zainal, 2007). Yin (2009) agrees with this and states that using a case study design allows the researcher to obtain an understanding of a precise situation or phenomenon. This type of study requires obtaining data which are in depth in order to find a recurring theme. Yin (2009) also describes a descriptive case study as one that is used in a real-life and current situation. The phenomenon in this study is human-technology interaction, specifically as it relates to the perceptions of teachers regarding the use of a 1:1 device as part of their classroom practices, within a preparatory classroom context.

Advantages of conducting a descriptive case study are that the data are rich; the data often illuminate the meanings that participants attach to the phenomenon; furthermore, the data provide a deeper understanding and, subsequently, an improvement in practice can result from a descriptive case study; readers can often learn more about the phenomenon due to the detailed narrative descriptions of the findings (Rule & Vaughn, 2011; Stake, 2005.). Specifically relating to this study, an advantage of

using descriptive case study research is that it is an appealing design for the education sphere. It generates detailed data and takes on narrative form, which other researchers may build on in their research. A disadvantages regarding case study research is that the researcher is the primary instrument for data collection and analysis: the researcher is left to his/her own subjective instincts throughout the study (Stake, 2005). Another disadvantage is the time needed to conduct a descriptive case study, which requires detailed and precise findings (Stake, 2005). Due to descriptive case study research focusing on a single phenomenon, where the sample needs to be representative, there is the concern that the findings are not generalizable to other contexts (Stake, 2005). The researcher addressed these disadvantages by remaining objective, by using relevant literature to guide the study, and by carefully analysing and interpreting the data.

The descriptive case study design is suitable for this study because the researcher generated rich descriptions relating to the teachers' perceptions on changes in their classroom practices resulting from the introduction and implementation of 1:1 devices inside their classroom environment. Descriptive case study was also chosen because of the real-life applicability of the phenomenon, that of using digital devices to influence teaching, which was researched in its natural environment. This links closely with the theoretical framework and constructivism in that new knowledge is gained by experience and interaction and teachers and learners form their own knowledge by using these devices.

3.4 Context of the study

The school in which the study was conducted is an affluent, private school in Irene, Gauteng where devices are used in the classroom. Pupils who attend this school come from well-of families that can afford private education. Although there are some bursary pupils, the majority of pupils come from families who can afford the school fees. The school is a non-profit organisation and the funds are ploughed back into the school. In 2015, the chosen school had to decide on which 1:1 device to implement. The college section of the school (Grade 8-12) had already implemented 1:1 devices in the form of BYOD and the preparatory school had taken the challenges experienced there into consideration when deciding on a device. When the school decided to implement electronic textbooks, there was a need for each pupil to have their own device. This decision was taken by the senior academic staff members after deliberation.

A contributing factor was that the pupils' bags were getting too heavy to carry. The increasing cost of textbooks to families was another concern. By buying online textbooks, which have a perpetual license (a once-off payment and the school owns the electronic textbook, which can be passed down from

year to year), the school and families could save costs. A team of senior educators and the IT department were involved in deciding on the relevant platform for the textbooks.

ITSI was chosen as the platform for online textbooks. The next consideration was the choice of device. ITSI is an educational technology company, which aims to merge traditional teaching methods and those of technology-led education. Due to the age of the pupils (Grade 4-7), management decided it would be best to select a single device as opposed to pupils using different devices. The device was chosen by the same academic team who did research in conjunction with the IT department. It was decided that one device would benefit the younger pupils as no status comparison of devices would be made. All devices would have the same appearance and functionality. Thorough research was conducted along with cost analysis, durability, and battery life. By using a single device, teachers could be upskilled to assist in managing minor issues in the classroom. IT would support other technological issues.

3.5 Participants

Eight participants were selected for this study, as the number is representative of the population of teachers in the senior preparatory school: the academic team consisting of 28 teachers in the preparatory school – excluding the deputies, principal and non-academic teachers. The participants in this study have all different classroom experience in different subjects. By interviewing eight participants, the research attempts to be representative of the population as participants were selected across gender, age and race. The researcher identified themes by using open coding to analyse the data and to draw conclusions. The participants were fully informed of the purpose of the research and provided written consent to voluntarily take part in this study. Permission from the school and board of directors was also obtained.

The researcher reassured the participants that their responses would be used only for the study and that confidentiality would be maintained in this study. Interviews were conducted at a time that was convenient to them – not during academic school time but during the afternoon when their co-curricular activities were completed or over weekends or holidays. Table 3.2 describes the demographics of the participants.

Table 3.2: Demographics of Participants

Participant	Age	Number of years teaching experience	Gender	Race	Subject currently teaching	Grade/s teaching
A	30	8 years	Male	White	Maths/IT	Grade 5-7
B	55	26 years	Female	White	Class Teacher	Grade 4
C	28	5 years	Female	White	Natural Science	Grade 7
D	34	11 years	Male	White	Maths	Grade 5-6
E	30	9 years	Female	White	Art	Grade 4-7
F	29	5 years	Female	White	Social Science	Grade 5-6
G	29	3 years	Male	Black	Sepedi/Life Orientation	Grade 5-7
H	35	12 years	Female	White	Afrikaans	Grade 5-7

Teachers from different learning areas were selected to represent all subjects across different grades. A mix between male and female participants with different years of teaching experience was chosen in order to gather a fair representation of the total population. By choosing people of different genders, race and age, the researcher hoped to identify themes, which stood out or themes which were relevant to a certain “type” of teacher.

3.5 Data collection

Interviews were used as the data-generation method in this study. Rubin and Rubin (2012) mention that interviews provide researchers with rich and comprehensive qualitative data, which describe the participants’ viewpoints of their experiences. Maree (2016) mentions different types of interviews. The table on the following page displays information regarding the different types of interviews.

Table 3.3: Types of Interviews

Type of Interview	Definition	Example of where and how this interview method is used
Open-ended/Unstructured Interview	According to Zhang and Wildemuth (2016), unstructured interviews do not have predetermined questions but rely on the conversations, which occur between the researcher and participants.	Used to draw on individual's own realities (Zhang & Wildemuth, 2016). Used to gather in-depth understanding of a concept (Zhang & Wildemuth, 2016).
Semi-structured Interview	According to Luo and Wildemuth (2016), semi-structured interviews are useful in gathering data of a phenomenon in which the researcher is interested and asking questions relating to specific information relating to the phenomenon.	Used to support data, which emerge from other sources (Maree, 2016).
Structured Interview	In a structured interview, the questions are carefully designed to be asked in a straightforward manner (Maree, 2016). There is no flexibility and the researcher is looking for facts as answers (Maree, 2016).	Used in multiple case study research and when looking for specific answers to questions (Maree, 2016).

The data-gathering process involved individual semi-structured interviews as this allowed the participants to fully engage in discussions where they felt comfortable to express their opinions and experiences. There are certain drawbacks when using semi-structured interviews. A researcher may not be experienced enough to prompt or probe during the questioning, which will then lead to irrelevant data being gathered (Galetta, 2013). In this study, disadvantages were addressed by carefully selecting the participants, by ensuring confidentiality by not naming the participants, by preparing the questions carefully, by asking probing questions during interviews, and by ensuring the sample was large enough to be representative of the population.

The purpose of using semi-structured interviews is to create an open conversation (Yin, 2009). Cohen (2000) also states that these interviews allow the participants to express their personal views when answering the questions. Interviews are suitable when one wants participants to share reflective knowledge (Cohen, 2000). Semi-structured interviews were selected for this study because the researcher had a set of defined questions but also wanted the opportunity to probe for more detail should the participant not give sufficient information. The researcher also had some knowledge on the phenomenon being studied and wanted in-depth answers to guide the study.

A set of pre-existing questions (see Appendix C for the Interview Schedule) was used to guide the conversation. The researcher took notes during the interviews, which were then transcribed. The participants reviewed their responses and they were allowed to make changes by adding or deleting certain quotations. I also included the participants in member checking, where I explained my understanding of the data analysis and asked the participants if they agreed with the outcome (Clark & Creswell, 2015). Each interview took about 30 minutes to complete and was conducted at a quiet time in a place on the school property that suited the participant – often in their own classrooms.

3.6 Data analysis

This study used qualitative data analysis in order to understand how teachers adapted to teaching with digital devices. When conducting case study research, it is important that high quality data are collected and properly analysed (Patton, 2001). Yin (2009) and Rule and Vaughn (2013) further emphasise the importance of data analysis in the reading for themes in the selection of the data collected. According to Engel and Schutt (2013), qualitative data analysis strives to explain the written and documented data so that the setting is understood.

In this study, the correct procedures were followed that reduced the possibility of the researcher making generalisations. The researcher transcribed each interview. By using open coding, the researcher was able to identify relevant themes (see Chapter 4). Open coding links with thematic analysis, which allows for meaning making through thematic exploration in the data. Open coding is used to analyse text in qualitative data. It involves breaking the data down in order to identify patterns and similarities or differences in the findings (Khandkar, 2009). Similarly, Miles and Huberman (1994) explain that coding assists in breaking the information into smaller parts that assists with data analysis. Bryant and Charmaz (2007) agree with Khandkar and add that the data collected may be more descriptive than conceptual. This means that data are described in detail and not just summarised.

In this study, open coding was conducted by looking at the questions and answers provided by the participants. By using coding, the researcher is able to make new connections with the data (Clifford,

French & Valentine, 2010). Clifford, French and Valentine (2010) further state that coding should be done simultaneously while doing data collection and analysis. Bryant and Charmaz (2007) suggest coding the initial data first and then comparing these with subsequent data in order to identify the emerging themes. In this study, the researcher coded the transcribed data by identifying relevant themes which emerged from the interviews, which linked with the strategy put forward by Clifford et al. Open coding also links with inductive data analysis, as data are coded, categorised and clarified to present thematic descriptions of the phenomena (McMillan & Schumacher, 2010).

The researcher followed the following six steps as outlined by Braun and Clark (2006):

- Reading through the transcripts meticulously, highlighting initial ideas;
- Creating codes for specific content;
- Grouping the codes into relevant themes;
- Reviewing these codes and themes;
- Defining the themes by continually analysing the data; and
- Reporting and linking the themes to relevant literature.

Khandkar (2009) mentions the benefits and disadvantages of open coding. The benefits being those of validity of the data collected. The data of this study are valid as the themes were identified across all the interviews and there were common thematic threads in the responses from the participants. The disadvantages include the fact that open coding is time consuming and tedious. The researcher needed to work meticulously, which she did, in order not to miss any themes, which emerged. Bryant and Charmaz (2007) also state that when the researcher begins coding, she may feel awkward in the beginning. However, the researcher will gain confidence and coding will become easier as she becomes more accustomed to coding themes. This observation is relevant to this study.

After careful coding of all the interview data in this study, responses were categorised which assisted in identifying the broader themes. These broader themes were then discussed (see Chapter 4). By using interviews, themes can be developed and then further explored.

3.7 Ethical considerations

By following the correct channels and ensuring ethical clearance was granted, the researcher ensured that the participants took part in this study voluntarily. The participants remained anonymous and their answers were used for the purpose of this study only. Due to the steps taken, the participants felt that they could express their views truthfully. The participants gave written consent to partake in this study and their voluntary participation was emphasised both in the letter to the participants and

during the interview. Participants were also informed that they could withdraw at any stage of the research process without any adverse consequences. All data were stored on the researcher's personal laptop and was password protected.

For ethical purposes, the participants' particulars were not revealed and their responses will remain anonymous.

3.7.1 Trustworthiness

With any qualitative study, the trustworthiness of the study is very important (Maree, 2016). Trustworthiness is the way the researcher collects, sorts and classifies data. The focus is on credibility, transferability, dependability and confirmability. These have been mentioned briefly in Chapter 1.

For this particular study, credibility linked to the significance of the findings whereby participants were able to view and comment on the transcribed interviews. The process of member checking was used to validate the semi-structured interviews.

The transferability of this study relates to other teachers and schools that may choose to implement 1:1 digital devices in their classrooms and schools. This study incorporated rich explanations by describing and reporting the data accurately. By including these rich descriptions, the study could be used to increase transferability to future studies looking to replicate the study (Guba, 1981; Maree, 2016).

The dependability of the data collected was ensured by allowing participants to cross-check their responses. Furthermore, the researcher confirmed that participants were satisfied with their transcripts. By sticking to the research procedures and research question and ensuring the researcher remained objective, confirmability was also upheld.

Due to the researcher having a personal interest at the school, there were also trusted and established relationships. As a researcher, honesty and integrity were acted upon as to not harm participants or the institution. The researcher looked at information, which was relevant to the study and maintained conversations with the participants and school as to how the data were going to be used. The implementation of this study took all ethical considerations into effect and endeavoured to avoid misuse of any information.

Conclusion

This chapter outlined and explained case study and qualitative research as it relates to this specific study. Case study research is relevant to this study because of the specific phenomenon being studied. Data collection methods in terms of the semi-structured interviews were explained. This type of interview was best suited to the study to gather data, which were relevant. Open coding was chosen because it enabled the researcher to identify main themes and to expand on these themes. Ethical issues which could arise for this study were addressed, for instance the anonymity of the participants as well as assuring them of the trustworthiness of the study. The methodology corresponds with the theoretical framework: a qualitative research approach in a descriptive case study allows for the thematic analysis of the phenomenon of technology-human interaction within a constructivist and multiliteracies learning space. The following chapter will look at the data analysis and present the findings.

Chapter 4: Research Findings

Introduction

This chapter documents the research findings by presenting key data from the transcribed interviews. Lauden, Traver and Lauden (1996) as well as Moses and Sibongile (2019) maintain that the effective implementation and use of digital devices to enhance teaching and learning are fundamental when looking at developing information systems at schools. Increasingly, efforts are being made to integrate digital devices into the curriculum, both globally and in South Africa. Subsequently, a certain level of digital device knowledge is required for teachers to utilise these digital devices for professional purposes (Becker, 1999; Spiteri & Rundgren, 2018).

In this study, data regarding teachers' perceptions were gathered and key themes were highlighted. Eight individual, semi-structured interviews were conducted to obtain the data described. Relevant and emerging themes were identified and these are explained in detail with supporting data in this chapter. Subsequently, this chapter is divided into sections according to emerging themes from the questions that were asked in the interviews.

Although there has been some research into the value of 1:1 device usage, there is limited research regarding teachers' perceptions of its usage, particularly in relation to the use in a preparatory school where, in my study, the device is used as an artifact of learning. All participants in this study acknowledged the value of integrating technology in the form of 1:1 devices into teaching and learning. According to the participants, these devices provide pupils with the skills for the future and in particular with the skills required for the fourth industrial revolution. These skills include being able to work with technology in various design stages (management, implementation as well as working with new technology), being able to be flexible and adapt to new work-related situations, and being empowered to express oneself and communicate effectively in a digital environment (Ronchi, 2019). Figure 4.1 displays the themes, which emerged from the findings and the rest of this chapter reviews these in depth. All these themes relate to the participant teachers' classroom practices.

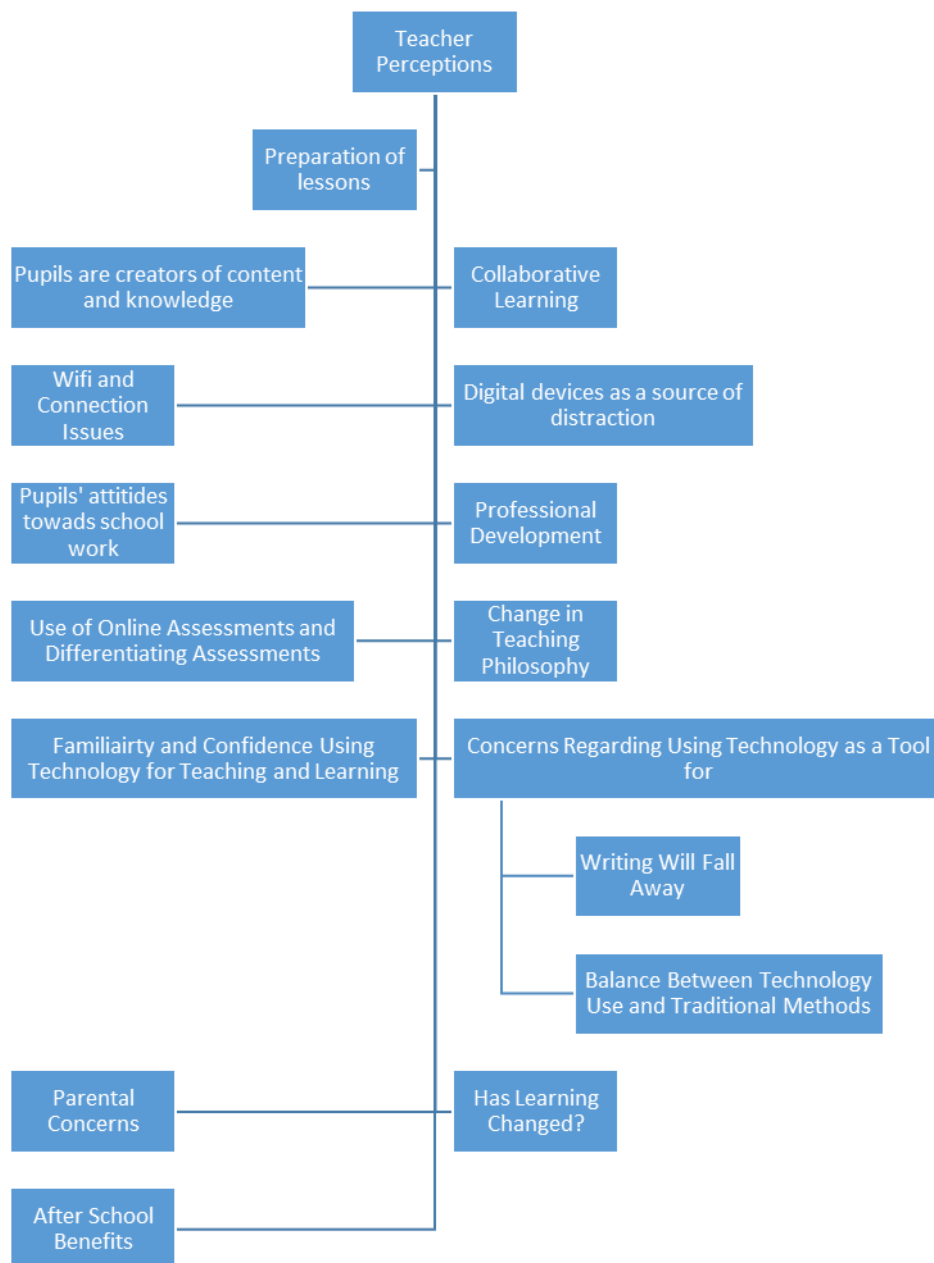


Figure 4.1 Generated Themes

4.1 Theme 1: Preparation of lessons

All teachers interviewed mentioned that their preparation for lessons had changed due to the Chromebook because it provides greater access to detailed and relevant content relating to what they were teaching. This was found across all ages and subjects taught. Table 4.1 (adapted from Chapter 3) provides the demographics of the participants.

Table 4.1: Demographics of Participants

Participant	Age	Number of years teaching experience	Gender	Race	Subject currently teaching	Grade/s teaching
A	30	8 years	Male	White	Maths/IT	Grade 5-7
B	55	26 years	Female	White	Class Teacher	Grade 4
C	28	5 years	Female	White	Natural Science	Grade 7
D	34	11 years	Male	White	Maths	Grade 5-6
E	30	9 years	Female	White	Art	Grade 4-7
F	29	5 years	Female	White	Social Science	Grade 5-6
G	29	3 years	Male	Black	Sepedi/Life Orientation	Grade 5-7
H	35	12 years	Female	White	Afrikaans	Grade 5-7

Seven of the teachers mentioned that they enjoyed having access to a variety of interesting and relevant information due to the Chromebook. However, this required more preparation as teachers needed to search for this content by applying multimodal synaesthesia; they had to shift between different modes when doing research in order to find the relevant information. Even though this process took time, they indicated the educational value that rich multimodal sources of content added to their lessons. Therefore, the learning material, which teachers now have access to in order to better prepare and equip their pupils, is of benefit to the pupils in their classes. Three participants also mentioned how this extra multimodal material is available instantly and that it can be 'sent' or 'posted' to the pupils in a digital format. This process entails that the teachers attach the documents and media to a portal – in this case, either in the Google Classroom or in their online textbooks.

Half of the participants mentioned that their formal preparation of lesson planning remains the same but it is the digital add-ons, which have added time to their preparation. They were not only using the textbook to prepare but also looking for other relevant information online to support their preparation. Participant F mentioned that the preparation is now more in depth in terms of the researching the relevance of and what new information is available. Participating teachers were able to interact more with the pupils regarding the learning content by involving them in the lessons and allowing pupils to take charge of certain sections regarding research such as pupils researching and

then presenting a section to the class or pupils actively getting involved when questions are asked by peers.

All the participants also generally commented on the varied content which can now be used. In the past, mainly hard-copy pictures and visuals were added for pupils to help them form an image of a learning concept. However, the Chromebook gave teachers and pupils access to videos, Google searches, blogs, podcasts, photos and diaries. This incorporates the TPACK model used as the theoretical framework of this study, and which is discussed in Chapter 5. In the preparation of lessons, participating teachers noted the need to source relevant and suitable content in their fields and subjects. This is required as there is so much information available that they need to decide what is most appropriate for the level and subject they are teaching, and this process added to their preparation time.

With the use of technology and the new forms of content teachers in general, and the participants of this study in particular, have also become more interested and their senses were awakened by using multimodal resources and by applying synaesthesia: using more than one sense to process and form new knowledge or gain information by using different semiotic modes. The participants mentioned that they are now also learning, which is an important life-long skill. The participants mentioned that they no longer need to have access to all the relevant information; pupils have access to searching for information and are guided by the teachers to choose the relevant information. This also assists with the participants' preparation as they took learning through discovery and cooperative learning into consideration when planning is done.

Participant B mentioned:

But there's also far more scope because you can allow the children to research certain things and there's far more information you can guide them to use than ever previously.

Participant E mentioned:

The content that I can give the children is a lot more, like I can give them images, make shared drives for them to use. I push the content to them or I create shared settings because I can't put it on the textbook. I basically make shared drives between the classes or they do like collaborative work which also makes it easier for me because you have everything digital, the notes are there and then while they work you can also comment which helps with the prep for the next class, it's easier for me to prep with the Chromebook than before.

Hutchison (2012) mentioned that teachers need to carefully plan the integration of technology in order for it to be effective by integrating TPACK into teaching and learning. Hutchison (2012) also

mentioned the importance of teachers realising that technology can be used effectively in the classroom. Participants adapted their teaching and preparation thereof, keeping in mind the 1:1 devices, in this case Chromebooks, and were required to carefully look at the implementation of lessons. By participants preparing lessons and content, which is relevant, they also incorporate this learning into the third space (see Chapter 5) where pupils can be more engaged and responsible for their own learning. This encourages pupils to become involved and take ownership of their learning. It also helps pupils to determine what content is important and assists the teachers to decide on which level to engage with the content.

Anshari et al. (2017) mentioned that teachers are able to use different mediums and modes when teaching with devices. This links closely with that which participants identified as being of benefit as they realised how much content and varied media are available for their subject. This also assisted with reaching pupils of differing learning styles and interests. Preparation of lessons remains vital as teachers need to integrate different media into their planning and this takes time as the teachers have to identify what is the best for their classes.

4.2 Theme 2: Pupils are creators of content and knowledge

The opportunities available today for pupils to be engaged and physically involved in the learning process through digital technology were mentioned by four of the eight participants. This links closely with the theoretical framework of constructivism that postulates that pupils should be engaged and involved in the learning process. It was mentioned by the participants that the positive influence of the digital devices which serve as artifacts of learning (see Chapter 5) allow for pupils to be more actively involved in the teaching and learning process. As mentioned before by the participants, teachers do not need to have all the information relating to specific topics; they can now guide and direct the pupils in their classes so that the pupils are responsible for their own learning when using digital devices.

Two participants (Participant A and C) mentioned that instant access also assists in this regard as pupils can look for the relevant subject-specific information at any time. Subsequently, there is not a delayed gratification for the pupils, who are used to instant gratification in terms of social media, because they have instant access to relevant information and to solutions to difficult questions. The participants observed that pupils are more involved in the lessons and often have the opportunity to take the lead and present certain sections of the curriculum in the classroom and online. This assists with their understanding and gaining of knowledge.

Participant A mentioned:

In the past kids were driven by the information that was given, now it is not just a case of them taking what we tell them, they can now research and take their education even further. They are not just consumers of content but actually produce content as well.

This links closely with pupils taking ownership of their own educational process and being nurtured and developed to work on their own and gather their own knowledge and skills. Pupils get bored if they just need to absorb information, which is 'fed' to them; they need to be encouraged to be curious about learning (Dann, 2013).

Participant C further mentioned:

Instant access, the kids being able to be creators of content (this has changed a lot). In the past I would tell them what to do. Now I let them do the introduction by themselves, I give them the topic and they will search it and they will quickly make a powerpoint on slides and where it was that every kid would work in a group which I like but each kid would get a slide and instead of me doing the introduction to the lessons, they do the introductions. You don't need to just feed them the content.

This statement also reveals that the pupils have the ability to use their own creativity and talents to present the work in a mode, which is meaningful to them. By not being restricted to certain modes of learning, pupils can explore and define their own learning.

Further statements supporting the fact that pupils are able to be creators of content and knowledge include:

. . . they can now research and take their education even further (Participant A).

. . . you (teachers and pupils) need to develop stuff, you need to think creatively and innovatively (Participant F).

. . . they prefer holding onto something and doing something in class (Participant G)

Anshari et al. (2017) and Harasim (2000) mention that the access to digital information assists the pupils in being more actively involved in the learning process and it allows for collaboration in both the teaching and learning. By pupils being more actively involved, they become more engaged in the actual process of learning by making meaning of the content they need. Two teachers mentioned this

active-learning engagement in the classroom so they must have experienced this process in their classes. Sujee (2019) also mentions that pupils need to be able to adapt to technology and this is closely linked with the way in which they will make sense of the information presented to them. The opportunity for pupils to be actively engaged in learning in the classroom is more prevalent in the 21st century than ever before with instant access to information and the expectation from society to develop technological skills for later in their life as the main features (Ronchi, 2019).

Four of the participants mentioned that pupils of today are more engaged and cope better when exposed to different texts. This is linked to multiliteracies' insistence on the use of different texts to enhance learning (see Chapter 5). This connects closely with pupils being involved in the multiliteracies' principle of designing of the content as they are actively involved. It also links to multimodalities as the pupils are exposed to more modalities and texts than just paper-based textbooks and chalk-and-talk teaching. The new type of pupil sitting in front of the participants led to the realisation by them that there was a need to change the way they used to teach.

By pupils becoming creators and designers of their own knowledge, they learn to solve problems which is a skill needed in the 21st century. By pupils becoming creators of knowledge, they also take more responsibility and are able to identify with the learning, knowledge and skills they are acquiring. The artifact (digital device) should be used effectively to ensure that pupils are creating relevant content and that they are not passive users of the device. By preparing thoroughly and including various texts and modes, the participants of this study used the digital devices effectively in the classroom.

According to the participants, the pupils have equal access to information, both in the textbook and on their devices to explore various digital resources. These include websites and access to what the participants have published and made available to the pupils on the Chromebooks. By the pupils using this access, they are able to form their own opinions and link what they know to what they still want to discover (third space of learning). This is substantiated by Participant A and C as mentioned above.

4.3 Theme 3: Collaborative learning

An aspect mentioned by six of the participants was the importance of collaborative learning. Collaborative learning allows pupils to work together and learn from each other. It also allows for group work and it creates interactive learning environments. Participant A specifically mentioned the importance of the Chromebook by stating that pupils have access to documents to work on collaboratively even if they are not in the same room or at school. Participant D mentioned how he

finds relevant problems and then poses it to the pupils. The pupils then have time to brainstorm and in their groups come up with suitable explanations using the digital devices and platforms such as Google Slides.

The Chromebook, in particular, is run by Google which supports the G-Suites Education applications such as Docs, Forms, Slides and Sheets. All these G-Suites can be shared and then fellow pupils/ group members/ colleagues collaboratively work on and edit the document. This is a form of collaborative learning where pupils are able to engage with each other across platforms. Creativity, individuality and collaboration are encouraged and included in these platforms where pupils add their own twist on these forms of documents by designing slides or documents to represent their learning.

Some of the participants' comments were:

. . . and the collaboration with the problem solving . . . (Participant D)

Google Docs is fine and links to collaboration and I do like that . . . (Participant D)

or they do like collaborative work which also makes it easier (in terms of locating and storing pupils' work) for me because you have everything digital . . . (Participant E)

. . . And for collaborative work like Slides. . . (Participant F)

According to Wagner (2009), communication, collaboration and innovation are important skills which pupils of the 21st century need to acquire. Collaborative learning, which encompasses communication and innovation, is therefore a very important aspect to consider when teaching and learning with digital devices.

Participant D mentioned the importance of collaboration, amongst not only pupils, but also teachers who teach the same or similar subject: Google Docs allow them to work together on a document. Participant D stated that Google Docs automatically saves the work. Thus, work is saved even when pupils/teachers forget to save work or fix an error. Participant E adds to this by stating that collaboration is easier on digital devices as all media and documents are automatically stored. As mentioned by Participant E, it makes it easier for the teacher to view and comment on work on the digital device in real time as it is often a live document. The Google interface makes it easier for collaborative work as a document can be shared and worked on, whether the pupils are in the same physical space or not (O Donnell & Perry, 2013). It also has a track changes feature so the teacher can see who was added to the document, and what each pupil's contribution was.

Participants also commented on the use of a Chromebook as an artifact of learning that allows for pupil-teacher interaction in the form of collaboration. While a pupil is working on an assignment or

document, the teacher can give advice or comment on the pupil's work. This enhances cooperative learning and aids in the pupils learning process with pupils being able to correct their work immediately instead of waiting for feedback. One participant even mentioned:

This has allowed for instant feedback. . . (Participant C)

Harasim (2000) mentions the fact that collaboration is an important skill for pupils to learn as it involves active participation during the learning process. Collaboration also allows for that third space of learning where pupils can take what they know (previous knowledge) and build on it by acquiring new knowledge in a new setting.

4.4 Theme 4: Wi-Fi and connection issues

Load shedding, volatile electricity production, and the subsequent Wi-Fi and connection issues in South Africa were raised as concerns by six of the eight participants. Chromebooks are reliant on Google, which requires Wi-Fi to work. One teacher went so far as to mention:

Of course Wi-Fi on the other hand, if we are talking about that, access is crucial. If kids don't have Wi-Fi to get on to the program, it's actually useless and from a teacher's perspective, teaching at our school and even other schools if the computers are down, you can't do anything. (Participant D)

Chromebooks are reliant on Wi-Fi to send what needs to be printed to the printer. If the Wi-Fi is down, then little work on the device and no printing is possible. The textbook provider does not need Wi-Fi in order to work so pupils are able to navigate and use their textbooks in the case of Wi-Fi or electricity interruptions. However, from the participants' feedback, it was evident that teachers, who set a Google Form as a quiz or assigned collaborative work on a Google Doc or Slide, were not able to complete this part of the lesson when there was a break in electricity as these functions were reliant on Wi-Fi. Additionally, other applications such as Google Classroom or educational games such as Kahoot do not work in the case of no Wi-Fi.

Therefore, when the Wi-Fi goes down, the interaction between teacher and pupils, as well as pupil and fellow pupil decreases as they lose the tool which was enabling interaction. With this being said, the participating school has started to put measures in place such as buying generators and putting in solar to assist with alternate power supply, which should aid with reliable Wi-Fi. Wi-Fi access allows for all pupils to be afforded the same opportunity for learning where they have a tool with information at their fingertips.

Certain negative comments regarding Wi-Fi and connectivity issues, which were mentioned by the participants include:

There are some instances which cannot be avoided like when Wi-Fi is not available and the Chromebook cannot connect. . . (Participant A)

Wi-Fi will also be an issue. . . (Participant G)

Another negative is Wi-Fi, there is an option to help a child whose Chromebook is not charged but if the Wi-Fi is down it's a big problem. Without Wi-Fi, we can't print, we can't do anything. (Participant H)

At the school where the study was done, pupils need to change their Wi-Fi passwords every month. This often causes confusion and often the pupils have to leave class to change their passwords at the IT department. One teacher specifically mentioned:

. . . especially when the Wi-Fi password needs to be changed, that's a bit of a nightmare for us. . . (Participant B)

Another participant mentioned:

Wi-Fi will also be an issue with passwords needing to be changed and then they [the pupils are] out my class. . . (Participant G)

None of the participants mentioned how they dealt with these challenges. However, they were aware of the issues Wi-Fi and connectivity bring as the current devices which the school uses are reliant on connectivity.

4.5 Theme 5: Digital devices as a source of distraction

There were mixed views regarding the 1:1 digital device and it being a source of distraction in the classroom. Some teachers regarded it as a distraction:

Having a Chromebook can serve as a distraction (being able to search online or play games) among other things but this only affects some children. . . (Participant A)

They can be distracted (by playing games) if you are not fairly strict. I think there needs to be control, especially with little ones. . . (Participant A)

I think they get distracted by it and when we are working from the textbook they will just scroll up and down, they would lose where we are, some of them won't highlight, they find the

highlighting difficult (as it is not a manual process of lifting a highlighter on paper) and now if their screens aren't on what it should be, they can play games or open another tab. (Participant C)

I've heard one or two guys [pupils] saying there are one or two guys playing games during the lessons where they are on their Chromebooks with the sound off and I can't see the screens from where I'm teaching in front of the class, that could definitely be an issue. (Participant D)

The distraction and playing games and other applications that even though we try to minimise it, they still find a way to hack it and break through that [fire] wall to rather play games instead of learning. (Participant F)

Conversely, four of the participants mentioned that the teacher and their classroom management style influence the way in which pupils use their devices as educational artifacts. The following aspects were mentioned:

You know I think if you manage your class properly, it can't be a distraction. The Chromebook is so child friendly, you know when you close the Chromebook it doesn't take anything away, they literally open on the same page so when you want them to focus, you tell them to close it. (Participant E)

They are kids so they are going to push the boundaries but I feel the limiting [of the Chromebook's use in the classroom] is the bigger concern. Class management should make it easy for you to not have kids distracted. (Participant E)

In the past when teachers worked from paper-based textbooks, distractions were still present but there is more to search and play on with the digital devices. As mentioned by Participant D, the inability for a teacher to monitor what a pupil does on their screen also remains a concern. This participant noticed this when the teacher asked pupils to read and realised they were not following on the screen. The participants did not mention how to overcome this form of distraction but raised it as a concern. There are certain programs that can assist with this such as Google Guardian but nothing is currently in place at the participating school.

4.6 Theme 6: Pupils' attitudes towards school work

Participants had varying opinions with regard to pupils' attitudes towards using the Chromebook for schoolwork. Participants who taught the younger grades (Grade 4 and 5) indicated that the pupils' enthusiasm and interest in lessons were higher than those who taught the higher grades (Grades 6

and 7). A contributing factor is that the 1:1 Chromebook as an artifact for learning is new in the younger grades (this being Grade 4 and 5). For the older pupils (Grade 6 and 7), the novelty of the 1:1 digital device has worn off as mentioned by Participant F; yet six of the participants recognised that pupils enjoy and prefer to complete work using the digital device.

Some comments regarding pupils being excited to use the Chromebooks were:

I do think they, specifically my subject (Math), I think they enjoy having the technology right on hand so that they can use it. (Participant D)

With the Grade Fours yes [they enjoy using the Chromebook], and Grade 5, you can see especially when you make it exciting and you incorporate group designs and stuff like that where they can actually work together, you can then see where it's being edited. . . (Participant E)

So if I compare them to previously, the pupils I teach now, they want to learn, by using their devices. (Participant F)

They more interested, for me it's been positive in class. (Participant G)

In certain subjects, the participants mentioned the following with regard to the older pupils and their attitudes towards using the Chromebooks:

. . . but as soon as you get to Grade Six and Seven, it's just the same old, same old. So you have to keep finding something new and fun and creative in your subject and with the Chromebooks to keep their attention otherwise they are going to get bored. (Participant E)

There were also those teachers who noticed no change regarding pupils' attitude. Some of their comments included:

Well I don't think there's a change, they are just more on the screen so I don't know if they come early just to play games or if they are here because they want to be at school. (Participant H)

There's not really a difference because it's more about the content than the resources that you use, for me, and I think if it was a different subject it could be different but my subject (Science) is practical. The attitude hasn't really changed, they are not more involved – much the same. (Participant C)

Although asked about the participants' views on the link between academic achievement and the use of the Chromebook in class, the participants could not link the change in attitudes to a change in academic performance. Participant G mentioned:

It does affect academic performance, but there needs to be further studies and it will take years to reach the conclusion. You need to look right up to varsity. (Participant G)

A study on academic performance would need to be a long term project across all phases and curricula in order to draw a valid conclusion; with the rollout of digital devices (1:1 specifically) this type of research could be something to look at in the next couple of years. Notwithstanding, with pupils being more responsible for their learning, pupils have access to resources which could be of benefit to the improvement of their current skills and knowledge.

4.7 Theme 7: Professional development

Professional development proved to be important as certain participants stated that it assisted them with new ways of implementing learning in their classrooms by using the Chromebook. Teachers in general often judge their own ability and are nervous to implement something they have not tried before (Hung & Hsu, 2007). Teachers need to be assisted with the skills and offered support to effectively implement teaching with technology, which will be beneficial to pupils in their classrooms (Hung & Hsu, 2007).

Comments from participants regarding the in-house professional development, which initially involved how to use a Chromebook in the classroom, include:

. . . in the training sessions sometimes (our professional development group) it's too big and it goes too fast. (Participant B)

So I think you need to work with it a little bit so that you get used to the program itself and now we have the professional development sessions. (Participant D)

We also have professional development which is of value as we have training sessions. These are especially useful to new staff and we like to give over new information and skills which would be relevant to their teaching practice. (Participant A)

Two of the participants mentioned that they would prefer to know what was going to be covered in the professional development sessions so that they could decide if they needed the skills. Management however, would like all teachers to attend as then they know what knowledge and skills were transferred to the teachers and teachers know what is expected. Teachers showing an interest

in attending indicates initiative and the desire to implement these skills/tools in the classroom. Participant B mentioned that she would prefer smaller sessions as then the skills can be practiced and not rushed as there is often a time limit. She also indicated that with many people attending, it could be overwhelming for those who are not as comfortable with digital devices.

An important part of professional development is incorporating TPACK as it encourages teachers to use technological skills and to change their mind-set and pedagogy. The Chromebooks and Chrome Suites added to the prescribed content (as found in the textbooks) and the participants realised that this provided for increased access to relevant knowledge found on the internet.

Google forms a part of the school's philosophy in their teaching methods and this is an important factor, which was also raised by participants. It is important that the teachers need to be comfortable working on the Google platform in order to effectively use this in their classrooms. A few comments regarding Google training were:

I would also suggest sending them [new teachers] on training where they can get acknowledgement like the Google training. (Participant A)

Google also keeps adapting things and that is challenging for me. (Participant B)

I would say do Google training as it teaches you the programs but also changes the way of thinking and you must open up a big world. (Participant C)

Training, like the Google training and definitely sitting with someone. . . (Participant E)

Participant C and D encouraged doing the formal Google training certificate. However, Participant F and H suggested that teachers first experiment on the Google platform and get used to the applications before completing the training. There are, therefore, mixed views, depending on the participants' competency regarding the formal Google training.

From the interviews, it became evident that participants seem confident in their abilities to implement learning with the Chromebook with the assistance of effective and continuous professional development. Many of the newer participants stated that they needed to adapt quickly to using the Chromebook in class but were offered support where needed. Some teachers take responsibility for their own understanding and implementation while others need more support.

Islam and Grönlund (2016), Penuel (2006) as well as Ruggiero and Mong (2015) mention that the successful implementation of 1:1 devices requires effective professional development (as mentioned in Chapter 2). Machado and Chung (2015) also mention the importance of improving a teacher's practice through professional development by effectively integrating the implementation of digital

devices in the classroom. The professional development also assists in informing teachers about using the digital device in the third space as an artifact for learning.

4.8 Theme 8: Use of online assessment and different types of assessments

One of the biggest changes within teaching practice when using 1:1 devices is the change in the methods of assessment. These devices create opportunities to assess in varying ways. Therefore, teachers have to use the devices for assessments as well. Using the Chromebook changed the participants' perspectives on how assessments should be implemented.

Participant A mentioned:

The Chromebook has also opened different ways of assessment such as online or video assessments which help with children who battle to read. You now have the ability to assess to different strengths and by doing this you are actually levelling the play field.

This shows the benefit of not only the change in formats of assessment – linking to multiliteracies and tapping into the new generation and how they learn – but also enhancing pupils' different strengths through the use of various modes or multimodality. This also links to pupils' varying abilities and how different pupils learn. Some pupils are more verbal, others visual therefore we need to ensure we are reaching pupils using their strengths in mind and building on their weaker areas (Skerrett, 2010).

Participant B mentioned that when using online assessments, it is easier for the teacher to determine with what content the pupils struggled with; this assisted the teacher in their reflection on assessment and how they needed to adapt the assessments. This assists with the moderation of both setting and marking of assessments and tests. With online assessments in Google, teachers have the ability to view all the children in a specific subject and grade, not only those that they teach. This gives a holistic view of where the group of pupils' (with different teachers) progress lies. Participant G agreed with these statements and mentioned:

From an analysis point of view, especially doing assessments, you can pick up trends, quicker than if you marking, and it wouldn't be as accurate as those where it shows you where they battle. Then you know you need to go back and address this again.

Google Forms was mentioned as a popular method of assessing pupils. Some statements regarding the use of Google Forms were:

The marking has become easier because we can use Google Forms so if you have a short topic the marking has become less. (Participant C)

One tool that we have been using is Google Forms and we are looking at doing at least one Google Forms assessment per term with each grade. (Participant D)

Also on the Google Forms they get an email with their results and they can see which questions they didn't answer and which questions were wrong, they can look at that and I go through that with them but again the actual writing of your normal assessments (paper-based) as they do on a weekly basis we haven't changed the way we give feedback on those assessments. (Participant D)

I love using Google Forms, I feel that helps me a lot even though I do go back and check the answers and adapt them, it's such a nice way for the computer to help me as I can set up some questions which are yes/no or easy to mark but then also I don't need to bring that whole pack of books to finish the marking. (Participant F)

Marking yes in a positive way because of the Google Forms and the computer marking. And then also for me it gives me more time to reflect on the kids work so, for instance, if today the computer marks it I can go in and check things and specific questions. (Participant H)

From these statements, it is clear that most teachers found effective ways to use Google Forms as an assessment method.

Participant A, C and D mentioned that effective and quicker feedback is possible when completing online assessments for marks; teachers can give feedback almost instantaneously and pupils can view their mistakes. Teachers can also use this to guide the pupils in the learning process. Feedback is an important part of the learning process and pupils are able to learn from their mistakes whether it is on a hard copy or digital format.

Teachers, however, still need to ensure that assessment is both fair and valid while reaching more pupils through the varying methods of assessments. Feedback, in whatever form, is integral in the learning process and teachers need to ensure pupils learn from the assessment process. Online assessments incorporate various modes (by using visuals and audio) which should address the varying needs of pupils.

In the past, assessments were conducted on paper where pupils were required to regurgitate learnt facts. Today assessment is skills based and applying knowledge to new situations. The use of a digital device as an artifact for learning allows pupils to apply themselves in various activities where

assessment is not only in the form of tests but include online collaborative work, and research. These assessments allow for both formative as well as summative assessments.

4.9 Theme 9: Change in teaching philosophy

The digital device required the participating teachers to change the way they prepared and delivered a lesson and the manner in which they reflected on these lessons. Participant C in particular mentioned:

I think children have changed and we all still learn the same but the kids world, the world they live in, is different to the chalk and talk world.

This statement shows that teachers had to adapt as they needed to be flexible in teaching with the Chromebook. Participant E further mentioned:

Kids don't think the way we used to think, you can't teach a new way of thinking to children the old way. You can't use old teaching habits to teach new content and technology and new ways of learning and new ways of assessment and criteria. You basically then not allowing the kids to transition between what we used to have as children and what they are currently experiencing. Society has changed the way you can teach, it's not the same.

It shows that participants need a change in mind-set to be able to teach the children of today. In relation to this participant G mentioned:

I'll go back to my first point where kids are not the same and they all learn differently and looking at our country at the moment, the diversity. The world is changing around us and that's the big thing. So if you are not preparing the kids for the world they are going to live in, we are setting them up to fail. As an educator, that is the vision you have to have. It is there to link with the children.

Participant F mentioned:

If some of us don't use it [Chromebook], it's like failing the system and I think that is a bit negative as some teachers aren't working with it and I feel some teachers don't want to learn, they just want the answers and it won't work like that, you need to teach yourself and you need to want to use the device because that is the future and what we use and you must work together. I think it depends on your attitude and some people just don't like technology.

This participant highlighted the importance of all teachers embracing the new way of teaching and learning. Teamwork in the education sphere is essential and the participants are already pulling from each other's strengths in order to grow and develop. Mentoring and peer coaching are professional development strategies, which can enable teachers to become more confident in themselves using technology as a tool to teach with. Participant A, who is involved in staff development stated the following, which adds to the reasoning of teachers working together in change:

You have to have buy in from the teachers as it makes life easier for other people. You will always find though that others will never buy in it doesn't matter what you do. You need to look and work on your staff as it depends on their personalities.

Therefore, the use of the Chromebook changed the participants' teaching philosophies in the following ways: change of view of using digital technology and integrating technology into their lessons, ensuring they are using diverse methods to reach more pupils (multimodality), collaborating with colleagues, and embracing change and professional development.

4.10 Theme 10: Familiarity and confidence using technology for teaching and learning

The following pie chart (Figure 4.2) shows the relationship between those participants who were comfortable and confident using a device and those who were not confident.

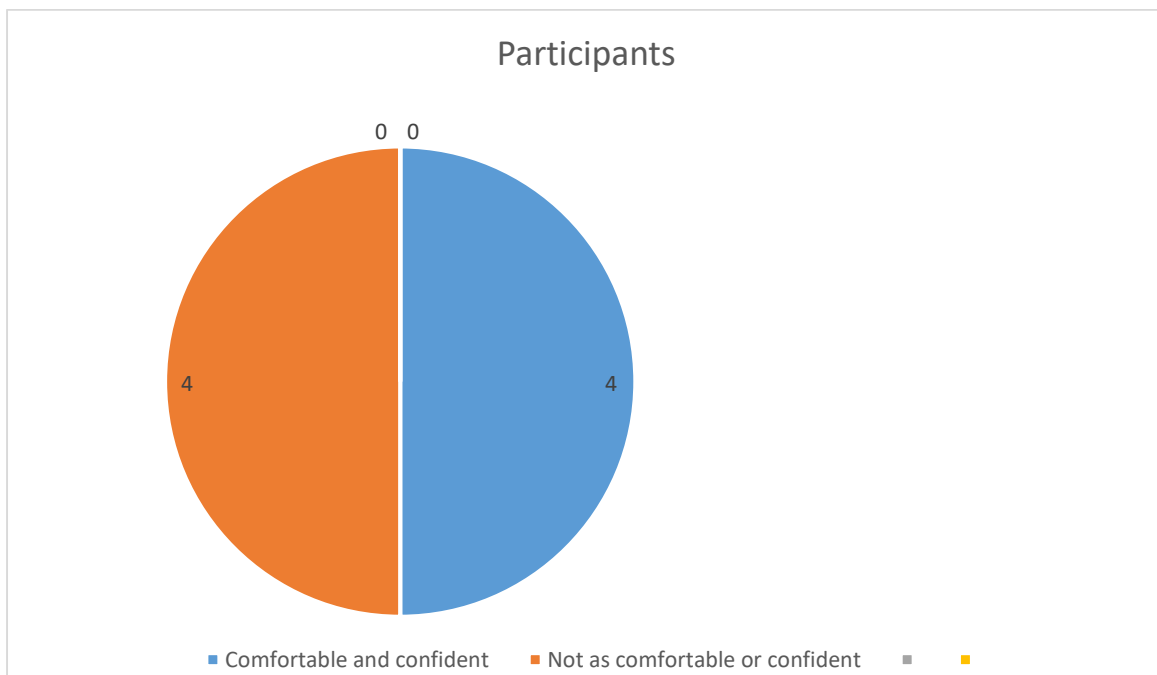


Figure 4.2: Pie chart showing the confidence levels of participants

The pie chart illustrates that there is an equal number of participants who are confident and comfortable and those who were not as comfortable and confident in using the device. Regarding those who were not as comfortable and confident, these participants have either been teaching for a longer period or have not experienced this inclusive technology teaching. Therefore, the adaption to new ways of teaching prove challenging. Some were not present during the implementation and rollout of these 1:1 devices and therefore have not had access to the same training. A few comments from these participants are:

I was terrified at first, getting used to the technology because I've come out of a background with no technology so it was very daunting and hard to believe that I would get it right and I've needed a lot of support. (Participant B)

Google also keeps adapting things and that is challenging for me. I'm the type of person who gets stressed about it, the younger people seem to take it in their stride. (Participant B)

As I've mentioned with the device and being in front of the class, that's one of the most practical things that I still need to figure out. . . (Participant D)

I think because I was not used to using any of these technology I was thrown in the deep end which is possible because I learnt it so much quicker than I actually thought but then you have to use it. (Participant F)

For me it was the Google Classroom – to figure that out and also what goes with it is Google Docs and how to get your test perfect and to figure out all the settings and all of that. (Participant H)

The comments made by the participants demonstrate the different needs the participants had and their perceptions on utilising these devices for teaching and learning. Some participants focused on the challenges caused by the software and programs while others mentioned the logistics of teaching when using devices.

With regard to those who were more comfortable, a few were younger generation teachers while others were open to change. Their comments included the following:

[I did] Not [struggle] much as I enjoy the technology but as a teacher you need to realise the stuff you struggle with, you just need to work on it. (Participant A)

They came in [the devices] early in my teaching career so I didn't really struggle to adapt. I am younger and I work with computers a lot so the adaptation was easy for me and I enjoyed it a lot and like I said in Science, they can have access to their device. (Participant C)

The transition was easy as I wasn't in a rut so the adaptation was actually nice. (Participant C)

To be honest I found it really easy to adapt to the Chromebooks because I see how technology is basically the children's future whether it comes to design, fixing IT, whatever it is I see what the benefit is to the future so it really wasn't difficult for me to adapt. (Participant E)

. . . I've embraced the change. . . I've had no issues. It's actually working smart, not working hard. I've enjoyed it. (Participant G)

The participants had positive responses and were able to adapt their teaching styles and classroom practices to teach with the Chromebooks. It is evident that training, years of teaching, as well as when a teacher joins an institution affects their confidence in using a digital device for teaching and learning. This is important as teachers need to adapt to new educational environments, and the different learning approaches a school practices.

4.11 Theme 11: Concerns regarding the use of technology as a tool

A few teachers raised some concerns regarding the use of technology. These are discussed under the sub-headings below.

4.11.1 Subtheme 11a: Writing will fall away

The basic skill of writing was brought up by participants (across all departments) and they felt that this remains an essential skill for pupils to master.

Participant B, who is in the language department, stated:

I just haven't got to the point yet where for English I have actually put their paragraph writing assessment online. I know it's possible and I have thought it's good for the children but at this stage just to teach them (Grade 4) to type with a capital letter and full stop is difficult.

Participant G, who is not in the language department but is involved as an HOD, mentioned:

. . . they don't like writing so much although I still feel we should not neglect, we need the balance but the kids prefer it [typing and navigating online] as well as it's just the touch button. It [the device] takes away the writing element, and yesterday even as a teacher when I needed to write on a board, I'm so used to technology. It's a simple word like 'ambitious' where when you type it the computer fixes it for you, now I must think when I'm writing so that element is

falling away and that is scary. If I look at the next generation, my fear is that they are not going to be able to write. You might know the word but you aren't physically writing. . .

I am for the 1:1 devices, even with challenges but I'm worried about writing skills.

Participant H, who is also in the language department, stated:

The writing aspect will fall away but you have the opportunity to have a balance in languages between paper and device. Certain things you have to keep on paper. (No specifics mentioned)

These three participants shared their concern regarding a loss of writing skills, which has a deeper impact than just on writing. It affects spelling, comprehension and understanding (Johnson, 2013). Interestingly, two of the participants were part of the language department where writing is an essential skill, which is assessed. The art of writing generally begins much earlier in a child's life where they need to acquire fine and gross motor skills, which aid them once they start with actual writing (Johnson, 2013). Mangen and Velay (2010) support this by stating that many children today will learn to first type before using their hands for writing. The skill of typing is an important part of the TPACK model where technology integration plays a role.

4.11.2 Subtheme 11b: Balance between technology use and traditional methods

Three participants mentioned that technology in education should be used as a tool to teach the pupils.

Participant B mentioned the following relating to the use of technology integration and hard copy based teaching:

I think the weaker children need more of a combined learning and teaching environment [because of the need for learning content in hard copy]. . .

Participant C mentioned:

They struggle to study off their Chromebook and if I compare it to the high school where we had [hard-copy] textbooks, their marks and the way they learnt was easier and more practical, they could make notes next to the paragraph where now it is more difficult because of the program [Google Suite/Docs]. In the [hard-copy] textbook that we use, there's one or two paragraphs which I want to take out or not let them study, you can't take that paragraph out, you have to say "Please don't study this paragraph" so changing content in textbooks is

difficult but adding the notes [in the hard-copy textbooks] is positive. (This make it easier to locate documents relating to a topic).

I think that would be the ideal for teachers where they have a hard copy to highlight and you have a device next to you to Google the work, create your content on this. Ideal world would be 50/50. Would like each child to have their own hard copy to write and make notes – keep their own textbook.

Participant D further stated:

. . . I prefer technology to be an add on to what we've traditionally done. I don't, and this is what I've seen now with my daughter, I don't want technology to be your main source of education and adding onto that with the old basics. Even though it is good in a way, I think you might be losing kids at a young age to have certain basic building blocks in place before they start using technology as something they have to make a job out of one day. I think if we push technology too much, that's not adding on to making our education better, we are taking over with technology and then we are dropping the ball now and again.

Participant H mentioned:

Certain things you have to keep on paper.

The comments made by these participants show that at least 50% of the participants thought it relevant to state that technology could and should be integrated with traditional methods of teaching and learning. They still saw the need and value in paper-based learning. This links to the proper integration of TPACK, which should be linked with the training of teachers.

4.12 Theme 12: Parental concerns

Parents should be involved in the education process and have an interest in what their children are using as a learning tool (Razak, Abdurahim & Mashhod, 2016). Below are some of the comments made by the participants with regard to the parents:

I think personally the Chromebooks need buy in from both the parents and the kids. The Chromebook seems to be enjoyed by the children so there must be some form of buy in from the parents. (Participant A)

We see that it is more the parents who are not used to this platform and they say it is easier to move around a physical textbook. (Participant A)

At this age (Grade 4), they can't always communicate to the parents what you've told them in class so the parents need to know as well, how you are using the device. They [parents] are very concerned about that. (Participant B)

. . . and just from listening to a few of the parents as well, there are some kids who tend to have a hard copy textbook . . . They say when it comes to studying it is more effective and easier, it's simpler to use the textbook to summarise and to study. (Participant D)

How effectively the kids and parents are using it at this stage I'm still not convinced, and even though it's the drive from the school's side and it looks like it's something that practical and could work, if your parents don't buy into the system and they don't keep checking what's going there, when are the assessments, are the breakdowns up, even though they get the email once a week, I feel because some of the parents miss the point of how we want to run the school using Google Classroom, their children aren't really buying into the project itself. (Participant D)

This shows that there are various concerns from the parents' side with regard to how the device is utilised for learning. These concerns include not being able to assist their own children as they do not understand the use of technology in education, wanting their children to still have hard-copy textbooks and to write more, and being worried that their child may lose or break the digital device (Chromebook). Another challenge is the parents' lack of understanding of digital learning. However, as teachers, we need to keep this in mind when setting tasks such as homework or study work where parents are still involved with their children. At the preparatory school stage of the participant school, parents are still involved and it is important to keep this relationship working for the pupils and the families' sake.

Many of the participants mentioned 'buy in from the parents' which shows how important it is for the parents to be supportive of digital education. It is the school's responsibility to assist the parents in understanding how the digital device will be used and ensuring that they are also involved as support. The school does provide support in the form of a "Night School for Parents" but this was not mentioned by any of the participants. Garcia and Thornton (2014) mention three positive factors by having parental involvement for a child's education: improved pupil performance, reduction of absenteeism, and parents have faith in the education system. Kwatubana and Makhamelele (2015)

agree with Garcia and Thornton (2014) and add that pupils with involved parents display better behaviour. It can, therefore, be deduced that involving parents in the learning process is beneficial for collaboration between the school and families as well as effective communication.

4.13 Theme 13: Has learning changed? How do our brains work?

Johnson (2006) mentions that cognitive development considers the change in cognition over a period of time. Healy (1990) and Prensky (2001) mention the elasticity of the brain and that it is an organ, which continually adapts to circumstances. Therefore, the brain can adapt to the interaction when technology is used.

Participant C felt strongly about how the brain works and if the form of learning and physical studying has changed, if at all. Participant C mentioned:

But I think the human brain studies hasn't changed and I think that physical part like a toddler where they use all their senses, I think when you are Grade 7 or matric you still use all those senses to learn and I think the devices limits the senses you use and also your brain learns using your senses, with electronic devices we take away those senses and we don't engage everything and then learning is inhibited and you need to put more effort in if you want to get your top marks and this is where it will affect your lower performers as they don't put in the extra effort.

This statement contradicts what the literature says about digital devices enhancing sensory learning. However, this teacher may not be exposed to this literature and has not explored all the options digital devices have to offer, thus the participant has this view. The researcher identified senses such as sight, hearing, touch, smell and taste. Using our senses links directly with multimodality. In multimodal learning, one needs to explore using different senses for different forms of learning.

Although none of the other participants mentioned the development of the brain, it is a factor which needs to be addressed, thus the incorporation of this topic in Chapter 2, the literature review. Sources state that a child's/person's brain will change structurally according to what they are exposed to (Firth, Torous et al., 2019; Healy, 1990; Prensky, 2001; Rothman, 2016). The younger the child, the more permanent and quicker the brain changes and adapts.

4.14 Theme 14: After-school benefits

Tertiary studies have changed in that they are integrating skills required for the workplace into their coursework. This links closely with the 21st century skills mentioned in the literature review. The integration of technology is important and the need to change the way we teach at school level was mentioned by participants because of its impact on after-school life:

As teachers we don't want the kids just to be consumers but rather producers [of knowledge] which is hopefully preparing them for further studies like varsity and later even work. There are very few jobs today which do not use computers and technology. If you do training with your staff, it is easier at school and they can then use it later in life. (Participant A)

That's what we need in this world of technology, you need to develop stuff (skills), you need to think creatively and innovatively. (Participant F)

It will be more beneficial for the kids, because by the time they have grown up the information is going to be different. (Participant H)

Another factor to consider is how technology has become integral in so many professions so we need to equip pupils early in their academic lives. Clearly a few of the participants have thought about the integration of technology to assist pupils in their future careers. They are not necessarily just looking at the current education system but thinking ahead to prepare the pupils for later in life.

Conclusion

This chapter focused on the findings from the interviews. The findings were supported by what the participants said and how they had adapted to the 1:1 devices in their classrooms. Focal points were that the participants agreed that changes in classroom practices had occurred when using 1:1 devices and most had adapted their classroom practices to this new way of teaching and learning. All participants agreed that the world the current pupils are growing up in is vastly different and teachers should adapt. The way the participants used 1:1 devices in their classrooms and their views on the use differed but each had their own journey in teaching. In the following chapter, I discuss these findings and link them to my theoretical framework and research question, by integrating the literature that was researched.

Chapter 5: Discussion of Findings

Introduction

This chapter focuses on answering the research question: How and why does the use of a 1:1 digital device influence preparatory school teachers' perceptions regarding their classroom practices? This chapter also links the findings with my theoretical framework discussed in Chapter 2 and 3 of this dissertation. I discuss each of the themes separately by linking the research question and theoretical framework to each theme.

Using a 1:1 device in the classroom for the purpose of teaching and learning changed the participants' perceptions of their classroom practices in a variety of ways, as supported by the findings discussed in Chapter 4. They stated that they had to adapt the approaches they used when teaching, and had to reflect constantly on their classroom practices due to the introduction of the Chromebook in their classrooms.

5.1 Theme 1: Preparation of lessons

All the participants acknowledged that their preparation for lessons had changed due to the use of the Chromebook in the classroom. Participants mentioned the importance of integrating different modes of teaching and learning when using digital devices as the content is available in various semiotic systems, including the linguistic, visual, audio, gestural and spatial. This links closely to multimodal teaching because there is a need to include different modes of teaching such as visual, verbal, written, gestural as well as musical in order to address all pupils' learning styles. Kress and van Leeuwen (2006) mention the importance of these multimodal forms of teaching and learning in that eclectic representation and communication is key in the understanding and the gaining of knowledge.

Mishra and Koehler (2006) mention in their study that the connection between TPACK and learning is vitally important when teachers are required to incorporate their knowledge of technology into their lesson planning and preparation. TPACK is a theoretical and pedagogical framework, which identifies the knowledge teachers need to effectively teach with the use and integration of technology. The participants acknowledge that there are varying degrees of competence with regards to the use of technology and that this affects how teachers in general are able to implement it in their planning. Participant B in particular mentioned the importance of TPACK training:

We do need training, the thing is the school is bringing in new young teachers and for them it is easy but for a lot of us, not even those who are my age because some of my colleagues are considerably younger than I am, in the training sessions sometimes (our professional development group) it's too big and it goes too fast.

Participant A also mentioned:

Personally I enjoyed the change but I have been teaching for more years with technology than without so I do not have struggles in particular.

From the findings it can be deduced that with training and support the participants were able to implement TPACK in their classes.

The participants mentioned that the Chromebook, which is a digital device or artifact, has become an important part of their teaching and learning process and they all realised the benefit of incorporating it into their classroom practice. The participants realised that the digital device should be used as a tool or artifact for teaching and learning, where learning can take place in the third space. The participants considered the digital device when planning for lessons as it is the artifact used in the classroom for learning. Machado and Chung (2015) explore this in their study where they found that teachers need to use the tools available to them effectively, in whatever form (in this study – digital devices) to maximise learning in the classroom.

The participants mentioned that they prepare lessons with a wider range of modes and content that allowed pupils to design their own learning. Thus, they used the artifact or digital device to prepare lessons to scaffold the pupils' knowledge. This links to my theoretical framework through constructivism because teachers used the device to assist pupils in forming their own understanding and to build on their current knowledge. By using different modes, multiliteracies are brought into the participants' subject areas and grades as pupils are exposed to the variety of modes, including videos, slideshows (some of which the pupils make and design themselves) that incorporate sound and visuals. Before the introduction of the Chromebook at the participating school, this was not as evident as the learning environment and tools available did not allow for multimodal teaching and learning. This links closely with the four pedagogical acts of multiliteracies, which participants were able to incorporate into their lessons. These acts include *experiencing, conceptualising, analysing and applying* (Cope & Kalantzis, 2009; Engelbrecht and Hugo, 2019). Participants realised the importance of incorporating different modes of learning into their lessons. They mentioned that pupils should be the creators of content, thus, situating them within a multiliterate world. Participants also stated that pupils should be immersed in the learning process by being actively involved while using the digital

devices. Subsequently, this process of the weaving of the different multiliteracies' pedagogical acts was evident in the participants' classroom practices.

The participants mentioned the need to incorporate different modes into their lessons. They added that the increase in multimodal content has changed the way in which they approach their preparation and planning. For instance, in searching for content during preparation, multimodal synaesthesia formed an important aspect of their planning. Multimodal synaesthesia involves using different senses and consciously involving these senses for teaching and learning (Erstad et al. 2019). Participants mentioned that the pupils were more interested and engaged in learning when different sounds and visuals in the form of videos, pictures and varied multimodal material were used in the classroom.

In the planning phase, it is evident that the digital device changed the teachers' classroom practices as they had to change the way they prepared and anticipated the running of lessons. This speaks to the research question, which allows for these changes, as teachers were required to adapt and even change their perceptions regarding the use of the device as an artifact of learning.

5.2 Theme 2: Pupils are creators of content and knowledge

Three of the participants mentioned that it is important for pupils to create content and knowledge. They gave the pupils the opportunities to create their own presentations and slideshows and used peer teaching in their classrooms. The participants facilitated the pupils' construction of knowledge by 'leading' them to find the relevant information and to distinguish between what digital content is important and valid. This point links closely with the literature on constructivism in that pupils use their digital devices for the purpose of learning and forming new knowledge, and that teachers act as the facilitators of learning through scaffolding the learners' understanding (Mvududu & Thiel-Burgess, 2012).

Participants mentioned that collaboration in creating content and knowledge plays an important role in their classrooms; teachers and pupils collaborated on documents. Google Docs were used on which pupils and participants collaborated to form new knowledge in the classroom and outside the classroom. This extends the classroom to the third space where teachers and pupils bring their knowledge from home and build on it, and share it with teachers and fellow pupils. This links to Webster's observation (2018) that learning is not limited to a set framework in the classroom but is expanded to include the pupils' various learning needs outside the classroom as well. The fact that participants have access to different modes of information allows them to use their strengths in designing the suitable learning environment for pupils. Simultaneously, these modes cater for the

pupils' learning strengths as they are allowed to design and form their own knowledge in a way that suits their learning style. This links closely to them being designers of their own learning in the multiliteracies approach. Multiliteracies stress the Design process and the findings from the interviews reveal that pupils are designers of knowledge and skills for their own social futures.

The participants acknowledged that the digital device serves as an artifact for learning. This allows the participants and pupils to participate more in the learning process and, subsequently, they are more involved and in control of their learning. By using this artifact, participants and pupils create evidence of learning – both the process and the product. Participants in particular mentioned the importance of the process of learning design, which allowed them to be part of the learning process. Participants could intervene where scaffolding was required. In the study by Mvududu and Thiel-Burgess (2012), the importance of the process of learning and the acquisition of skills and knowledge is acknowledged due to the teachers and pupils being collaboratively involved in this process.

The participants acknowledged that they needed to adapt the way they taught in order to allow pupils to take the lead and to promote their own learning. The role of the teacher and the implementation of the device is vital in the successful gaining of knowledge using the specific device. Chromebooks, in particular, allow for collaboration; pupils create content and then have the ability to share it with their peers which in turn builds on other pupils' knowledge and exposure to content (Hutchison & Woodward, 2018; King, 2016).

Participant A mentioned that pupils could extend themselves by doing more with the Chromebook than what they normally would with working from a textbook. He also indicated that the pupils were exposed to more information than what pupils had been exposed to in the past. This is very important in the construction of knowledge as pupils can “push” themselves as they are enabled to challenge themselves even more. If pupils find an interesting topic, they can further research the topic.

One thing to keep in mind with pupils being the creators of content and their own knowledge is that they need to be taught digital literacy in order for them to distinguish between what is credible and what is not. The participants assisted in this process by effectively implementing TPACK in their teaching and learning. The literature on TPACK by Mishra and Koehler (2006) and Morris (2018) states that teachers have a vital role to play in the implementation of technology in schools. Gutiérrez (2008) mentions that by being actively involved in the learning process, pupils are constructing new knowledge in the third space as they are merging prior knowledge and new knowledge which allows them to compare what they know and is familiar with, to the new content they are exposed to. In doing this, they link home and school literacies. Home literacies refer to knowledge the child has been exposed to in their home setting such as the exposure to reading and spoken language (Galarza &

Watson, 2016). School literacies refer to the curricular models, which a school follows to enhance literacy skills (Galarza & Watson, 2016).

5.3 Theme 3: Collaborative learning

Harasim (2000) realised the importance of collaboration in classrooms today. Collaboration was an important factor mentioned by six of the participants and links to the social and communication skills needed in today's world, both in school and in the workplace. Participants mentioned they had to adapt their teaching methods and include this type of learning in their classrooms.

Participants mentioned that they needed to consider how they presented their lessons to include collaboration, especially since Chromebooks allow for this type of learning and integration. The type of collaboration mentioned by the participants did not only involve the pupils working together, but also the teachers as they could comment and guide pupils while they were working. This also allowed for work to be done outside the classroom, or during times when pupils were not together in a specific class. Sometimes when group work was assigned and certain pupils were not at school, the group could continue working as the absent pupils could work from home. Likewise, if work was not completed in class, the activity could be completed at home. Furthermore, the participants had constant access to pupils' work on the device.

McCollum et al. (2019) mention the importance of trust between teachers and pupils alike when using collaboration in teaching and learning. Participants realised the value of this interaction and mentioned that learning occurred, even when the preparation or ideas for their lessons did not go as planned. For example, if a lesson lacked certain information, it was easy for the teacher to rectify it before teaching the next class by using the Chromebook as a research tool.

Significantly, teachers and pupils had to adapt to collaborative learning such as using Google Docs or Google Slides to work in groups. This links closely with the literature on constructivism in that learning occurs through different methods and modes in the classroom. Pupils construct their own knowledge using a tool; this is emphasised by the founders of constructivism who acknowledge that pupils need to interact with the tools in their environment to form new knowledge; learning is also a process of adapting to new contexts and challenges (Bruner, 1979; Piaget, 1970; Vygotsky, 1978).

In the past, teachers were seen as the bearers of knowledge; it is evident from the findings that participants needed to adapt their classroom practice in order to allow for communication and collaborative learning in groups due to the use of the device in their classrooms.

5.4 Theme 4: Wi-Fi and connection issues

In the case of an interruption of Wi-Fi connection, be it due to load shedding, problems with a server or connectivity issues, participants mentioned their frustrations and how reliant they were on it in order to get the content covered. As mentioned in Chapter 2, Chromebooks are powered by Google and rely on Wi-Fi connectivity in order to be effectively used in the classroom. This connects closely with TPACK where teachers integrate technology into their teaching practice and then ensure that the technology positively affects the learning climate, classroom management, as well as the interaction between the teacher and the pupils (Sujee, 2019). This links to the findings in that for technology to have a positive effect, the artifacts needed to work effectively. For the technology to be implemented effectively and the devices to be used optimally, a stable Wi-Fi connection is essential.

As digital devices become more integral in teaching and learning, Wi-Fi is essential for the practical implementation in the classroom. In order for the construction of knowledge to take place, the access to Wi-Fi is necessary. This links to constructivism where pupils construct their own knowledge using the device (Mvududu & Thiel-Burgess, 2012). The participants indicated that when Wi-Fi connection was not stable, it determined what information the pupils had access to and the ability they had to form new knowledge. In times of non-connectivity, the participants were not able to share or “push” the relevant information or documentation for the pupils collaboratively to work on.

5.5 Theme 5: Digital devices as a source of distraction

There were mixed reactions among the participants towards the digital device being a cause of distraction. Sauers and McLeod (2012) mention the impact of devices as a cause of distraction for pupils in the classroom. The devices offer a platform where multiple modes such as visuals, videos, images and audio can be displayed. This often creates more chances for distraction than to those in the past where there were only hard copy textbooks. When these devices serve as a distraction, they are diverting from their academic purpose where technology is used for learning and teaching purposes.

The pupils at the participating school are younger and not mature enough to take responsibility for their learning and are easily distracted; this fell heavily on the participants and it became their responsibility to integrate management strategies in their classrooms to alleviate these distractions which they have had to manage.

Management of classes and pupils was brought up by participants. Teachers had to change their classroom management style; this affected how and what they are teaching to ensure pupils are grasping concepts and not missing out on important facts. The participants mentioned that they needed to be more alert to the children in the classroom; they walked around and observed what the pupils did, more so compared to what they had done in the past. Anshari et al. (2017) as well as Sauers and McLeod (2012) acknowledge that the devices may serve as a source of distraction, which could turn these devices into an undesirable tool in the classroom. It is evident from the findings that teachers had to adapt their classroom management styles to monitor learning with a digital device. Participant B mentioned having more “control” of the classroom and teachers being more vigilant as pupils had access to more ‘interesting’ digital information, than the more traditional and ‘boring’ hardcopy textbooks.

5.6 Theme 6: Pupils’ attitudes towards school work

The findings reveal that, when pupils feel they have value to add, by being knowledgeable on the topic or being interested in the topic, their attitude is positive and engaging. Participants stated that the availability of multimodal knowledge seems to spark more pupils’ interests and, therefore, caters for more learning styles and preferences. These include a variety of modes incorporated into teaching and learning such as using videos to display learning or creating slides to share with others. This links closely with the literature on constructivism, which states that pupils construct their own knowledge by cooperating with others (Bruner, 1979; Piaget, 1970; Vygotsky, 1978). Pupils’ mind-set (positive/negative/eager to learn etc.) influences the content they acquire and use.

Three of the participants mentioned that pupils are the designers of their own knowledge due to the collaborative setting that the device encourages; this enhances their confidence and encourages a positive attitude towards their schoolwork and learning. Multiliteracies hold that pupils are designers of their own learning which links closely to current trends in education (Cope & Kalantzis, 2016). In turn, participants are also designers of the learning environment. Participants included innovative pedagogies in the design of the learning environment and these allowed pupils to grow and develop to their potential. The findings reveal that the participants were able to effectively include the use of the digital devices in their classroom to enhance learning.

The outcomes described by the participants regarding pupil attitude varied. This could be because of the participants’ perceptions of the pupils’ attitude and the participants teach different grades. Most participants acknowledged that when the digital device is seen as a novelty, pupils seem more

interested. As the pupils grow accustomed to the device, it becomes the norm and not as exciting as it initially was.

5.7 Theme 7: Professional development

Professional development is of vital importance when implementing a new idea/new device or changing the way teachers have been teaching. All the participants mentioned what their needs were. Needs included training on the use of the devices and the software on the devices, as well as how to effectively utilise these devices to maximise teaching and learning. Participants had different expectations from the professional development sessions and they mentioned that they were at different levels of expertise when using the devices in their classrooms. Three of the participants mentioned benefitting from a bigger group setting during training because they were able to collaborate and learn from each other. Four of the participants mentioned that they were comfortable enough to “play around” with the device on their own to familiarize themselves with it. Two of the participants indicated that they needed more personalised professional development in order to implement effectively the use of the device in their classroom. This could be due to differing personalities of the participants and their confidence in regards to using the device. Some participants indicated that they implemented a new way of teaching or a new lesson. However, these new ideas may not have worked the way they wanted it to but they felt that they were learning nonetheless.

In these professional development sessions, it is vitally important that TPACK has a role to play. These sessions allow for teachers to develop themselves and their knowledge on how to teach content and adapt their pedagogy to using the device. The effective implementation of technology in classrooms is important, now more than ever, as pupils are the digital natives and relate to this learning environment. Studies by Islam & Grönlund (2016), Penuel (2006) and Ruggiero & Mong (2015), stress the importance of professional development at critical times such as implementing 1:1 devices.

Multiliteracies are important in professional development; this concept encourages teachers to be designers of new and multiple modes of knowledge in their subjects (Engelbrecht & Genis, 2019). By participants having access and the flexibility to be creative in their lessons, planning and assessment, they can design their learning to address the specific learning needs of their pupils. Many participants recognised that they had to develop themselves and become equipped for a digitised teaching and learning environment. The professional development sessions allowed the participants to explore different and new ways of including multimodal resources, thus, allowing for a multiliterate classroom environment.

Through interviewing the participants, it is clear that the participating school values professional development. The school implemented set times for professional development to keep their staff up to date and as tech-savvy as possible. Although most participants mentioned being comfortable in using technology, they acknowledged that they were not fully confident in accommodating the device in their classroom practice. Minshew and Anderson (2015) specifically look at how professional development should link to a specific field or subject so that the technology can be used optimally in a subject. This is important and links to this study as some participants mentioned the value of smaller group sessions, which could be based on TPACK training for a specific subject.

The findings indicate that, although the Chromebook was integrated into classrooms, it is questionable whether it was optimally utilised as a learning artifact in all the teachers' classes. This conclusion was drawn from many of the comments made by the participants with regard to their own or a colleague's practice. Some participants mentioned that colleagues had not integrated the Chromebook effectively by not using the basic functionalities. Some participants even mentioned some of their own shortcomings, such a lack of knowledge or confidence, with integrating the Chromebook in their classrooms and in specific subjects. For instance, Participant C was not able to use it to teach creative writing.

This relates to the research question in that without proper professional development, teachers would not be able to change their teaching practices in order to accommodate the pupils in their classes by addressing all learning styles through the device. The participants noted that teachers should be more flexible and incorporate what they are learning in the professional development sessions.

5.8 Theme 8: Use of online assessment and different types of assessments

All participants acknowledged that assessment changed due to incorporating the Chromebook in the classroom. The opportunity for varied assessments such as oral presentations, video presentations, slideshows and audio assessments had become evident when teaching with the 1:1 devices. Participant A specifically mentioned "assessing different strengths" as some pupils excel in different ways, e.g. orally, designing a presentation, creating a video and creating digital posters. Three of the participants mentioned that teachers had become creative in their assessment techniques by incorporating multiliteracies in their assessments. This presents a fairer reflection of the pupils' academic abilities as some pupils are visual learners, and others are auditory or kinaesthetic learners. This is supported by the study done by Cope and Kalantzis (2000) who mention the value of varying assessments. By implementing these different forms of assessment, pupils have the opportunity to excel in the area of their strength. These different forms of assessments are beneficial not only to the

pupils, but also to the participants who were able to reflect on their teaching and incorporated more modalities in their lessons. Participants used the data captured by the device to analyse their teaching; this affected positive changes to their classroom practices, as they knew when it was necessary to reteach certain concepts. This illustrates the effectiveness of constructivism in the classroom as pupils displayed their knowledge in varying forms, e.g. giving a speech or designing a presentation.

By applying these different forms of assessment, the participants realised that learning could take place anywhere at any time and that the digital devices were artifacts for learning, thus, creating a third space for learning. The artifact increased the variety of available resources and the types of assessments, which could take place in the classroom. The artifact was utilised as the tool for constructing new knowledge and for gaining new skills to display this knowledge. This artifact allowed for the activation of multiliteracies in that it is geared for visuals, audio and tactile experiences (Cope & Kalantzis, 2016). The need for assessment to change if the learning environment has changed is crucial. According to the participants, who had successfully implemented different types of Chromebook-based assessments, the pupils at the research site were now more creators of the content than they had been before the introduction of the device. The use of the varying assessment methods by the participants also allowed for assessment to be less rigid as assessments took place on a continuous basis in varying forms. For instance, Google Forms and digital means of designing and assessing content were used. This relates to TPACK where technology is effectively integrated in the assessment section of teaching and learning (Koehler & Mishra, 2009). By using these varying assessment methods, the devices changed the participants' classroom practices in that they needed to change the way they previously assessed.

From the findings, it is evident that participants had to adapt not only the way they assessed but also the manner in which they viewed assessments to ensure variety. This links to their teaching practice as they had to adapt in order to assess in a manner that was more beneficial to all pupils.

5.9 Theme 9: Change in teaching philosophy

As mentioned in Chapter 4, teachers need to focus on their outlook to teaching and they need to be resilient in the classroom as the world, along with the pupils in front of them, is changing. Diversity was brought up by Participant G, which links to multicultural education. Participant G specifically mentioned South Africa and its multicultural people who have differing backgrounds and educational needs. Participant G also mentioned preparing pupils for the world of work, which teachers need to be mindful of when teaching. The responses given by Participant G indicate that the device does pose the need for teachers to change their philosophy and the way they are teaching. All of the above links

to multiliteracies where teachers are able to identify certain modes of teaching and learning and then relate them to their new knowledge and skills.

All participants realised the importance of changing their teaching philosophy in order to accommodate their multicultural and multilingual pupils. Participants discussed the changing world and the need for education in order for pupils to become creators of content. Pupils should form their own bank of knowledge and skills, which is not based on a “chalk and talk” method. Participant E mentioned the transition between what pupils know and what they need to know in today’s world. Most of the participants understood the need for teachers to change and implement learning in different ways to what they were taught or were used to. This included not just teaching from the black or smart board, but creating opportunities for interaction in the classroom by using different learning tools. Constructivism is different to the way many of today’s teachers had formed their knowledge, which was based on factual learning from a textbook. The participants were mindful of this and, consequently, they were able to create environments for the pupils, or the third space of learning, where everyone shared their knowledge and skills. The participants acknowledged that the use of 1:1 devices changed their teaching methods. Mvududu and Thiel-Burgess (2012) mention the importance of constructivism in their study and the need for teachers to adapt their philosophy to enable pupils to learn in an environment, which offers them opportunities to use the tools at their disposal – in this case, the digital devices.

5.10 Theme 10: Familiarity and confidence using technology for teaching and learning

Participants mentioned that they became more confident and creative as they used the digital technology more often. They created different types of lessons such as using videos to add to their lessons or allowing the pupils to create presentations. They also became more assertive when they implemented new ideas, which ties in with the design process in the multiliteracies approach as teachers are now designing creative methods to teach (Koehler & Mishra, 2000). It became evident from the interviews that certain personality types, years of teaching experience, and exposure to the use of digital devices affected the participants’ comfort levels when implementing content using the digital devices. Positive perceptions were shared by the younger staff members, who were more confident when working with devices. Similarly, positive perceptions were shared by those who had freer and open personalities, which allowed them to explore without fear of failure. Negative perceptions were shared by those who were less confident, or participants of the older generation who were fearful of the unknown. Professional development, as mentioned in sub-section 5.7, is thus vital in enhancing the participants’ familiarity and confidence. Although personality had an effect on

how the participants integrated the use of digital devices in their classrooms, teaching experience and time spent in the classroom also affected how the participants perceived the use of devices for teaching and learning. Teachers who were more confident in the traditional ways of teaching found it harder to adapt.

Six of the participants mentioned the fact that pupils seem to be confident using digital technologies, possibly because they are digital natives, who are used to digital technology. The participants were also mindful that pupils, in the private school where the study took place, had been exposed to a variety of digital technologies from a young age and that they were able to navigate various digital platforms. Two of the participants mentioned that this could be daunting to a teacher who had not had as much exposure, therefore, negatively affecting their confidence. As participants became more familiar with the device, they creatively incorporated different methods of teaching and assessing using digital technology. They incorporated the design and redesigning principle of multiliteracies which conceivably reached more pupils than their previous teaching methods. This is supported by Cope and Kalantzis (2000), who mention the use of different modes for communication and the building of knowledge and skills through designing. This is further supported by Boyd and Brock (2015), who mention that the devices is a tool for the designing of learning; thus linking it to multiliteracies and the way the pupils use these digital devices in the designing of their learning.

5.11 Theme 11: Concerns regarding the use of technology as a tool

The two main concerns raised by the participants were that the physical act of writing would fall away due to pupils mainly using the devices. Secondly, there could be a disconnect between integrating digital technology and traditional teaching methods.

The concerns regarding writing falling away had deeper sentiments than just the act of writing. Participants mentioned negative aspects such as spelling, comprehension and memory. Many pupils often relied on the act of writing when studying and now if most studying and work is being done on digital platforms, it poses a threat to their retention of knowledge. According to the participants, pupils may lose the more traditional skills and would be required to find a new way of learning. Reading and writing have always been seen as essential skills for literacy but the digital natives first exposure to writing may very well be on a digital device (Mangen & Velay, 2010). Writing forms an important part of multiliteracies and multimodal learning as script will always be essential to visual pupils. Writing is also used for communication and is essential in schools to portray knowledge and skills. The act of writing or typing to construct new knowledge is important. As mentioned in Chapter 2, the child's memory processes change due to what they are exposed to. Therefore, if a child is mainly

exposed to digital technology, their brain adapts their memory skills to that environment. Our brains are geared to the adaptation and development of certain situations. A study by Ophir, Nass and Wagner (2009) indicates that stimulation from digital technology positively affected pupils' cognitive performance.

With regard to a balance between technology use and traditional methods of teaching, a general concern regarding "the basics" was raised by the participants. Participants mentioned things like being cautious with screen time, and the basic fine motor and gross motor skills, which are so important in the younger years and often assist in learning and meaning making as pupils grow up. Most participants felt that pupils need the "basics" such as fine and gross motor skills, and the ability to count and read properly; these skills should be in place (concretely) before the integration of digital technology. The participants acknowledged that pupils are already exposed to technology from a young age and that, consequently, certain traditional teaching methods should be combined with digital technology. Donohue (2015) stresses the importance of critical thinking as an essential life skill due to technology being ever evolving. Therefore, the pupils need to be able to adapt to the ever-changing digital world. Therefore, the skills taught need to be a blend of traditional skills and digital technology skills. This will allow pupils to form meaning, to create awareness, and to analyse, evaluate, create, reflect, participate, as well as take action (Donohue, 2015).

5.12 Theme 12: Parental concerns

Participants mentioned the role of parents in the learning process and noted that parents were brought up in a different era than those of the digital natives; they do not always understand the educational processes involving digital technology in teaching and learning. A few participants mentioned that it is, therefore, necessary to educate and include parents in the learning process. Parents of this age group of children are still very involved; from homework, to assisting with studying. If they do not understand how the digital devices work or the impact technology has on the process, it is difficult for them to work with their own children, which may cause frustration. Five of the participants mentioned the importance of parents being "on board" in order to make the integration of technology in the classroom successful. This is due to the pupils being young and needing "parental guidance" when it comes to homework, studying and any extra educational assistance. If the parents do not understand the current systems in place, they will not be able to assist their children. Five of the participants were mindful of this and mentioned the need to have parents understand how the devices are used. It is important to note that although most pupils are digital natives, the parents are not.

Although the “Night School” where parents get to experience and learn about the digital device was not mentioned by the participants, this forms an important aspect in the implementation as this is where parents get a hands-on experience of the device. During that evening, parents are exposed to the various tools used on the Chromebook such as Google Classroom, MiEbooks (textbooks), and the expectations of the pupils at school and home. This was possibly not mentioned by the participants as the questions did not lead to this answers or they forgot about the evening classes as they take place early in the year.

5.13 Theme 13: Has learning changed? How do our brains work?

Participant C strongly felt that the way people learn because of the increased use of digital devices in the classroom has not changed. However, studies have shown that the brain develops according to the stimuli it is exposed to; the brain’s plasticity and, therefore, stimulation has the ability to reorganise/reconstruct the way the brain works (Firth, Torous et al., 2019; Healy, 1990; Prensky, 2001; Rothman, 2016). However, Chorab (2016) mentions the detrimental effect of using digital devices at a young age as they stimulate children’s sensory motor sensations and they are then programmed to think and react in a certain way.

Chorab (2016) mentions that digital natives are used to interacting and receiving information from different sources in the multiliteracies framework such as visuals with audio or videos (multimodal learning) and, subsequently, traditional teaching methods do not interest these pupils. This links closely with TPACK being effectively integrated by the teachers so that pupils are learning in the correct way and ways, which are suited to them. The study by Ling Koh, Chai and Tay (2014) focused on the importance of TPACK and its integration to benefit pupils. Pupils in today’s classroom are used to multitasking where they socially connect with someone while simultaneously working or studying. Digital natives enjoy initiating learning where they are able to take control. This is very different to the traditional styles of teaching and learning, which were more passive forms of learning.

Four of the participants acknowledged the diversity of their pupils. They stated that these pupils learn and think differently from a young age. This relates to how the brain works. The way the brain learns is linked to constructivism where pupils bring what they know to the classroom and then build new knowledge from what they are exposed to, thus learning takes place in the third space. Digital natives are growing up with devices and their need for knowledge and skills is different to those of previous generations.

5.14 Theme 14: After-school benefits

Participant A specifically mentioned pupils becoming creators of content and, therefore, design their own understanding using these devices as a learning tool. This links closely with the design process mentioned in the multiliteracies approach (Kalantzis & Cope, 2009). Participant A mentioned most careers incorporate “computers or technology”. It is important to note that most careers are now reliant on some form of digital competence that accesses all forms of technology (Ronchi, 2019). Pupils becoming more involved and responsible for their learning and “creating” content ties in with the multiliteracies component of design, where pupils are the “designers” of new knowledge (Kalantzis & Cope, 2009).

All the participants realised that pupils have to acquire digital skills in order to be successful in their tertiary studies or in their careers. The participants acknowledged that the world is ever evolving and our pupils need to be exposed to a wide range of skills and knowledge so they can apply it in any setting one day. This also forms part of them being resilient.

Participant A mentioned that pupils have to be producers of new knowledge. This once again links with them being designers of new knowledge and skills in the multiliteracies approach (Kalantzis & Cope, 2009). This is very important as in the fourth industrial revolution, the skills linked with technology require creativity and entrepreneurial skills (Bhabha, 1994). By pupils becoming designers, they embrace becoming life-long learning as they acquire these skills from a young age.

Conclusion

This chapter linked the findings from Chapter 4 to the literature study and theoretical framework presented in Chapter 2 and 3. The participants all agreed that change was needed across all spheres of classroom practice, including planning, teaching, assessing and learning when incorporating 1:1 digital devices in the learning environment. The participants mentioned that teachers should be guided to change the way they think and implement digital activities in their classrooms. Many of the participants acknowledged, in one form or another, that classroom activities needed to be more pupil-centred so that the pupils could take ownership of the learning experiences. Significantly, the devices are artifacts of learning that enhance cooperative and self-directed learning. Pupils collaborated on on-line documents and created their own meaning constructs by designing slideshows and videos.

The concept that was emphasised by the participants was that pupils were the designers of their learning, which is incorporated in the multiliteracies approach. This is vitally important and teachers

need to be cognizant of this when planning and implementing tasks in the classroom. The participants also emphasised the importance of TPACK and the development of staff members and parents. Teachers should have the knowledge and skills to use technology effectively for teaching and learning and parents have to support their children's learning with the device. It is apparent that professional development is required so that the effective integration of technology and devices in the classroom reflects the principles of the TPCK framework.

The final chapter of this thesis will draw conclusions and make recommendations for future studies. The relevance and implications of this research will be identified and elaborated on.

Chapter 6: Conclusion and Recommendations

Introduction

This chapter draws conclusions and summarises the themes, which emerged while linking these to recommendations. 1:1 Teaching and learning using digital devices is becoming more prevalent and important in schools both nationally and internationally. The investigation of this study focused on teachers' perceptions of the changes brought about in their classroom practices due to the use of the Chromebook in the classroom. It also focused on identifying how teachers should adapt their pedagogy, teaching styles, as well as administration as a result of the incorporation of this digital device in their classrooms. The topic of digital technology being integrated into the classroom, especially 1:1 in a South African classroom, is broad and multifaceted (Padayachee, 2016). Therefore, the researcher aimed to streamline what she was looking for by asking specific questions in the interviews and ensuring she remained on topic.

This study was conducted to further delve into how teachers perceive the integration of 1:1 devices in particular in their classrooms. The school where the research was conducted is at the forefront of using technology in their learning. Many teachers at the school present at conferences on the use of technology in the classroom. At the participating school, the preparation for the integration of 1:1 devices was done in advance with research conducted, which was supported by the management team.

6.1 Summary of the findings

Teachers at the selected school were familiar with technology in the classroom. However, the integration of 1:1 devices in teaching and learning posed challenges to the participants, which they had to address within their classroom practices. Globally, technology is currently used in classrooms as a tool to enhance teaching and learning (Parsons et al., 2020). The researcher wanted to understand how the implementation of 1:1 digital devices changed the participants' classroom practices and what support teachers needed in order to effectively teach the digital natives who are currently in their classes. Once teachers have acquired the necessary skills, they need time to prepare and develop the successful implementation of these 1:1 devices. Teachers also have to consider the skills and knowledge that pupils bring to school to develop a third space for learning.

The findings revealed that the participants believed in the value the 1:1 digital device has in the classroom and its benefits to the pupils. Despite all the identified challenges in learning using digital devices, they adapted to Chromebooks and used them as easy-to-use, portable and flexible learning and teaching support material in the classroom.

A theme that emerged quite clearly from the findings is the easy access to information. Pupils have instant access and teachers are no longer the bearers of all knowledge but are encouraged to allow pupils to be the creators of content. The use of 1:1 devices allows varied methods in teaching where pupils can use the devices according to their own capacity and draw on their individual strengths to facilitate learning, thus using a multimodal approach. By pupils having 1:1 devices, teachers now have more opportunities to 'push' multiliterate content such as using visuals, audios, videos and presentations. These multimodalities appeal to digital natives who respond better to visual and aural stimulation, as they are exposed to digital material from a young age.

Participants mentioned the importance of being confident in using the programs (such as the G-Suites and online textbook platform, ITSI) and having sufficient knowledge to effectively teach with these devices. These devices offer an opportunity of creating new knowledge in the third space, where pupils utilise their current knowledge and build on it in the classroom. TPACK is very important as teachers need to have the effective strategies when implementing technology with pedagogy, content and knowledge.

However, the devices also serve as a distraction in the classroom. This is an area that needs monitoring by the teachers and a system should be put in place to ensure distractions are kept to a minimum.

Teachers need to ensure that they are reaching out to pupils and meet them on their level of understanding and address what they are accustomed to – meeting them in the third space of learning where they can relate to what is being taught as they bring their current knowledge into the classroom and then build on it using what is provided in the class and using the tools they have. Pupils arrive at school being already exposed to different knowledge and skills and it is the duty of the teacher to provide opportunities for the pupils to add to this knowledge and to build on their current skills. Table 6.1 below summarises the finding from Chapter 5 into the positive and negative aspects, which were identified.

Table 6.1: Summary of findings: positive and negative aspects relating to teaching with devices

Positive Aspects	Negative Aspects
Preparation of lessons include multimodal aspects that allow teachers to gather more relevant information, which is of interest to the pupils.	Wi-Fi and connection can be an issue – especially when the device is reliant on Wi-Fi to run most of its programs.
Pupils have become creators of content and designers of their own future learning.	Digital devices serve as a source of distraction to some pupils.
Digital device is used as an artifact for learning and allows for more active participation from pupils.	Professional development is sometimes not at the required level for everybody and sometimes the groups are too large or the instructors work too quickly through content.
Teachers and pupils can collaborate on documents in real time.	Some teachers battled to change their teaching philosophy and fear failure.
Pupils seem to be more eager and interested to participate in class.	Not all teachers are confident or creative when implementing new teaching methods and styles in teaching with the device and need practice and reassurance.
Professional development enables teachers to use devices properly.	Writing may fall away as the skill to type will override it. The subsequent negative consequence is that spelling and comprehension will suffer.
Teachers now use different types of assessments, which appeal to different learning styles (auditory, visual etc.).	It is not easy to balance technology-based teaching with traditional methods.
Pupils’ brain functions have changed so teachers should adapt their teaching methods.	Parents do not always understand what is expected as this type of teaching and learning is different to what they are used to.
Careers and tertiary studies now require technology integration so pupils are at an advantage when they already have acquired these skills.	

6.2 Recommendations

A number of conclusions have been drawn which assist with the recommendations mentioned. This research shows that in order to effectively implement a 1:1 digital device in preparatory/primary schools, there is a need for teachers to change the way they think, plan and execute lessons. The successful implementation of these 1:1 devices is dependent on the execution of the curriculum by teachers and their openness to embrace changes and adapt their teaching methods.

Teachers should consider the way they prepare for lessons and ensure they appropriately plan for open-ended learning opportunities where pupils have the opportunity to collaborate and form their own learning using the device. Teachers should be able to incorporate different modes into their teaching strategies. Teachers should be equipped with the skills and knowledge to source multimodal resources and information, which will aid the pupils on their learning journey. Exploratory learning is important when teaching with devices as pupils have the opportunity to use multiliteracies to form their learning.

In professional development sessions, it is vital that TPACK plays a role as teachers develop themselves and their knowledge on how to deliver content. Professional development should aim to include aspects on how to integrate technology with the content to maximise learning. It is crucial to provide professional development so that teachers can adapt and learn. This, in turn, will improve the quality of the teacher who will implement skills, which the pupils of today need, such as collaboration, working in groups, and being able to be creators of content and knowledge. Professional development should be the key for teachers to adapt their teaching practice in order to integrate technology in their classrooms.

Teachers should carefully plan assessments that are in line with their new teaching strategies. One cannot assess using traditional methods of written memory testing when the learning style has changed due to the use of a device. Skills-based and varied assessments including various modes should be incorporated so that pupils have opportunities to excel in different ways by drawing on their different strengths. There is a need for variance in assessment. If our teaching methods and pedagogy have changed, we need to reconsider our assessments and the way we determine if learning takes place. Pupils are also exposed to more than just textbook work as digital natives are exposed to digital devices from an early age and enjoy the visual aspect. Therefore, teachers should take that into consideration when assessments are set. Teachers still need assistance in ensuring that the new forms of assessment they set are valid and fair. This can be achieved by following official guidelines for setting assessments and ensuring that all the styles of learning are assessed, such as auditory,

kinaesthetic and visual styles. Although teachers enjoy the varied marking techniques and assessments, the results may not always reflect the pupils' abilities as they may not be inclined to that type of style. Thus, it is important to implement different types of assessments.

Schools as a whole should look for programs that ensure online safety and security and block certain sites and games. The research site has many firewalls in place and digital citizenship is important in all subjects. This is communicated to parents on through social media and emails. Although there are current programs in place at the school where the research was conducted, teachers should be made aware that extra programs such as Google Guardian (mentioned in Chapter 4) could be considered as a source of extra security. This will reassure both parents and teachers' minds when pupils are working with digital devices. Pupils should also be exposed to digital citizenship where they are able to learn what the devices can be used for, and be cautioned about the dangers of online activity.

Successful 1:1 device integration can occur despite barriers. However, it is used more effectively and with confidence when teachers have the time to prepare and if they have the correct knowledge and skills when teaching and learning with these devices.

The aim of using the device is to encourage pupil interaction and engagement in the classroom setting. Pupils should be constructing their own knowledge and sharing their experiences with others. Pupils should be monitored so that they are not 'lost' in lessons but rather participate in the learning experience. As pupils have different backgrounds, teachers should adapt to teach the new digital-age pupils sitting in their classrooms.

A vital piece of information to note is that the device should be used as an artifact for learning. It is not simply a novelty but rather a LTSM that should be used to enhance classwork and the learning environment. The access to different literacies and modes of literacies should excite the diverse pupil population as it addresses each pupil's different learning style, need and interest. The pupils remain children who need to be guided and encouraged in the learning process. Teachers should change their pedagogy in order to hold the interest of the pupils and to facilitate learning on the appropriate level of the pupils. By pupils being actively engaged and interacting, their attitude will match this and their will to learn should improve. TPACK is vital as teachers have the opportunity to integrate technology in a meaningful manner. Teachers should use multimodal teaching to incorporate technology effectively. As teachers become more confident and used to the digital device's capabilities, they will experiment and add multimodal aspects to their traditional teaching methods. Digital devices have many capabilities but the effectiveness of these capabilities are most importance and, therefore, professional development to inform teachers of the device's functionalities is vital.

Celik and Yesilyurt (2013) mention a link between confidence in teachers and the way in which they integrate and use digital technology in the classroom. Schools should be mindful when implementing a new strategy or employing staff for effective continuation of the use of digital technologies in teaching and learning. Pupils using digital devices have instant access to information that was not the norm previously and teachers should be confident and know how to broach certain assignments in order to maximize pupils' learning. Teachers and parents should ensure that pupils are equipped with digital citizenship so that digital devices are used for productive purposes.

6.3 Recommendations for further research

The researcher was able to reach conclusions and make recommendations from this study for further research.

1. Many teachers were concerned about the digital device being a source of distraction instead of a learning artifact. This could be a focal point for a study in order to give feedback and suggestions on how to improve this situation in classrooms.
2. Teachers should accommodate pupils where their learning currently is and further engaging them in that learning process. Pupils are often at different levels and come to school from multicultural backgrounds. This means they are exposed to very different information and skills. Teachers need to make sure that they are equipped to bridge this divide using the device as a tool. With pupils being more in control and being the designers of learning, teachers can use their current knowledge to build new knowledge.
3. Every participant questioned the impact of digital devices on the pupils' actual academic ability and this is an area, which will require a longitudinal study in the future.
4. The value and type of professional development required in terms of using 1:1 digital devices (although proved important in this study) could be delved into further as some teachers are definitely less proficient than others despite professional development.
5. This study focused on Preparatory teachers (Grade 4-7), and a further study which involves a wider range of participants teaching in lower or higher grades should be conducted.
6. This study was conducted in one school and further research should compare different schools and their perceptions on using 1:1 digital devices.
7. Studies on how much time teachers need to prepare effectively using 1:1 devices in their classrooms are a key need. Should teachers be thrown in the deep end or should time be invested in the form of professional development and extra preparation time?

8. How are learning strategies and styles changing now that 1:1 digital devices are being used in the classroom?

6.4 Limitations of this study

Limitations are controls enforced on a study, normally contextualising the research. This study focused on a particular school where professional development is done in a certain manner. Looking at a wider participant base could provide different perceptions and results. The findings reflect the teachers' perceptions who are currently involved with the integration of 1:1 digital devices. The participants had to make time for the interview, which was sometimes difficult with different schedules due to sporting and other commitments.

Case study research also poses some limitations in terms of the number of participants. However, rich data were collected from the participants and relevant themes emerged. According to Yin (2009) the limited number of participants in a case study does not allow for the results to be generalised to other populations. Although the researcher tried to ensure a representative sample of subjects, age group and experience of participants, it may be of value to gather a larger participant base to ensure the results are more generalised.

The researcher was also conscious of the limitations of the qualitative research, particularly when dealing with subjective material and considering that findings could be generalised or that the results may not apply to other contexts. The researcher ensured she remained objective and relayed the information as was given to her. By focusing on teachers' perceptions of 1:1 digital devices, this study can be used in other schools to guide their usage and implementation.

Conclusion

This research provided further insight into teachers' perceptions when integrating and implementing 1:1 digital devices in their classroom practices. This study highlighted the positive as well as the negative aspects and strived to determine if teachers are effectively or ineffectively using technology in their classrooms. As more schools start implementing the use of 1:1 devices, this study could serve as a guideline to improve and guide schools when starting their implementation process. Teachers' pedagogical experiences regarding these devices are vital to the success or failure of the implementation process for effective teaching and learning. Teachers today have a new role in

teaching digital citizenship and in ensuring that pupils realise that the digital device can be used as an ‘artifact’ for learning.

The research showed positive learning outcomes where digital devices were used effectively. The key is to enable all teachers to be confident enough to implement activities for effective teaching and learning. The general consensus is that today’s pupils are in a position to be creators/designers of their own knowledge and teachers should foster this and create the ideal environment for this.

Using digital devices opens up a whole new playing field for all pupils to become confident in numerous areas such as becoming more vocal in class or participating in group presentations. Technological preparation for the future is key, especially in a world where education and careers are evolving at a rapid rate. Technological skills the pupils need are essential in their life-long learning and preparing them for their future careers and survival in the world, which links closely with multiliteracies.

Although digital technology has become an important aspect of teaching and learning, teachers and their role in education remains pivotal. It is, therefore, even more important for them to have the relevant teaching and learning philosophy to benefit the pupils they teach. This philosophy should include being flexible in their classes and being willing to learn and adapt to new ways of teaching, to draw on pupils’ current knowledge and to build on that, to encourage different skills in the classroom such as collaboration and communication, and to motivate pupils to be critical thinkers. Pupils should not merely accept the content that is given to them but should explore and form their own opinions. Teachers need to be confident and understand the value of TPACK and the importance of integrating technology in their pedagogy, content and knowledge.

Integrating technology into the classrooms has become a global trend and in some cases essential for effective learning to take place. Digital natives – today’s learners – thrive in environments where they can incorporate and use technology in the creation of their knowledge and skills. It is important to note that teachers should create a space where transformation of learning can take place, where students can create their own knowledge by merging their home literacies with school literacies. This process will create a third space for learning. Critical thinking and creativity are key when using digital devices in the classroom.

Although most of the study was completed when the COVID-19 pandemic hit, it is important to note that the school in this study was well prepared for online teaching and learning. Pupils and teachers were confident using these devices and, therefore, distance learning for most of Term 2 of 2020 was possible. Teachers covered the curriculum and pupils were able to learn from home. Teachers could

spend time learning new skills of how to use these devices for distance learning and implement these while at home, while focusing on digitally connecting with pupils. This school was definitely at an advantage where other schools needed to find solutions to navigate their teaching and learning on-line.

The researcher hopes that other schools will benefit from the findings and teachers will thrive in the environment they create for themselves. Management of schools will hopefully find support for their teachers and ensure that all aspects are in place before the implementation of digital devices occurs so that teachers are confident when teaching with technology.

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Appendix A: Letter to the School and Board of Directors



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education



CORNWALL HILL COLLEGE

Dear Mr Dicks and The Board of Directors at Cornwall Hill College

RE: Request for permission to be done at Cornwall Hill College

I am currently completing my Masters at The University of Pretoria in Education. My research project is titled *1:1 Digital devices and preparatory school teachers' classroom practices*.

The aim of the study is to research how teachers have adapted their teaching methods and classroom practices when using 1:1 digital devices, in our case, Chromebooks. By doing so I would like to learn more about how teachers have adapted and to find out if using 1:1 digital devices is beneficial to the teachers and how they use them in their own classroom space. I will need 8 teachers who will voluntarily take part in my study.

This research project will use interviews to gather data from teachers on their use and views of teaching and using 1:1 devices in their classrooms. The information gathered will be treated with the strictest confidentiality and will only be used for this research study. I will not use school time to complete these interviews but will find a time and venue that is convenient to the participants.

I hope to find out more about the use of digital devices in classrooms which will be of benefit not only to our school, but to the greater society too. I will share my findings with the school once I have completed my dissertation and I am happy to run a workshop with the staff relaying all the information I have gathered.

Yours sincerely

Janine Dumas Kuchling

Appendix B: Consent Letter to Participants



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education



CORNWALL HILL COLLEGE

Dear Prospective Participant

I am currently completing my Masters at The University of Pretoria in Education. My research project is titled *1:1 Digital devices and preparatory school teachers' classroom practices*.

The aim of the study is to research how teachers have adapted their teaching methods and classroom practices when using 1:1 digital devices, in our case, Chromebooks. By doing so I would like to learn more about how teachers have adapted and to find out if using 1:1 digital devices is beneficial to the teachers and how they use them in their own classroom space. You will be interviewed by the researcher at a time and place which is convenient to you as the participant.

If you agree to participate, you will be interviewed for about 60 minutes. The individual interview will be a one-on-one meeting between the two of us. I will ask you several questions about the research topic. I will take notes during the interview and you will be able to view my notes to ensure I have correctly captured what you have said. I do not think there will be any questions which will cause physical or emotional discomfort.

Although you may not directly benefit from this study, I would appreciate your cooperation as this will benefit other teachers who are in the same position as we are. You will unfortunately not be paid for the study but should you travel for the interview, I will reimburse your travel costs.

The decision to take part in the study is yours and yours alone. You do not have to take part if you do not want to. You can also stop at any time during the interview without giving a reason. If you refuse to take part in the study, this will not affect you in any way.

This study was submitted to the Ethics Committee of the University of Pretoria and approval to go ahead with the study has been given.

I will not record your name anywhere and no one will be able to connect you to the answers you give. Your answers will be linked to a fictitious code number or a pseudonym (another name) and I will refer to you in this way in the data, any publication, report or other research output. All records from this study will be regarded as confidential. Results will be published in a dissertation in such a way that it will not be possible for people to know that you were part of the study.

The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the Research Ethics Committee. All of these people are required to keep your identity confidential.

Appendix C: Interview Schedule for Teachers



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education



CORNWALL HILL COLLEGE

INTERVIEW SCHEDULE FOR TEACHERS

1. How have you changed your classroom practice while teaching pupils who have 1:1 Chromebooks?
2. Has your preparation for lessons changed at all?
3. What positive attributes have come out while teaching with 1:1 Chromebooks?
4. What negative attributes have come out while teaching with 1:1 Chromebooks?
5. What would you say has been the most challenging for you to adapt to?
6. Do you see a difference in the pupils' attitude towards school while teaching with a device?
7. Has the use of 1:1 Chromebooks impacted on marking and the reflection of your lessons?
8. What strategies would you advise to new teachers when starting to teach with 1:1 devices?
9. Why, in your opinion, is there a need for change when teachers start teaching pupils with 1:1 devices?
10. In your opinion, do you think using a 1:1 device enhances pupils' performance?
11. Is there anything else you would like to add?

Researcher: Janine Dumas Kuchling

Signature: 

Date: 24 March 2019