Integration of Technological Resources into the Curriculum in the Fourth Industrial Revolution: the Context of Primary Schools in Pinetown District

By

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This dissertation is submitted in fulfilment of the requirements for a Doctor of Philosophy degree in Education and Curriculum Studies School of Education, College of Humanities, University of KwaZulu-Natal, Durban, South Africa.

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Submitted:

DECLARATION

COLLEGE OF HUMANITIES

DECLARATION – PLAGIARISM

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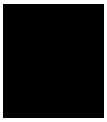
Signature: 
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DEDICATION

I dedicated this work to God and my ancestors who have imbued me with immense wisdom, strength and perseverance throughout this journey.

I also dedicate this work to the greatest woman I ever knew; my late mother, Nonhlahla Primrose Nene, who did not get a chance to see this work become a reality. Her support, encouragement, and constant love sustained me throughout my life until her passing. Ngiyabonga mama.

ACKNOWLDEGMENT

I thank Almighty God for providing me with the strength and direction which made me focus and succeed in life. The power and strength to complete this dissertation was all bestowed through your Grace and Mercy. I lift up my heart in deepest devotion to the Most High, for He is good and kind. It has been an exciting journey on the road to achieving this goal. There have been so many people who have helped me along the way, and I would like to acknowledge several individuals whose help was invaluable during the course of my studies.

- I would like to record my sincere thanks and appreciation to Dr Cedric Mpungose for his excellent guidance, which has enabled me to complete this research. I certainly benefited from his compassionate yet powerful supervision.

I also thank

- My late mother, Nonhlahla Primrose Nene, who always supported and prayed for me to rise high. Ngiyabonga, Mama.

- My late father, Theophelus Falaza Nene, who did not live to realise that my dream had come true.

- The research participants for their cooperation and willingness to share valuable information, personal stories and insights with me. Without their support, this research project would not have seen the light.

- All the family members who always support me and pray for me to rise high and go on in life, my older brother, Njabulo Zibane and Noluthando Nkosi.

- Finally, my editor (Lydia Weight), who has ensured that the language used in this study is at an appropriate level: thank you for your time and positive input.

ABSTRACT

This research is a qualitative study that utilises a phenomenological research study, by means of 24 teachers at primary schools in South Africa, to fulfil its purpose. This study employs an interpretivist paradigm. This paradigm has been utilised because the study aims at exploring three missing levels of integration (constructive, unconstructive, and personal) during teaching and learning. The study intended to understand why teachers resist integration of technological resources. The methods of data generation employed are three online techniques owing to COVID-19: emailed reflective activity, Zoom focus-group discussion, and Skype one-to-one semi-structured interviews. These methods have been used for the purpose of sampling. Convenience sampling was utilised to select the most accessible participants. This study was framed by the curriculum origins concepts which originate from the curricular spider web (Van den Akker et al., 2009). This study utilises the technological pedagogical content knowledge (TPACK) as the theory that shapes the study. Data were analysed through guided analysis in which deductive and inductive methods were deployed. Lastly, ethical issues that are aligned with a qualitative study were considered. These include trustworthiness, dependability, confirmability, credibility, and transferability. This study employs this collection of research methods, the aim being to answer the following critical research questions:

Research Questions:

1 .Which technological resources do teachers integrate into the curriculum in the fourth industrial revolution?

2. How do teachers integrate technological resources into the curriculum in the fourth industrial revolution?

3. What informs teachers in the fourth industrial revolution when integrating technological resources into the curriculum in the way they do?

These research questions were underpinned by the following research objectives:

Objectives of this Study:

1. To explore technological resources integrated into the curriculum in the fourth industrial revolution.

2. To explain the lessons to be learned when teachers integrate technological resources into the curriculum in the fourth industrial revolution.

3. To understand what informs the teachers' integration of technological resources into the curriculum in the fourth industrial revolution.

From the literature, three major concepts were generated by the research phenomena: constructive integration, unconstructive integration, and personal integration. These concepts were aligned with three categories of the curriculum, namely, the pragmatic, the horizontal, and the vertical.

The literature and the findings of this study point to the actions of the majority of teachers, when integrating technological resources, being informed by constructive integration. Constructive integration occurs when teachers are compelled to follow a prescribed document such as a CAPS document and manuals. Thus, teachers are following a vertical curriculum. On Skype one-on-one semi-structured interviews teachers reflected on unconstructive integration. Such occurs when teachers' actions are motivated by their social experience; this means that teachers share information. Such suggests that teachers are driven by the needs of horizontal curriculum. Online reflective activity also revealed that few teachers integrate technological resources, and their actions are informed by personal integration. This imbalance of integration leads to the poor integration of technological resources in which personal integration was singled out as the area for attention. Consequently, the main findings of this study indicate that teachers integrate technological resources into curriculum informed by three levels of integration: constructive, unconstructive and personal integration.

Keywords: Integration, curriculum, curriculum origins, interpretivist paradigm.

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LIST OF ABBREVIATIONS

1. CAPS- Curriculum and Assessment Policy Statement
2. ICT- Information and Communication Technology
3. DVD- Digital versatile Disc
4. SA SAMS- South African School Administration and Management
5. DBE- Department of Basic Education
6. 4IR- Fourth Industrial Revolution
7. TPACK- Technological Pedagogical, and Content Knowledge
8. COVID-19- Coronavirus Diseases
9. 3D- Three-dimensional
10. TK- Technological knowledge
11. CK- Content Knowledge
12. PK- Pedagogical Knowledge
13. 5G- 5^{th} Generation
14. US- United States
15. UK- United Kingdom
16. IOT- Internet of Things
17. WHO- World Health Organization
18. SMT- School Management Team
19. EMS- Economics and Management Sciences
20. GPS- Global Positioning System
21. USB- Universal Serial Bus
22. DSTV- Digital Satellite Television
23. ZOOM- Zeroed Output Optical Meter
24. Wi-Fi- Wireless Fidelity
25. CITR- Comprehensive Integration of Technological Resources

CHAPTER 1

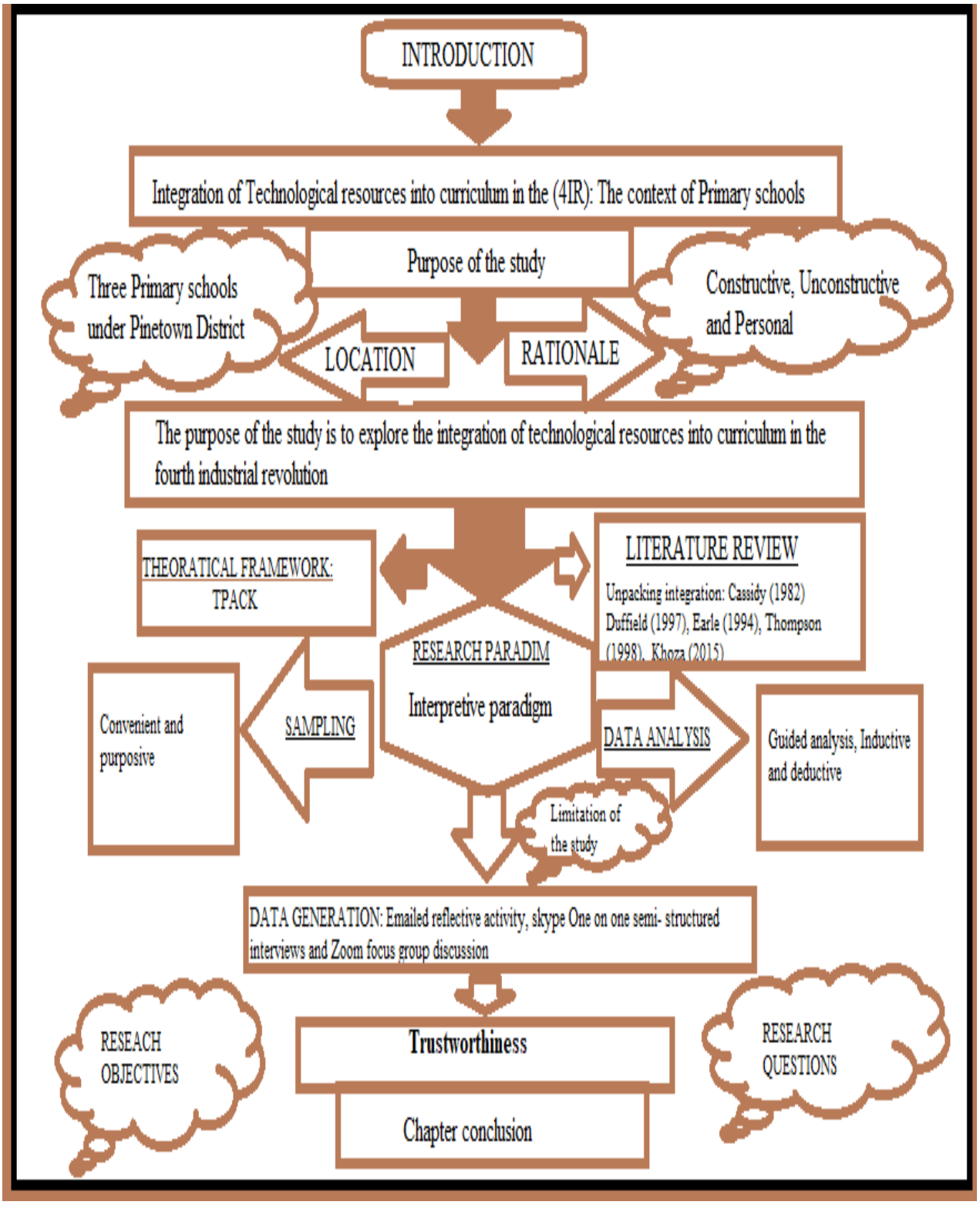


Figure 1.1 Structure of Chapter One

1.1 Introduction

This chapter aims at providing a clear understanding of how this study unfolds. The researcher identifies a clear and understandable research title which is moulded by the research focus and purpose. It is stated clearly at this level that the purpose of this study is to "explore integration of technological resources into the curriculum in the Fourth Industrial Revolution (4IR): the context of primary schools in Pinetown District". A rationale for this study is included. This study is framed by the theory of technology, pedagogy, and content knowledge (TPACK). Above all, research objectives and critical research questions that complement one another are clearly stated. Other research concepts such as research design and methodology, research paradigm, research style, sampling, data-generation methods, data analysis, trustworthiness, ethical issues, limitations, and the summary of each chapter, were not merely discussed, but extensive meaning is afforded the readers.

1.2 Focus and Purpose of the Study

The purpose of this study is to evaluate the integration of technological resources into the curriculum in line with requirements of the Fourth Industrial Revolution .

1.3 Background to the Study

Globally, integration of technological resources into the curriculum has dominated the field of education. It has also led schools to adopt and use various technological resources for a different purpose (Cussó-Calabuig, Farran, Bosch-Capblanch, & Technologies, 2018). The development of technology is rapid in the world today. Teachers must keep up with integrating technological resources into the curriculum, particularly in this 4IR era (Laschou, Kollias, & Karasavvidis, 2018). These technological developments come with numerous challenges that affect curriculum implementation and teachers' practice in schools, particularly in the South African context. These unforeseen changes in technology pose challenges such as teachers' lack of skills, lack of knowledge as to how to integrate technological resources into a curriculum, lack of funds, and a shortage of technological resources in schools (Stéphan, Joaquin, Soumyajit, & Gwénaël, 2019). In South Africa, President Cyril Ramaphosa mentioned in his speech at the Digital Economy Summit that South Africans have to embrace the technological revolution, even though it comes with challenges, because of the rapid pace of change required for teaching and learning (Kumar, 2018).

The promise of technological developments to enhance teaching and learning has led to the Department of Basic Education supplying technological resources in schools such as SMART boards, projectors, laptops, and software programmes South African School Administration and Management System (SA SAMS) (Muriithi & Masinde, 2016). Hutchison and Woodward (2014) share the view that the Department of Basic Education is striving to find a solution to the issue of teachers who cannot access information globally by providing technological resources to be integrated into the curriculum. Such will ensure that teachers are equipped to face the challenges of global competition. Teachers have to integrate technological resources into the curriculum for proper teaching to take place. Thus integrating technological resources helps teachers to advance their practice at nano (personal/individual) and micro (school) levels (Khoza, 2018).

Likewise, the integration of technological resources into the curriculum is highlighted through teachers' contributions to international literacy studies (Kabilan, 2007; Mewborn, 1999; Schön, 2017; Valli, 1997; Ward & McCotter, 2004). These studies share the view that integration is the main ingredient to ensure the success of technological resources in increasing the quality of delivering the content. In other words, teachers need to use their conscious minds in integrating technological resources into the curriculum to become aware of their actions at all times. However, local studies by Rosenberg (2004), Khoza (2018), and Mpungose (2019) agree that when teachers integrate technological resources into the curriculum, they overcome the curricular challenges that affect their teaching, increasing the quality, accessibility, and cost-efficiency of their teaching, while taking advantage of the benefits of networking learning communities together to equip them to face the challenges of global competition. In other words, teachers need to use technological resources smoothly and effectively during the teaching and learning process.

1.4 Rationale for this Study

The integration of technological resources into the curriculum in the 4IR is my research interest because it emanates from my own professional experience as a teacher. During the implementation of the intended curriculum in the school, I have observed that teachers face enormous challenges, and experience difficulties in integrating technological resources, owing to their lack of the necessary skills and knowledge, and lack of technological resources

during curriculum implementation. The school I am currently serving at is one of those privileged to have technological resources such as computers, laptops, projectors, digital video disks (DVDs), CDROMs, the internet, and other available software. However, I have noticed with great concern how teachers resist the integration of technological resources into the process of teaching and learning. The Minister of Basic Education in 2012 introduced CAPS, provided technological resources, and encouraged teachers to integrate technological resources into the curriculum (Khoza, 2015). The Department of Basic Education in KwaZulu-Natal from 24 to 26 March 2020 introduced teachers to Artificial Intelligence (coding subject) and the language to be used to communicate with computers (programme design) to embrace this revolution of technology.

However, teachers seemed to lack the basic fundamental knowledge and skills of integrating technological resources into the curriculum in their practices. Hence, I am eager to understand the difficulties met by teachers when delivering the content using technological resources; and the influence of their practice on the school. The issue of teachers neglecting to integrate technological resources into the curriculum in their practice, particularly in the 4IR era, is a grave disservice to the learners. This has triggered the conducting of this study, placing more focus on the integration of technological resources by teachers during teaching and learning in South African primary schools.

The term "technological integration" is viewed as connoting a range of technological resources for learning, from a stand-alone technological resource in a classroom to a situation in which the teaching is achieved using numerous technological resources to accomplish the curriculum (Yu & Prince, 2016). The study conducted by Cussó-Calabuig et al. (2018) shares the view that the Department of Education was striving to provide the solution to the issue of a large number of teachers resisting integrating technology into the curriculum. These studies have indicated some of the challenges met by teachers during the integration of technology, which include: (1) interaction with online content (active learning); (Engeström, Miettinen, & Punamäki). interaction between the teacher and the learner; (3) discussing topics relating to the subject; (Engeström et al.) interaction among teachers (collaboration); and (Engeström et al.) active participation in building understanding and knowledge (interactivity). Thus, these challenges have created a great deal of resistance to teaching in primary schools (Khoza, 2015). As a result, there emerged two solutions: to provide schools with technological resources, and to introduce a computer literacy module at the universities (Khoza, 2018). The

integration of technological resources into the curriculum needs continual training and support, coming as it does with problems such as inadequate integration skills (Nelson, Voithofer, Cheng, & Education, 2019; Reed, 2017).

Mwalongo (2018) and Cuttance and Stokes (2010) explain that the continuing demand for wider integration of technological resources is evidenced in that the country demands teachers who are technologically equipped to integrate these resources into the curriculum. In a study conducted by Koohang (1989) on teachers' perceptions of ICT integration, it emerged that some teachers were integrating technology into a curriculum based on the qualifications or knowledge formally received at the university. The study asserts that most teachers depended on assistance from their colleagues; there were very few who used their own initiative to integrate technology into the curriculum. In line with these findings, Nelson et al. (2019) concluded that teachers in primary school are largely driven by either constructive integration (qualifications) or unconstructive integration (assistance from others) at the expense of personal integration (using their own initiative). This varying use of technology integration can lead to poor implementation of the intended curriculum to achieve good results (assessed curriculum) (Laschou et al., 2018; Mpungose, 2019). Therefore missing these three comprehensive levels of integration (constructive, unconstructive, and personal) may not do justice to the use of technology during teaching and learning of CAPS subjects. In filling that gap, the study intends to explore teachers' integration of technological resources into the curriculum in the 4IR era. The study intends to understand why teachers resist integration of technological resources, while showing teachers the importance of integrating technological resources into the curriculum during the lockdown of the country.

1.5 Review of the Preliminary Literature

Integration is reviewed in various studies (see studies by Cassidy (1982), Duffield and Learning (1997), Earle (1994), Underwood and Technologies (1997), Kim, Sharp, and Thompson (1998), R. Fox, Henri, and Society (2005), and Khoza (2018)). These studies assert that integration contains the logic of inclusiveness by bringing together all vital features into the teaching and learning process. The studies also argue that comprehensive integration (constructive, unconstructive and personal) may result in the goal of the curriculum being attained. Khoza and Mpungose (2018) concur with these studies that comprehensive integration acts as the primary vital feature. Mohamed and Ahmad (2019) add that comprehensive integration is practical when integration levels are followed (entry,

adoption, adaption, appropriation, invention). Teachers thus first need to understand integration levels before they integrate technological resources into the curriculum. This clearly means that the integration of technological resources is driven by integration levels. The study conducted by Amory (2010) concludes by defining integration as the way in which teachers use technology to carry out curriculum activities more reliably and productively.

The term technology is defined by Selby (1993) as being attached solely to machines. Both Gaston (2006) and Prensky (2001) posit that the revolution of technological resources (hardware, software, and ideological-ware) is pressuring "digital Neanderthal" teachers to continue using the traditional methods in the process of teaching and learning. Digital Neanderthals are teachers who are resistant to change in the face of the implementation of technological curricular evolution (Prensky & Berry, 2001). These studies (Gaston, 2006; Prensky, 2001) state that this pressure on digital Neanderthals can be applied to teachers willing to become digitally wise, thus expressing digital wisdom (willingness to adapt). However, Kabilan (2007) and Dewey (1933) embolden teachers to accept digital wisdom when integrating technological resources into the curriculum in their practice. Such teachers will produce learners that meet the standard of skills demanded in the employment sector.

This thinking is in line with the interpretive case study conducted by Zhou et al. (2020), the purpose of which was to present online learning to stop the spread of the outbreak of COVID-19 in Wuhan, China. The study concluded that technological resources create an online learning community that helps both teachers (who have digital wisdom) and learners (who are digital natives) to have a virtual space in which they can share knowledge. Technological resources can thus play a primary role in teachers interacting with learners in the teaching of the curriculum (Stéphan et al., 2019). In other words, in integrating technological resources, the Fourth Industrial Revolution era provides an unlimited way for teachers to organise, manage, and deliver the content via the internet. The Fourth Industrial Revolution is defined as the fourth stage in the development of knowledge and the fusion of technologies (artificial intelligent (robotics), blockchain, Internet of Things, nanotechnology, biotechnology, 3D printing and quantum computing (Reali, 2018).

These studies conducted by Cassidy (1982) and Cullen (2008) agree with Khoza (2018) that integrating technological resources in the Fourth Industrial Revolution involves teachers who draw much from various experiences. Therefore teachers may draw from experiences formally received from their educational institution, and use the relevant documents

(constructive integration); or integrate technological resources using their knowledge of life experiences (personal integration); or integrate technological resources with the assistance of other teachers (unconstructive integration).

Khoza (2018) and Mpungose (2019) argue that constructive integration requires teachers to be driven by professional/formal experiences, which are defined as the product of mutual interaction of knowledge, and associated with teaching and learning guided by relevant policies. On the other hand, Khoza (2018) and Earle (1994) maintain that teaching/learning in unconstructive integration is motivated by social experience, as a lifelong process in which its participants acquire skills through shared information from society. Further to this, these studies (Perrotta, 2013; Selwyn, 2012; Semerci & Aydin, 2018; Underwood, Cavendish, & Lawson, 1996) argue that that personal integration is about teachers' own thoughts and feelings. The latter further express that personal integration relies on habitual actions from the individual and surroundings thoughts. Therefore, to attain the goal of integrating technological resources into the school curriculum, comprehensive integration must be adopted and practically applied.

According to Kelly (2009) and Doll (1992), curriculum as intended at schools gives direction to both teachers and learners, as it clearly stipulates what is to be taught in schools, and how. These studies (Doll, 1992; Kelly, 2009; Khoza, 2018) explain that integrating technological resources into the curriculum as intended requires teachers to understand the curriculum at a SUPRA level (international curriculum), MACRO level (national curriculum), MESO level (school curriculum), MICRO level (teacher curriculum), and NANO level (learner curriculum). Schön (2017) and Van den Akker et al. (2009) state that curriculum as intended is related to the vertical curriculum. Here teaching and learning is demarcated as in a class driven by hardware resources such as books, a teacher, a chalkboard, and others. In other words, curriculum-as-intended is an official and constructive document of content to be covered which is informed by constructive integration. However, these studies (Salmon, 2003; Schiro, 2012; Schubert, 1996; Zhou, Wu, Zhou, Li, & Example, 2020) reveal that teachers seem to lack understanding of curriculum-as-intended that is informed by hardware resources, textbooks, lesson plans, and curriculum policy documents. Further to this, these studies (Reed, 2017; Rikhye, Cook, Berge, & Learning, 2009; Rosenberg, 2004) suggest that documents such as textbooks, lesson plans, and all other curriculum policy documents can be taken as curriculum-as-intended. All such documents consist of formal content and activities

to be covered during teaching and learning. In other words, curriculum-as-intended provides the guidelines for curriculum-as-implemented.

Schubert (1996), Hoover and Education (1987) argue that curriculum-as-implemented is what teachers and learners practise in the classroom. Bernstein (1999) delineates curriculum-as-implemented as the actual integration of a curriculum to learners, or what it consists of in practice. Hoadley and Jansen (2013) agree with Hoover and Education (1987) that curriculum-as-implemented is driven by the process of teaching and learning; further, it is driven by both teachers and learners. Thus without curriculum-as-implemented, teaching and learning cannot take place. In other words, curriculum-as-implemented is influenced by constructive integration grounded on the written facts of each subject offered in a school. These studies (Doll, 1992; Hoadley & Jansen, 2013; Kelly, 2009; Schiro, 2012) indicate that curriculum-as-implemented can be viewed as the integration, preparation, and monitoring of planned or instructional content directly as it is from the intended curriculum to learners in the classroom. However, these teachers seem not to acknowledge that the curriculum-as-implemented is the receipt/ingredient for curriculum-as-achievement (Bernstein, 1999; Khoza, 2018). This suggests that in curriculum-as-implemented proper skills of integrating technological resources are tested. Teachers can thus apply comprehensive integration for improvement purposes, which can assist learners in their curriculum-as-achievement.

Bernstein (1999) is in line with Bravmann, Green, Joseph, Mikel, and Windschitl (2000) that curriculum-as-achievement is perceived by learners as measured through their learning outcomes/output. The above studies show that the outcomes of what takes place in the classroom (integrating resources) are considered the attained curriculum. Khoza (2018) states that curriculum-as-achieved is more concerned with producing unconstructive integration based on the contextual issues that affect teaching and learning; and it is dynamic (teachers must provide creativity to deliver the content in a particular context). Fullan (2007) states that curriculum-as-achieved is the curriculum that indicates the knowledge, understanding, skills, values, and attitudes that learners actually acquire as a result of teaching and learning, is assessed through various technological resources. Nevertheless, these scholars (Bernstein, 1999; Bravmann et al., 2000; Caswell & Campbell, 1935) maintain that integration of technological resources into the classroom can be determined by the learners' performance.

Amory (2010) and Laschou et al. (2018) believe that it is impracticable to have software resources and hardware resources without modelware (pedagogy or theories) to enhance the

integration of technology into the curriculum. The studies outline modelware as teaching pedagogical/theories. Khoza (2018) explains that to achieve the goal of integrating software and hardware, modelware is a tool that drives the teaching process, and has crucial influence on the goal of the curriculum. Modelware integrates rudimentary learning theories such as behaviourism, cognitivism and constructivism in the process of learning (Kumar, 2018). Gaston (2006) and Mpungose (2019) state that studies are emerging of a variety of learning theories as the modelware of using technological resources,; this includes a five-stage model of learning (Salmon, 2003), the cultural-historical activity theory (CHAT) (Engeström, Miettinen, & Punamäki, 1999), and connectivism (Siemens, 2014), the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003), and the technological, pedagogical and content knowledge (TPACK) (Koehler, Mishra, & Education, 2009). Therefore Modelware may be used to drive the integration of technology during teaching and learning at primary schools. In other words, integrating modelware can ensure that the goal of curriculum is attained. The theoretical framework of this study will emerge after unpacking the above theories.

These scholars (Kelly, 2009; Khoza, 2018; Mpungose, 2019; Schön, 2017; Van den Akker et al., 2009; Visscher-Voerman, Gustafson, & development, 2004) argue that the above theories share the same components with a curriculum spider web that is guided by precise approaches (pragmatic, communitive, and instrumental) driven by curriculum signals. The latter studies maintain that the pragmatic approach to curricular activities takes place interactively, driven by (peer, over-time, online, facilitator, software, informal, content, outcome, and financial) approaches. The communitive approach to curriculum activities takes place under the perceptions and views of the target group, and other stakeholders, which are driven by (cultural, aims, content, continuous, modelware, blended, spare-time and formative); and the instrumental approach emphasises the importance of a system that is driven by (objectives, content, formal, hardware, face-to-face, summative and contact time) (Kelly, 2009; Khoza, 2018; Mpungose, 2019; Visscher-Voerman et al., 2004).

In bridging the gap, these studies (Cassidy, 1982; Duffield & Learning, 1997; Earle, 1994; Khoza, 2018; Kim et al., 1998) indicate that most studies are conducted to account for the integration technology in higher education. Nonetheless, the literature seems to be silent, or at least, little has been said about comprehensive integration of technological resources at the basic education level. This is especially so in the current curriculum (CAPS) in the African

context in the era of 4IR. Nelson et al. (2019) declare that there is a need to conduct studies to empower teachers to integrate technological resources comprehensively, transforming them from digital immigrants to purveyors of digital wisdom.

1.6 Theoretical Framework

TPACK is a theoretical framework generally used in the education field to understand teachers' involvement in and understanding of integrating technology (Khoza & Biyela, 2019). Koehler and Mishra (2013) suggest that TPACK is now observed as one framework that captures technology integration with emphasis mainly on three knowledge components (technology, pedagogy, and content). Mishra and Koehler (2006) state that these three types of knowledge do not work in isolation, but must be integrated for effective integration of technology into the curriculum. The study was guided by the three main knowledge components.

TK is defined as "knowledge about the different range of tools and technologies, from traditional technologies such as pencil, paper, chalk and chalkboard to digital technologies such as the internet, computer simulations, interactive whiteboards, discussion forums and software programs" (Govender & Khoza, 2017, p. 77). Shulman (1986) contends that technological knowledge is based on teachers' understanding of technologies that must be integrated into the classroom – not just knowing technology, but being fully able to integrate it into the curriculum. Nonetheless, Thompson and Mishra (2007) and Schmidt et al. (2009) concur that technology is part of the resources that have a constructive influence on learners' learning. Technological knowledge thus requires teachers that know how to use resources (hardware, software, and modelware) for learners to understand the lesson in the era of 4IR (Amory, 2010). Thompson and Mishra (2007) and Khoza and Biyela (2019) agree that teachers should use effective ways of integrating technology into the curriculum to maintain collaborative, and cooperative teaching and learning. Thus, this study of TK is driven by unconstructive integration because it addresses the needs of society. This component (TK), in the context of this study, therefore, will identify whether teachers are using multiple technological resources to actively engage learners in the process of teaching and learning, thus addressing their content knowledge needs.

CK is regarded as knowledge of the module/subject to be taught and learned (Khoza, 2018). Koehler and Mishra (2013) and Graham (2011) define CK as the phenomenon that contains an understanding of the content. Such comprises knowledge of how one's subject matter may

be improved by the application of technology. Similarly, Mishra and Koehler (2006) maintain that content may be defined as the actual subject matter to be learned. Nonetheless, Schmidt et al. (2009) and Mpungose (2020a) concur that CK helps teachers understand the content for teaching a particular subject. Clearly, if teachers have insufficient CK, learners can develop incorrect conceptions of the subject taught (Shulman, 1986). In other words, teaching a subject without sufficient CK cannot properly address the subjects' needs. CK therefore requires teachers to have knowledge of the subject matter to be taught via the application of technology (Khoza, 2018). Thus, this component is based on the subject content, which is informed by constructive integration. As a result, this component (CK) will assist to discover whether teachers are specialists in their subjects (Harris, Mishra, & Koehler, 2009). CK, in the context of this study, will address whether teachers own CK, and are able to use pedagogical knowledge during the teaching and learning process.

Pedagogical knowledge (PK) is influenced by various factors, including the goals, values, and purposes of an individual teacher (Mishra & Koehler, 2006; Schmidt et al., 2009). Mishra and Koehler (2006) state that PK refers to profound or in-depth knowledge of the methods and practices of learning. In the context of this study, therefore, PK is influenced by personal integration, and requires teachers to know about methods and theories in the process of unpacking the learning content. Schmidt et al. (2009) mention that PK requires teachers to have various theories and methods for how using technologies. PK will assist in the context of this study to assess whether teachers use methods and theories in the process of teaching and learning. PK will establish whether teachers have a direction in terms of a lesson plan, class management, teaching, and assessment strategies, including goals to be achieved.

1.7 The Objectives of this Study:

1. To explore technological resources integrated into the curriculum in the 4IR.

2. To explain the lessons to be learned when teachers integrate technological resources into the curriculum in the 4IR.

3. To understand what informs the teachers' integration of technological resources into the curriculum in the 4IR.

1.8 Research Questions:

1. Which technological resources do teachers integrate into the curriculum in the 4IR?

2. How do teachers integrate technological resources into the curriculum in the 4IR?
3. What informs teachers in the 4IR when integrating technological resources into the curriculum in the way they do?

1.9 Research Methods/Approach to the Study

1.9.1 Research approach

This study has adopted a qualitative research approach. The qualitative approach intends to explore a problem or a situation (Christiansen, Bertram, Land, Dampster, & James, 2010). Cohen, Manion, and Morrison (2013) indicate that qualitative research gives a platform for gaining insights; this approach explores the depth, richness and difficulty of a case . Creswell and Creswell (2017) concur with Cohen et al. (2013) that in the qualitative approach the researcher attempts to understand and describe how different individuals make subjective sense of their lives. Bertram and Christiansen (2014) affirm that the qualitative approach consists of textual or visual data, such as field notes recording observations. In the context of this study, I will use a qualitative approach to gain rich and in-depth information on teachers' integration of technological resources into the curriculum in the 4IR. Cohen et al. (2013) argue that one of the weaknesses of the qualitative approach is that it does not focus on statistical procedures or other means of quantification. To address these limitations, I will apply words instead of figures to express all proceedings about the study. According to these scholars (Christiansen et al., 2010; Cohen et al., 2013; Creswell & Creswell, 2017; Khoza, 2018), qualitative research is appropriate for studying people. I therefore decided to use the qualitative research approach as it would elicit first-hand knowledge of the teachers' integration of technological resources into the curriculum in the 4IR. It would also provide an understanding of how technological resources should be integrated.

1.9.2 Research paradigm

The study adopts the interpretive paradigm. Cohen et al. (2013) and Christiansen et al. (2010) affirm that the interpretive paradigm is grounded on the understanding of social behaviour, and the meanings people associate with their experience. Creswell and Creswell (2017) argue that the interpretive paradigm is primarily geared towards understanding and gaining knowledge of an individual from a personal perspective. Scotland (2012) states that interpretive research aims to present a perspective on the situation under study; analysing it to

provide insight into how a particular group of people makes sense of their situation, or the phenomena (integration) they encounter. Scotland (2012) adds that the interpretive paradigm entails a description of occasions on which the study questions the actions of people in order to describe and understand teachers' integration of technological resources into the curriculum.

Denscombe (2014) perceives that the interpretive paradigm holds different views, such as focusing on the nature of reality (ontology). In dealing with ontology in this study, I will take a stand based on how teachers perceive things, thus integrating technology. Knowledge (epistemology) is constructed through various experiences of real-life or natural settings (Brey & Machines, 2005). Consequently, I will construct knowledge through the various experiences of teachers, by involving participants reflectively. These scholars (Denscombe, 2014; Scotland, 2012; Tuli, 2010) agree that the interpretive paradigm holds a truth that is multilayered and deserves multiple interpretations. Thus the adoption of the interpretive paradigm can improve the integration of technological resources into the curriculum; this paradigm aims at a description of events about which the study questions "what" and "why". Adopting an interpretive approach can result in gaining an understanding of the integration of technological resources into the curriculum. Phothongsunan (2010) avers that working with the interpretive paradigm has a weakness in that it requires the researcher to comprehend beliefs, values, behaviours, and the way in which people make meaning of their social phenomena. I will therefore seek to understand the nature of the participants, and will consider their subjective experiences of the external world by making meaning of their social phenomena.

1.9.3 Research style

This study adopted the intrinsic case-study approach to comprehend the teachers' integration of technological resources into the curriculum in the 4IR. An intrinsic case study studies the case, this being interesting in itself; it gives insight into ways of achieving a positively attained curriculum (Yin, 1994). Springer (2009, p. 407) states that "the case study is advantageous because of the richness of information that results from the intensive focus on one situation." Yin (1994) and Cohen et al. (2013) concur that a case study is advantageous in analysis, in that the researchers examine a set of findings concerning wider theoretical components. An intrinsic case study will thus assist by using various methodologies to obtain data. Cohen et al. (2013) outline that a case study can be understood as particular practice,

procedure, or condition (particularistic), the deep and wide group of particulars concerning the event (descriptive), and the analysis used to establish generalizations or theories that materialize from data, (inductive).

Silverman (2013) mentions difficulties in setting boundaries to the case study, gaining access to case-study settings, and ensuring, where relevant, that case studies move beyond description to analysis and evaluation. Consequently, I have chosen a case of eight teachers per school in three schools chosen because of their accessibility. This might hold the readers' attention. Teachers in the era of 4IR ought to provide rich information on the integration of technological resources into the curriculum. Cohen et al. (2013) point out that case studies involve a diversity of perceptions embedded in particular situations. A case study may therefore be a plan, an experience, or an action restricted by timing and location (Christiansen et al. (2010). I will therefore adopt an intrinsic case study to explore teachers' integration of technological resources into the curriculum in the 4IR.

1.9.4 Sampling

Sampling is defined by Christiansen et al. (2010) as a process in which the researcher chooses the group of people (teachers) and the location (Pinetown district) to study. Cohen et al. (2013) comment that sampling can be understood as a component of analysis; and the sample selected by the researcher depends on the data-generation methods, total population, and style of the study. This means that the size of the sample of this study will be subject to the style and population size. Therefore, I will use purposive and convenience sampling to select the twenty-four teachers (eight teachers per school in three schools selected from the Pinetown district) in the foundation, intermediate, and senior phases. Specifically, I will use purposive sampling to include teachers with whom I work – those integrating technological resources into the curriculum, and those unenthusiastic to do so.

Sampling will also be convenient because I will recruit teachers in the Pinetown district telephonically and send fliers via email. Silverman (2013) identifies the strength of convenience sampling as being that it is usually quick and inexpensive. However, it does not result in a representative sample, thus this study will use both purposive and convenience sampling. I want to explore teachers' integration of technological resources into the curriculum, generating data from teachers who are easily accessible. Christiansen et al. (2010) emphasize that sampling should not be intended to generalize findings, but to enhance credibility. Therefore, I will ensure that once the study has been finalized, I will arrange with

participants using Skype to give feedback. I will allow participants to check whether everything we have discussed has been accurately captured. Khoza (2015b) states that bias in sampling is one of the weaknesses in research. Therefore, in ameliorating this weakness, I will ensure that both teachers who are unenthusiastic and teachers who integrate technological resources into the curriculum are equally represented in the sample.

Table 1.1 Participants' Details

Schools	Participants	Age	Gender	Qualification	Phase
King Zwelithini Primary School	Miss Phuthini	24	Female	BA + PGCE	Foundation
	Miss Cele	45	Female	BEd	Foundation
	Miss Zulu	36	Female	BA	Foundation
	Miss Ngema	30	Female	BA + PGCE	Intermediate
	Mrs Ntuli	27	Female	B Ed	Intermediate
	Mr Mthiyane	64	Male	PGCE	Senior
	Mrs Mnguni	24	Female	BA	Senior
	Mr Biyela	27	Male	BA + PGCE	Senior
Albin Primary School	Mrs Nigel	33	Female	BA + PGCE	Foundation
	Mrs Pan	35	Female	BEd	Foundation
	Miss Oak	54	Female	BA	Foundation
	Miss Zulu	36	Female	BA + PGCE	Intermediate
	Miss Thabethe	27	Female	BEd	Intermediate
	Mr Ngema	29	Male	PGCE	Senior
	Miss Dlomo	33	Female	BA	Senior
	Mr Thethwayo	53	Male	BA + PGCE	Senior
Sicelulwazi Primary School	Miss Lushaba	27	Female	BA + PGCE	Foundation
	Mrs Nala	33	Female	BEd	Foundation
	Mrs Mkhize	35	Female	BA	Foundation
	Miss Biyase	54	Female	BA + PGCE	Intermediate
	Mrs Mkhize	36	Female	BEd	Intermediate

Mr Mkhize	27	Male	PGCE	Senior
Miss Mbhele	24	Female	BA	Senior
Mr Khwela	45	Male	BA + PGCE	Senior

1.9.5 Data analysis

Analysing data entails "operating with data, categorizing, splitting it into convenient units, building it, probing for patterns, identifying crucial patterns, and making a decision of what to tell others" (Bogdan & Biien, 1982, p. 145). Cohen et al. (2013) state that data analysis involves breaking up complex data into themes, patterns, and relationships. Kenny, Kashy, and Cook (2006) and Cohen et al. (2013) concur that breaking complex data into themes and convenient units, and organizing the information may be regarded as data analysis. Cohen et al. (2013) point out that qualitative data analysis is mainly about unloading data based on the data given by the participants. Thus, I will derive from the participants' experiences and explanations an understanding of the integration of technological resources into the curriculum in the 4IR.

This qualitative study adopted a thematic analysis, which moves beyond counting explicit words or phrases, and focuses on identifying and describing both implicit and explicit ideas within the data (Christiansen et al., 2010). Thematic analysis encompasses reasoning which involves the use of existing knowledge or observations to make predictions about novel cases (inductive reasoning); and a theory-testing process which begins with established theory, ascertaining whether the theory applies to specific instances (deductive reasoning). (Mallia, 2014). In the context of this study, data generated will be framed around three levels of integration ─ constructive integration, unconstructive integration, and personal integration. Therefore, data will be organised into categories and patterns. I will deductively map the codes into the set categories (from the theoretical framework and the literature) to form themes. In addition, I will use an inductive process to recapture the remaining codes which are not deductively analysed during the prior analysis, to form categories. This will assist to reveal the purpose of this study.

1.9.6 Methods of data generation

The study will adopt three online techniques in data generation owing to COVID-19: emailed reflective activity, Zoom focus-group discussion, and Skype one-to-one semi-structured interviews.

1.9.6.1 Emailed reflective activity

Giles Jr and Eyler (1994) describe reflective activity as an open question which allows the participants to use their own words to answer the question. Such is defined by Cohen et al. (2013) as a written activity that asks participants to complete a short series of questions about the issue studied (integration of technological resources). Thus, this study will design an open-ended questionnaire as a reflective activity that will be emailed to participating teachers. The questionnaire will be guided by TPACK components for the eight teachers per school in the three selected schools. This will provide a foundation for individual semi-structured interviews. Bertram and Christiansen (2014) outline that a researcher creates questionnaires in the hope that the participants will respond honestly. However, it seems it will be impossible for participants to respond honestly to the activity given to them. Therefore, this study will explain to the participants the issue of honesty and give sufficient time to respond to questions. An extra three weeks will be granted to participants before answers are requested to be sent back via email.

1.9.6.2 Skype one-to-one semi-structured interviews

The study will adopt one-to-one semi-structured interviews using Skype for data generation. These interviews are defined by Harrell and Bradley (2009) as the main source of data generation, and are frequently preplanned for designated times and settings. Semi-structured interviews generally include prearranged open-ended questions (Harrell & Bradley, 2009). Semi-structured interviews are a data-generation method suitable for this study, allowing participants to give more detailed responses based on the set of questions asked during reflective activity. However, Barriball and While (1994) comment that semi-structured interviews as a data-generation method result in large amounts of textual data; therefore when the data are transcribed, much time is needed. I will therefore ensure that 45 minutes per participant is given. Khoza (2015b) states that semi-structured interviews are appropriate data-generation methods for drawing out attitudes and opinions of the participants. The interviews will be Skyped during the day, and video-recorded by means of a laptop computer.

1.9.6.3 Zoom focus-group discussion

Cohen et al. (2013) state that using a Zoom focus group as a data-generation method will encourage group members to become active, with the researcher facilitating group discussion. Questions for the discussion will be based on TPACK components similar to the questionnaires from the reflective activity. All the participants will be brought together on a Zoom platform in one forum to share their experiences on integrating technological resources into the curriculum in the era of 4IR. Krueger and Casey (2002) indicate that the strength of the Zoom focus-group discussion is that the 'tarn of knowledge' becomes broad, making it easier for ideas and solutions to emerge for all members playing a part in the process; this does not take much time. However, Krueger and Casey (2002) state that the drawback is that certain members wish to speak endlessly, while others are not able to express their views. To address this limitation, I will encourage everyone to talk. Rabiee (2004) says that focus groups can be understood as a form of group interview in which confidence is placed in the interaction within the group. The group discusses the topic supplied by the researcher, yielding a collective rather than an individual view. I will request that teachers join Zoom meetings after they have watched Zoom training videos, and have been informed of the study and its purpose. I will let them know the time and date for data generation.

1.9.7 Trustworthiness

Guba and Lincoln (1994) stress that trustworthiness goes to a researcher's competence in convincing readers that the findings of the research are truthful. Connelly (2016) states that trustworthiness will be considered at the data-presentation stage, in data generation, and data analysis. This will ensure that the findings of the study reflect the situation, and that readers will trust the study. Guba and Lincoln (1994) add that the researcher must pay attention to issues of credibility, transferability, dependability, and confirmability to increase trustworthiness in a qualitative study.

The applicability of the research findings to another context is defined by Guba and Lincoln (1994) as transferability. This study will ensure transferability by ensuring that the accurate findings from the study will be beneficial, applicable, and exemplary for other teachers not involved in the study, but in another context (integrating technological resources) having similar aspects as this study. Guba and Lincoln (1994) concur that dependability can be understood as the reliability of the research findings, which are about providing accurate

information in the study. Consequently, I will ensure dependability by the direct quotation of the participants' responses, thereby allowing readers themselves to assess the findings. Shenton (2004) points out that the extent to which findings reflect participants' experiences and ideas, and are not influenced by the researcher, can be understood as confirmability. To ensure coherence and consistency I will therefore acknowledge that participants 'position did not influence the findings. Poland (1995) describes credibility as a label for findings that reflect reality and the lived experiences of the participants. Subsequently, I will ensure credibility by arranging for each participant per Zoom video call to view whether the findings match what they intended, and check that what was recorded was accurately captured.

1.9.8 Ethical issues

According to Cohen et al. (2013), ethics in research plays a fundamental role, especially when the research involves people, ethics being about moral sensitivity to other people's rights, respecting their dignity as human beings. Leedy and Ormrod (2005) suggest categories of ethical consideration that are important in a research project. These include protection from harm, informed consent, the right to privacy, and honesty. Therefore, for this study, I will seek permission from the research office to conduct the research. Once permission has been granted by the research office, I will contact participants per email and telephonically to ask their permission to include them in the study. If the intended participants agree to take part in the study, I will send them consent forms explaining the purpose of the study to them. I will also inform all participants via email, WhatsApp, and telephonically of their rights to confidentiality, anonymity, and their voluntary participation. I will then explain to participants that the study will use pseudonyms, not their real names. I will also assure the participants that the information provided will be confidential between them and me. The participants will be informed that they have a right to withdraw their participation at any time, but that the study will be beneficial to them, and will do them no harm.

1.9.9 Anticipated problems/limitations

The limitations refer to those factors that may affect the process of generating or collecting data (Hodkinson & Hodkinson, 2001). The limitations are determined by the method used to collect data and restrict the findings of the study. The participants in the study may include digital immigrants. I acknowledge that the process of data generation may be affected owing

to the online technique of generating data from the participating teachers. However, I will create videos to teach participants how to use Zoom, Skype, and emails.

CHAPTER 2

Literature Review

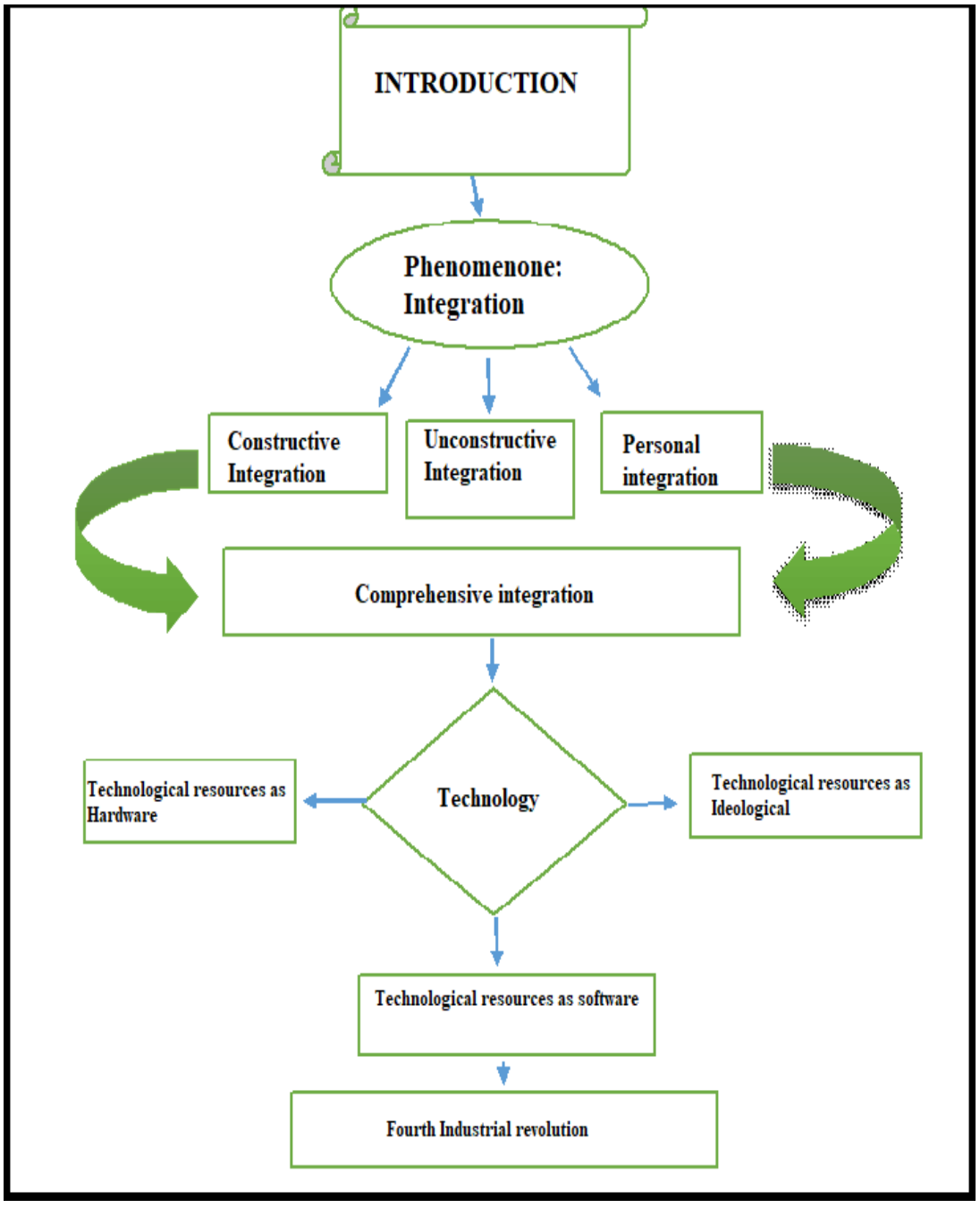


*Figure 2**.1: Chapter 2 Overview***

2.1 Introduction

The previous chapter has outlined the study background. The study background views the focus and the purpose of the study, the study location, research aims, and objectives, research questions, preliminary literature, the importance of the study, and gives a basic review on a theoretical framework, research, and design. This chapter will focus on integration (phenomenon) grounded in three categories: constructive integration, unconstructive integration, and personal integration. This chapter aims to further unpack the literature on educational technology, or technological resources, which are divided into three categories, namely, hardware, software, and ideological-ware resources (Khoza & Mpungose, 2018). It is one of the main objectives of this chapter to show the influence of the Fourth Industrial Revolution on the integration of technological resources into the curriculum. The discussion of the influence of the Fourth Industrial Revolution leads to the curriculum characteristics of the Fourth Industrial Revolution. Such emerge as artificial intelligence, robotics, blockchain, Internet of Things, nanotechnology, 5G, biotechnology, 3D printing, and quantum computing. Towards the end of this chapter, the significance of curriculum signals will be highlighted before the conclusion is drawn, which will lead to the next chapter. A literature review is a fundamental component of the study. It helps to share the results of previous studies related to the one under study; also extending prior studies and filling the gaps (Cooper, 1988). Further to this, Marshall and Rossman (2014) point out that a literature review is an analysis of relevant resources for the research that helps set the context and define the research topic. Hence, this chapter intends to explore the literature on the integration of technological resources into the curriculum in the Fourth Industrial Revolution.

2.2 Integration (phenomenon) in Education

It is challenging to discover a direct and consistent definition of integration, as this term is often used interchangeably with the word 'use' (Cassidy, 1982; Cussó-Calabuig & Farran, 2018; Duffield, 1997; Earle, 1994). Nevertheless, scholars propose numerous definitions of integration. Historical integration (from the Latin integrare, to make whole) includes a sense of completeness or wholeness and incorporates the need to overcome artificial separation by bringing together all essential elements in the teaching and learning process (Cassidy, 1982; Cussó-Calabuig & Farran, 2018; Duffield, 1997; Earle, 1994). On the other hand, Ackermann (2012) argue that the term integration originated from the term 'integral' that was first used by Cavalieri, an Italian mathematician, in around 1635. Ackermann (2012) view the adjective integral as standing for a continuous function on the interval [a,b]; to be the limit of sums of the areas of thin rectangles. Further to this, the development of the integral technique was a branching one; one that births the technique that is currently known as 'integration' (Ackermann, 2012). Richardson (1954) views integration as the operation of finding a function whose differential is known as b. This is the operation of solving a differential equation.

Integration is defined "as a continuum, or a set of ordered stages, that describes the type and degree of connectedness between programs and services" (Morrison-Saunders et al., 2014 p.2). Haedicke, Frehse, Fey, Große, and Drechsler (2011) posit that integration implies that the various dimensions of sustainable development should be presented in a way that acknowledges the linkages and interrelationships between them. Scholars (Booth, 1992; Cakir, 2012; Heyberi, 2013; Kumar, 2018) concur with Haedicke et al. (2011) that integration is an act of bringing together smaller components into a single system that functions as one. Conversely, Lachman (1997) argues that integration is not a solitary occurrence but a series of events that occurs over a long period. (See a qualitative interpretive case study conducted by Mthembu (2018) on the perceptions of teachers on the integration of computer technology in school in Grade 10). The main aim of the study was to understand the perceptions of teachers on the integration of computer technology in school. The study concluded that integration is a variety of non-segregated settings and is also a process of increasing participation in occurring events. Integration is therefore about bringing together all essential components into the process of teaching and learning to enhance participation of learners in the classroom. This study therefore defines integration as a system of bringing together two or more elements to work together.

In addition to the above, Syomwene (2017) believes that integration aims to support teachers' understanding of the subject content (knowledge) and to think openly and learn the problems of their teaching practice. A mixed methods study that was conducted by Reed (2017) emphasises that integration is an action whereby teachers participate in exploring their constructive experiences to develop and lead them to new understandings. Regardless of scholars' understanding of the term integration, it is commonly agreed that 'integration' supports teachers' understanding of pedagogy as well as their ability to work flexibly and objectively; and to learn problems from their practice (Lim & Khine, 2006). Integration therefore assists teachers to work flexibly and to be more productive.

In the 1980s, according to Cassidy (1982), integration was not new in the education profession, especially during the teaching and learning process (See the study conducted by Gans (1985) on integration attitudes and implications). It is revealed that integration is about examining involvement in technology based on past and present activities to shape future activities. Integration gives teachers a chance to analyse difficult situations, tackle the problem, and to think differently in finding solutions to problems (Gans, 1985). Integration thus involves personal thinking in finding the solution. This is evident when Harris et al. (2009) emphasize that integration assists teachers to move from routine activities influenced by traditional beliefs and habits to integration activities that are a result of self-assessment and self-development. During the process of integration there should therefore be change and transformation for developmental purposes in the profession (education). Thus, the major outcome of integration in the education profession is the measure of activities carried out more reliably, and fruitfully integrated with technology (Javaid et al., 2020). Integration then assists teachers in executing activities more reliably and successfully.

Liao et al. (2017) and Xu et al. (2018) confirm that the integration of resources in the education sector has been adopted by several schools across the world to help transform education and improve teaching and learning. On the other hand, the study conducted by Yurtseven Avci, O'Dwyer, and Lawson (2020) discovered that, although schools globally show interest in integrating resources to transform education and improve teaching and learning in their practice, the integration of these resources is not active, and focuses on the individual (teachers of digital natives). Javaid et al. (2020) concur with Cussó-Calabuig and Farran (2018) that, even though resources are being provided in schools by the Department of Education, teachers still seem to be reluctant to integrate these resources into the curriculum

to transform education and improve teaching and learning. In short, the integration of resources is implemented by individuals in the school, which results in the deteriorating quality of education.

In addition to the above, Levine (1998) and Khoza (2016) outline that integration is a procedure applied regularly to support both teaching and learning across levels and subject matter in the teaching and learning process. The following studies (Cuban, Kirkpatrick, & Peck, 2001; Hennessy, Ruthven, & Brindley, 2005; Yurtseven Avci et al., 2020) indicate that integration relies on (constructive, unconstructive, and personal integration) to carry out familiar activities more reliably and productively, and how such use may be reshaping these activities. Thus, a mixed methods study was conducted by Earle (2002) on the integration of instructional technology into public education. The study aimed to grasp the prospects for the integration of instructional technology into public education. This study concurs with the survey-based quantitative research conducted by Cakir (2012) on technology integration and technology leadership in schools as learning organizations. The main aim of the study was to investigate technology integration in primary schools from the perspective of leadership in learning organizations. These studies concluded that when teachers integrate technological resources teachers may draw from action formally received from their educational institution. Teachers may then use the relevant documents (constructive integration); or integrate technological resources using their knowledge of life experiences (personal integration); or integrate technological resources with the assistance of other teachers (unconstructive integration) as depicted in Figure 2.2 below.

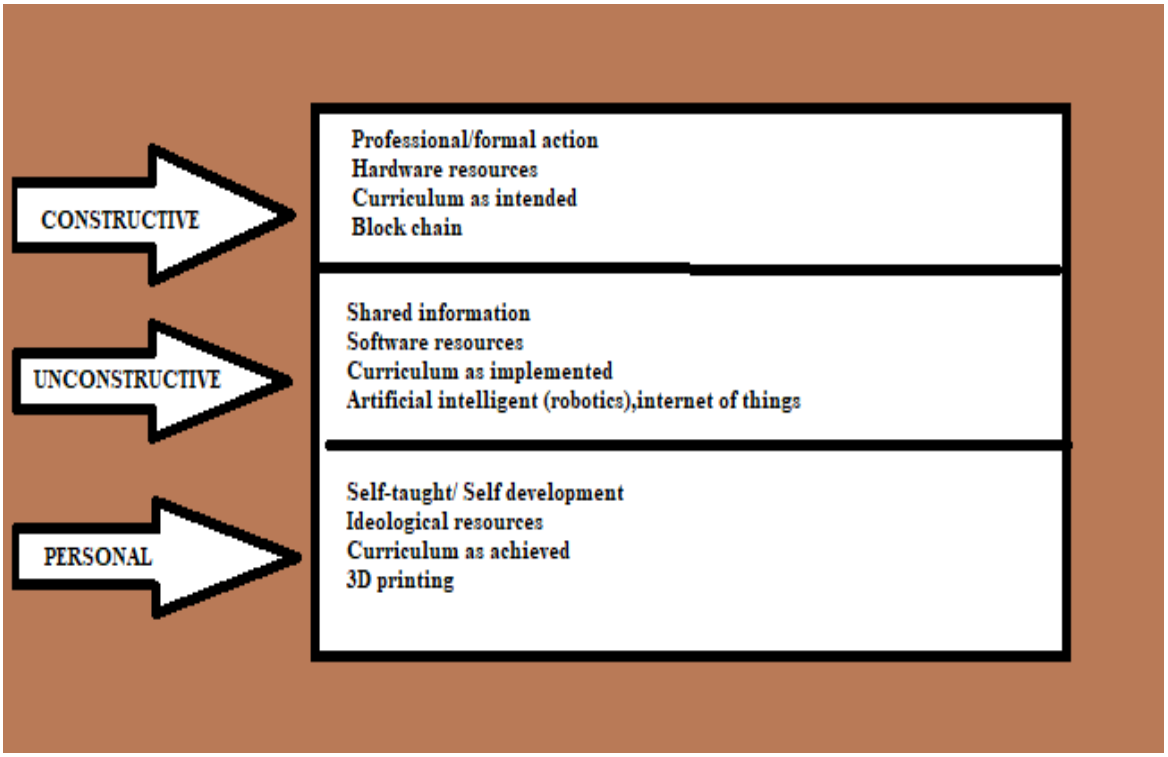


Figure 2.2 Overview of integration levels

2.3 Constructive Integration in Education

Khoza and Mpungose (2018) suggest that constructive integration requires teachers to be driven by professional/formal actions during the teaching and learning process, which are defined as the product of mutual interaction of knowledge, and associated with teaching and learning guided by relevant policies. The latter authors argue that teaching/learning in constructive integration is very organized. The teacher has control of what is to be learned (selection), when it is to be learned (structure), and how quickly it must be learned (pacing) (see a qualitative interpretive case study conducted by Koszalka and Wang (2002) on integrating technology into learning). The main aim of the study was to understand the problems related to integrating. The study concluded that constructive integration is related to the prescribed curriculum (vertical curriculum). Teaching and learning is driven by numerous hardware resources (laptop, tablet, SMARTboard); and teachers read manuals and books to understand how to use a particular resource (Mwalongo, 2018; Nelson et al., 2019). Teachers therefore need to have content knowledge about the module/subject to be taught and learned, so as to integrate these resources.

A mixed methods study was conducted by Ng (2006) on factors that influence the integration of information and communications technology into the classroom seeking pre-service mathematics teachers' perceptions. The main aim of the study was to field-test the instrument which measures secondary school mathematics teachers' perceptions of the positive impact of factors on ICT implementation. The study concluded that constructive integration is the fundamental level of assisting teachers with directions and guidelines on how to integrate technological resources into the curriculum. Such enables teachers to produce the desired performance in reduced time and with less effort. Constructive integration therefore depends on policy documents that provide straightforward user-guides and procedures on how to integrate technological resources. Kumar (2018) concurs with a qualitative interpretive case study conducted by Moya, Musumba, and Akodo (2011) on management attitude, support, and integration of information communication technologies in higher education in Uganda. The study aimed to investigate the management attitude effect on the integration of Information Communication Technology (ICT) into the classroom environment. The study concluded that constructive integration may be understood as a level that provides written steps to assist teachers on how to integrate these technological resources during teaching and learning. Thus, constructive integration focuses on consistent integration that is guided and which influences written work by others. In other words, constructive integration is informed by written documents.

Also, according to these studies (Amory, 2010; Mwalongo, 2018), teachers seem to lack the understanding to integrate technological resources into the process of teaching in both the face-to-face and online contexts. (Bates & Poole, 2003; Ramorola, 2014; Rao & Prasad, 2018; Reali, 2018) argue that the issue of teachers not understanding integration of technological resources may be eliminated. Such would occur provided teachers adhere to integration stages with content knowledge when implementing the prescribed curriculum. These stages include entry, adoption, adaption, appropriation, and invention (Van Manen, 2016). Teachers thus need to be aware of these stages to enhance constructive integration during teaching and learning. In other words, without understanding these stages teachers may hardly be driven by constructive integration.

Lim and Khine (2006) suggest that constructive integration in the education sector is in line with the formal learning process. These scholars (Mpungose, 2020a; Muriithi & Masinde, 2016; Mwalongo, 2018) agree that constructive integration is documented about the learning

process procedures; assessment, and activities are also stipulated. A qualitative interpretive case study was conducted by Mann (2014) on science teachers' experiences in integrating information and communication technology (ICT) into their teaching practices. The main aim of the study was to understand two middle- and secondary-school science teachers' experiences of integrating technology into the classroom. The study concluded that constructive integration has a positive role to play in the education sector because it provides opportunities for teachers and room for improvement. Be that as it may, Meyers and Bagnall (2017) further mention that constructive integration has the purpose of structuring teachers' thinking and behaviour in a particular way towards the integration of technological resources. Teachers in constructive integration are shaped as knowledgeable in their subjects. Nevertheless, Livingstone (2012) states that to be knowledgeable in one's subject, teachers must undergo a particular formal education that is offered and legally recognized by the Department of Education. Universities and colleges remain the source of constructive integration whereby teachers can acquire scholastic knowledge in bringing development to the teaching and learning process (Mpungose, 2020a; Mwalongo, 2018; Ng, 2006). Constructive learning is thus driven by the scholastic knowledge from colleges and universities. However, constructive integration is not enough alone − unconstructive integration is also needed in the process of teaching and learning.

2.4 Unconstructive integration

Khoza (2018) and Earle (1994) propose that teaching/learning in unconstructive integration is motivated by social experience, as a lifelong process in which its participants acquire skills through shared information from society. Livingstone (2012), Baleni (2017) and Hew and Brush (2007) further posit that unconstructive integration is associated with a horizontal curriculum, in which learners have control over the enacted curriculum. The latter studies indicate that unconstructive integration enriches learners' skills and adds to the ability to have control over how they are learning. This notion draws from Kim et al. (1998) and Javaid et al.'s (2020) argument that unconstructive integration deals with drawing conclusions based on external factors that might influence a classroom exercise. Such can include the individual's socio-historical and politico-cultural environment. Thus, Mpungose (2019) suggests that in unconstructive integration teachers must have the technical knowledge to involve social technological platforms (WhatsApp, Facebook, Instagram, and other social platforms) in the process of implementing a curriculum to guarantee that the curriculum is not

disrupted. This seeks that teachers have the technical knowledge to understand unconstructive integration.

Khoza and Mpungose (2018) agree that unconstructive integration involves teachers sharing ideas about the integration of technology. This can be achieved in various ways, such as when teachers attend workshops, cluster meetings, and staff-development meetings at school. Mwalongo (2018) insists that unconstructive integration constructs a social space in which issues of technology can be discussed in addressing the needs of society (see a qualitative interpretive case study conducted by Mthembu (2018) on the perceptions of teachers on the integration of computer technology in school in Grade 10). The main aim of the study was to understand the perceptions of teachers on the integration of computer technology at school. The study reveals that teachers in unconstructive integration have an opportunity to share their challenges on technology and the ways that can be adopted to improve their practice when integrating technological resources. Consequently, a qualitative interpretive case study was conducted by Jhurree (2005) on technology integration in education in developing countries. The main aim of the study was to understand guidelines for policymakers on the successful integration of ICT into the classroom. The study reveals that the goal of a horizontal curriculum (implemented/actual) can be attained when teachers are driven by unconstructive integration during the implementation of the curriculum. In short, a horizontal curriculum is informed by unconstructive integration.

A qualitative interpretive case study was conducted by Keengwe (2007) on faculty integration of technology into instruction, and students' perceptions of computer technology to improve student learning. The main aim of the study was to examine the nature of the relationship between faculty integration of technology into classroom instruction and students' perceptions of the effect of computer technology to improve their learning. The study pointed out that in curriculum implementation by unconstructive integration teachers should involve insights into social technological platforms in their work in the classroom, integrating such with technology knowledge (integration-in-action). A lesson or activity using technological resources (integration-in-action) prepares the ground for future planning (integration-for-action). The integration of technological resources into the curriculum therefore holds meaning for the thinking processes and success of teachers. In other words, teachers must accept technology knowledge using their personal life experiences which shape their identity and inform their performance.

These scholars (Almekhlafi & Almeqdadi, 2010; Amory, 2010; Cakir, 2012; Hew & Brush, 2007) further remark that unconstructive integration is drawn from the indigenous setting in which teachers learn from one another in an informal setting about integration of technology, whether consciously or unconsciously. The above-mentioned authors further agree that the unconstructive integration of technology is a life skill that has been acquired by an individual from other people (see a mixed methods study conducted by Almekhlafi and Almeqdadi (2010) on teachers' perceptions of technology integration in the United Arab Emirates school classrooms). The main aim of the study was to understand teachers' perceptions of technology integration. The study also reveals that unconstructive integration takes the form of indigenous knowledge acquired by individuals through participating in social occasions. However, a qualitative interpretive case study was conducted by Koszalka and Wang (2002) on integrating technology into learning. The main aim of the study was to understand the problems related to integration. The study advocated that unconstructed integration is not self-conscious, predetermined by time, place, or content of learning − rather, unconstructive integration is generally learned by people spontaneously in social and friendly gatherings.

Laschou, Kollias, and Karasavvidis (2018) contend that unconstructive integration is the most vital tool in comprehending how users (teachers) experience the integration of technological resources into the curriculum. Furthermore, a qualitative interpretive comparative case study was conducted by Heyberi (2013) on integrating technology into the curriculum for enhanced learning. The main aim of the study was to compare England and northern Cyprus in their technology integration into the curriculum for enhanced learning. The study reveals that this level (unconstructive integration) is a valuable tool that plays a crucial role in bridging the gap between these technological resources and teachers. Unconstructive integration is positioned within a social context, in which teachers can network with one another to share an idea about the integration of technological resources (Cassidy, 1982; Dias, 1999; Hammou & Elfatihi, 2019; Rao & Prasad, 2018). Conversely, these scholars (Baleni, 2017; Cassidy, 1982; Cussó-Calabuig & Farran, 2018; Dias, 1999; Jee, 2017) state that unconstructive integration focuses on the interaction between teachers. This level of integration also emphasizes the significance of social interactions, in which teachers interact and interpret particular events, and create meanings (Gordon, 2019). Mwalongo (2018) argues that "it takes all sides of human existence, it brings in the world, as the methodological point of departure". Unconstructive integration is a central aspect when exhausting technological resources. It requires collaboration among teachers so that they share and communicate ideas

on any given activity. Therefore, this level of integration may be either intentional or unintentional because it also relies on the changes in the curriculum and environment (M. Nelson, 2019). Teachers integrating technological resources into the curriculum should therefore be motivated, interacting with curriculum managers to become more knowledgeable. If teachers integrate technological resources, concentrating on constructive and unconstructive integration without personal integration, the quality of curriculum implementation will deteriorate (Khoza, 2016).

2.5 Personal Integration

Personal integration is defined by Taole (2013) and Koehler and Mishra (2009) as synonymous with teachers' self-identity (love, passion, values, flexibility). Cussó-Calabuig et al. (2018) agree with Koehler and Mishra (2009) that personal integration is more often self-taught, and is in existence based on individuals' choices and preferences. Khoza (2018) argues that personal integration provides the fundamental background for both constructive and unconstructive integration. Mpungose (2019) agrees with Prisecaru (2016), who advocates that teachers need first to be grounded in their self-development (personal needs) in the use of technological resources (personal integration) before they address the needs of subjects (constructive integration) and the needs of society (unconstructive curriculum) (see the qualitative interpretive case study conducted by John (2015) on the integration of information technology in higher education). The main aim of this study was to change the attitude towards IT adoption in the teaching process. The study reveals that personal integration relates to a pragmatic curriculum. A pragmatic curriculum addresses the personal needs of teachers, and promotes links between the vertical and horizontal curriculums. The pragmatic curriculum strives for pedagogical knowledge and personal consciousness to meet personal needs (Meyers & Bagnall, 2017). However, studies indicate that teachers integrate technological resources for communication purposes instead of for learning purposes, which eliminates the need for integrating these resources into the curriculum (Amory, 2010; Bates & Poole, 2003; Cussó-Calabuig et al., 2018; Mpungose, 2019). In sum, the integration of resources will not only focus on communication purposes but also on learning purposes.

Further to this, a qualitative interpretive case study was conducted by Mann (2014) on science teachers' experiences in integrating information and communication technology (ICT) into their teaching practices. The main aim of the study was to understand two middle and secondary school science teachers' experiences of integrating technology into the

classroom. The study pointed out that personal integration is about teachers' thoughts and feelings. Personal integration relies on habitual actions from the individual and surroundings thoughts (Ramorola, 2014; Reed, 2017). A qualitative interpretive case study was conducted by Misirli (2016) on integrating technology into teaching and learning using a variety of models. The study aimed to understand the teaching and learning models that were used in this integration. The study argued that personal integration has to conduct self-introspection of an individual; for instance, teachers integrating technological resources may also be driven by self-integration in their integration practice to improve their level of understanding of these technological resources. Thus, without a positive mindset about the integration of technological resources teachers will not have a progressive practice of integration of technological resources (Perrotta, 2013; Rosenberg, 2004; Schön, 2017). A mixed methods study was conducted by Mwendwa (2017) on the perception of teachers and principals of ICT integration into the primary school curriculum in Kitui county, Kenya. The main aim of the study was to understand teachers' perceptions of ICT integration in education as a significant factor in the implementation of technology-related innovations. The study divulges that personal integration is related to the state of individual subjectivity in which teachers as social beings build their state of reality. Xu, David, and Kim (2018) accept that personal integration is more self-taught and is in existence based on individuals' choices and preferences. Personal integration is thus a more purposive and voluntary integration learned by teachers in a diverse range of social environments (Yu & Prince, 2016).

A qualitative interpretive case study was conducted by Hew and Brush (2007) on integrating technology into K-12 teaching and learning. The main aim of the study was to understand the current knowledge and gaps in the integration technology. The study concluded that personal integration plays a vital role in the adaptation outlook and the capabilities of teachers in their integration practice at the school. Teachers under personal integration have opportunities to rethink their practice of integrating technological resources (Yurtseven Avci et al., 2020). This suggests that when teachers personally integrate technological resources, their professional identity involves the creation and recreation through their practical experience of integrating these technological resources. Thus, under personal integration, teachers construct and reconstruct their knowledge over some time; this process is conducted from their previous knowledge-building towards current knowledge (Zawacki-Richter, 2018). In other words, personal integration is developed and informed by personal identities which help teachers to understand themselves, their origin, and who they are.

A qualitative interpretive case study was conducted by Mthembu (2018) on the perceptions of teachers of the integration of computer technology into school in Grade 10. The main aim of the study was to understand the perceptions of teachers on the integration of computer technology into school. The study concluded that the unbalanced use of levels (Figure: 2.2) of integration (constructive, unconstructive, and personal), may hinder the progress of teaching and cause turmoil during the learning process. Consequently, little research has been conducted on balanced or comprehensive integration, particularly when it comes to technological resources integration into education. This shows the need for this study to be conducted to explore and understand teachers' integration of technology, therefore striking a balance for effective teaching and learning (refer to Figure: 2.3). Similarly, these studies (Bernstein, 1999; Hoadley & Jansen, 2013; Hoover & Education, 1987; Schiro, 2012; Van den Akker et al., 2009) argue that teachers can acclimatize and understand comprehensive integration only if their practice in the classroom can draw from constructive, unconstructive, and personal integration of technology into the curriculum. The integration of resources in the process of teaching and learning will then be balanced or comprehensively applied to achieve the goal of the curriculum.

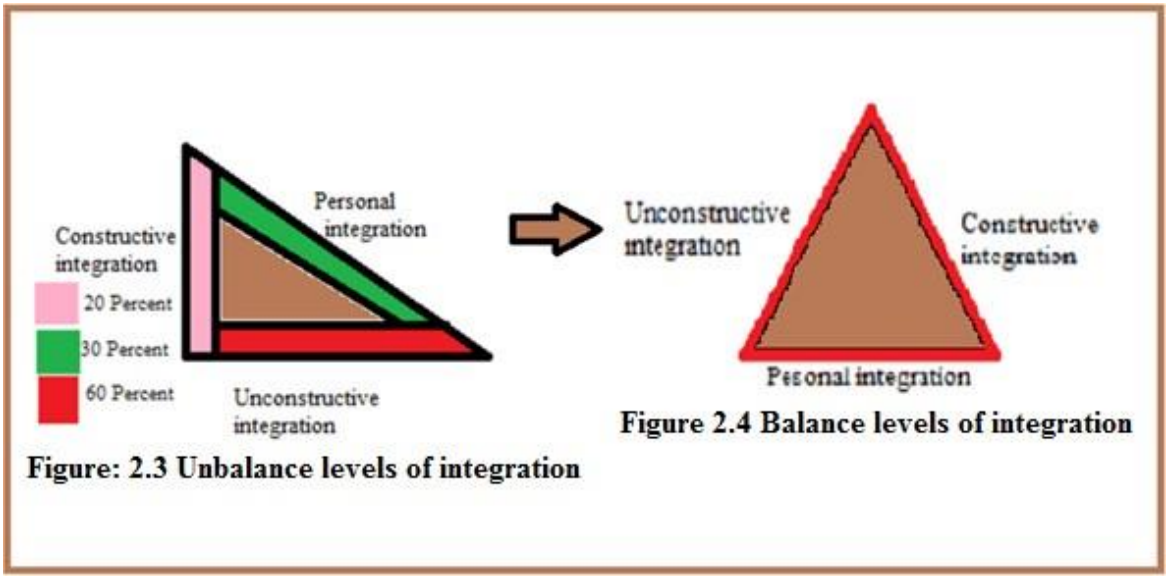


Figure: 2.3 Unbalance levels of integration

Figure 2.4 Balance levels of integration

Figure 2.3 Unbalanced levels of integration **Figure 2.4 Balanced levels of integration**

2.6 Comprehensive Integration Levels/Balanced Levels of Integration

A qualitative interpretive case study was conducted by John (2015) on the integration of information technology in higher education. The main aim of the study was to understand the faculty's attitude towards IT adoption in the teaching process. The study concurs with these scholars (Khoza, 2015b; Windschitl & Sahl, 2002; Zawacki-Richter, 2018; Zhou, Wu, & Zhou, 2020) that a comprehensive integration means bringing different parts together to combine into a whole. The latter authors further argue that the integration is attained when schools demonstrate the emerging approach (emerging), carry out school activities relying on comprehensive integration (applying), infuse comprehensive integration across learning or prescribed activities (infusing), and rethink and renew school activities in creating ways that are transformational (transformational). A survey-based quantitative research was conducted by Cakir (2012) on technology integration and technology leadership in schools as learning organizations. The main aim of the study was to investigate technology integration in primary schools from the perspective of leadership in learning organizations. The present study aligns with this study that comprehensive integration is achieved by teachers when teachers follow integration levels to carry out prescribed activities. This suggests that integration needs to be comprehensive and be intertwined with integration levels. Comprehensive integration with integration therefore plays an essential role in achieving the goal of the curriculum.

On the other hand, a mixed methods study was conducted by Mwendwa (2017) on the perception of teachers and principals on ICT integration into the primary school curriculum in Kitui county, Kenya. The main aim of the study was to understand teachers' perceptions of ICT integration in education as a significant factor in the implementation of technology-related innovations. The study concluded that the reluctance of employing comprehensive integration in the process of teaching and learning to support, enhance, inspire, and create opportunities for learners may have a negative outcome. Yurtseven Avci et al. (2020) and Selwyn (2020) agree with these studies that unwillingness to adopt comprehensive integration and not embracing all levels of integration of technological resources may lower the quality of education. Teachers therefore must balance integration levels and be driven by comprehensive integration. Comprehensive integration does seem to have a positive outcome regarding teaching and learning

In addition to the above, Nene (2019) conducted a quantitative study on SMTs' experiences with the supervision of CAPS at South African primary schools in Pinetown District. The

purpose of the study was to explore SMTs' experiences with the supervision of CAPS at South African primary level. The study used a questionnaire for data collection, and a curriculum spider web as a theoretical framework. The study reveals that the adoption of comprehensive integration in education points toward a positive direction in the teaching and learning process. The study revealed that most teachers lack comprehensive (constructive, unconstructive, and ideological) integration of technological resources. The study concluded that teachers who lack comprehensive integration harm their performance. The study recommended comprehensive integration for teachers to execute curriculum goals successfully.

Moreover, these scholars (Siemens, 2014; Stéphan, Joaquin, Soumyajit, & Gwénaël, 2019; Zucker, 2008) argue that schools that integrate comprehensive technological resources have mostly attained favourable results. Schools that integrate technological resources for constructivist learning execute the goals of the curriculum successfully. Thus, my study claims that, even though technological resources have been integrated into the curriculum, some teachers are reluctant to integrate technological resources comprehensively. Therefore, my study questions how we can address the reluctance to comprehensively integrate technological resources. Referring to Figure 2.2, this study is concerned about the imbalance of these levels when integrating technological resources. This study thus strives towards the status shown in Figure 2.3 where these levels are balanced when integrated. This study is introducing comprehensive integration to do away with unbalanced levels of integration in technological resources.

2.7 Defining Educational Technology

The term technology has been defined by numerous scholars as their understanding of such systems. Historically, however, Byrum (1984) reveals that 'technology' is derived from the Greek word 'techne'. The term was used by the Greeks to refer to "the knowledge required to get the job done". On the other hand, Hunt (1992) argues that 'technology' originated from the Greek word 'technologia' which meant a systematic treatment of methods and processes. Further to this, Selby (1993) conducted studies in the United States that discovered that scholars view technology as machines, gadgetry, equipment. Selby (1993) also discovered that scholars in Britain view technology as an engineering process, implicitly perceiving technology as machines and tools.

These scholars (Amory, 2010; Cuban, Kirkpatrick, & Peck, 2001; Cullen, 2008; Prensky, 2001; Selwyn, 2020) define technology as material that can be used as machines and tools to solve real-life challenges and to improve people's lives. Scholars have defined technology as textbooks, computers, tablets, DVDs (hardware resources), worldviews/ideologies/theories/methods (ideological-ware resources), and Microsoft PowerPoint, spreadsheet, YouTube, Twitter (software resources) used for teaching and learning. This enormous technological variety must be integrated into the curriculum by teachers (Bates & Poole, 2003; Kilfoil, 2015). Further to this, these tools have supported teaching and learning successfully in educational practice around the world, including e-learning environments, web 2.0 tools, wikis, shared paces, and video-conferencing (Moelker, 2006). Kirschner (2015) argues that technology is a new adventure that brings changes. Dias (1999) concurs with Kirschner (2015) that technology is a catalyst for change in the education sector because it provides a distinct departure, a change in context that suggests alternative ways of operating. Because of technology, teaching and learning have shifted from the traditional approach towards an eclectic set of learning activities that include knowledge-building situations for learners. On the other hand, Khoza (2018) reveals that the process of integrating technology involves a combination of complex cognitive and higher-order skills, highly integrated knowledge structures, interpersonal and social skills, and attitudes and values. Integrating technology thus demands diverse tools (hardware, software, and ideological-ware) and technologies to be attained in the education sector.

2.8 Technological Resources as Hardware

Hardware resources are defined by Carneiro et al. (2018) as any technologies or tools used in teaching and learning. Khoza (2018) further states that these hardware resources are necessary tools with which to meet teaching and learning needs, such as tablets, overhead projectors, notepads, smartphones, televisions, and computers. See the survey-based quantitative research conducted by Cakir (2012) on technology integration and technology leadership in schools as learning organizations. The main aim of the study was to investigate technology integration in primary schools from the perspective of leadership in learning organizations. The study discovered that hardware resources are divided into two: external hardware [tools that are joined in the main computer − examples may be speakers, mouse, keyboard, monitor, and printers]; and internal hardware [these are essential for the computer to operate, which includes a hard drive and Motherboard]. A critical paradigm study was conducted by S. Zuma (2019) on reimaging Moodle as an effective learning management

system through the experiences of geography lecturers at a selected South African university. The study discovered that technological resources as hardware resources can be integrated into both learning and face-to-face contexts, depending on the nature of the learning activity. Hardware resources are physical resources that can be seen and touched. These resources are constructively integrated into the curriculum because physical resources are guided by guidebooks/manuals on how to integrate vertical curriculum into teaching and learning. Hardware resources are channelled by constructive integration which address the subject's needs (Mpungose, 2020a). Technological resources such as hardware resources are informed by a vertical curriculum. In other words, teachers need to understand the vertical side to successfully execute technological resources as hardware.

An interpretive case study was conducted by Budden (2016) on factors that inform curriculum studies students to use e-resources in conducting master's of education dissertations at a South African university. The study aim was to understand the factors that inform curriculum studies students to use e-resources. The study discovered that the integration of technological resources as hardware into the South African schools is growing as the economy demands graduates who are well versed in skills and knowledge of technology in the working space Zuma (2019) shares the same sentiment that learners in schools integrate hardware resources to learn to use well-known accounts such as YouTube, iTunes, Facebook, WhatsApp accessible per hardware resources. Therefore, the hardware resources contribute to learners' knowledge and experience (Windschitl & Sahl, 2002). Without hardware resources, learners will not have an understanding of these programmes/accounts (YouTube, iTunes, Facebook, WhatsApp). Zhou et al. (2020) aver that schools have recognized and noticed that the integration of hardware resources into the curriculum is the way forward in addressing progressive learning in the 4IR era. Khoza (2018) comments that integrating technological resources as hardware is essential as most of the schools are now equipped with smart touch screens, projectors, computers, and tablets that convey information instantly. Hardware resources in this era thus ensure that the goal of the prescribed curriculum is executed smoothly and effectively. Nonetheless, hardware resources cannot work as a stand-alone; software resources also play a vital part in the process of teaching and learning (Mpungose, 2020a).

2.9 Technological Resources as Software

A qualitative interpretive comparative case study was conducted by Heyberi (2013) on integrating technology into the curriculum for enhanced learning. The main aim of the study was to compare the technology integration of England and northern Cyprus into the curriculum for enhanced learning. The study defined software resources as any material that is manufactured for the hardware to display information or to communicate learning. The study reveals that examples may be antivirus programmes, emails, internet browsers, and presentations (Amory, 2010). Schools thus depend on the internet to support learners. Khoza (2015b) identified two examples of software resources as offline transparencies for the overhead projector and online PowerPoint slides. Online and offline software differ in that online software may be seen and not touched, whereas offline software may be seen and touched. The integration of software technological resources is driven by unconstructive integration, in which the actions of teachers in integrating these resources are based on addressing the societal need.

The above definitions and examples display that numerous human activities use software resources in the process of teaching and learning. Technological resources such as software are informed by other people's ideas and beliefs. These scholars (Khoza, 2015b; Khoza & Mpungose, 2018) further state that unconstructive integration of software resources provides a social space in which everyone can suggest ideas or opinions during teaching and learning. Software resources may therefore be driven by unconstructive integration in which teachers feel comfortable to express their ideas. Technological resources such as software are informed by the implemented curriculum. A qualitative interpretive case study was conducted by Keengwe (2007) on faculty integration of technology into instruction; and students' perceptions of computer technology in improving student learning. The main aim of the study was to examine the nature of the relationship between faculty integration of technology into classroom instruction and students' perceptions of the effect of computer technology to improve their learning. The study outlined that the implemented curriculum involves how both teachers and learners implement or practice such. Technological resources such as the software provide a space in which teachers' actions may transform the intended curriculum in practice. Scholars (Windschitl & Sahl, 2002; Yurtseven Avci et al., 2020; Zawacki-Richter, 2018; Zucker, 2008) suggest that in the teaching of a curriculum, integrating technological resources as the software allows information-sharing. Teachers and learners therefore can invent new behaviours, understanding, and practices. Moving further, the literature outlines

that the combination of these resources (hardware, software, and ideological) are the elements found in achieving the goal of integrating (Amory, 2010).

2.10 Technological Resources as Ideological-ware

A qualitative interpretive case study was conducted by Misirli (2016) on integrating technology into teaching and learning using a variety of models. The study aimed to understand the teaching and learning of a variety of models used for integration. The study concluded by defining ideological-ware resources as teaching and learning strategies and theories such as the cultural historical activity theory (CHAT), constructivism, and connectivism. On the other hand, Shulman (1986) views ideological-ware as the teacher's understanding of the curriculum, the activities that cannot be seen and touched. A qualitative interpretive case study was conducted by Jhurree (2005) on technology integration in education in developing countries. The main aim of the study was to understand guidelines for policymakers in the successful integration of ICT into the classroom. The study revealed that providing schools with hardware resources and software resources at the expense of ideological-ware resources might negatively affect the goal of the curriculum to be achieved. Ideological-ware resources thus play a vital role in achieving the goal of the curriculum.

The above literature suggests that technological resources as ideological-ware demands personal development to understand these theories. This suggests that the integration of ideological resources can be addressed under personal integration (Khoza & Mpungose, 2018). These scholars (Khoza & Mpungose, 2018; Muriithi & Masinde, 2016; Mwalongo, 2018; M. Nelson, 2019) further add that personal integration influences teachers to examine their behaviour or actions in the process of teaching and learning. 'Personal-integration' teachers are driven by personal development on how to integrate technological resources into a curriculum, relying on these theories. Furthermore, qualitative critical action research was conducted by Khoza (2015a) on six Grade 12 high school teachers who used Turnitin as part of their assessment processes. The study aimed to explore the teachers' reflections of Turnitin used in assessing their learners' work. The study indicated that the teachers' understanding of the subject matter or content is informed by integrating the correct methods of teaching and learning. Gleason (2018) acknowledges that the success of integrating these technological resources relies on ideological-ware. Ideological-ware resources in the classroom have thus become an important aspect of successful teaching, only if teachers understand how to integrate this level in the Fourth Industrial Revolution (4IR).

2.11 The Influence of the Fourth Industrial Revolution on the Integration of Technology

The term industrial revolution was coined by the British economic historian Arnold Toynbee (Reali, 2018). Schwab (2017), the founder and executive chairman of the World Economic Forum developed this term, citing it as the Fourth Industrial Revolution at the world economic forum (WEF) 2016. The Fourth Industrial Revolution is defined by these scholars (Banwari; Javaid et al., 2020; Kumar, 2018; Reali, 2018; Schwab, 2017) as the fourth stage in the development of knowledge and the fusion of technologies (artificial intelligence, robotics, blockchain, Internet of Things, nanotechnology, 5G, biotechnology, 3D printing, and quantum computing). A study was conducted by Xu et al. (2018) on the Fourth Industrial Revolution: opportunities and challenges. The purpose of the study was to explore Fourth Industrial Revolution opportunities and challenges. The study agreed with these scholars (Banwari; Javaid et al., 2020; Kumar, 2018; Reali, 2018; Schwab, 2017) that the First Industrial Revolution occurred in the 1780s with steam power, making humans more productive. The study conducted by Wilson, Lennox, Brown, and Hughes (2017) was on how to develop the creative capacity for the Fourth Industrial Revolution: creativity and employability in higher education. The purpose of the study was to explore the future of higher education and to consider the implications of change for educational strategy. The study revealed that in the 1870s the Second Industrial Revolution occurred with the development of mass production and electrical energy. In the 1870s, the country was undergoing the second revolution of technological resources. The Third Industrial Revolution then occurred in the middle of the last century with the development of IT and electronics, which enabled even more efficient production (Wilson et al., 2017; Xu et al., 2018; Zawacki-Richter, 2018; Zhou et al., 2020; Zucker, 2008). The world is now experiencing the Fourth Industrial Revolution (4IR) (refer to Figure: 2.5), in which we are witnessing technological resources transformation that plays a vital role in schools across the globe (Schwab, 2017; Xu et al., 2018; Zhou et al., 2020).

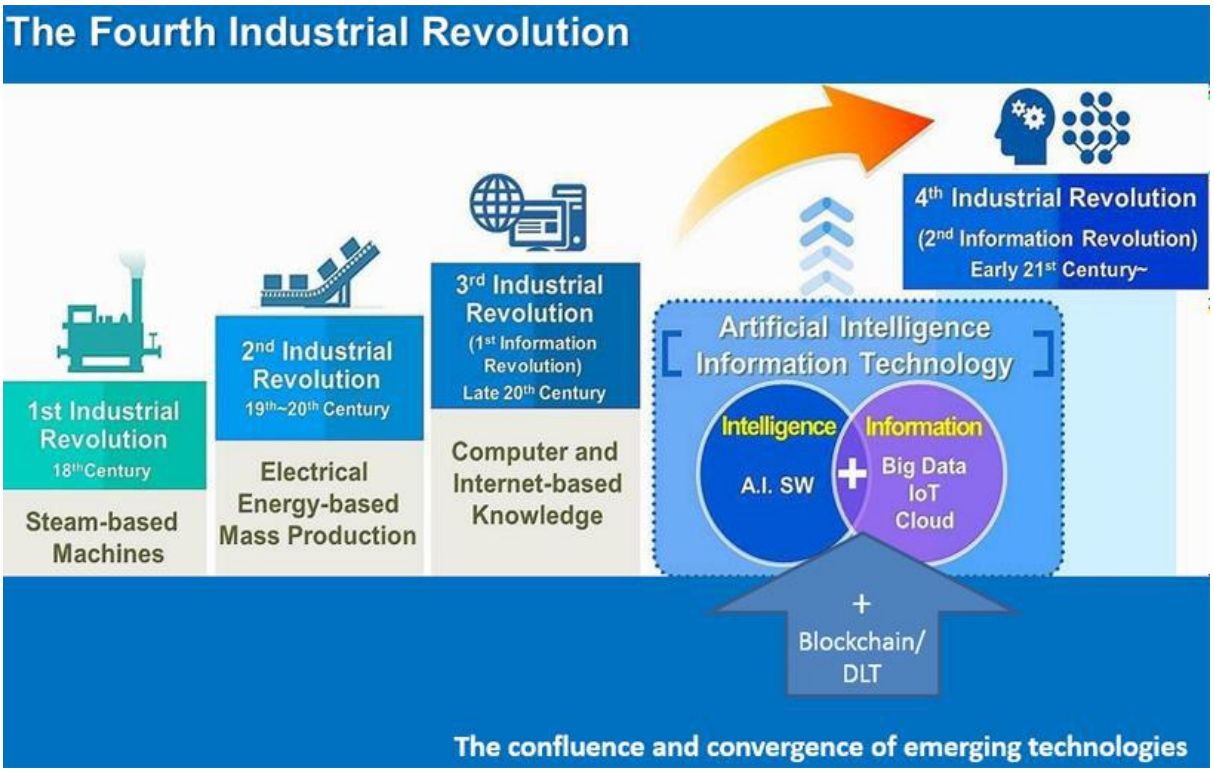


Figure 2.5 The Fourth Industrial Revolution demonstration

Mpungose (2020b) reminds that numerous countries have integrated technological resources and advanced their curricula to introduce subjects that address the needs of 4IR − countries such as China, USA, UK, and Australia. A qualitative study was conducted by Oke (2020) titled: Innovations in Teaching and Learning: Exploring the Perceptions of the Education Sector on the 4th Industrial Revolution (4IR). The purpose of the study was to explore the readiness of the education sector for 4IR. The study discovered that artificial intelligence (AI), robotics, and the Internet of Things (IoT) have recently been introduced into the South African context. Oke (2020) states that the Minister of Education (Ms. Angelina Angie Matsie Motshekga) has tried to develop curricula for coding and robotics for Grades R to 9, and has further proposed subjects such as art and design, civil technology, digital technology, electrical technology, inter alia, that will address the needs of the 4IR. This will assist pupils to compete and understand the functioning of the digital world (Mpungose, 2020b). This development suggests that schools must embrace the development of technology (4IR) and be driven by the information world. In other words, schools must advance their technological knowledge driven by AI, robotics, and the IoT, to ensure that teaching and learning continue even in the era of pandemics (COVID-19).

In the year 2020, on March 11, the World Health Organization (WHO) declared that the world was facing COVID-19 as a pandemic (Mpungose, 2020b). The South African president Cyril Ramaphosa, on the 23 of March 2020, addressed the nation insisting that the country would enter a nationwide lockdown for 21 days to curb the spread of this pandemic. Thus, schools had to be shut down to curb the spread of this disease. This pandemic posed a threat to the face-to-face learning context in schools worldwide (Zhou et al., 2020). A qualitative study was conducted by Oke (2020) titled: Innovations in Teaching and Learning: Exploring the Perceptions of the Education Sector on the 4th Industrial Revolution (4IR). The study revealed that teachers were frightened by the pandemic and the new developments brought about by the department in the field of education. This development included integrating of technological resources into the curriculum to keep the process of teaching and learning ongoing. These studies (Mpungose, 2020b; Yurtseven Avci et al., 2020; Zhou et al., 2020) reflected that the pandemic (Covid-19) has demanded teachers with skills and advanced in technological knowledge to execute the goal of the curriculum. Consequently, technological knowledge has become the major knowledge for teachers to master in the 4IR (S. Zuma, 2019). Therefore teachers training at the universities must tackle the issue of how to integrate technological resources (technological knowledge) into schools. It will be of no use to have technological resources in schools when teachers are not well versed on how to integrate these resources into the curriculum. Teachers training at the university must cover the issues of how to constructively, unconstructively, and personally integrate technological resources into the curriculum during the 4IR era.

2.12 **Teachers' Integration of Technological Resources in the 4IR Era**

Misirli (2016) argues that the integration of technological resources in the 4IR era is determined by the kind of knowledge teachers have assimilated at university. An interpretive case study conducted by Lee and Kim (2020) was titled: Innovation in University Education: Focusing on Fifth Generation (5G) Mobile Communication. The purpose of the study was to explore implications of accelerating the adoption and exploitation of 5G for innovating university education. The study discovered that the 4IR era required teachers to be well versed in knowledge of blockchain, 5G, hardware resources, etc. Thus, Javaid et al. (2020) contend that the 4IR blockchain is a secure and transparent way of recording and sharing data that can be integrated into teachers' smartphones and utilized by teachers in schools. The actual subject matter that is to be learned (content knowledge) in the blockchain era can be secured during the constructive integration of technological resources (cellphones). These

scholars (Lee & Kim, 2020; Oke, 2020; Zhou et al., 2020) posit that by introducing 5G into schools, the curriculum goal will be attained in a short period of time. High-definition (HD) videos previously taking 30 minutes to download will now be downloaded in 0,8 seconds, 5G affording super high-capacity data. Therefore5G will enable transformation in our schools and contribute to executing the curriculum objectives within a short time. Thus, constructive integration alone in the 4IR era is not sufficient; it must be supported by unconstructive integration in the process of teaching and learning (Mwalongo, 2018).

An interpretive case study was conducted by Rao and Prasad (2018) titled: The Impact of 5G Technologies on Industry 4.0. The purpose of the study was to examine the evolution of the Industrial Revolution and the technologies that have impacted its growth. The study maintained that understanding the Internet of Things (IoT), virtual reality (VR), and artificial intelligence (AI), is vital when integrating unconstructive technological resources. Reali (2018) implies that the integrating of the IoT in unconstructive integration can enable teachers to process vast amounts of data while implementing the curriculum, embracing the Cloud, WhatsApp, Instagram, and Facebook. Teachers can then use their cellphones as a form of learning instead of communication by using apps such as Cloud, WhatsApp, Instagram, and Facebook (Mpungose, 2020a). Teachers need to know the different range of tools/apps (technological skills), making use of such an application or developing software resources. Further to this, Lee and Kim (2020) argue that virtual reality can be used to simulate a condition in which learners will be able to absorb technological knowledge n the process of teaching and learning as if they are using real equipment/tools. Virtual reality can assist learners to take in technological knowledge in the process of teaching and learning. Nonetheless, teachers' integration of technological resources in the 4IR era must not be grounded only on constructive or unconstructive integration. Personal integration must be infused to support the implementation of technological resources (Rao & Prasad, 2018)

Oke (2020) and Javaid et al. (2020) aver that integrating technological resources into personal resources is informed by biotechnology, augmented reality (AR), 3D printing, etc. These studies further argue that AR allows for enriching the environment, surrounding learners with additional subject knowledge. A study was conducted by Ibáñez, Portillo, Cabada, and Barrón (2020) on the impact of augmented reality technology on academic achievement and motivation of students from public and private Mexican schools. The study discovered that AR allows support for impaired learners, integrating their learning experience through

appropriate visual, auditory, and haptic interfaces. Likewise, learners with barriers in schools will benefit more when AR is infused into the school. However, these studies (Gleason, 2018; Kumar, 2018) indicate that integrating biotechnology into teaching and learning, especially in experiments, has a positive impact − it demonstrates the actual experiment during the lesson. For instance, teachers can personally integrate biotechnology to demonstrate how plants grow in sunlight (photosynthesis). Teachers need not go outside to demonstrate this pedagogical knowledge − biotechnology will enable innovation in education services. In other words, curriculum implementation demands all the integration levels in the 4IR era.

The above-mentioned literature in the 4IR era is driven by curriculum signals, such as hardware resources, face-to-face learning, content, days, (constructive integration) etc. A qualitative interpretive case study was conducted by Salehi and Salehi (2012) on challenges of using ICT in education. The main aim of the study was to investigate the teachers' perceptions of the barriers and challenges preventing teachers from integrating ICT into the classroom. The study pointed out that these curriculum signals are informed by a vertical curriculum and intended curriculum to integrate technological resources. Nonetheless, Mohamed and Ahmad (2019) argue that it is essential in the 4IR era also to pay attention to these curriculum signals, software resources, assessment facilitator, weeks, online learning (unconstructive integration), and more. Thus, Mpungose (2020b) avers that these curriculum signals are driven by a horizontal curriculum when integrating technological resources. Further to this, Khoza and Mpungose (2018) comment that the imbalance of these curriculum signals, ideological-ware resources, blended learning, culture, hours, etc. (personal integration) may affect the process of integration Thus, Khoza and Biyela (2019) concur that these signals are informed by a pragmatic and achieved curriculum.

2.13 Conclusion

At the outset of the chapter, the study sought to pinpoint integration (the phenomenon) that frames the literature in such a way that the phenomenon identifies levels/elements that inform the integration of technological resources in the Fourth Industrial Revolution. This chapter charted how constructive integration, unconstructive, and personal integration arise from the literature. The literature portrayed the integration of technological resources into the curriculum in the Fourth Industrial Revolution as an excellent opportunity of bringing innovation to schools (Javaid et al., 2020). The chapter has unpacked the concepts of technology as educational technology. The chapter has outlined the various kinds of

technological resources such as hardware resources, software resources, and ideological-ware resources. The chapter has also explained the Fourth Industrial Revolution with its characteristics such as blockchain, artificial intelligence (robotics), the Internet of Things, and 3D printing. The following chapter aims to unpack curriculum signals in the integration of technological resources into the curriculum.

CHAPTER 3

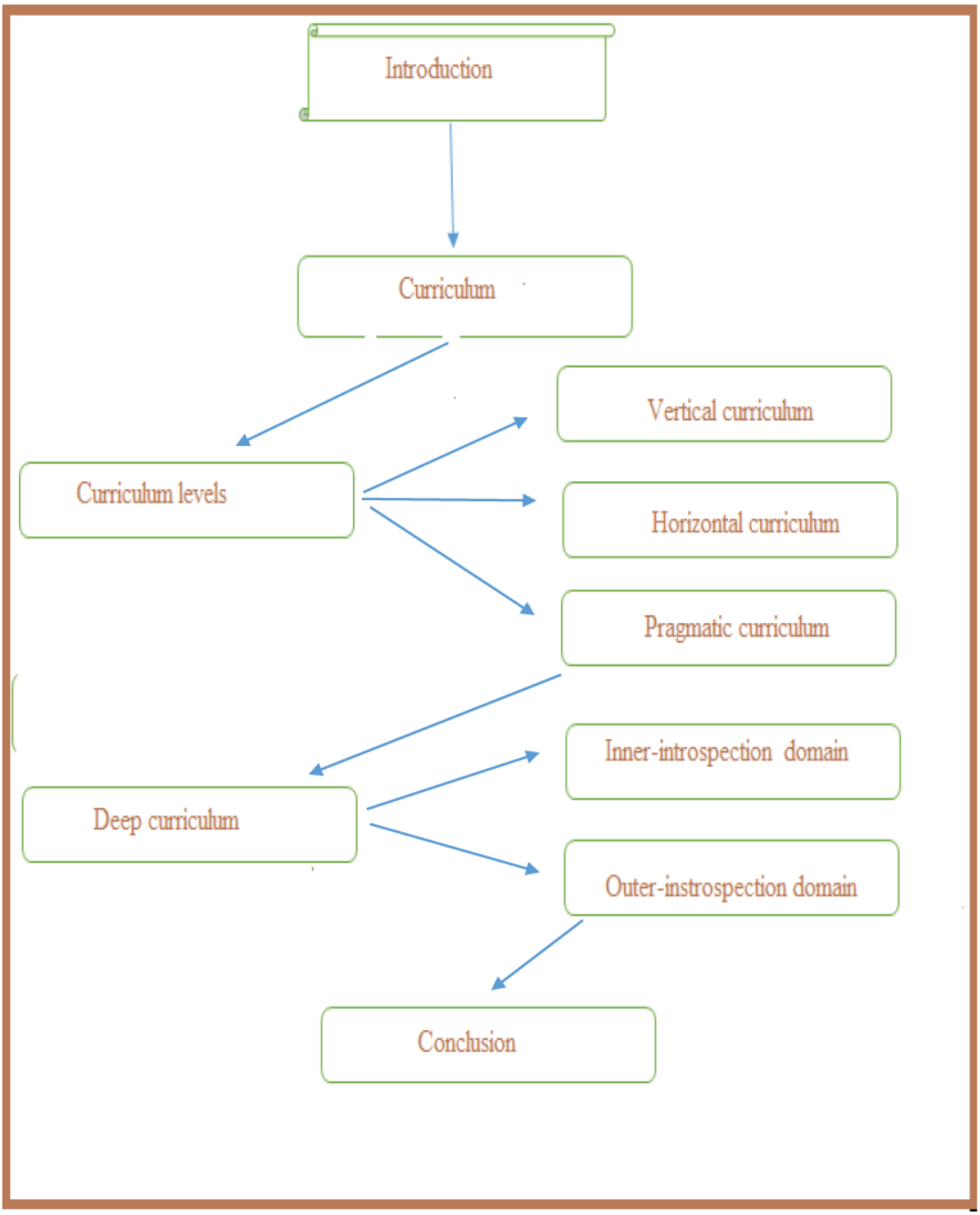


Figure 3.1 Chapter 3 Overview

3.1 Introduction

The previous chapter (Chapter 2) covered two crucial concepts, namely, integration (phenomenon) and technological resources in teaching (focus). The literature from the chapter on the integration phenomenon explored the three elements which included constructive integration, unconstructive integration, and personal integration. These elements were used to frame the discussion of resources based on hardware, software, and ideological-ware resources. Further to this, the chapter has provided clarity on the integration of technological resources into the curriculum in the 4IR era. Consequently, understanding integration of technological resources without understanding the curriculum signal is pointless: this may lead to weakening the process of teaching and learning (Khoza & Mpungose, 2018; Yu & Prince, 2016; S. Zuma, 2019). At the outset, this chapter anticipates defining curriculum before unpacking types of curriculum activities which lead the discussion of the levels of curriculum (vertical, horizontal, and pragmatic). It is the goal of this chapter to also unpack deep curriculum domains.

Besides these studies (Baleni, 2017; Booth, 1992; Hammou & Elfatihi, 2019; Khoza & Mpungose, 2018; Yu & Prince, 2016; S. Zuma, 2019) point out that curriculum signals should all merge together to achieve the goal of teaching and learning. An interpretive case study was conducted by Khoza (2015b) on teaching without understanding curriculum visions and goals. The purpose of the study was to explore the postgraduate students' understanding of curriculum visions and goals in teaching their subjects. The study concluded that incorporation of curriculum signals have a successful impact when integrated with technological resources Therefore, this chapter (Chapter Three) has the intention of further explaining and articulating the impact of curriculum signals integrated with technological resources into teaching and learning.

3.2 What is Curriculum?

It is challenging to discover a direct and consistent definition of curriculum. The concept curriculum has been given numerous definitions by different authors/scholars from the literature. For instance, these scholars (Hoadley & Jansen, 2013; Pinar, 2010; Van den Akker et al., 2009) point out that the term curriculum stems from the Latin verb "currere" which means to run, for example, a course. An interpretive case study conducted by Khoza (2015b) was on teaching without understanding curriculum visions and goals. The purpose of the study was to explore the postgraduate students' understanding of curriculum visions and goals in teaching their subjects. The study argued that the curriculum also refers to a course and a vehicle for learning. However, when it comes to the context of education, the curriculum is referred to as all the features which produce the life of the school, the values exemplified in the way the school sets about its tasks, and how teaching and learning have been organized and managed (Van den Akker et al., 2009). Further to this, Pinar (2010) argues that the curriculum may be viewed as a plan of learning (vertical and horizontal). This suggests that the curriculum is in line with the content that teachers deliver to learners; the approach of teachers in conveying the content to learners should integrate with the curriculum. For teachers to successfully implement the content of the curriculum, teachers should integrate technological resources in the process of teaching and learning. Likewise, Van den Akker et al. (2009) argue that a curriculum may be viewed as a plan for learning (intended stage). This study defines curriculum as a framework that indicates and guides what teachers should integrate with technology in the class for learners to learn.

An interpretive case study was conducted by Nene (2019) on SMTs' experiences in the supervision of CAPS at a South African primary school in the Pinetown district. The purpose of the study was to explore SMTs' experiences in the supervision of CAPS at South African primary school. The study concurs with a qualitative case study situated within the interpretive paradigm conducted by Cele (2019) on exploring first-year students' experiences of using Moodle in learning an accounting undergraduate module at a South African university. Its main purpose was to explore undergraduates' experiences of using Moodle in learning an accounting undergraduate module; and to further probe how their experiences improved their learning of the accounting module using Moodle. These studies propose that the curriculum is driven by any tool/machine/object used in education (hardware resources) that focuses on constructive integration. Constructive integration is informed by the vertical curriculum − teachers integrate technological resources face to face in the process of teaching

and learning. A qualitative case study situated within the interpretive paradigm was conducted by Biyela (2018) titled: Exploring teachers' experiences of the teaching of mathematics in the intermediate phase in (Grade 4-6) Nongoma Circuit. The study revealed that the curriculum is material integrated with tools for carrying/displaying information (software). The curriculum is driven by technological knowledge in such a way that teaching and learning processes have been fulfilled online unconstructively. Thus, Khoza (2018) argues that the curriculum addresses teachers' personal needs during the integration process (personal integration). Teaching and learning take place in a blended space integrating activities that we cannot see and touch; similar to theories and others (ideological-ware resources).

Additionally, Pinar (2010) argues that curriculum is concerned with what teachers and learners practise constructively in the classroom to achieve the written objectives weekly as documented in a vertical curriculum informed by content knowledge. These studies (Mthembu, 2018; Muriithi & Masinde, 2016; Mwalongo, 2018) further posit that curriculum is a plan of an act or a written text that comprises aims that teacher must personally achieve hourly in a pragmatic curriculum informed by pedagogical knowledge. A qualitative critical action research was conducted by Khoza (2015b) on six Grade 12 high school teachers who used Turnitin as part of their assessment processes. The study aimed to explore the teachers' reflections on Turnitin used in assessing their learners' work. The study reveals that a curriculum comprises the daily outcomes of the subject that must be achieved unconstructively. Mpungose (2020a) avers that in the process of integrating technological resources, outcomes are driven by a horizontal curriculum and technological knowledge.

Moreover, these scholars (Ng, 2006; Parisi & Society, 2009; Perrotta, 2013; Pinar, 2010) further contend that curriculum may be viewed as a body of knowledge that teachers teach and that learners are expected to learn and integrate into a specific subject (content). Thus, the curriculum is a course of study that seeks teachers to follow certain content. For instance, the curriculum seeks teachers to interact and integrate technological resources to achieve the identified educational topic in the content guided by constructive knowledge and a vertical curriculum (Mthembu, 2018). A qualitative interpretive case study was conducted by Mann (2014), titled: Science teachers' experiences in integrating information and communication technology (ICT) into their teaching practices. The main aim of the study was to understand two middle and secondary school science teachers' experiences of integrating technology into

the classroom. The study revealed that the curriculum may be horizontal. Thus, horizontal curriculum relies on technological knowledge that is defined by Laschou et al. (2018) as a series of processes that learners in schools must associate with, as this will ensure that learners are developing the ability to do the actions that make up the affairs of adult life unconstructively. Thus, the curriculum focused on actions (experiment) and all the features that help learners to have and to develop confidence. A qualitative interpretive case study was conducted by John (2015) on the integration of information technology in higher education. The main aim of the study was to improve the attitude towards IT adoption in the teaching process. The study pointed out that a curriculum is subject knowledge guided by personal integration in the process of integrating technological resources. For instance, teachers will integrate technological resources led by the pragmatic curriculum to bring about pedagogical knowledge that will change the learner behaviour.

Mpungose (2020b) further advocates that a curriculum is also informed by unconstructive integration where teachers are expected to question their technological knowledge, authority, and thinking on their practice during the continuous assessment of informal activities in the horizontal curriculum. Thus, a mixed methods study was conducted by Mwendwa (2017) on the perception of teachers and principals of ICT integration in the primary school curriculum in Kitui county, Kenya. The main aim of the study was to understand teachers' perceptions of ICT integration in education as a significant factor in the implementation of technology-related innovations. The study concluded that the curriculum comprises formal activities documented in the vertical curriculum that seeks teachers to constructively integrate content knowledge in the process of summative assessment. A qualitative case study was conducted by Mpungose (2020a) on whether Moodle or WhatsApp was the preferred e-learning platform at a South African university: first-year students' experiences. The purpose of the study was to understand that Moodle or WhatsApp is the preferred e-learning platform at a South African university. The study discovered that a curriculum is driven by directives from the teacher's point of view (personal integration) because teachers are integrating pedagogical knowledge continuously guided by a pragmatic curriculum. Moreover, these scholars (Hoadley & Jansen, 2013; Khoza & Mpungose, 2018; Pinar, 2005, 2010; Van den Akker et al., 2009) suggest that the curriculum may be represented by three main categories ─ intended, implemented, and achieved.

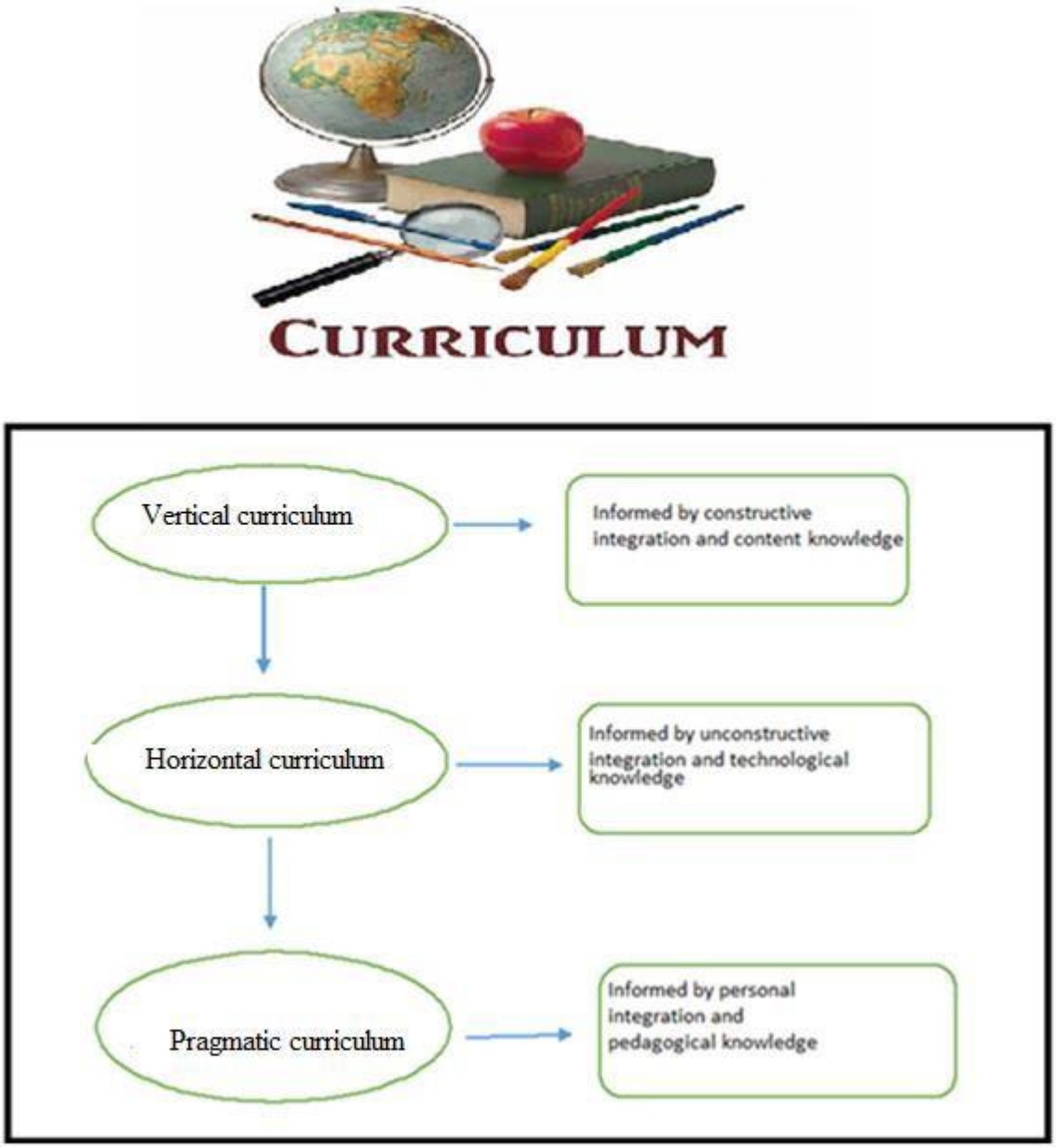


Figure 3.2 Curriculum presentation

3.3 Integrating Technological Resources into the Vertical Curriculum

This diagram in figure 3.1 demonstrates how each category of the curriculum is related to the other. The study conducted by Pinar (2010) reveals that schools have the constructively planned, officially acknowledged curriculum, and this curriculum is known as the vertical curriculum. Pinar (2010) further argues that the vertical curriculum is a prepared plan of teaching and learning in which the written text contains all prearranged content to be learned

at a particular time within the year. This calls for teachers to be driven by subject objectives (precise reports of teaching) which integrate technological resources and address the subject's needs as stated in the CAPS documents (vertical curriculum). Further to this, Khoza (2018) argued that the vertical curriculum is informed by written policies constructed by educational vision, the intentions of the curriculum stipulated. A vertical curriculum therefore requires teachers to become instructors, integrating technological resources as stipulated, and having control of the pace of the teaching and learning process. Mpungose (2020b) believes that the vertical curriculum is influenced by constructive integration − instructors (teachers) contribute more to organized written ideas, principles, procedures, and knowledge on the policy documents intended to be learned by learners. This is in line with the study conducted by Mthembu (2018) stating that teachers integrate technological resources in the process of teaching and learning into the vertical curriculum. These teachers should select the type of formal activities such as the test, examination, and others (as displayed in Figure 3.2) to be executed at the end of the term. In short, teachers should act as instructors to meet content knowledge and curriculum needs.

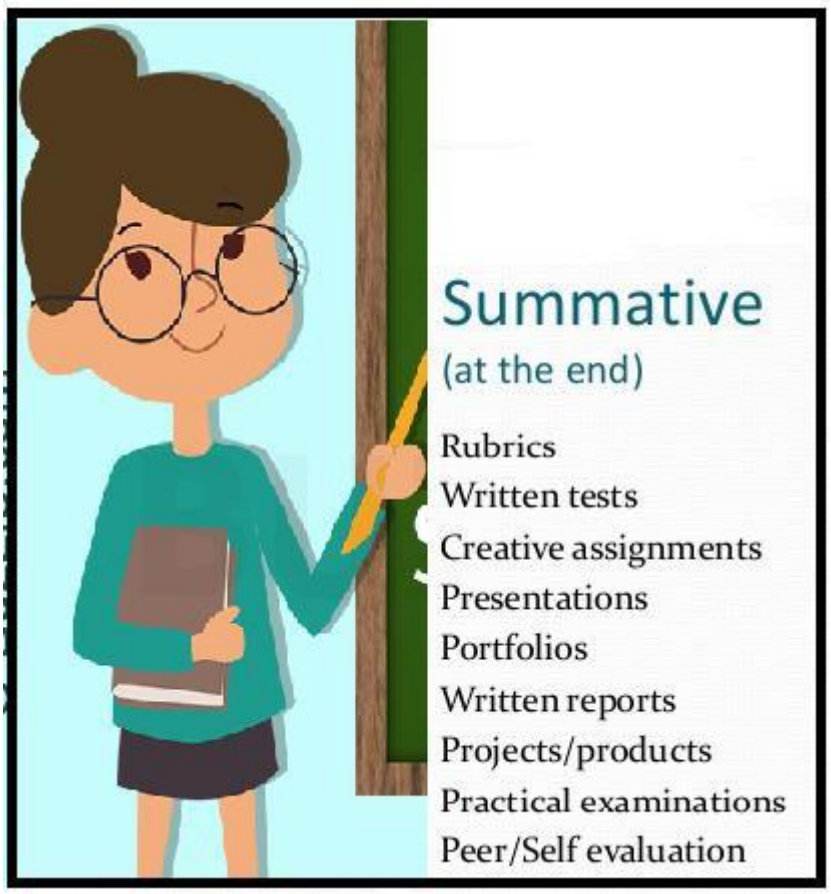


Figure 3.3 Constructive activities in the vertical curriculum

These scholars (Khoza, 2018; Mbhele, 2018; Mpungose, 2020a; Nani, 2019; Van den Akker et al., 2009) propose that the vertical curriculum requires teachers to be driven by constructive integration to integrate any available physical resources in the process of teaching and learning, such as laptops, cellphones, textbooks, classrooms, and others. Teachers can then deliver the content face to face in a learning atmosphere that will accommodate all learners' needs (Syomwene, 2017). The study conducted by Salehi and Salehi (2012) further points out that the vertical curriculum mission can be achieved only if teachers rely on these formally provided guidelines written down by the department. Teachers are told in writing to give learners relevant summative assessments towards the end of the term. Learners must thus prepare or execute summative assessment integrating any available physical hardware resources.

A qualitative interpretive case study was conducted by Misirli (2016) on integrating technology into teaching and learning using a variety of models. The study aimed to understand the teaching and learning variety of models used to integrate. The study has argues that the goal of the vertical curriculum cannot be achieved without being executed by curriculum drivers/ practitioners such as teachers, learners, and other stakeholders integrating hardware-resources (textbooks, pens, computers, laptops, cellphones). This is supported by the study conducted by M. Nelson (2019) on hardware resources playing a crucial role in understanding the actual process of the vertical curriculum. Further to this, a qualitative case study was situated within the interpretive paradigm conducted by Cele (2019) on exploring first-year students' experiences of using Moodle in learning an accounting undergraduate module at a South African university. The study discovered that the vertical curriculum is a planned learning course that schools wish to offer within a set period of time for the pupil. For instance, teachers will execute the curriculum with pupils weekly (contact time) integrating technological resources. This planned learning course has elements such as what is learned (content). As a result, a vertical curriculum must be assessed (summative assessment) to determine that what is learned (content) has been successfully attained. This suggests that when teachers integrate technological resources into the curriculum to achieve the goal of the vertical curriculum shall evaluate their performance

Ramorola (2014) further argues that the vertical curriculum has content (topics and subtopics) constructively written down that must be executed by teachers. The content in the vertical curriculum is intertwined with the methods and strategies to be used during teaching and

learning at all curriculum levels (Pinar, 2010; Van den Akker et al., 2009). The vertical curriculum is written down in formal text which is informed by constructive integration to achieve the subject's needs. (Pinar, 2010; Van den Akker et al., 2009). Hagay, Baram-Tsabari, and Peleg (2013) state that the vertical curriculum is a prescribed curriculum or curriculum as a plan. Documents integrated into the process of teaching and learning, such as textbooks and policy documents form part of the curriculum as intended. All are driven by constructive content to be taught during the process of integrating technological resources, thus addressing the subject requirements.

A qualitative interpretive case study was conducted by Mpungose (2020a) exploring student teachers' knowledge in the teaching of CAPS subjects. The purpose of the study was to explore student teachers' knowledge in the era of the Fourth Industrial Revolution. The study aligns with an interpretive case study conducted by Khoza (2016) on teaching without understanding curriculum visions and goals. These studies reveal that a vertical curriculum offers direction to teachers and learners. The content stipulates the direction of what must be learned and how the content must be curated to learners. The vertical curriculum gives direction and guidelines for both learners and teachers to execute the curriculum (Khoza, 2016). Moving further, the literature outlines that there are two more categories or levels of curriculum which include a horizontal and a pragmatic curriculum.

3.4 Integrating Technological Resources into the Horizontal Curriculum

Van den Akker et al. (2009) and Khoza (2016) argue that a horizontal, enacted, or practised curriculum is concerned with the actual process of teaching and learning integrating of technological resources into the classroom. A qualitative interpretive comparative case study was conducted by Heyberi (2013) on integrating technology into the curriculum for enhanced learning. The main aim of the study was to compare the technology integration into the curriculum between England and northern Cyprus. The study reveals that the horizontal curriculum incorporates the Internet of Things because, irrespective of learners' financial constraints with attending schools, an online discussion platform can be created on which learners will share their ideas and opinions to ensure that the horizontal curriculum is executed. For instance, teachers may integrate any available software applications in the process of teaching and learning. A horizontal curriculum allows self-government among learners who share their ideas on the content.

Further to this, Khoza and Biyela (2019) argue that the horizontal curriculum allows teachers to be flexible. The process of integrating technological resources may take place (over time) at any time, not necessarily the time stipulated in the school time table. Teachers using the horizontal curriculum are free to integrate technological resources in their own way and at their own pace. However, Dlamini (2019) revealed that the horizontal curriculum is informed by the integration of technological resources of the planned content from (vertical curriculum) to learners in the classroom. The study further argues that the horizontal curriculum is completed or implemented the way it is prearranged. A horizontal curriculum has constructive steps that teachers must adhere to in the process of teaching and learning. For instance, the outcomes of the horizontal curriculum are informed by the vertical curriculum. Teachers are not expected to deviate from what is prearranged in the process of teaching and learning under the horizontal curriculum.

A qualitative interpretive case study was conducted by Gorder (2008) on teacher perceptions of instructional technology integration in the classroom. The study discovered that the horizontal curriculum is informed by an instrumental approach which is driven by formal steps when implementing the curriculum. As a result, the horizontal curriculum yields to the vertical curriculum. A qualitative interpretive case study was conducted by Keengwe (2007) on faculty integration of technology into instruction; and students' perceptions of computer technology for improving student learning. The main aim of the study was to examine the nature of the relationship between faculty integration of technology into classroom instruction and students' perceptions of the effect of computer technology on improving their learning. The study pointed out that the horizontal curriculum success relies on learners being given informal activities based on relevant content. A horizontal curriculum can be achieved if learners are given informal activities such as homework, case studies, etc. Moreover, Nene (2019) argues that teachers in the horizontal curriculum are driven by unconstructive integration: learners' assessment (continuous assessment) tasks may be conducted to meet learners' needs irrespective of their locations. In a horizontal curriculum continuous assessment is completed to support learners who need to understand the content.

A study was conducted by Mpungose (2017) exploring the lecturers' reflections on the teaching of physical science modules using the Moodle learning management platform (LMP) at a South African university. The study revealed that the horizontal curriculum is informed by constructive integration and an instrumental approach; the process of

implementation of technological resources is logical and orderly, following certain prescribed content daily. Bloom (1956) argues that the horizontal curriculum is driven by six levels (refer to Figure 3.3). For instance, teachers ask a question to understand whether learners have acquired certain knowledge from the lesson (knowledge level). A teacher of economics and management sciences (EMS) may ask the question: Why do we need entrepreneurs in our communities? (entrepreneurship topic). Learners can then show understanding or can interpret the facts (comprehension level). For example, learners will be able to state the need for entrepreneurs in our communities. The teacher might ask learners to solve the problem with the knowledge they have gained in class during curriculum implementation (application). For instance, the learner may be allowed to sell at school items/products that other learners need, such as pens, rubbers, dictionaries, etc. Learners may be asked by the teachers to go beyond their own knowledge to see patterns that they may integrate in analysing a problem (analysis). For example, learners will now be required to identify whether they have made a profit or not after selling, by analysing their figures. The teacher will ask learners to create a new way of making more money when they are selling. Thus, learners will use the knowledge from multiple subjects and synthesize this information or suggest a new idea (synthesis). The teacher will ask learners to assess the information and come to a conclusion (evaluation). Khoza (2018) argues that teachers should be well aware of these learning levels when implementing the curriculum because the horizontal curriculum is guided by these levels in the process of practice.

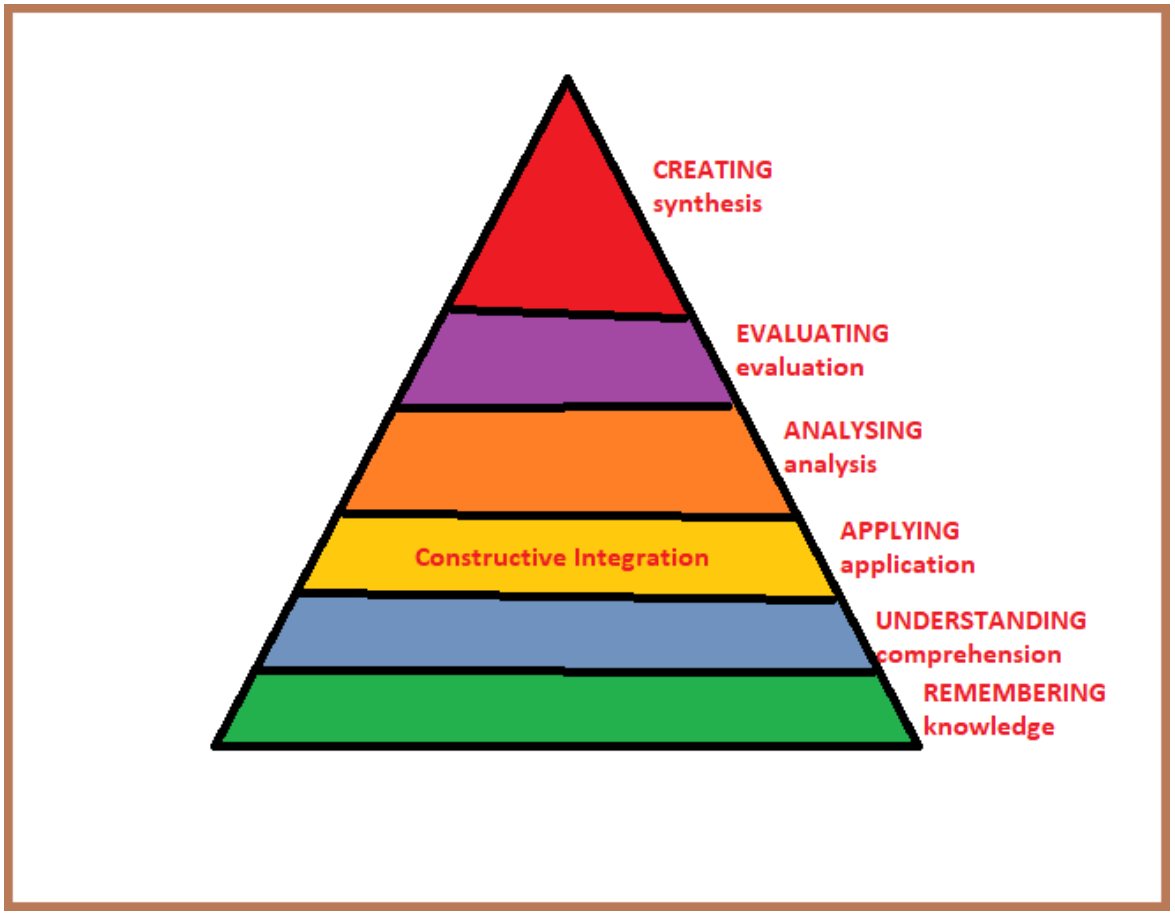


Figure 3.4 Bloom's taxonomy. classification of levels in implemented curriculum. Source: (Bloom, 1956)

A qualitative case-study style grounded within the interpretive paradigm was conducted by Khoza (2019) on curriculum managers' perspectives on managing the curriculum in schools of King Cetshwayo District. The study discovered that the horizontal curriculum focuses on levels of understanding with precise content and sequenced constructive school knowledge. Thus, this curriculum places discipline/content at the centre of teaching, and encourages international knowledge and collection of knowledge to ensure that all basic knowledge is imparted. Scholars (Hoadley & Jansen, 2013; Kelly, 2009) further argue that there are firm distributive rules regulating access, transmission, and evaluation of knowledge in implementation of the curriculum in which time, space, and teachers are the main agents of these regulations. Thus, teachers should consider knowledge, assessment, time, space, learners, and approach, as key factors in understanding and integrating the horizontal and pragmatic curriculums.

3.5 Integrating Technological Resources into the Pragmatic Curriculum

Van den Akker et al. (2009) argue that the pragmatic curriculum is informed and measured by the achievement of the learning results. Hoadley and Jansen (2013) point out that the pragmatic curriculum detects whether the horizontal and vertical curriculum have been achieved. An interpretive case study was conducted by Khoza (2016) on teaching without understanding curriculum visions and goals. The purpose of the study was to explore the postgraduate students' understanding of curriculum visions and goals in teaching their subjects. The study asserts that a pragmatic curriculum offers feedback on both the vertical and horizontal curriculums. This is in line with an interpretive paradigm conducted by Nani (2019) on teachers' experiences of teaching economics threshold concepts in the Grade 10 FET phase in Ugu district. The main aim of the study was to explore how teachers assign to the economics curriculum implementation processes in a classroom situation to make the subject content meaningful to learners. The study pointed out that a pragmatic curriculum plays a crucial role in both horizontal and vertical curriculums in determining learners' understanding. In short, the pragmatic curriculum acts as a bridge between a vertical and a horizontal curriculum. Mpungose (2020a) argues that integration of technological resources into the process of teaching and learning is not all about vertical and horizontal curriculums. Teaching and learning activities that cannot be seen and touched, such as theories, have a fundamental role in the pragmatic curriculum. A pragmatic curriculum obliges teachers to integrate technological resources, having an understanding of theories such as the cultural historical activity theory (CHAT), and learner/teacher-centred methods to be used during the process of integration. Further to this, a qualitative study that utilized the interpretive approach was conducted by Dlamini (2019) on teachers' approaches to the teaching of geography at an Eswatini school. The study presented Eswatini geography teachers' approaches to teaching a section of research skills in Form 5 for the Swaziland General Certificate of Secondary Education (SGCSE) syllabus. The study revealed that a pragmatic curriculum creates a blended environment. The curriculum encompasses technological resources and modifies the teaching setting. Thus, Mthembu (2018) emphasises that a pragmatic curriculum is integrated into the classroom as a continuous way of observing learners' performance. Likewise, Mwalongo (2018) avers that a pragmatic curriculum requires time (spare time) for monitoring of learners' progress when teachers integrate technological resources. The pragmatic curriculum assists with pedagogical knowledge to ensure that learners grow and improve their learning, such as relating to homework and class

activities. An interpretive case study was conducted by Mbhele (2018) on lecturers' strategies for decolonizing the English curriculum at a South African university. The purpose of the study was to understand strategies employed to decolonize the English curriculum at a South African university. The study reveals that a pragmatic curriculum assists teachers to identify the amount of knowledge the learner has achieved. A pragmatic curriculum thus requires teachers to integrate technological resources driven by the subject aims for the sake of learners' growth.

These studies (Cele, 2019; Khoza & Mpungose, 2018; Mbhele, 2018; Van den Akker et al., 2009) posit that the pragmatic curriculum supports teachers in evaluating their work and improving in their curriculum implementation style/strategy. For instance, the pragmatic curriculum drives teachers to become researchers, allowing them to provide continuous activities to learners in their prospective areas. In other words, a pragmatic curriculum allows teachers to integrate technological resources by sending formative assessment (as displayed in Figure 3.4) tasks to learners via cellphones.

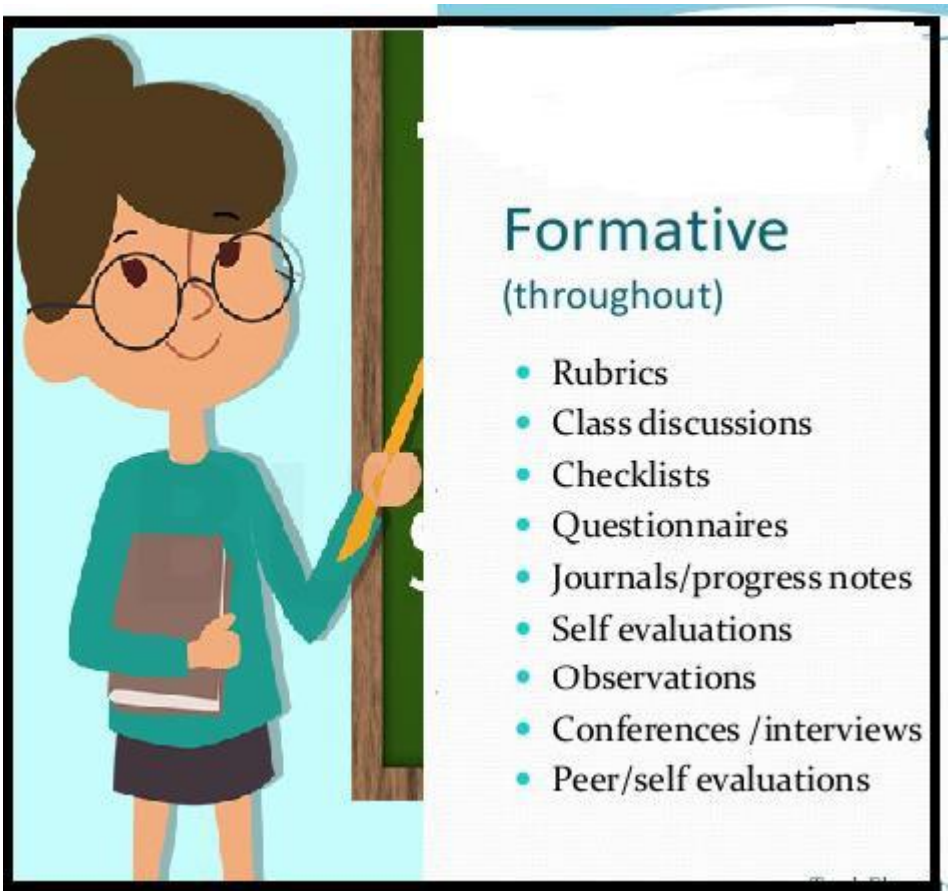


Figure 3.5 Personal activities in pragmatic curriculum

Mpungose (2020b) further states that a pragmatic curriculum evaluates the vertical curriculum if it is taught and learned. For instance, the pragmatic curriculum is for teachers to study learners who meet the goal of a specific subject such as economics and management sciences. Thus, the pragmatic curriculum is a more useful way of describing the ongoing process of implementation. The pragmatic curriculum emphasises the educational experience that students and teachers jointly undergo as they determine what the curriculum will be like in the classroom. Michalec (2013) posits that the pragmatic curriculum supports teachers when is aligned with a deep curriculum that advocates for inner-introspection − teachers will have an opportunity of reflecting (self-introspection) on their actions of integrating technological resources.

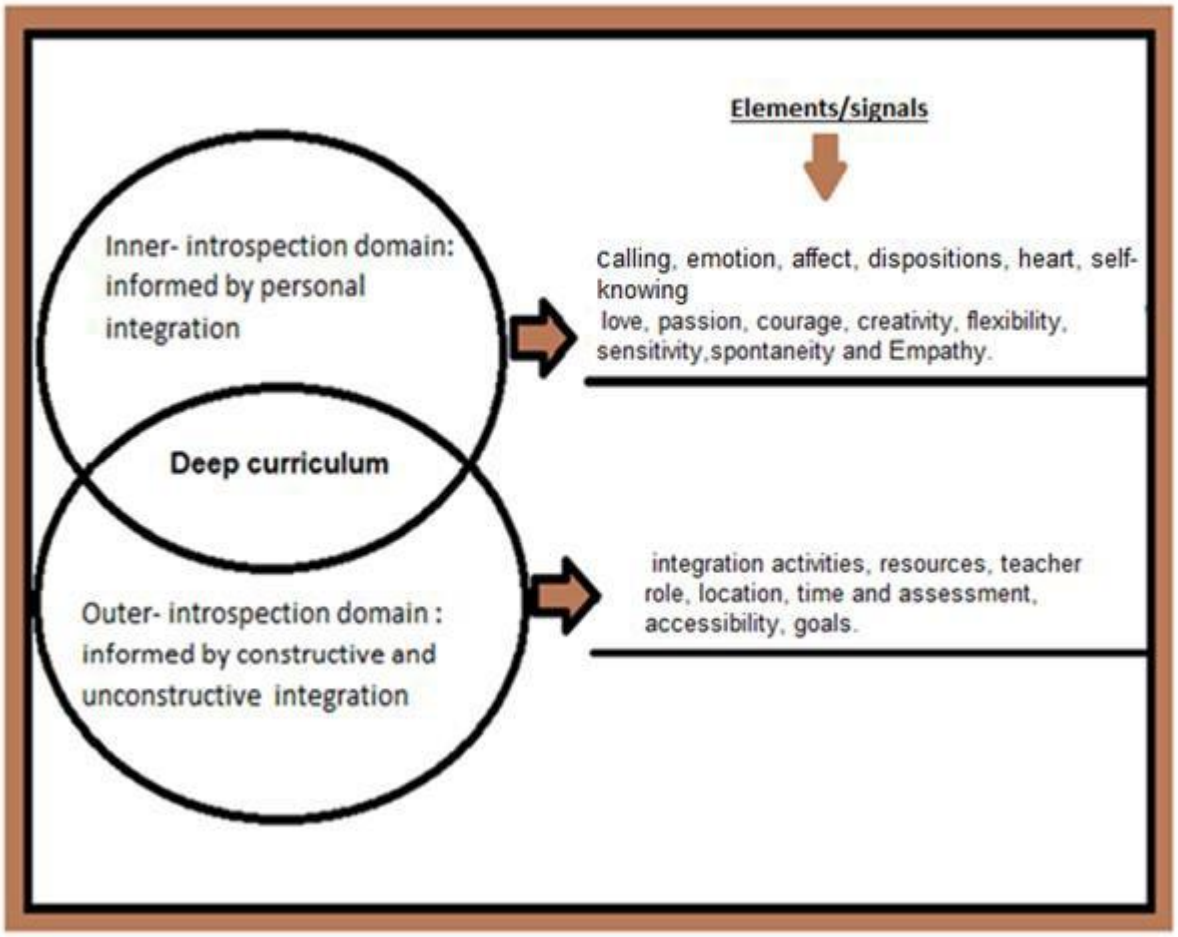


Figure: 3.6 Deep curriculum presentation sources: (Michalec, 2013)

These scholars (Michalec, 2013; Mpungose, 2020a; Valtierra & Michalec, 2017) believe that the deep curriculum is about self-introspection in the process of integrating technological resources. The authors further argue that the deep curriculum is aligned with personal

integration that is informed by the inner-introspection domain that drives teachers to embrace these elements (calling, love, passion, courage, heart, self-knowledge). Valtierra and Michalec (2017) agree with Van den Akker et al. (2009) that the deep curriculum is all about teachers reflecting on their understanding of the subjects into which they have integrated technological resources in order to innovate. In other words, a deep curriculum seeks teachers to integrate technological resources from their heart and be passionate about integrating technological resources. This study views a deep curriculum as a device that connects teachers with their technological resources.

Ramnarain and Hlatswayo (2018) agree with Pinar (1978) that the inner-introspection domain is influenced by self-identity that guides teachers to integrate technological resources from the heart. Teachers who are driven by the introspection domain will integrate technological resources into their work beyond the call of duty (passionate) (Nene, 2019). Thus, self-identity/love will help teachers to integrate technological resources (Mpungose, 2020a). According to Moroye (2009), the inner-introspection domain seeks a trustworthy/authentic representation of teachers, comprising instructional style, personal-beliefs commitments, and content knowledge (complementary curriculum). The study conducted by Makumane and Khoza (2020) argues that the outer-introspection domain (content and pedagogy) in the process of integrating technological resources must be intertwined with the inner-introspection domain, becoming the core element in the integration process that is driven by heart, passion, love, and courage. Teachers will thus be able to integrate technological resources into unconducive, disruptive schools. This study examines the inner-introspection domain as a noteworthy tool to be integrated into technological resources (Nene, 2019). Teachers must incorporate the inner-introspection domain to renew the purpose, values, vision, goals, motivations, and beliefs of integrating technological resources into the curriculum.

Mpungose (2020a) has observed that the integration of technological resources process is not balanced. South African education prioritises the outer-introspection domain (assessment, resources, accessibility, infrastructure) at the expense of the inner-introspection domain (calling, love, self-identity). Most teachers fail to integrate technological resources because they are deprived/robbed of the opportunity of inner-introspection (self-identity) for teaching subjects they love and understand. Michalec (2013) proposes that the highly effective integration of technological resources requires both the inner-introspection domain and

outer/common-introspection domain to work collaboratively to ensure that teachers integrate technological resources effectively for all learners.

Moroye (2009) further observes that the outer/common-introspection domain carries more weight and necessitates more attention than the learning outcomes and goals of the inner-introspection domain when integrating technological resources. It is thus essential for teachers to focus more on the outer/common-introspection domain when integrating technological resources. Korthagen and Vasalos (2005) suggest that deeper forms of reflection are needed to enrich the complexities of integrating technological resources. The latter author further suggests that '*core reflection'* applied in the outer/common-introspection domain can lead to profound changes. Michalec (2013) and Mpungose (2020a) remark that to address the imbalance of these domains when integrating technological resources in schools, the integration process must be centred on four significant questions, as presented in the following Figure 3.5:

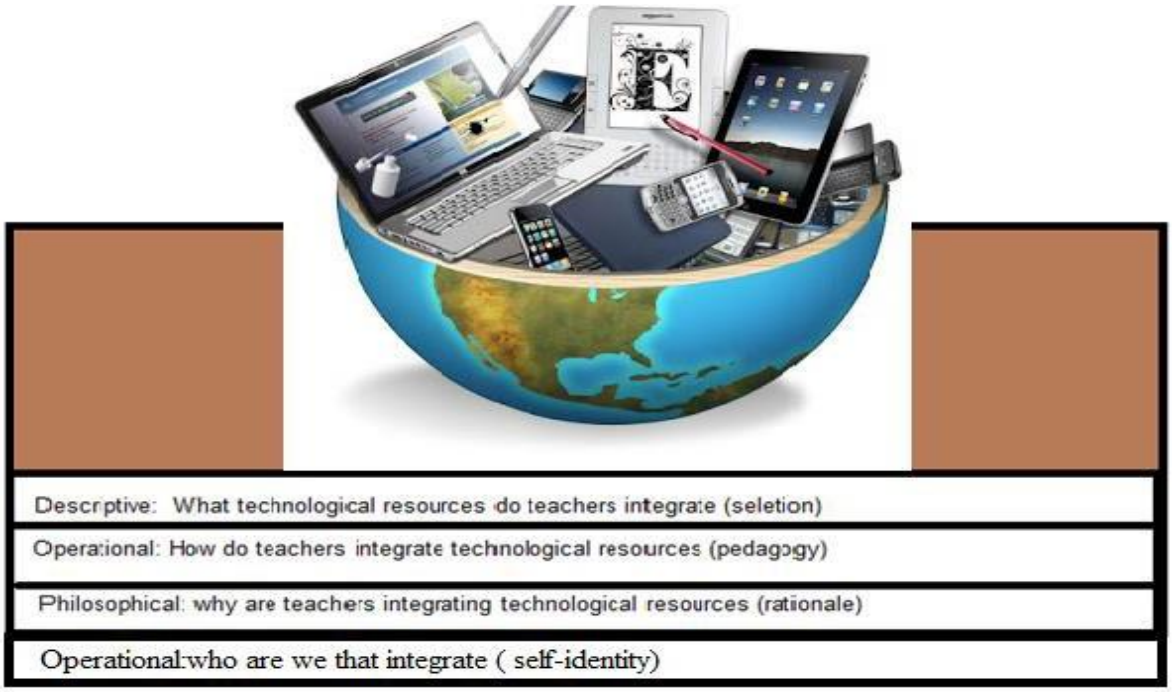


Figure 3.7 Significant questions for integrating technological resources Source: (Michalec, 2013)

Michalec (2013) contends that the descriptive question of 'what', teachers are integrating into the curriculum by way of technological resources is imperative. For instance, the policy

document teachers use for teaching and learning expresses inadequate/no knowledge of technological resources to be integrated for the subject topics they teach. The subject content and knowledge may have gaps that deprive teachers of the opportunity to fall in love with and be adaptable (inner-introspection domain) apropos their subject before integrating technological resources (Msibi & Mchunu, 2013). Further to this, Msibi and Mchunu (2013) state that that inadequate knowledge on pedagogy (the operational 'how' question), that is informed by the outer-introspection domain harms the process of integrating technological resources into the curriculum. Teachers with inadequate knowledge are reluctant to integrate technological resources; and lack the courage to stand in front of learners while integrating technological resources (Mpungose, 2020a). It is essential for universities to bid for the modules that guide and teach teachers on how to integrate technological resources into schools. Makumane and Khoza (2020) comment that the (philosophical 'why' question) seeks teachers who integrate technological resources to have a vision that places self-control or profession at the centre of the learning environment (constructive integration). The (philosophical 'why' question) places individual (self-identity) teachers at the centre of the teaching/learning environment (personal integration). Thus, Makumane and Khoza (2020) also note that the (philosophical 'why' question) relates to teachers wanting to satisfy the needs of society (learners), society being at the centre of the teaching/learning environment (unconstructive integration). Lastly, there is the question of 'who'? Mpungose (2020a) articulates that this seems to be neglected in the process of integrating technological resources. The question 'who' is informed by self-identity, in asking who we are that integrate. If teachers cannot address the 'who' question, teachers may become reluctant to integrate technological resources. Self-identity will vanish and negate the reasons behind integrating resources.

3.6 Conclusion of the Chapter

This chapter (Chapter 3) at the outset has defined the concept of a curriculum. The discussion of the curriculum in this chapter has led to the discussion of the levels of curriculum (vertical, horizontal, and pragmatic). This chapter has also reflected that all the levels of curriculum are driven by either constructive, unconstructive, or personal integration. Thus, the discussion of the levels was framed under constructive, unconstructive, and personal integration. Further to this, this chapter has expressed that these levels of curriculum are successfully integrated

with technological resources when they are intertwined with the deep curriculum that seeks for self-introspection in the process of integrating technological resources.

CHAPTER 4

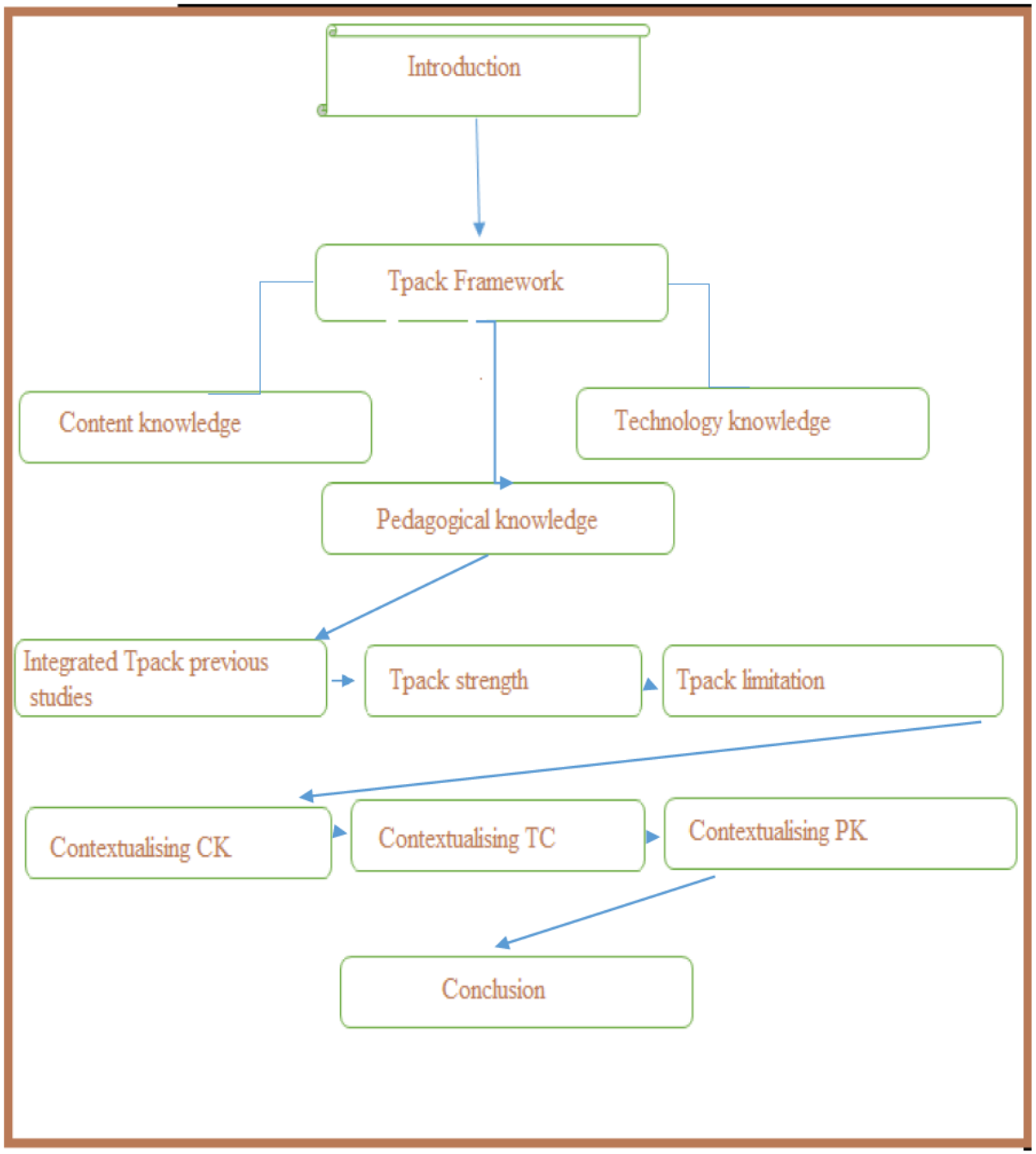


Figure 4.1: Chapter 4 overview

4.1 Introduction

Chapter 3 (the previous chapter) has intensively discussed the literature on curriculum and curriculum levels (vertical, horizontal, and pragmatic). Further to this, the chapter has provided clarity on how the deep curriculum relates to curriculum levels. Initially, this chapter anticipates discussing the theoretical framework. Swanson and Chermack (2013) affirm that a theoretical framework is integrated into the study to explain, comprehend, and predict phenomena, to challenge existing human knowledge based on planned support. Swanson and Chermack (2013) further state the fundamental roles of a theoretical framework that a researcher must comprehend in the research study. Firstly, the theoretical framework allows the reader explicitly to comprehend the phenomenon and be able to assess it critically. Secondly, the theoretical framework connects the existing human knowledge with the researcher to back up the hypothesis. Thirdly, the theoretical framework articulates assumptions around the theory concerning research questions of why and how. Lastly, the theoretical framework can identify the key variables that must be examined on the phenomenon (integration). Thus, this chapter intends to reveal the TPACK framework that seems to be the most relevant for this study, advocating as it does for three relevant knowledge types that address the phenomenon of this study (content, technological, and pedagogical). This chapter will intensively discuss the studies that have integrated the TPACK framework, the limitations, and the benefits of integrating the TPACK theory into the study. Lastly, this chapter aims to contextualize the TPACK concepts within the relevant concepts of integration (the phenomenon).

4.2 Theoretical Framework: Technological Pedagogical Content Knowledge (TPACK)

It is difficult to give a direct and consistent definition of the term ‘theoretical framework’, as this term is often used interchangeably with the term ‘conceptual framework’ (Casanave & Li, 2015; Fox & Bayat, 2007; Merriam, 1998, 2001; Wacker, 1998). These scholars (Marshall & Rossman, 2014; Maxwell, 1890) integrate or use these terms contingently. For instance, Maxwell (1890) favours the ‘theoretical framework’. On the other hand, Marshall and Rossman (2014) favour the term ‘conceptual framework’. Casanave and Li (2015), in their findings on the theoretical and conceptual frameworks, conclude that a 'theoretical framework’ is more constructively integrated into the study and is more abstract than a ‘conceptual framework’.

Wacker (1998) and Liehr and Smith (1999) define a theoretical framework as a set of interrelated concepts that structure a systematic view of a phenomenon. Imenda (2014, p. 189) insists that a theoretical framework "is the application of a theory, or a set of concepts drawn from the same theory, to offer an explanation of an event, or shed some light on a particular phenomenon or research problem". A theoretical framework acts as a guide in outlining the study both epistemologically and philosophically (Grant & Osanloo, 2014). Sinclair (2007) concurs that a theoretical framework helps the researcher not to deviate from the putative theories, thus contributing philosophically. Osanloo and Grant (2016) add that the theoretical framework may be viewed as the global positioning system (GPS) or map that guides the researcher to reach the destination without deviating from the map. The theoretical framework is seen as a structure that describes the nature of the phenomenon of the researcher. In other words, a theoretical framework promotes systematic knowledge the researcher may apply in the study.

Merriam (2001, p. 45) describes the theoretical framework as "the structure, the scaffolding, the frame of your study". This is supported by these scholars (Khoza, 2016; Mpungose, 2020b; Simpson & Belsky, 2008; Sinclair, 2007) who believe that a theoretical framework is a structure that contains the system theory or self-efficacy that is informed by the selected specific theory. Hence, the structure is informed by a constructive researcher integrating literature related to the title of the study. The researchers Marshall and Rossman (2014) posit that a theoretical framework is an image of the territory the researcher wishes to study. It is a graphic demonstration of the researcher's current working theory, a portrait of what the researcher believes is occurring in the phenomenon the researcher is studying.

A qualitative study was conducted by Zuma (2019) on reimaging Moodle as an effective learning management system through the experiences of geography lecturers at a selected South African university. The study adopted convenience sampling to select the most accessible participants; and data were analysed through guided analysis in which deductive and inductive methods were deployed. The study agrees with findings of Liehr and Smith (1999) that the theoretical framework is more of a blueprint, a guide for modelling a structure. This is also in line with Merriam (1998), who describes the theoretical framework as the soul of the study, the skeleton, the frame of the study. On the other hand, a qualitative study was conducted by Budden (2016) exploring factors that inform curriculum studies students who use e-resources in conducting master's in education dissertations at a South

African university. The study generated data using one-to-one semi-structured interviews, document analysis, and online reflection activity. Data generated were analysed through guided analysis in which deductive and inductive were employed. The study supports Swanson and Chermack (2013) who believe that a theoretical framework has to build a foundation of study, and to demonstrate how a study advances knowledge. Thus, in the context of this study, a theoretical framework will help to provide a reference point for the interpretation of findings. Consequently, for this study, the technological pedagogical and content knowledge (TPACK) framework seems to be the relevant choice.

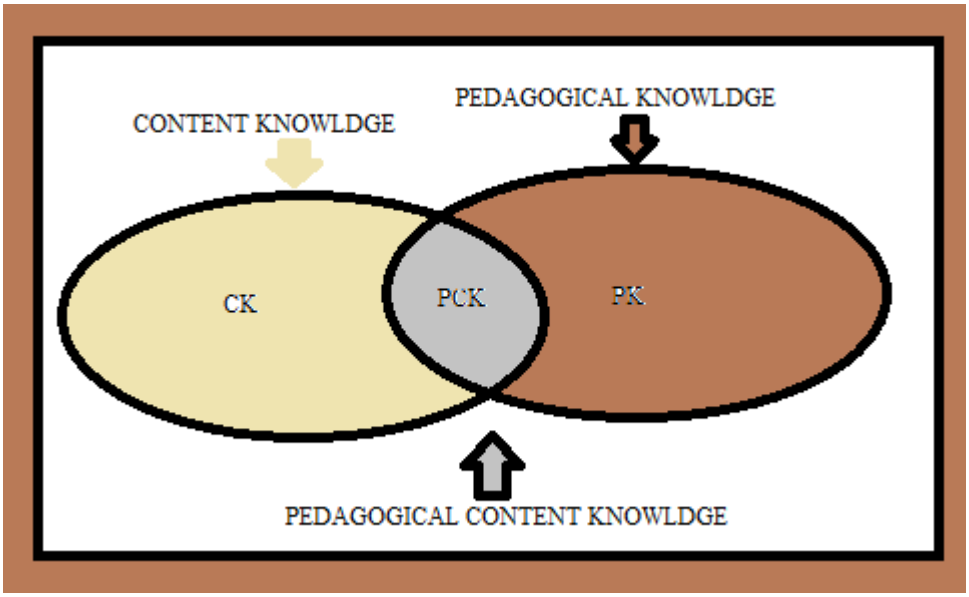


Figure 4.2: Pedagogical content knowledge (PCK) by (Shulman, 1986)

Figure 4.2 depicts the work that was constructed from the work of Shulman (1986), who revealed that content knowledge and pedagogical knowledge are interconnected. Such became known as a PCK (pedagogical content knowledge) framework. The PCK advocates for knowledge of strategies or approaches to facilitate teaching and learning, because PCK focuses on a particular subject (Shulman, 1986). The PCK therefore encourages constructive integration and personal integration in facilitating teaching and learning. Constructive integration is informed by content knowledge (CK) that is driven by actual understanding of the subject matter. Personal integration is informed by pedagogical knowledge (PK) that focuses on methods that teachers integrate into the process of teaching and learning. Shulman (1986) asserts that pedagogical knowledge (teaching methods), together with teachers' content knowledge (subject matter), should enhance teaching practice in the classroom. Mishra and Koehler (2006) have developed this theory to infuse technology into the teaching

(pedagogy) of the curriculum (content). The latter argue that it is not adequate to have pedagogy and the content without integrating technological resources in the world of digital natives (4IR). The TPACK framework has seven components as depicted in Figure 4.3 after the infusion of technological knowledge (TK) that is informed by unconstructive integration. Mpungose (2020b) agrees with Khoza (2019) that technological knowledge is all about the knowledge of how to integrate the emerging technologies in the 4IR. The above-mentioned seven components are: pedagogical knowledge (PK), content knowledge (CK), technological knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological, pedagogical, and content knowledge (TPACK) (Koehler & Mishra, 2009), as displayed in Figure 4.3.

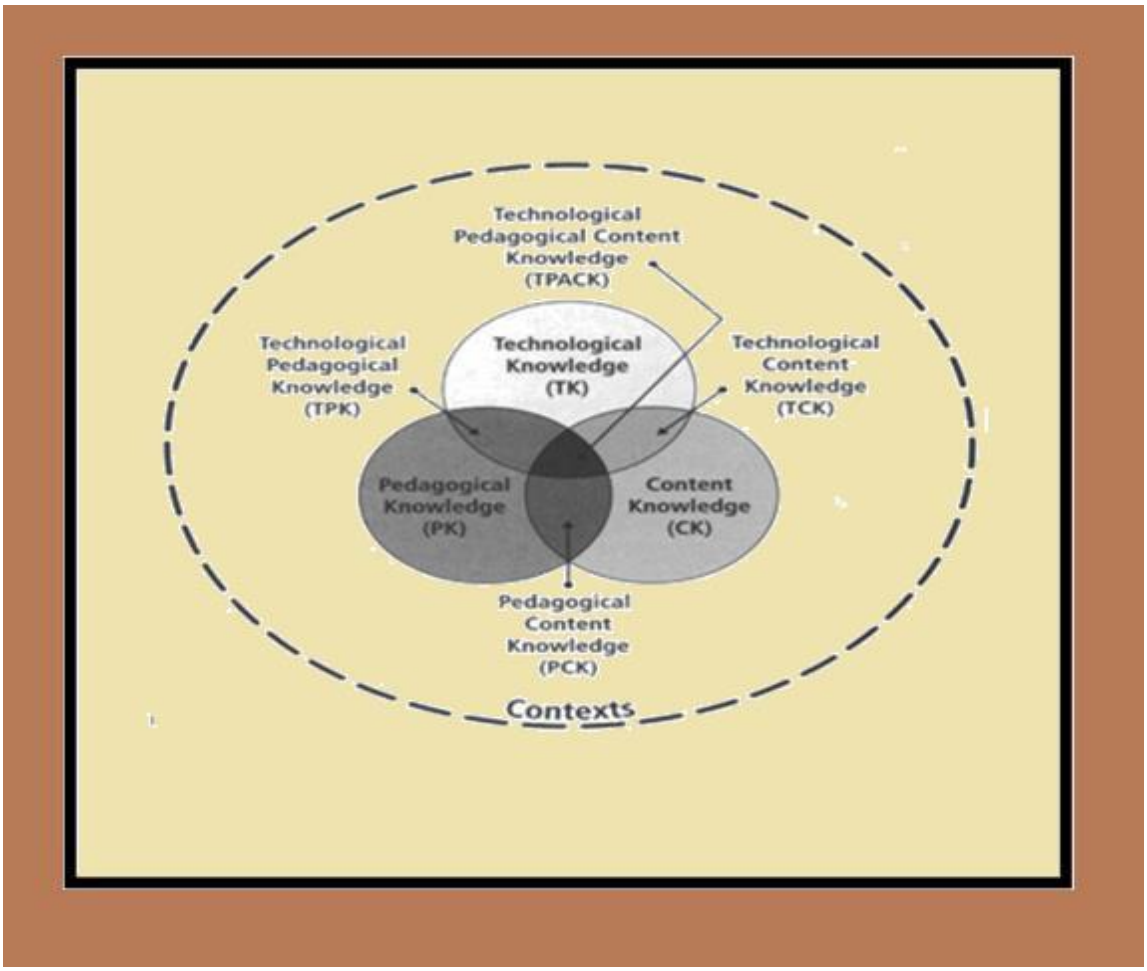


Figure 4.3: Technological, pedagogical, and content knowledge (TPACK) by Mishra and Koehler, 2006, p. 3.

The theory was developed to integrate technology (tools/resources) into the implemented curriculum (content) (Mishra & Koehler, 2006). Further to this, Misirli (2016) states that

understanding the TPACK main components in the process of integrating technological resources has a great impact. These components are: 1. Pedagogical knowledge (PK) (see the qualitative study conducted by Keating and Evans (2001) on three computers in the back of the classroom: preservice teachers' conceptions of technology integration. The study advocates that pedagogical knowledge is about methods that teachers integrate in process of teaching and learning that include learners' involvement and assessment); 2. content knowledge (CK) (see the qualitative study conducted by Luik, Taimalu, and Suviste (2018) affirming that content knowledge is about the actual indulgence of the subject matter, knowledge on the subject taught); 3. Technological knowledge (TK) is disclosed in a qualitative study conducted by Tzavara, Komis, and Karsenti (2018) on a methodological framework for investigating TPACK integration in educational activities by prospective early childhood teachers using ICT. The study revealed that technological knowledge is all about teachers' understanding of various technological resources that may be integrated into teaching and learning such as hardware and software programmes; 4. Pedagogical content knowledge (PCK) is defined in a qualitative study conducted by Koh, Chai, and Tay (2014) on TPACK-in-Action: unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge. The study pointed out that PCK advocates for teaching methods integrated with the content knowledge for effective teaching practice in the classroom; 5. Technological content knowledge (TCK). A qualitative study conducted by Hong and Stonier (2015) reveals that TCK is demarcated within technological resources understanding and the influence of subject matter; 6; Technological pedagogical knowledge (TPK). Graham, Borup, and Smith (2012) aver that TPK is driven by the understanding of how technological resources may be integrated into the process of teaching; and teachers' mindfulness that technological resources may transform how teachers explain/teach; and 7. Technological pedagogical and content knowledge (TPACK).

Koehler and Mishra (2009) remark that (TPACK) advocates for the understanding (knowledge) of technological resources that teachers must integrate into their teaching process to address their subject matter. Teachers must adopt three types of knowledge when addressing their subject matter, namely, CK, PK, and TK. Moreover, Koehler and Mishra (2013) agree with Mpungose (2020a) that TPACK has three main types of knowledge (TK, CK, PK) that are difficult to work with in isolation but necessitate the involvement of curriculum elements: accessibility, goals, content, activities, resources, time, assessment and

location. Thus for teachers to adopt the TPACK framework it is imperative to have a deep understanding of these elements. Understanding these elements is not adequate − teachers must also understand the curriculum representations (vertical, horizontal, and pragmatic). Thus, curriculum representations may be profoundly understood when teachers adopt three levels of integration (constructive, unconstructive, and personal). The above three main types of knowledge (TK, CK, PK) enlighten the process of integrating technological resources in the 4IR era.

4.3 Content Knowledge (CK)

"Content knowledge is knowledge about the actual subject matter that is to be educated or skilled, including knowledge of central facts, concepts, and procedures within a given field" (Shulman, 1986, p. 1026). This is in line with the conclusion from a qualitative study conducted by Zuma (2020) on exploring lecturers' understanding of Turnitin utilization in assessing mathematics at a South African university. The study concluded that CK in any subject denotes the amount and organization of knowledge per subject in the mind of the teacher. This knowledge about the subject focuses on actualities and ideas because it relies on constructive integration in which knowledge is structured and incorporates the facts and concepts. Zulu (2020) avers that CK is informed by constructive integration since teachers are required to be equipped with sufficient prescribed knowledge to provide the solution to learners. For instance, teachers who teach economics and management sciences must have a deep understanding of their subject concepts such as battering, entrepreneur, asset, surplus, and deficit, etc. Mishra and Koehler (2006) further view CK as the phenomenon that contains an understanding of the content which comprises knowledge of how one's subject matter may be improved by the application of technology. Thus, teachers are expected to have CK of their topics and have an understanding of their subject. Teachers will execute their formal activities constructively when they have a deep understanding of the content knowledge of their subjects.

Furthermore, Mishra and Koehler (2006) maintain that CK covers the central facts of the subject matter that is to be studied. For instance, teachers may physically integrate any hardware resources to execute the objectives (refer to Table 4.1) of the actual subject matter to be learned. Thus, this study views CK as constructive knowledge of the subject matter. In other words, teachers who are driven by constructive integration rely on constructive

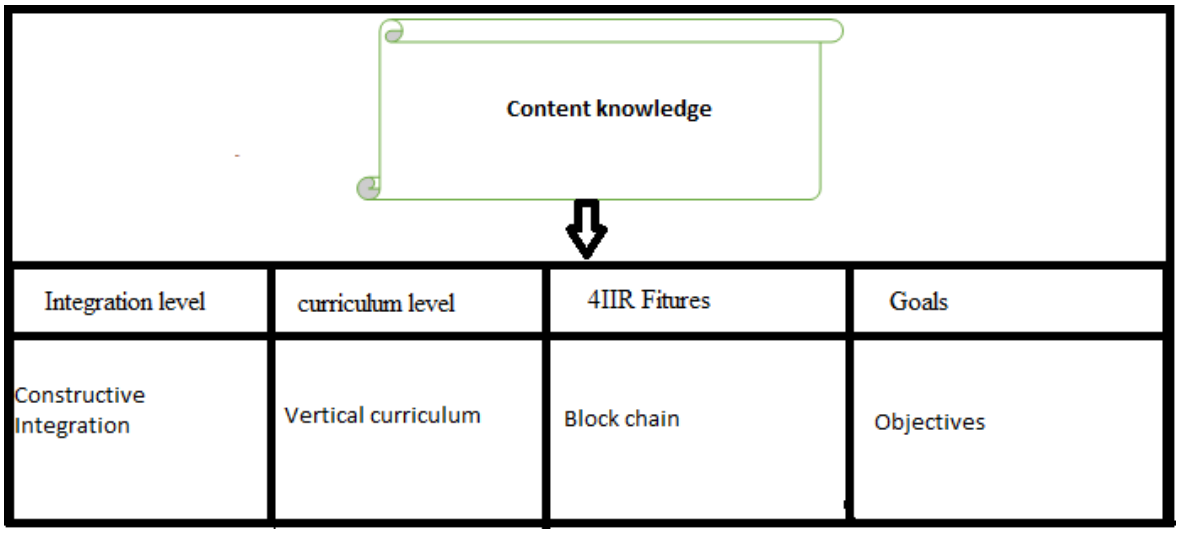
knowledge to be driven by the subject matter. Nonetheless, Schmidt et al. (2009) and Mpungose (2020a) believe that teachers who have insufficient CK and are not driven by constructive integration develop incorrect conceptions about the subject they are teaching. Shulman (1986) concurs with the latter that teachers who are not motivated by constructive integration and CK have poor understanding of their subject. Therefore, these scholars (Mishra & Koehler, 2006; Yurtseven Avci et al., 2020; Zhou et al., 2020; Zulu, 2020) suggest that teachers share information in the 4IR era embracing up-to-date apparatus such as blockchain (refer to Table 4.1) to ensure that learners are not developing incorrect conceptions. In other words, teaching a subject without sufficient CK cannot address the subject's needs. Therefore CK requires teachers to become instructors when addressing the subject needs (Khoza, 2018).

Mpungose (2020b) stresses that CK advocates for constructive integration and relies on the vertical curriculum (refer to Table 4.1) because it is informed by what is written down (CAPS). Thus, CK necessitates that teachers know the subject matter to be taught with the application of technology and with what is written down (CAPS) (Khoza, 2018). Technological resources in schools may thus assist to execute the goal of summative assessment when teachers are well versed in CK. This component (CK) can assist to discover whether teachers are specialists in their subjects (Harris et al., 2009).Thus, when CK is aligned with constructive integration, blockchain, summative assessment, contact time, and location may support teachers in understanding their subject matter and in applying pedagogical knowledge during the teaching and learning process (refer to Table 4,1 for alignment).

A qualitative action research was conducted by Mlaba (2020) on four lecturers at a university in KwaZulu-Natal reflecting on their teaching of business studies modules, using the Moodle learning management system. The study employed a critical methodological paradigm. The main purpose of the study was to explore the lecturers' reflections when teaching business studies modules. Thus, reflective activity, artefacts and one-on-one semi-structured interviews were employed to generate data. The study discovered that the strength of integrating CK into the process of teaching and learning, teachers' CK, informs designs of horizontal and vertical curricula for a subject. Further to this, CK focuses on the subject-area content to be considered through teaching and learning at the expense of other factors

important at school. Culture, politics, and values are neglected. CK thus relies on constructive integration since the focus is on written existing theories, ideas, organizational frameworks, and addressing the needs of the subject. On the contrary, see the qualitative approach study conducted by Mlilo (2019) on the integration of technology-based tools into intermediate phase mathematics classrooms. The study has discovered the limitations of CK in that teachers are informed by horizontal and vertical curricula at the expense of pragmatic curricula. Such may reduce the high standard of the curriculum when integrating technological resources.

Table: 4,1: Alignment of Content Knowledge, Integration Levels, 4IR Features, and Curriculum Signals.



4.4 Pedagogical knowledge (PK)

Mishra and Koehler (2006, p. 569) are of the view that PK is "representation and formulation of concepts, pedagogical techniques, knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology in specific contexts". A study was conducted by Cox and Graham (2009) using an elaborated model of the TPACK framework to analyse and depict teacher knowledge. The study argues that PK comprises strategies for encouraging learners, communicating with learners and parents, offering information to learners, and classroom management, among many other aspects. Thus PK is pointing towards personal integration as it is driven by various factors such as goals, values, and purposes of an individual teacher (Mishra & Koehler, 2006; Schmidt et al., 2009). Additionally, Mishra and Koehler (2006) contend that PK is informed by personal integration since it refers to profound or in-depth knowledge of the methods and practices of

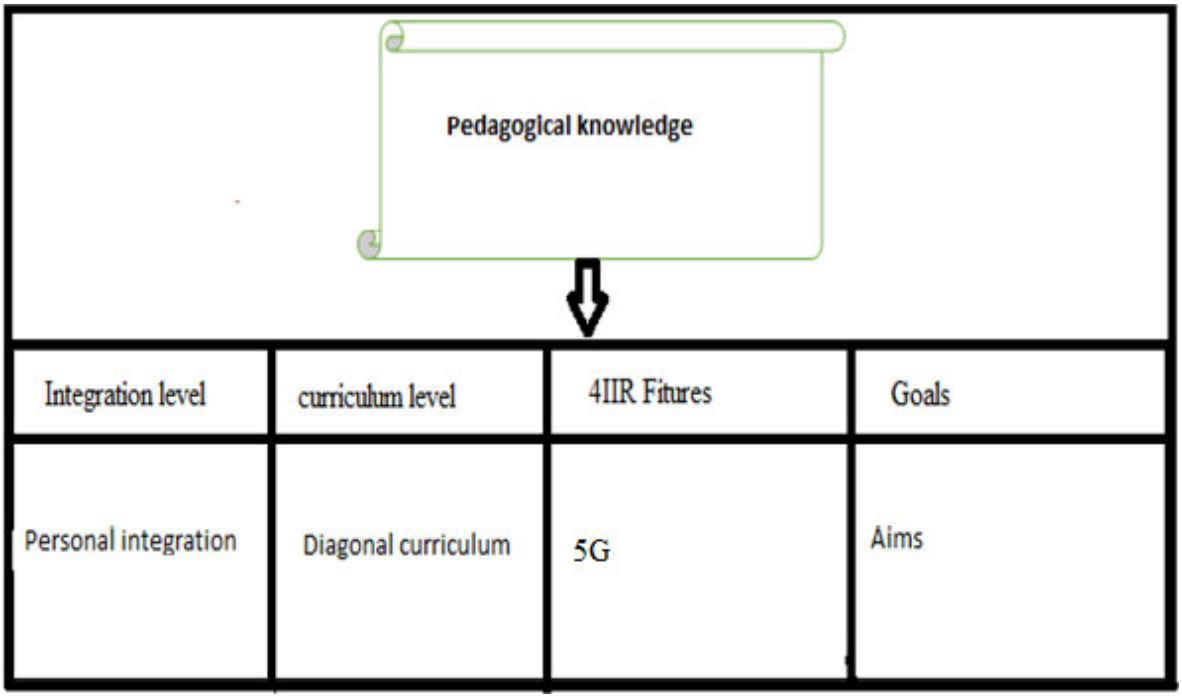
learning. Thus, teachers must have a deep indulgence in teaching methods to achieve the aims (refer to Table 4.2) of their subjects. Lastly, teachers who are driven by personal integration and PK require an understanding of cognitive, social, and developmental theories of learning and how they apply to learners in the classroom; such as connectivism, behaviourism, and cognitivism. Teachers must have deep PK to construct knowledge with the required skills to achieve the aims of the subject.

A qualitative study conducted by Mohamed and Ahmad (2019) concluded that pedagogical knowledge is motivated by personal integration, and requires teachers to know about models in the process of unpacking the learning content. For instance, teachers may continuously be integrating forms of models/methods and theories to successfully implement the curriculum. This may help teachers to employ the relevant approaches and models in line with the subject they teach. Salehi and Salehi (2012) argue that pedagogical integration advocates for teachers to integrate suitable techniques such as applying a sources method, in which learners will learn directly from the sources, to support blended learning. Teachers may make use of the 5G technique of downloading (refer to Table 4.2) in their teaching. Teachers can download formative assessments tasks uploaded by the Department of Education on their own computers. This will assist teachers to overcome the challenge of adequate information. All the documents and information teachers need are uploaded onto the department page or Google site. Thus, the alignment of PK, integration levels, 4IR features, aims, formative assessment, and subject knowledge may assist if teachers have the right direction in terms of a lesson plan, class management, teaching, and assessment strategies, including goals to be achieved. Refer to Table 4,2 for the alignment.

Mishra and Koehler (2006, pp. 1026-1027) outline that PK is driven by “teachers knowledge about techniques or methods to be used in the classroom; the nature of the target audience; and strategies for evaluating learners understanding.” Correspondingly, a study was conducted by Maor (2017) on using TPACK to develop digital pedagogues: a higher education experience. The study argues that PK is focusing on teachers’ knowledge at the expense of learners’ knowledge. This limitation is evidence of the study conducted by Mwalongo (2018) on parents’ perception of the integration of information communication technology in education and its influence on school choice in private pre-primary schools in Tanzania. The study argued that PK focuses on the knowledge that a teacher must have to

teach all teaching activities. This suggests that PK is informed by personal integration because it is informed by the individual needs of teachers. Thus, teachers need to use the appropriate method (ideological-ware) when integrating resources into their teaching. Thus PK may assist in the context of this study to discover whether teachers are using the correct methods and theories in the process of teaching. It can be concluded that PK is informed by a diagonal curriculum (refer to Table 4.2) in which teachers are expected to know teaching methods and correct techniques to adopt in the process of teaching.

Table:4.2: Alignment of Pedagogical Knowledge, Integration Levels, 4IR Features, and Curriculum Signals.



4.5 Technological Knowledge (TK)

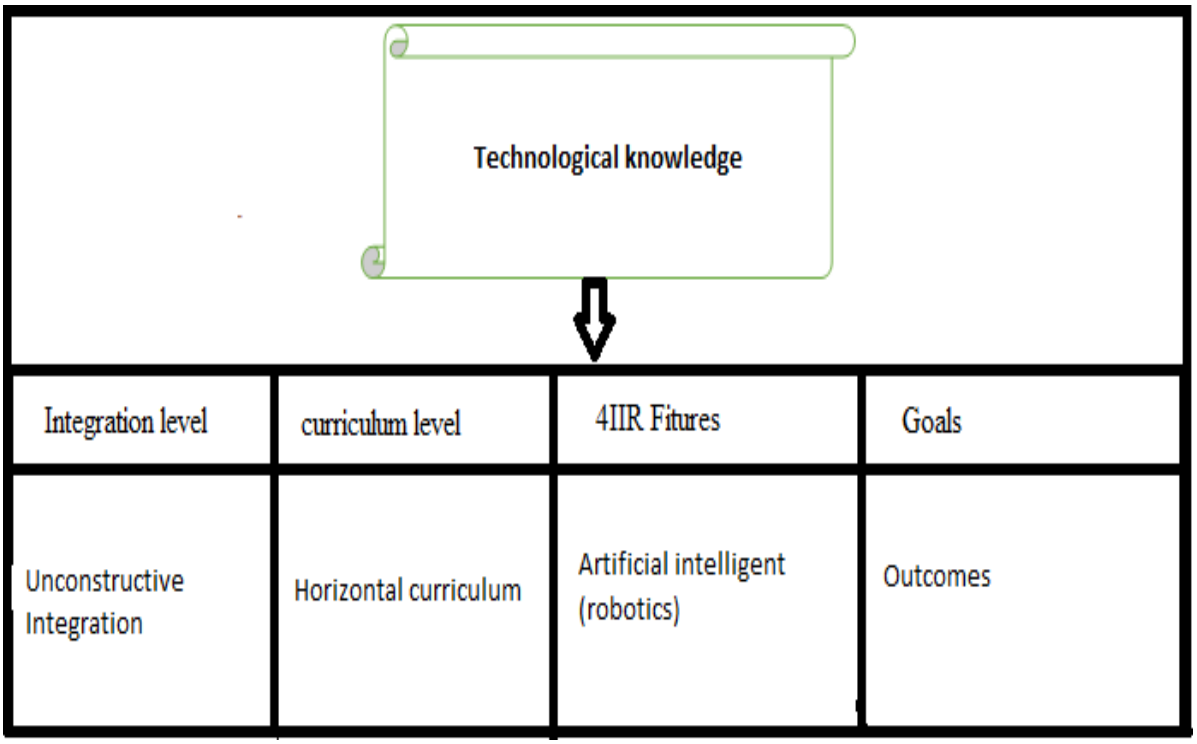
A mixed methods approach study was conducted by Khoza and Govender (2009) on lecturers' experiences of integrating information and communication technology into teaching at a college of education. The study suggests that TK is about " different range of tools and technologies, from traditional technologies such as pencil, paper, chalk and chalkboard to digital technologies such as the internet, computer simulations, interactive whiteboards, discussion forums, and software programs" (Khoza & Govender, 2009, p. 7). This is supported by the qualitative study conducted by Jang and Tsai (2013) exploring the TPACK of Taiwanese secondary school science teachers using a new contextualized TPACK model. The study concludes that TK is about understanding PowerPoint, multimedia,

interactive whiteboards, and more advanced technologies, such as the internet, digital videos, etc. Oke (2020) assures that TK is informed by unconstructive integration since it involves the skills required to operate particular technologies. Shulman (1986) is also of the view that TK is informed by unconstructive integration as it is based on teachers' understanding of technologies that must be integrated into the classroom − not just knowing technology, but being able to integrate it within the diagonal curriculum (refer to Table 4.3). A teacher must become a facilitator when integrating technological resources in the process of executing informal activities to achieve the outcomes (refer to Table 4.3) of the activity. When teachers become facilitators they are able to understand the most desirable technological resources to implement in executing informal activities. Teachers' knowledge of TK must involve knowledge of how to install and remove devices, install and remove software programmes, and create and archive documents and others.

Thompson and Mishra (2007) and Schmidt et al. (2009) state that technology is part of the resources that have a constructive influence on learners' learning. For this reason, TK requires teachers that know how to use resources (software) for learners to understand the lessons in the era of 4IR (Amory, 2010). A teacher teaching EMS covering the topic of informal business may display per projector an informal business in the area instead of visiting the actual informal business. This suggests that TK is informed by unconstructive integration. It plays a vital role in the process of teaching when teachers are knowledgeable about artificial intelligence (refer to Table 4,3) in the 4IR era. Dlamini (2019) further supports the above that unconstructive integration relies on TK. Teachers can engage learners by integrating online platforms such as WhatsApp, Facebook, Moodle, and emails. Thus, the financial constraints of learners who attend school can be circumvented when these platforms are embraced. Thompson and Mishra (2007) and Khoza and Biyela (2019) maintain that teachers should use effective ways of integrating technology into the curriculum to maintain collaborative and cooperative teaching and learning. The alignment of technological knowledge, integration levels, 4IR features, continuous assessment, outcomes, software, and online learning in the context of this study, may indicate whether teachers are using numbers of technological resources to actively engage learners in the process of teaching and learning to address their technological knowledge needs. Refer to Table 4.3 for the alignment.

Mishra and Koehler (2006, p. 1027) outline that TK includes " teachers knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as word processors, spreadsheets, browsers, and e-mails". On the other hand, Mpungose (2020a) asserts that there is a limitation to this assertion because it focuses on the technological resources (software tools) to be integrated into the classroom. It does not provide theories (constructivism, connectivism, and others) to be integrated with these resources. Misirli (2016) argues that TK includes knowledge of how to connect and remove technological resource devices (artificial intelligence or robotics). However, technological knowledge is silent on how to integrate theories in the Fourth Industrial Revolution. In short, technological knowledge focuses on unconstructive integration because its acquires skills through shared information from society

Table:4.3 Alignment of Technological Knowledge, Integration Levels, 4IR Features, and Curriculum Signals.



Integration level	curriculum level	4IIR Fitures	Goals
Unconstructive Integration	Horizontal curriculum	Artificial intelligent (robotics)	Outcomes

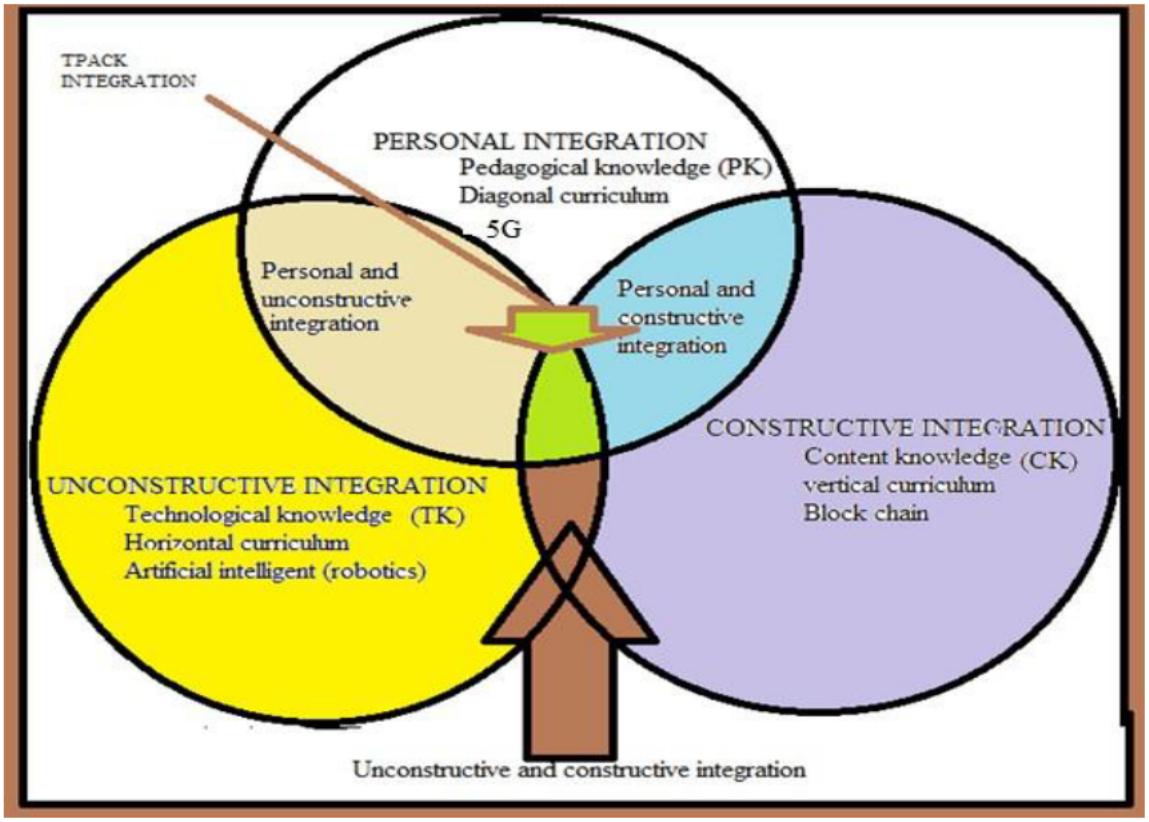


Figure 4.4: Interconnection between theoretical frameworks (TPACK), levels of integration, types of curriculum, and 4IR features

4.6 Previous Studies Integrated TPACK Framework

Teaching in schools relies on pedagogical knowledge and content knowledge to achieve the goals of education (Misirli, 2016; Reed, 2017; Schmidt et al., 2009). These scholars (Jang & Tsai, 2013; Koh, Chai, & Tay, 2014; Koh, Chai, & Tsai, 2014; Maor, 2017; Mishra & Koehler, 2006) assure that the integration of technological knowledge, pedagogical, and content knowledge (TPACK) has had positive results in executing the educational implications. The authors declare that the TPACK framework has been regarded as a necessity in the integration of technological resources in teaching and learning. Refer to Table 4.4 below indicating various studies in which the TPACK framework was previously integrated.

Table 4.4: Studies that integrated TPACK as a Framework

Authors	Keating and Evans (2001)
Study summary	This was a qualitative case study. The study adopted reflective activity and a one-on-one semi-structured method. The framework of TPACK-in-practice, derived from the

	PCK model was integrated into this study.
The purpose of the study	The purpose of the study was to understand whether teachers are developing 21st century technological knowledge.
Findings /conclusion	The study findings reveal that the millennials (digital natives') teachers integrated technological resources for their personal benefit in their lives. Thus, the study concludes that teachers are naïve when integrating technological resources for constructive integration. Teachers have the confidence to integrate technological resources for personal integration and less confidence when they have to integrate technological resources for constructive integration.
Educational implications	This suggests that teachers' integration of technological resources is informed by pedagogical knowledge (personal integration) when integrating technological resources and less by content knowledge (constructive integration). It may lower the quality of education if such knowledge is not comprehensively integrated.
Authors	Anderson and Barham (2013)
Study summary	This qualitative study primarily adopted a case-study approach. Data was gathered through semi-structured interviews. The technological, pedagogical, and content knowledge (TPACK) theoretical framework was adopted for this study.
The purpose of the study	The purpose of this study was to consider practical issues of using the TPACK framework as a research tool, as a lens through which to view online teachers' knowledge of pedagogy, technology, and content.

Findings /conclusion	The study revealed that lecturers were lacking the skills of facilitators of online learning. It was evident from the findings that pedagogical knowledge in all lecturers demonstrated awareness of pedagogical principles such as the need to plan and progress learning at the expense of content and technological knowledge. As a result, the study concludes that lecturers do not meet the needs of students who are digital natives. The study recommended seminars at which lecturers could discuss how to facilitate the issue of online learning comprehension.
Educational implications	Lecturers' integration of technological resources is informed by personal integration at the expense of both constructive and unconstructive integration. This brings about an educational implication in executing online activities if such knowledge is not balanced when integrated with online activities.
Authors	Lin, Tsai, Chai, and Lee (2013)
Study summary	In the mixed methods study, a survey-based questionnaire applied the model of TPACK involving the seven factors of knowledge.
The purpose of the study	The purpose of the study was to explore science teachers' perceptions of technological pedagogical content knowledge (TPACK) addressing teachers' perceptions of the affordances of technology application in instruction.
Findings /conclusion	The findings indicate that female science teachers are perceived as having higher self-confidence in pedagogical knowledge but lower self-confidence in technological knowledge than males. The study concluded that teachers should bring about development and practice in technology knowledge for both male and female teachers.

Educational implications	TPACK is taking the side of personal integration and unconstructive integration at the expense of constructive integration. The imbalance of lecturers' gender when the TPACK frame is integrated by the science lecturers may affect the success of executing such knowledge during the process of teaching and learning.

Authors	Baya'a and Daher (2015)
Study summary	This is a mixed methods study. Data was gathered through semi-structured interviews. The study was guided by the TPACK framework in assessing teachers' TPACK knowledge.
The purpose of the study	The purpose of this study was to examine the consequences of implementing a college plan to advance the use of ICT in college instructors' teaching, adopting TPACK levels of knowledge.
Findings /conclusion	The findings of the research indicate that instructors and pedagogical supervisors in Al-Qasemi Academic College of Education had relatively high positive attitudes toward computers after the college intervention. The study concluded that the instructors' ICT proficiency improved significantly after the college intervention, especially as a result of three components of this intervention.
Educational implications	This then suggests that TPACK application is moving towards constructive, unconstructive, and personal integration. Such can improve the quality of interest of instructors in computers.
Authors	Budden (2016)
Study summary	The study adopted a qualitative research approach which

	enabled a platform for seeking detailed accounts of participants' experiences, perspectives, beliefs, and opinions when using e-resources. The theoretical framework of the cultural historical activity theory (CHAT) was merged with the curriculum concepts to produce the curriculum CHAT theory.
The purpose of the study	The purpose of the study was to explore factors that inform curriculum studies students to use TPACK knowledge (e-resources) in conducting their master's of education dissertations at a South African university.
Findings /conclusion	The findings indicated that certain e-resources were favoured over others. E-resources were explored in the context of hardware (HW), software (SW), and ideological-ware (IW). The study concluded by recommending the alignment of all e-resources. This could be achieved by adapting the TPACK framework which covers all these e-resources (HW, SW, and IW).
Educational implications	The imbalance of integrating e-resources can affect curriculum studies students negatively in the use of TPACK knowledge. These e-resources must be comprehensively integrated to circumvent implication.
Authors	Maor (2017)
Study summary	A mixed methods study was conducted that employed a qualitative method. The data was generated through open-ended questions. The TPACK framework was used to analyse the data.
The purpose of the study	The purpose of the study was to explore the use of the TPACK model in two higher education e-learning courses in Australia that enhanced students' ability to use technology in their learning and later in their professions.

Findings /conclusion	The study found that the majority of students became digital pedagogues and took the opportunity to implement the TPACK model in their classrooms. The study finding suggests that students focus on technological knowledge (unconstructive integration) and neglect content knowledge (constructive integration) and pedagogical knowledge (personal integration). Therefore, the study recommended the sharing of ideas on the use of TPACK models to enhance students' ability to use technology comprehensively.
Educational implications	Application of TPACK addresses unconstructive integration at the expense of constructive and personal integration. Such can disturb the understanding of the TPACK model if students rely only on the unconstructive level at the expense of the constructive and personal models.
Authors	Goradia (2018)
Study summary	A mixed methods study, using a survey-based questionnaire, was undertaken to collect academics' perspectives on various technologies and pedagogies. The pedagogical content knowledge component framed the research.
The purpose of the study	The purpose of the study was to collect academics' perspectives on various technologies and pedagogies used at the institute through the lens of the TPACK framework.
Findings /conclusion	The study reveals that problem-based learning, enquiry-based learning, and constructivist learning were highly rated at the expense of the TPACK model during the process of integrating technological resources. Thus, the study concludes that academics should have a written document (policy) that will ensure the integration of TPACK components when integrating technological resources.
Educational implications	The TPACK application is moving towards personal

	integration (personal teaching methods) and less towards constructive and unconstructive integration. Interest in integrating various technologies may decline if the institute neglects other levels and the TPACK framework.
Authors	Zuma (2019)
Study summary	The study employs a critical paradigm. The methods of data generation employed are reflective activity, use of artefacts, and semi-structured interviews. The TPACK framework was used to guide the study.
The purpose of the study	The study aims at exploring the TPACK (Moodle) as an effective learning management model in the integration of technological resources, through the experiences of geography lecturers at a selected South African university.
Findings /conclusion	Findings indicate that geography lecturers shared their experiences. Geography lecturers are teaching geography using Moodle driven by the needs of the students. Following the shared experiences, geography lecturers reflect on specialized experience, which suggests that these lecturers are driven by the needs of their speciality/content. The study recommends that lecturers share and have seminars on how to integrate Moodle as a balanced and effective learning management system.
Educational implications	Experiences in this study indicate that lecturers follow a shared experience (unconstructive integration) and specialized experience (constructive integration) at the expense of personal integration. This might bring confusion in the use of Moodle if these levels are not comprehensively integrated.
Authors	Al-Shammari (2020)
Study summary	A mixed methods study. The study generated data using

	questionnaire survey designs. The study was framed using the TPACK model.
The purpose of the study	The purpose of the study was to probe the opportunities and challenges of tutors and teachers, using the TPACK theory in teaching ICT in class.
Findings /conclusion	The findings of this study indicated that tutors exhibited a good understanding of TPACK knowledge. Teachers exhibited a poor understanding of ICT, although they have a better understanding of content knowledge. Thus, the study recommends that teachers apply self-development to understand and integrate ICT.
Educational implications	In this study, tutors can explore constructive, unconstructive, and personal integration. However, teachers seem to be naïve about ICT (technological knowledge) although they do have an understanding of constructive integration (content knowledge). Such can bring implications for ICT integration in the classroom.
Authors	Mpungose (2020b)
Study summary	The qualitative case study adopted observation, reflective activity, and a one-on-one semi-structured interview. A technological, pedagogical, and content knowledge (TPACK) framework was used to frame the study.
The purpose of the study	The purpose of the study was to explore student teachers' TPACK knowledge in the teaching of CAPS subjects.
Findings /conclusion	The study revealed that student teachers are good at standard content, pedagogical, and technological knowledge while having no notion of advanced knowledge that caters for the 4IR. Thus, the study recommended the advanced signal (AS)-TPACK which emerged from the findings as the most useful framework for knowledge growth in education to prepare student teachers in the 4IR era.

	Therefore, the study concluded that training received from the university must meet the skills of the 4IR era. TPACK's application is taking the direction of all levels of integration.
Educational implication	The inadequate training received from the university contributes to the failings of student teachers to advance to knowledge that caters to the 4IR. This can affect the educational system as the universities are producing teachers who are unskilled in 4IR knowledge.

With reference to Table 4.4, most of the above studies seem to take the direction of pedagogical knowledge that is informed by personal integration when integrating technological resources. This suggests that teachers at basic education and lecturers in higher education have a better understanding of pedagogical knowledge. In the other two knowledge components (content and technological), teachers seem to be reluctant to integrate these into the process of teaching and learning, struggling to embrace two components when integrating such technological resources. What is also noted from these studies is that content knowledge and technological knowledge are missing in the process of integrating technological resources. These studies displayed in Table 4.5 show that teachers lack content knowledge skills and technological knowledge skills. Such lacks might deteriorate the quality of integrating technological resources.

Table 4.5: Summary of the Above Studies that integrated TPACK as a Framework

Authors	**Applicable Knowledge**	**Knowledge Gaps**
Keating and Evans (2001)	**Pedagogical**	**Content and Technological**
Anderson, Barham, and		

Northcote (2013)	**Pedagogical**	**Content and Technological**
Lin, Tsai, Chai, and Lee (2013)	**Technological and pedagogical**	**Content**
Baya'a and Daher (2015)	**Content, pedagogical and Technological**	**None**
Budden (2016)	**Content, pedagogical and Technological**	**None**
Maor (2017)	**Technological**	**Content and pedagogical**
Goradia (2018)	**Pedagogical**	**Content and Technological**
Zuma (2019)	**Content and Technological**	**Pedagogical**
Al-Shammari (2020)	**Content**	**Technological and pedagogical**
Mpungose (2020b)	**Content, pedagogical and Technological**	**None**

A qualitative interpretive case study was conducted by Mthembu (2018) on the perceptions of Grade 10 teachers on the integration of computer technology in school. The main aim of the study was to understand the perceptions of teachers on the integration of computer technology in school. The study concludes the same as these studies (Anderson & Barham, 2013; Graham et al., 2012; Maor, 2017; Mpungose, 2020b; Thompson & Mishra, 2007; Zulu, 2020) that most teachers in schools have sufficient pedagogical knowledge such as theories/ideological that may be applied when integrating technological resources in the process of teaching and learning. However, the dominance of one knowledge component of TAPCK over the other two knowledge components (as indicated in Figure 4.5) is putting the process of integrating technological resources at risk of being fruitless.

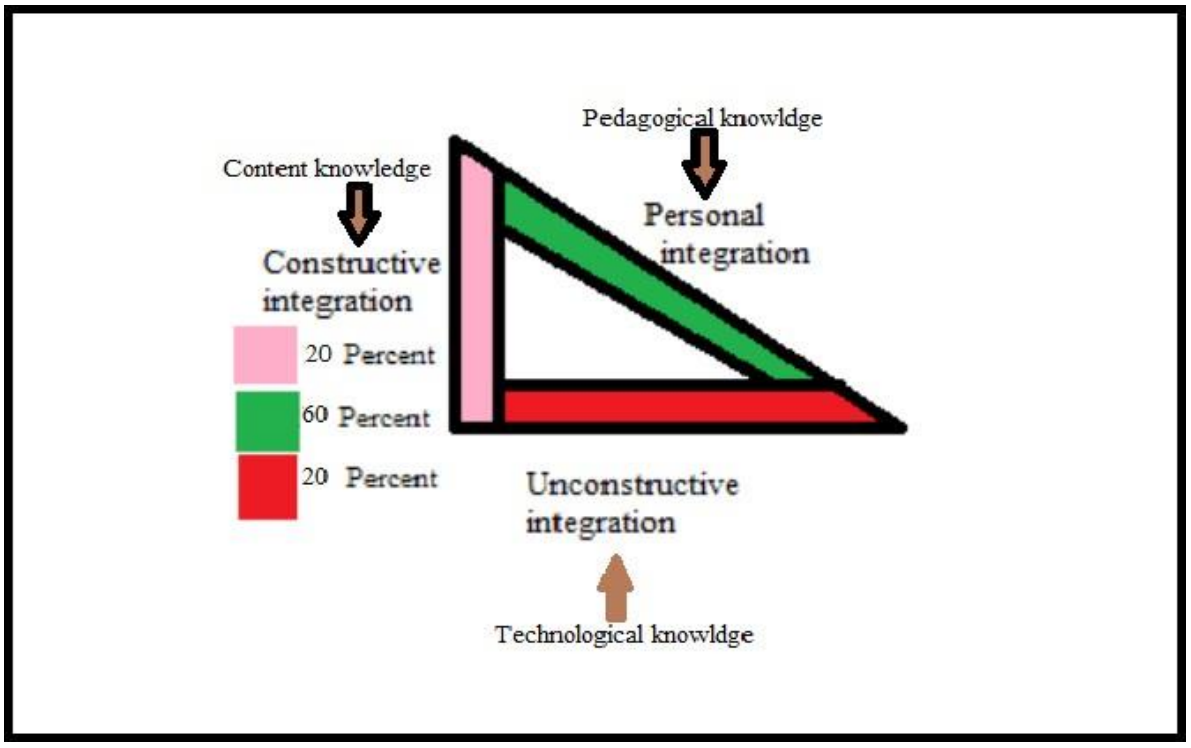


Figure 4.5 The imbalance between the TPACK framework and three levels of integration

Studies by (Graham et al., 2012; Koh, Chai, & Tay, 2014; Maor, 2017; Misirli, 2016; Thompson & Mishra, 2007) agree that the process of integrating technological resources may be achieved if teachers possess all levels of knowledge. Such will lead to the possession of all levels of integration (constructive, unconstructive and personal integration). In Figure 4.6, the

technological knowledge that is informed by a horizontal curriculum is underpinned by unconstructive integration. Technology skills/knowledge is driven by the needs of society. The technological abilities of teachers are not disconnected from pedagogical understanding. Pedagogical knowledge that is informed by a pragmatic/diagonal curriculum is underpinned by personal integration. The inner being of an educator in pedagogical knowledge must be driven by the technological resources informed by the subject matter. An educator should inwardly strive for content knowledge that is informed/underpinned by constructive integration. Teachers are integrating technological resources in the best interests of their subjects or phases at schools. Here the focus is on the technologies, concepts, theories, and other elements intending to promote the integration of technological resources. Consequently, understanding TPACK elements and integration levels is imperative for teachers who integrate technological resources to sidestep the limitations of the framework. The following Figure 4.6 explains the intersection that teachers must integrate into their technological resources in the 4IR era. Here all the components/elements of TPACK and levels of integration are applied to integrate technological resources.

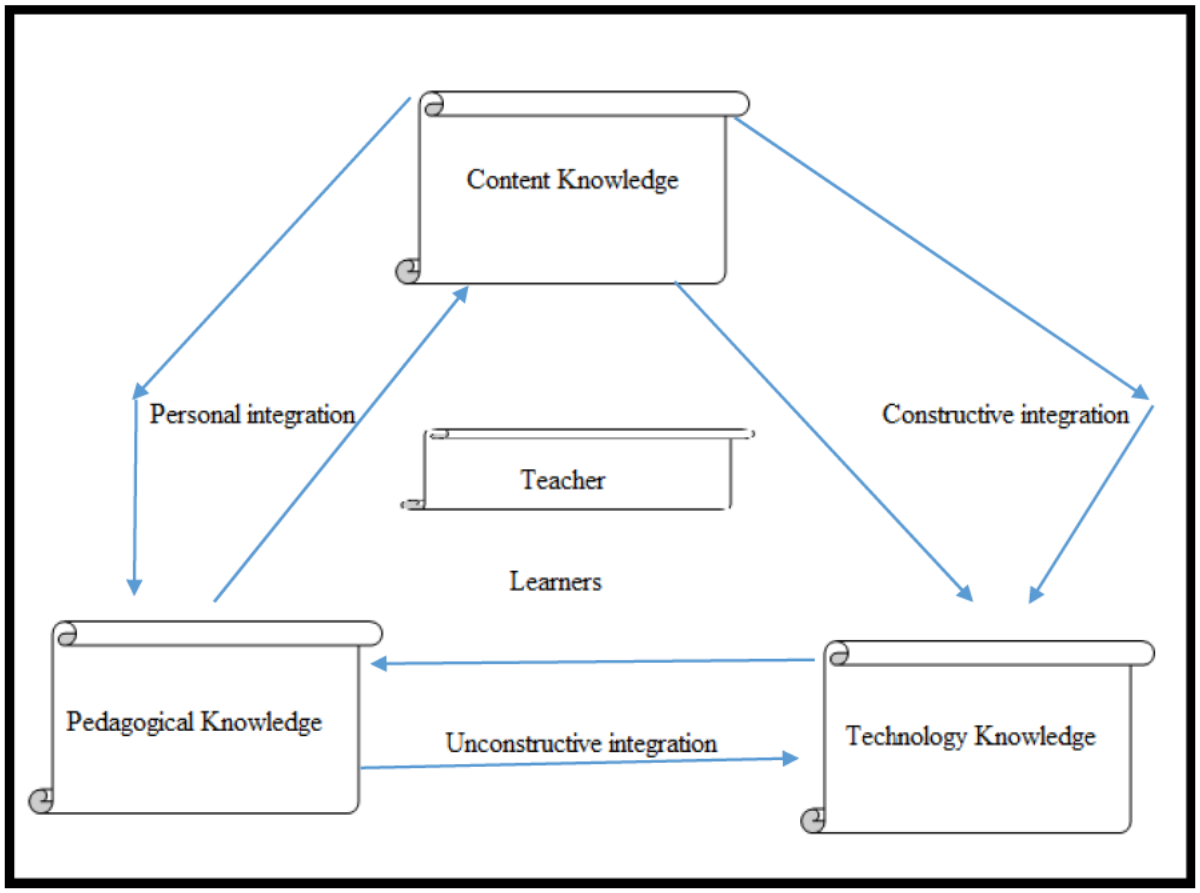


Figure: 4.6 The intersection between the TPACK framework and three levels of integration

4.7 Disadvantages/Limitations of integrating the TPACK framework in the 4IR

These scholars (Khoza & Mpungose, 2018; Koehler & Mishra, 2009; Koh, Chai, & Tay, 2014; Koh, Chai, & Tsai, 2014; Maor, 2017) argue that the TPACK framework was not constructed as an entire package for all educational levels. For instance, levels of education are not the same from the primary schools to the university level. The levels of knowledge (content, technology, and pedagogical) will not be integrated in the same way. The TPACK framework addresses the needs of certain educational levels at the expense of other levels. Refer to Figure 4.7 below for more illustration.

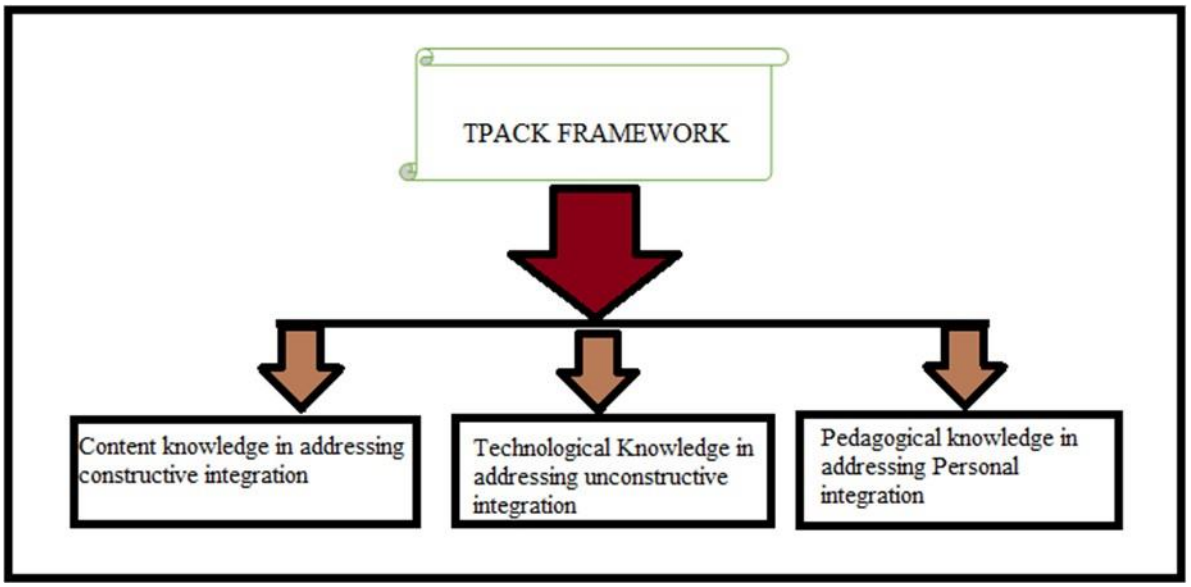


Figure: 4.7 Disadvantages/limitations of integrating the TPACK framework in the 4IR

A qualitative study was conducted by Pyneandee (2018) on exploring teachers' perceptions, and experience of the integration of online technologies, social media, in their personal lives, and for professional practice, to find the best predictors of teachers using Web 2.0 tools in their professional practice. The study argued that, among the limitations of TPACK, the integration of technological resources adopting TPACK relies on an individual's willingness or ability. Teachers must therefore be striving to advance their technological knowledge to apply TPACK. This is supported by Koehler and Mishra (2009, p. 64), who contend that "teachers should understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or

impede the achievement of a goal, and to continually adapt to changes in information technology". Mlaba (2020) agrees with Koh, Chai, and Tsai (2014) that the TPACK framework is more applicable in urban areas at the expense of rural areas. Teachers in urban areas are more privileged to receive retraining in the process of integrating technological resources from the Department of Education; whereas in deep rural areas, schools have poor infrastructure and shortage of resources applicable to the TPACK framework. The TPACK framework may thus be integrated into the curriculum more in urban areas, and become irrelevant to rural areas because of the environmental constraints.

A qualitative action research study was conducted by Mlaba (2020). The study employed reflective activity, artefacts, and one-on-one semi-structured interviews to generate data. The non-probability sampling method, comprising purposive and convenient sampling, was adopted. The focus of the study was on four lecturers reflecting on their teaching of business studies modules using the Moodle learning management system at a university of KwaZulu-Natal. The study outlined that the information from the TPACK framework is not clear and lacks consistency in terms of integrating technological resources. It therefore confuses teachers (digital immigrants) when integrating technological resources guided by this framework. Koehler and Mishra (2013) add that confusion in instruction can point to lack of respect and trust of the framework thus a decline in constructive, unconstructive, and personal integration.

A qualitative study that adopted the interpretive paradigm was conducted by Mbele (2019) on five isiZulu educators from two primary schools in the Umkomaas circuit in the Ugu Cluster, in KwaZulu-Natal. The purpose of the study was to explore educators' knowledge of teaching isiZulu; and the study sought to understand what informed their knowledge. The data was generated using semi-structured interviews and a focus-group discussion; and purposive and convenience sampling were utilized to select the most accessible isiZulu educators. The study argues that content knowledge assumes that teachers have sufficient content knowledge of the subject in the process of integrating technological resources. Content knowledge must thus be informed by constructive integration to address the subject matter. Anderson and Barham (2013) see this as a limitation to the TPACK framework. Content knowledge only addresses the issue of the subject during the process of teaching and learning. Thus, addressing the issue of the subject matter only at the expense of other issues or factors that relates to the

content such as culture and politics may not serve the purpose of this knowledge (content knowledge).

A qualitative action research study was conducted by Mpungose (2017) on five lecturers who reflected on their teaching of the physical science modules using the Moodle learning management platform at a South African university. The main purpose of the study was to explore the lecturers' reflections on the teaching of physical science modules using the Moodle learning management platform (LMP) at a South African university. Reflective activity, one-on-one semi-structured interviews, and artefacts were utilized for data generation to ensure the process of triangulation during the exploration of lecturers' reflections. The study discovered that TPACK content knowledge is informed by the curriculum as intended. However, more attention was placed on when and where this intended curriculum may be implemented at the expense of how it should be implemented. The TPACK framework is not clear on how to link content knowledge with available resources in schools in the 4IR era (Mpungose, 2017). The TPACK framework thus encourages decisions on where and when technological resources may be integrated into teaching and learning. For instance, a school may be equipped with technological resources (tablets, laptops, SMARTboard); however, the content knowledge does not address how these resources may be integrated into the curriculum, delivering the content.

A qualitative approach study was conducted by Mlilo (2019) which adopted and was informed by the interpretive paradigm. The purpose of this study was to explore the integration of technology-based tools into intermediate phase mathematics classrooms. The study discovered that the TPACK framework content knowledge is driven by the teacher's knowledge at the expense of learners' knowledge. The TPACK framework is informed by the teacher-centred approach and neglects the learner- or student-centred approach. Thus, content knowledge is informed by the vertical side of the curriculum that strives for the module/subject to be taught and learned. However, the focus on one side of the curriculum may affect the process of integration of technological resources. Hence, a balance of these sides of the curriculum (vertical, horizontal, and diagonal) is recommended in the process of integrating technological resources.

A qualitative approach study that employed the interpretivist paradigm was conducted by Paul (2019) on lecturers' experiences of teaching Level 2 life orientation (computer skills) for the national certificate vocational at a technical vocational educational and training (TVET)

college in a township. The purpose of the study was to explore life orientation lecturers' experiences in teaching computer skills at a township TVET college. Data was generated using semi-structured interviews with the four purposively selected life orientation lecturers who taught Level 2 computer skills. The study has discovered that technology knowledge is driven by the availability of resources (HR/SR and IR) in schools. Hence, the study points out this as a limitation of TPACK in schools that are poorly/unequipped with resources. Further to this, Mishra and Koehler (2006) remark that technological knowledge is driven by the teacher's knowledge in the integration of technological resources. Technological knowledge is thus informed by unconstructive integration that focuses on the operation of resources such as artificial intelligence, robotics, and the Internet of Things.

A qualitative study that employed the post-positivist paradigm was conducted by Peter (2019) on lecturers' and students' views of integrating technology into the fashion curriculum. This study aimed to examine the views of lecturers and students on integrating technology in the fashion design programme for the purpose of teaching and learning at the Butterworth campus of the Walter Sisulu University (WSU). The data was gathered through a questionnaire. The study discovered that the technology element is successfully implemented when teachers have mastered how to integrate technological resources into the curriculum. Nonetheless, Luik et al. (2018) argue that the TPACK framework has no direction or guidelines that guide teachers to master how to integrate these technological resources into the curriculum in the process of teaching and learning in the 4IR era. For instance, teachers use their cellphones for communication purposes. The technological element doe not guide them on how these resources (cellphones) may be integrated into the curriculum for learning purposes. Technological knowledge displays no guidelines on how to integrate technological resources.

An interpretive qualitative study was conducted by Zulu (2020) exploring the integration of technology by mathematics teachers: the case of 10 schools in KwaZulu-Natal in the Umlazi District. Data was collected from the participants using a questionnaire, interview, classroom observation schedule, and document analysis; while the thematic analysis method was employed to analyse the data. The study discovered that pedagogical knowledge is informed by the knowledge that teachers must understand all the learning and teaching activities in the process of integrating technological resources. This is in line with Mishra and Koehler (2006) who argue that pedagogical knowledge means that teachers must have a flawless

understanding of formative assessment to address pedagogical knowledge. Consequently, this points in the direction of personal integration. In other words, the pedagogical knowledge moves towards the pragmatic curriculum at the expense of other levels of the curriculum.

A mixed methods study was conducted by Dlamini (2018) on practitioners' enquiry into the benefits of social networking services in the teaching and learning of business studies at a particular high school in Eswatini. Data was collected from the participants using a questionnaire, interview, classroom-observation schedule, and document analysis. The study has discovered that another limitation of the TPACK framework is that it was created from the existing theoretical framework, and it has poor theoretical framework straightforwardness. Graham (2011) has pointed out that the TPACK framework adds another hurdle for teachers using the already difficult PCK framework, in presenting another unclear component. Further to this, Graham et al. (2012) argue that because the TPACK framework was constructed from another theoretical framework it becomes difficult to decide how this knowledge or elements thereof connect/relate to one another. Teachers may be demotivated to comprehensively integrate these elements when there is unclear connection of these elements. The TPACK framework may be limited to one element that teachers can manage to integrate into the process of teaching and learning. However, the TPACK framework has benefits in the process of integrating technological resources in the 4IR era (Mlaba, 2020).

4.8 Benefits/Advantages of integrating TPACK during the Teaching and Learning process

Several studies have been conducted internationally and nationally on the benefits of integrating the TPACK framework in the process of teaching and learning in the 4IR. Scholars (Graham et al., 2012; Harris et al., 2009; Ibáñez et al., 2020; Khoza, 2019; Mishra & Koehler, 2006; Misirli, 2016) have argued that one of the main benefits of integrating the TPACK framework into the curriculum is that it enriches and encourages teachers to integrate technological resources in schools. It creates a reliable teaching and learning environment. This is supported by Maor (2017), who adds that the TPACK framework is a tool that gives clarity to teachers on how and when teachers may integrate technological resources into their teaching. The study conducted by Cakir (2012) on technology integration and technology leadership in schools as a learning organization discovered that the TPACK framework ensures that teachers rely upon and integrate all the knowledge (content, technological and pedagogical) that is vital for teachers to adopt in their teaching and learning

process. The TPACK framework addresses all levels of integration (constructive, unconstructive, and personal). For teachers to advance their understanding of integrating technological resources into their teaching, teachers should integrate the TPACK framework in the process of teaching and learning. The TPACK framework reduces the stress of understanding technological resources, especially for digital refugees.

These two studies (Mishra & Koehler, 2006; Mpungose, 2020b) emphasise that the TPACK framework endorses the integration of technological resources, and supports the teachers' ability to discover numerous methods of teaching, which results in a high level of skill. When teachers integrate the TPACK framework informed by constructive, unconstructive, and personal integration, they undergo less stress. Teachers integrate any available resources (H/W, S/W, and I/W) around them during the process of teaching; and learn to execute professional, societal, and personal needs. Koh, Chai, and Tay (2014) aver that the TPACK framework makes the process of teaching and learning run smoothly and effectively. The framework compels teachers to integrate technological resources into their teaching. Thus, the TPACK framework may be identified as a tool that ensures the integration of technological resources in the 4IR (Nene, 2019).

A survey-based quantitative research was conducted by Cakir (2012) on technology integration and technology leadership in schools as learning organizations. The main aim of the study was to investigate technology integration in primary schools from the perspective of leadership in learning organizations. The study has discovered that the TPACK framework supports teachers in assessing their knowledge of technology and advancing their knowledge of technology when properly integrated into the curriculum. Teachers who advance their knowledge by integrating the TPACK frame into the curriculum are in a better position to achieve the goals of the curriculum. When teachers integrate the TPACK framework into their teachings this helps them to choose the appropriate approach in the process of integrating technological resources.

Kilbane and Milman (2017, p. 51) argue that the TPACK framework "offers teachers a mental framework visualizing the complex relationships between the different domains of their knowledge". This is in line with the mixed methods study conducted by Mwendwa (2017) on the perception of teachers and principals on ICT integration in the primary school curriculum in Kitui county, Kenya. The main aim of the study was to understand teachers' perceptions towards ICT integration in education as a significant factor in the implementation

of technology-related innovations. The study concluded that the TPACK framework has helped teachers to plan professionally when integrating technological resources. Kilbane and Milman (2017, p. 41) argue that the TPACK framework "can serve as a tool enabling an analysis of a teacher's knowledge and for planning future professional development he or she requires for optimal use of educational technology". This is supported by Al-Shammari (2020) − the TPACK framework is a tool that might enable future professional development to be efficient and effective.

Moreover, these studies (Anderson & Barham, 2013; Graham et al., 2012; Maor, 2017; Mpungose, 2020b; Thompson & Mishra, 2007; Zulu, 2020) agree with the qualitative action research study conducted by Mlaba (2020). The study employed reflective activity, artefacts, and one-on-one semi-structured interviews in generating data. The non-probability sampling method comprising purposive and convenient sampling was adopted. The focus of the study was on four lecturers at the University of KwaZulu-Natal reflecting on their teaching of business studies modules using the Moodle learning management system. These studies argue that another advantage of the TPACK framework is that, during the process of teaching and learning, the framework acts as the solution to the digital divide. It seeks teachers to integrate technological resources irrespective of the socio-economic factors.

CHAPTER 5

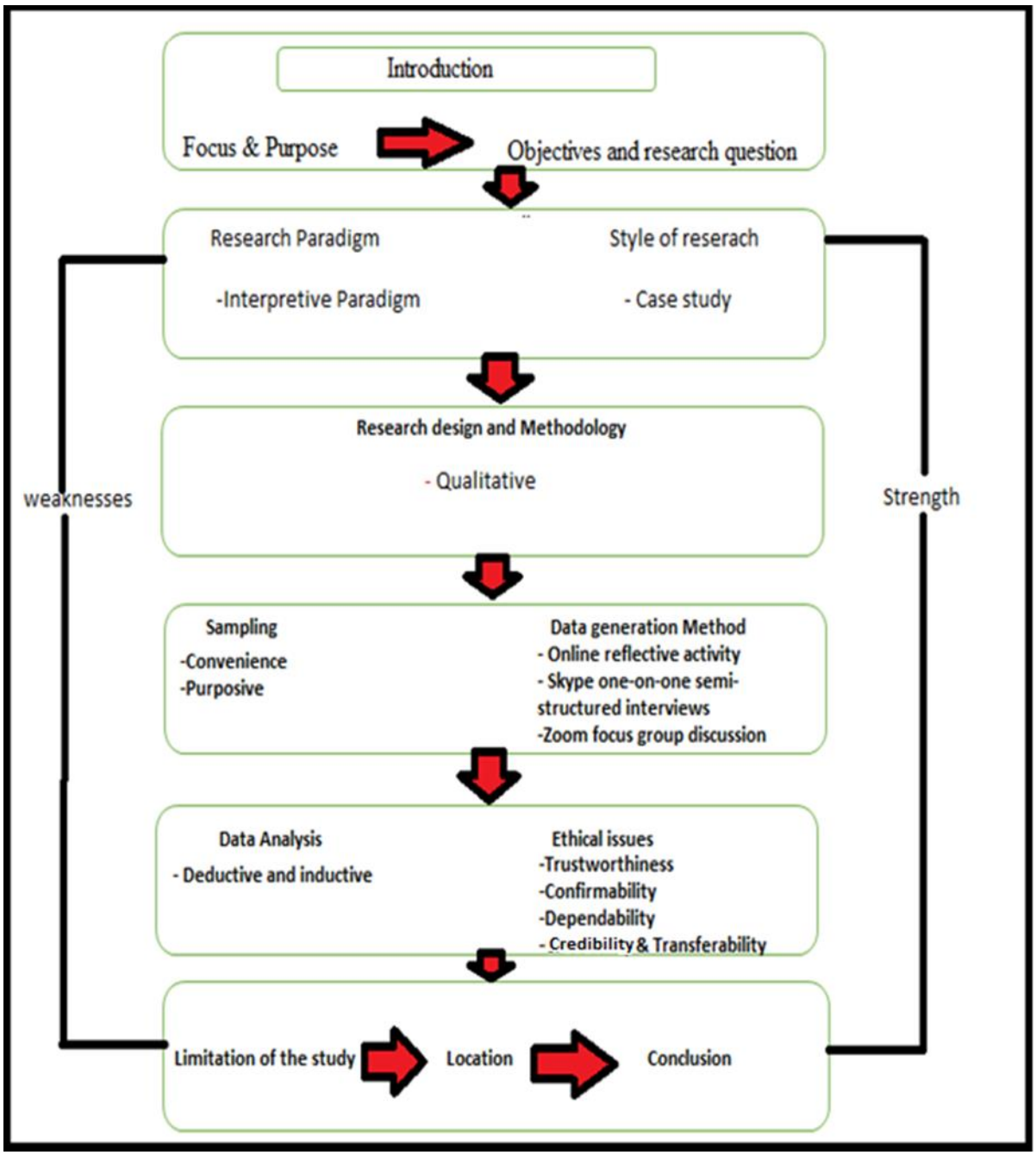


Figure 5.1: Chapter 5 overview

5.1 Introduction

The previous chapter has unpacked the TPACK framework that seems most relevant for this study because it advocates for three pertinent knowledge types that address the phenomenon of this study (content, technological and pedagogical). Each knowledge type was aligned with the phenomenon or components of integration that guide this study, namely, the constructive, the unconstructive, and the personal. The previous chapter has also intensively discussed the studies that have integrated the TPACK framework, the limitations, and the benefits of integrating the TPACK theory into teaching and learning, as presented in the study. This chapter uses an appropriate research method to achieve the research objectives, answering the research questions. To achieve the research objectives, this study is driven by 1. The interpretivist paradigm; 2. Purposive and convenience sampling; 3. Skype semi-structured interview, online reflective activity, and the Zoom focus group for data generation; 4. Deductive and inductive for data analysis; and 5. Ethical issues and trustworthiness, which include confirmability, dependability, credibility, and transferability. The research method mentioned above is informed by three levels of integration: constructive, unconstructive, and personal integration, as indicated in Table 5.1. below.

Table: 5.1: Integrating Levels of Integration with Research Design

	Constructive Integration	**Unconstructive Integration**	**Personal Integration**
1. Paradigms	Positivist/ Postpositivist	Interpretivist/ Constructivist	Pragmatic
2. Methods	Quantitative	Qualitative	Mixed
3. Sampling	Random	Purposive	Convenience
4. Data generation	Experiments Quasi-experiments Tests Scales	Interviews Observations Document reviews Visual data analysis	Interviews Observations, testing and experiments
5. Data analysis	Deductive	Inductive	N/A

5.2 The Focus and the Purpose of the Study

The purpose of this study is to explore the integration of technological resources into the curriculum in the Fourth Industrial Revolution (4IR): the context of primary schools in the Pinetown district. The study focuses on explaining the lessons that can be learned when teachers integrate technological resources into the curriculum in the 4IR.

5.3 Research Objectives

i. To explore technological resources integrated into the curriculum in the 4IR.

ii. To explain the lessons that can be learned when teachers integrate technological resources into the curriculum in the 4IR.

iii. To understand the reasons that inform the teachers' integration of technological resources into the curriculum in the 4IR.

5.4 Research Questions

This study aimed to answer the following questions:

i. What technological resources do teachers integrate into the curriculum in the 4IR?

ii. How do teachers integrate technological resources into the curriculum in the 4IR?

iii. What informs teachers to integrate technological resources into the curriculum in the 4IR the way they do?

5.5 Integrated/Utilized Paradigmatic Lens in Research

The term paradigm was constructed from the Greek term 'paradeigma' which simply means the pattern or the design (Alharahsheh & Pius, 2020; Goldkuhl, 2012; Goulding, 1999; Ponterotto, 2005). The term was embraced by a group of scientists in referring to finding resolutions (Brad Wray, 2011).

Thus, a paradigmatic is defined by numerous scholars (Alharahsheh & Pius, 2020; Goldkuhl, 2012; Goulding, 1999; Kroeze, 2012; Pham, 2018; Ponterotto, 2005; Wahyuni, 2012) on their own understanding. Morgan (2007, p. 47) avers that the paradigm is "the set of beliefs and practices that guide a field, and it can be used to summarise the beliefs of researchers". Bogdan and Biklen (1998, p. 22) consider that a paradigm is "a loose collection of logically related assumptions, concepts, or propositions that orient thinking and shared beliefs within a society of research". Khoza (2018) argues that the research paradigm is informed by unconstructive integration in which the view of society is drawn from community ideas. This is in line with Morgan (2007) who avers that a paradigm is "a set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares

them, especially in an intellectual discipline". Similarly, Blanche, Blanche, Durrheim, and Painter (2006) express that a paradigm may be viewed as an envisioned set of basic beliefs symbolizing a worldview that explains the nature of the world. Thus, Zuma (2019) argues that the paradigm keeps an eye on personal integration when the world view is driven by individual identity. Guba and Lincoln (1994) maintain that a paradigm is the universally recognized scientific achievements that provide model problems and solutions to practitioners. This suggests that a paradigm follows the direction of constructive integration. Here the view of the world is universally recognised, and relies on certain documents to provide a solution (Mackenzie & Knipe, 2006).

Scholars such as (Blanche et al., 2006; Denzin & Lincoln, 2005; Denzin, Lincoln, & Smith, 2008; Kuhn, 1962; Mack, 2010) have discovered a number of theoretical paradigms into which a researcher may position the study. Morgan (2007, p. 8) concedes that positivism is referred to as the "scientific method or science research that is based on the rationalistic''. This is supported by Denzin et al. (2008, p. 9), in that "positivists objectives is to test a theory or describe an experience through observation and measurement to predict and control forces that surround us". Postpositivists therefore believe that a world view is influenced by any piece of research built and developed by researchers. Postpositivists take the direction of constructive integration in which the world view is informed by a written piece of research or documents. Postpositivists thus see the "world as ambiguous, variable and multiple in its realities, what might be the truth for one person or cultural group may not be the truth for another" (Mackenzie & Knipe, 2006, p. 445).

Furthermore, Mackenzie and Knipe (2006) agree with Guba and Lincoln (1994) that the world may view interpretivism as that which is informed by the world of human experience. These scholars (Guba & Lincoln, 1994; Morgan, 2007; Mpungose, 2020a) further argue that interpretivist scholars are driven by the participants' views on the problem or situation being considered. The truth about interpretivism is that it is unconstructively constructed or generated from the participants. Interpretivists take the direction of unconstructive integration which is informed by the ideas of others. A study was conducted by Khoza and Fomunyam (2020) on exploring and understanding the alignment of digital resources with human needs involved in the teaching of Master of Education (MEd) students. Semi-structured interviews, focus-group discussions, and document analysis were used for data generation. Purposive

with convenience sampling was used to select the eight most accessible participants. The study revealed that interpretive scholars rely on other peoples' experiences and philosophies.

Potrac, Jones, and Nelson (2014), and Mackenzie and Knipe (2006) believe that the disappointment with existing well-known paradigms gave rise to the transformative paradigm during the 1980s and 1990s. Thus, Creswell (2003, p. 9) points out that transformative researchers "believe that inquiry needs to be intertwined with politics and a political agenda". Mertens (2007, p. 4) avers that "the transformative paradigm is characterized as placing central importance on the lives and experiences of marginalized groups, such as women, ethnic/racial minorities, people with disabilities, and those who are poor". This is supported by Potrac et al. (2014) that a paradigm must comprise an action agenda that may transform the lives of participants. In short, the transformative paradigm is informed by personal integration in which participants rely on their personal experiences to view the world. A study conducted by Romm and Research (2015) on re-examining the tenets of the transformative paradigm was explained by Mertens in various publications. The study discovered that the transformative paradigm strives for the greater diversity of values and positions informed by personal integration.

Creswell (2003) posits that scholars who adopt the pragmatic paradigm rely on the 'what' and 'how' of the research situation or the problem. Doyle, Brady, and Byrne (2009) consider that the pragmatic paradigm maximizes the strengths and minimizes the weaknesses of applying one approach. In other words, the pragmatic paradigm bridges the gap between the qualitative and quantitative approaches. This is supported by Morgan (2007, p. 40) who views a "pragmatic approach as a new guiding paradigm that can act as a basis for supporting work that combines qualitative and quantitative methods and as a way to redirect our attention to methodological rather than metaphysical concerns". Consequently, Creswell (2003, p. 11) concludes that the pragmatic paradigm "places the research problem as central and applies all approaches to understanding the problem". This suggests that the pragmatic paradigm advocates for personal integration in which researchers are driven by 'what' and 'how' questions. Refer to Figure 5.2 for alignment between the research paradigm and integration levels.

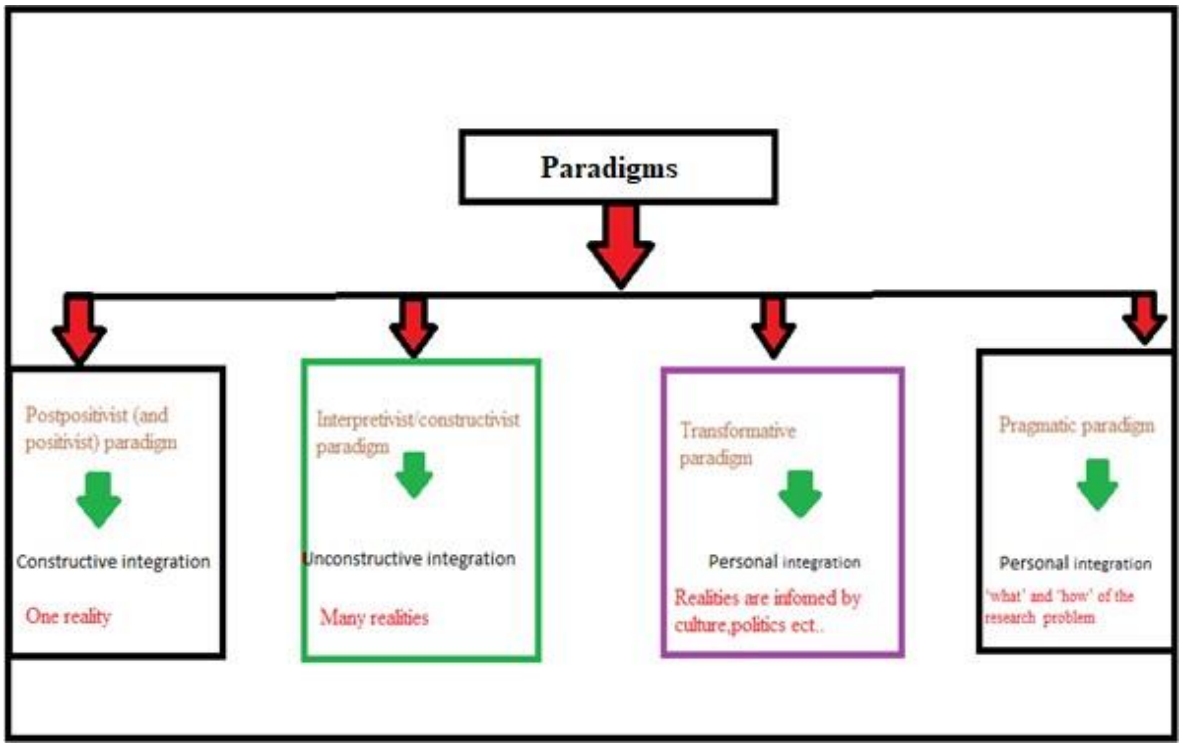


Figure 5.2: Alignment between research paradigm and integration levels

5.4.1 The rationale for integrating interpretive paradigm

This study has adopted an interpretive paradigm for various constructive reasons. These scholars (Alharahsheh & Pius, 2020; Morgan, 2007; Ponterotto, 2005; Wahyuni, 2012) argue that interpretivism seeks to understand a particular context; and that the core belief of the interpretive paradigm is that reality is socially constructed. This is supported by the study conducted by Magwanyana (2018) located within the interpretative paradigm; and a qualitative approach was adopted. The main purpose of the study was to explore the learning experiences of three FET phase life orientation (LO) teachers in professional learning communities in one secondary school in the Umkhambathi circuit. The study agreed that interpretative paradigmatic objectives are to understand the world of the human experience in a particular context. Therefore, the interpretive paradigm was deemed suitable for this study. This study was guided by this paradigm (interpretive) in understanding teachers' experiences in the integration of technological resources. Further to this, this paradigm (interpretive) accommodates multiple perspectives and versions of truths (Cohen et al., 2013; Creswell, 2003; Dlamini, 2019; Goldkuhl, 2012). This study integrates this paradigm (interpretive) to gain insight into and in-depth information about multiple perspectives and truths around the phenomenon (integration).

Furthermore, these scholars (Bogdan & Biklen, 1998; Creswell & Creswell, 2017; Doyle et al., 2009; Khoza & Mpungose, 2018) argue that the interpretive paradigm is mostly informed by the qualitative research method. However, the combination of both qualitative and quantitative (mixed) methods are also applicable to effectively uncover the phenomenon. This is supported by the qualitative study conducted by Mthembu (2018) on the perceptions of teachers on the integration of computer technology in school in Grade 10. The study findings revealed that qualitative data may be utilized under this paradigm to successfully deepen the description. This paradigm (interpretive) was the most suitable because this study intends to expand the phenomenon (integration), guided by qualitative data.

Pham (2018) comments that interpretivism intends to survey the world by interpreting the understanding of the individual. Therefore, interpretivism assumes that reality is subjective and that it varies according to participants' experience (Ntombela, 2020). This is in line with a qualitative approach study conducted by Williams (2019) on teachers' experiences of implementing the English home language curriculum in Grade Four. The study was underpinned by interpretivist and constructivist paradigms. A case study method was used to collect data from purposively selected participants. The study reveals that the participants' experiences may be influenced by their social, individual, or professional perspectives. Therefore, this could assist to address teachers' different perspectives about the integration of technological resources. Integrating the interpretive paradigm could thus help to reveal various perspectives, this paradigm believing that reality is unconstructively constructed.

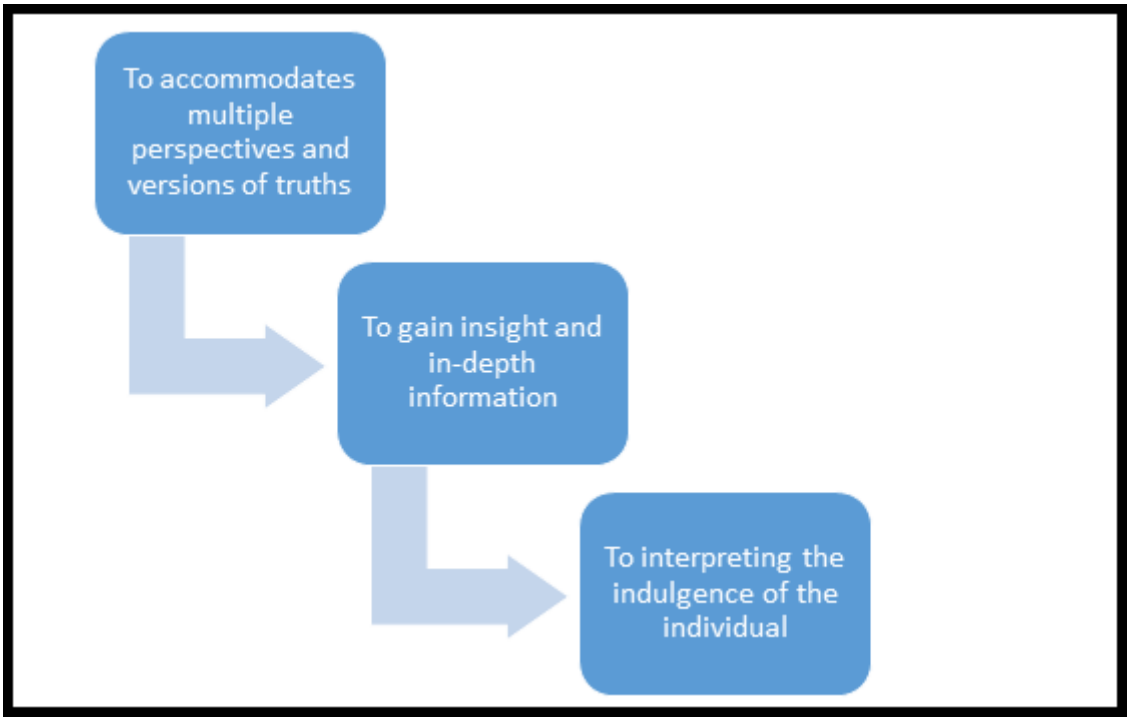


Figure 5.3: Motives for adopting the interpretive paradigm

5.4.2 What limited the use of the interpretive paradigm?

Phothongsunan (2010) concurs with Mackenzie and Knipe (2006) that paradigms (positivist, constructivist, pragmatic and transformative) have disadvantages when integrated into the research. "The interpretivism perspective, researchers tend to gain a deeper understanding of the phenomenon and its complexity in its unique context instead of trying to generalize the base of understanding for the whole population" (Creswell & Creswell, 2017, p. 142). This is supported by a case study under the interpretive paradigm conducted by Naidoo (2011). The purpose of the study was to gain a deeper understanding of the messages conveyed by principals in one context, that of well-resourced schools, the participants being in well-resourced schools. The study reveals that researchers in interpretivism focus on the attainment of a deeper indulgence of the phenomenon in its context at the expense of the whole population. In dealing with such limitations of the interpretive paradigm, the study has reviewed literature related to the phenomenon (integration).

Khoza and Fomunyam (2020) argue that interpretivist researchers neglect scientific trials. The interpretive researchers' research has a gap in the validity of the research outcome in not adopting scientific trials. Further to this, see the study conducted by Mthabela (2019). This study adopted an interpretive qualitative approach. Purposive and convenience sampling was

utilized to choose five educators from each department as participants in the study. Questionnaires, one-on-one semi-structured interviews and document analysis were used for data generation in exploring educators' views. The study further declares that the interpretivist paradigm point of view inclines to subjectivity rather than objectivity. For this reason, research outcomes are unquestionably affected by the researcher's interpretation, own belief system, ways of thinking, or cultural preference which causes too much bias. Thus, the limitation was overcome by generating data from the participants' own beliefs, and culture, and by supporting the study with relevant literature.

Rahman (2020, p. 435) avers that interpretivism "lacks addressing the political and ideological impact on knowledge and social reality". Pham (2018, p. 234) argues that this paradigm "targets to the understanding of current phenomena rather than focusing the problems related to empowerment of individuals and societies". A qualitative study was conducted by Mvune (2020) on 20 teenage fathers at two public high schools in the rural Ugu District of KwaZulu-Natal, South Africa. Five focus-group discussions and 20 individual interviews were held. The purpose of this study was to determine how impoverished teenage fathers living in a socio-economically marginalized rural area negotiate fatherhood and its expectations; and how they navigate the socially defined standards of masculinity and fatherhood that are often expected of them. The study argued that interpretivism is informed by the current phenomenon at the expense of investing in social reality. Thus, relevant methods of data generating were adopted to accommodate social reality. Further to this, in addressing the lack of a political side the relevant literature review in line with politics was reviewed.

5.4.3 Case study

In ensuring the understanding of the integration of technological resources into the curriculum in the 4IR, the intrinsic case study research style was adopted. The case study is defined by numerous scholars (Eisenhardt, 1989; Tuskan & Walsh, 2001; Yin, 1994, 2003). Yin (1994) defines a case study as "an empirical inquiry that investigates contemporary phenomena within its real-life context, especially when the boundaries between phenomena and context are not evident". On the other hand, Tuskan and Walsh (2001) argue that a case study is a "systematic investigation of a unit of analysis that is conducted over a period of time where in-depth data is obtained". Further to this, Bromley (1990) specifies that a case study is a "systematic inquiry into an event or set of related events which aims to describe

and explain the phenomenon of interest". Eisenhardt (1989) thereafter suggest that case study researchers practise multiple data-generation methods, for instance, Zoom focus-group discussions, online reflective activities, and Skype one-on-one semi-structured interviews. Eisenhardt (2004) then noted that a case study approach is a strategy for understanding the dynamics presented within a single setting, integrating multiple methods of data generation.

Furthermore, these scholars (Stake, 1995; Yin, 2003) argue that different case studies are serving different purposes in the study. For instance, a researcher who has a genuine interest in the case and wants to better understand the case, is informed by the intrinsic case study (Stake, 1995). A researcher who aims to explore differences within cases with the goal being to reproduce the findings is driven by a multiple case study in research (Yin, 2003). Further to this, Yin (2003) argues that a case study that describes an "intervention or phenomenon and the real-life context in which it occurred" may be viewed as a descriptive case study. In the situations in which the intervention being evaluated has no clear, single set of outcomes, the researchers integrate an exploratory case study (Yin, 2003). Stake (1995) further insists that an instrumental case study is integrated to accomplish something other than understanding a particular situation.

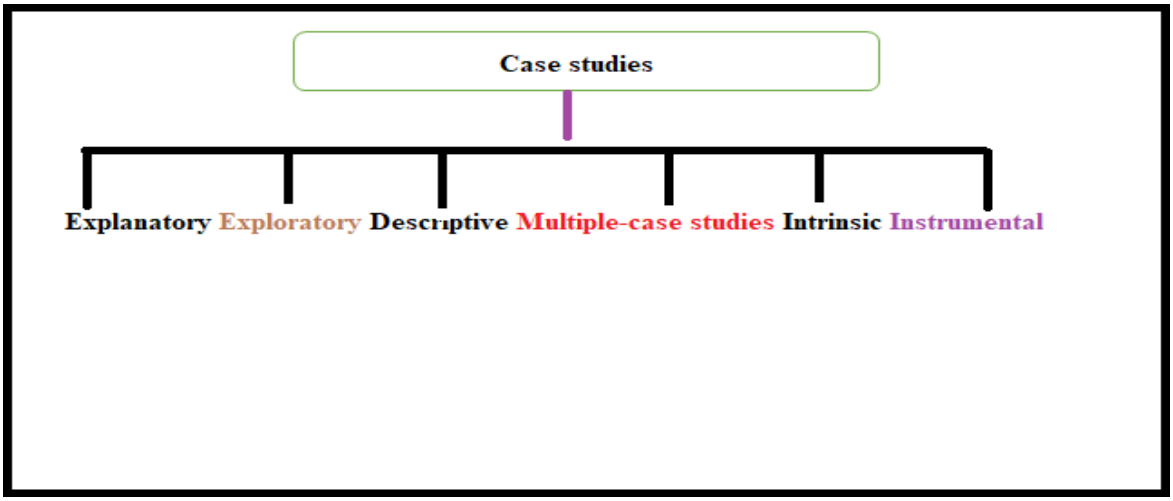


Figure 5.4: Different types of case studies

5.4.4 The rationale for using an intrinsic case study

The study has adopted the intrinsic case study for various constructive reasons. For instance, in intrinsic case studies, the findings from the participants (teachers) on the integration of technological resources into the curriculum were not generalized. However, these scholars

(Magwanyana, 2018; Mpungose, 2020b; Tzavara et al., 2018; Xu et al., 2018; Yin, 1994, 2003) believe that transferability is possible in the case of studies only if a researcher can produce a thick description of the case. The researcher is then able to transfer conclusions from one case to another based on fittingness. Further to this, Tuskan and Walsh (2001) argue that case study provides detailed data and makes it more flexible and broad. The data generated from this research (integration of technological resources) during the case study is much richer than were it obtained by other research methods. In short, the case study has guided this research to generate the richest data.

Moreover, the study adopted an intrinsic case study because it concentrates on one situation (integration of technological resources) which allows a researcher the opportunity of generating large amounts of data. Thus, an intrinsic case study was employed to focus on one instance of the phenomenon (integration), to study the phenomenon in-depth, and to generate a large amount of data. Eisenhardt (1989) argues that a case study opens a new perception of already established concepts (integration). It shows the incorrect understanding of the concept and challenges the researchers face and is more accurate about the concept. The integration of technological resources was explored as a new concept in fully understanding why teachers are reluctant to integrate technological resources in the 4IR.

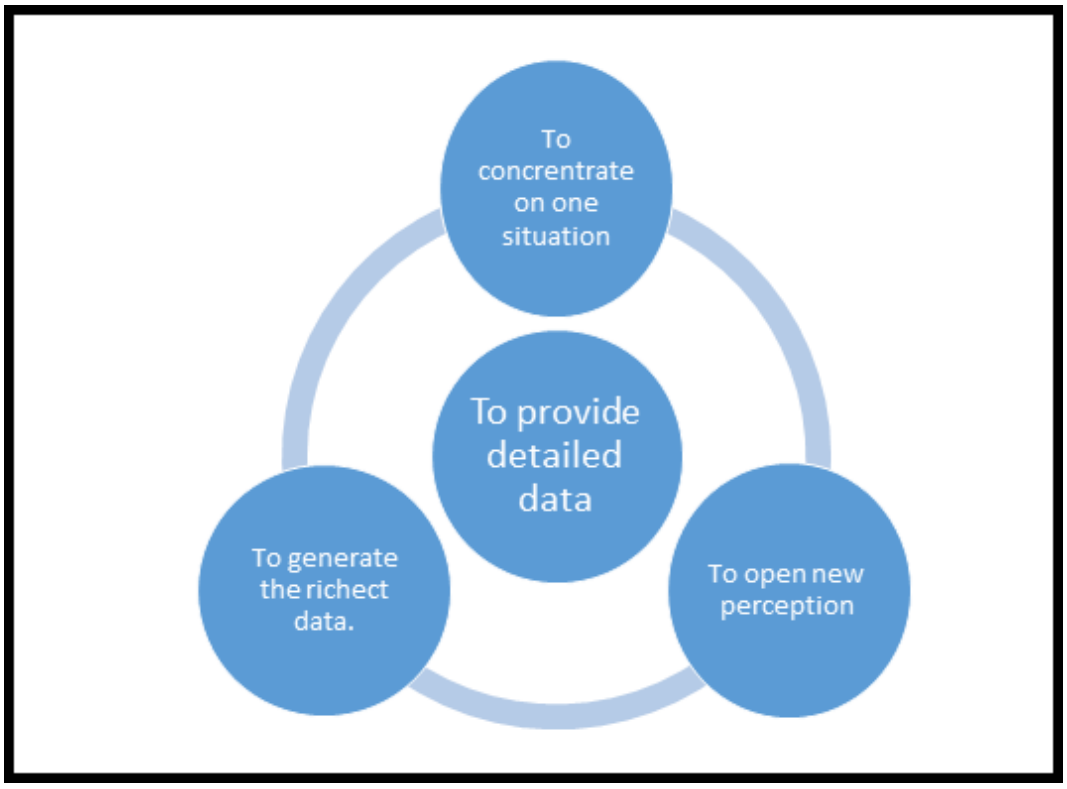


Figure 5.6: Motives for adopting an intrinsic case study

5.4.5 Limits of the use of an intrinsic case study

Springer (2010) states that the shortcomings of a case study are that the case studies rely on a single case (integration of technological resources) which may include many people as participants. This is in line with a qualitative study conducted by John (2015) on the integration of information technology in higher education. The main aim of the study was to discover the attitude towards IT adoption in the teaching process. The study concluded that the case study focuses on one unit − it cannot suit all the cases. Consequently, the data that was generated for this study was not generalized. However, it is valid and related to this study. Although the case study relied upon a single case, I have overcome that by using literature that presents diverse perceptions on the topic being studied. The participants have provided their perceptions on the integration of technological resources into the curriculum. Thus the literature was used to extend the data that was generated from them.

Yin (2003) reveals that a case study method is effective in generating relevant and detailed data. However, this research style requires much time and determination. This is supported by a qualitative interpretive case study conducted Keengwe (2007) on faculty integration of technology into instruction; and students' perceptions of computer technology to improve student learning. The main aim of the study was to examine the nature of the relationship between faculty integration of technology into classroom instruction; and students' perceptions of the effect of computer technology on improving their learning. The study concluded that the case study method is one of the most time- and effort-consuming methods. However, to overcome this challenge the study has adopted the Zoom focus-group discussion to save time during the data-generation period.

Khoza and Mpungose (2018) further aver that the case study is not reliable because it focuses on history. Such may cause errors in the results of data analysis. A qualitative interpretive case study was conducted by R. Budden (2016) on integrating technology into teaching and learning, using a variety of models. The study aimed to understand the teaching and learning per a variety of models used to integrate. The study concluded that case study always has the possibility of errors of memory, every person interpreting the past events differently. This study has thus used literature to support the findings from the participants.

5.6.6 Qualitative research

Aspers and Corte (2019, p. 4) argue that qualitative research is "interdisciplinary, transdisciplinary, and sometimes interdisciplinary". Hence, it is difficult to derive one single definition of qualitative research. Scholars (Cohen, Manion, & Morrison, 2002; Cohen et al., 2013; Denzin & Lincoln, 2011; Onwuegbuzie & Leech, 2007) attach various understandings of qualitative research. Cohen et al. (2013, p. 124) argue that qualitative research is "concerned with clarifying and developing an understanding of social issues that shape our understanding of the world, questioning why things are the way they are". Thus people in qualitative research make their meaning of the phenomenon (integration). This is in line with a study conducted by Denzin and Lincoln (2011) stating that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. As a result, this study has interpreted the phenomenon (integration) and made meaning of integrating technological resources into the curriculum. Further to this, Onwuegbuzie and Leech (2007) argue that qualitative research involves gathering of a variety of empirical materials. Such include case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts that describe routine and problematic moments and meanings in individuals' lives. Therefore, the research attempts to understand these empirical materials to gain rich content.

Cohen et al. (2013) state that qualitative research is a method that offers an in-depth understanding of the phenomenon (integration) in which the researcher can answer questions such as 'how' and 'why' fully. An interpretive case study was conducted by Khoza (2016) on teaching without understanding curriculum visions and goals. The purpose of the study was to explore the postgraduate students' understanding of curriculum visions and goals in teaching their subjects. The study further argued that qualitative research is not only concentrated on the objective nature of behaviour but also on its subjective meanings: individuals' accounts of their attitudes, motivations, behaviour. This study is also supported by Aspers and Corte (2019) who aver that qualitative research studies people acting in the natural course of their lives. As a result, this research has studied teachers' rationale for their reluctance to integrate technological resources into the curriculum in the 4IR.

5.6.7 The rationale for qualitative research

The study has used qualitative research to gain a deep understanding of the integration of technological resources into the curriculum. Magwanyana (2018) concurs with Merriam

(1998) that any study conducted to gain an understanding of the phenomenon (integration) has the potential to bring about change in peoples' lives. Thus, qualitative research was appropriate to this study because it advocates for providing an in-depth understanding of the phenomenon and the understanding of the social world. The aims and objectives of qualitative research are in line with the aims and objectives of this study which explores the integration of technological resources into the curriculum in the Fourth Industrial Revolution. The study intended to explore multiple meanings of individual participants by learning the sense participants make of their social situation (Ibáñez et al., 2020). The above statement is in line with a qualitative study conducted by Javaid et al. (2020) stating that qualitative research has the intention of understanding participants' (teachers) points of view or perspective.

Zuma (2020, p. 104) comments that the qualitative approach attempts to extend understanding of "why things are the way they are in reality, and why people act the way they do". This was used as an advantage of this study in understanding why teachers integrate technological resources the way they do. Thus, online reflective activity, semi-structured interviews, and the Zoom focus group were used to generate data to gain understanding on why teachers act the way they do when integrating technological resources into the curriculum. Merriam and Simpson (1995) maintain that qualitative researchers are concerned with how people interpret their perspectives, how they hypothesize their worlds, and to what they attribute their perspectives. Therefore qualitative research was the best approach for this study which explored the integration of technological resources into the school curriculum in the 4IR.

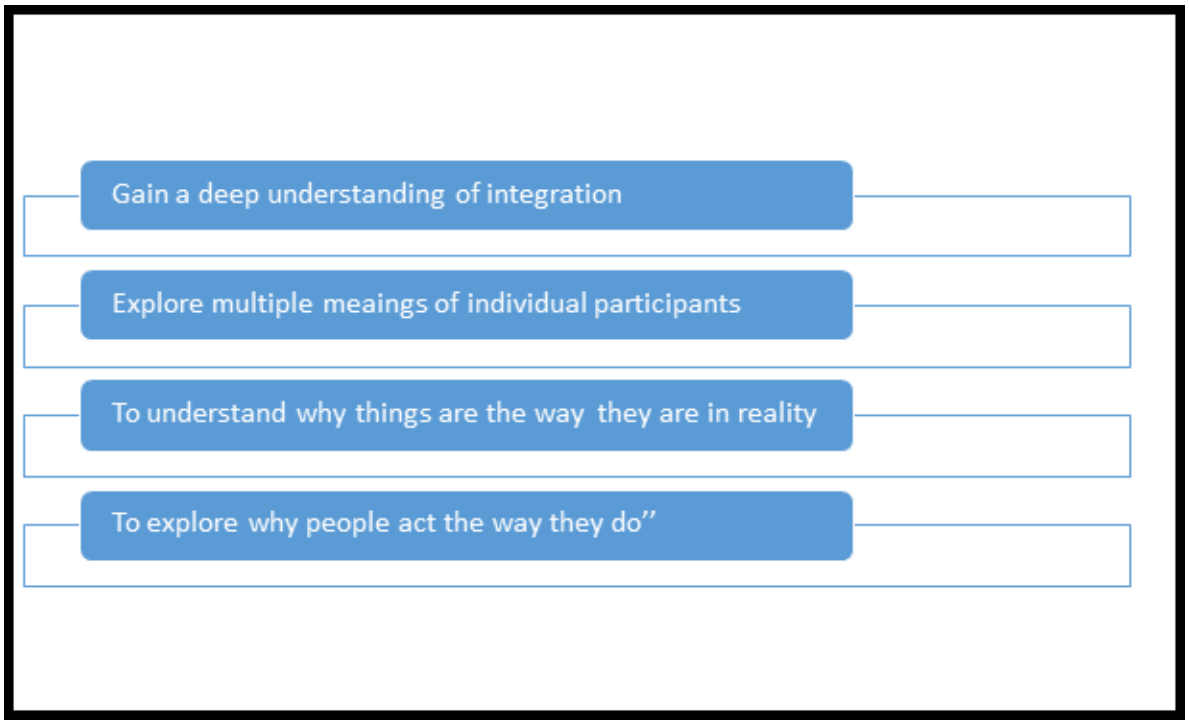


Figure 5.7: Motives for adopting qualitative research

5.6.8 Limits of the use of qualitative research

As with any other research approach, the qualitative research has its own limitations. L. Nelson (2003, p. 15) posits that "qualitative researchers struggle to capture and represent complex phenomena partially because they tend to collect a large amount of data". This is supported by a qualitative interpretive case study conducted by Stéphan et al. (2019) on challenges in using ICT in education. The main aim of the study was to investigate the teachers' perceptions of the barriers and challenges preventing teachers from integrating ICT into the classroom. The study argued that, while the qualitative research analysis is correct, it becomes impossible to conduct a detailed, microscopic examination of a large amount of data. Thus, this may also hinder the true outcome of the researcher due to the complexity of the data. The study has overcome this limitation by carefully adopting data-generation styles that allowed the researchers to gain rich information about the phenomenon from the participants.

Further to this, Pham (2018) argues that qualitative research has another limitation in which its findings from the participants cannot be generalized. A qualitative interpretive case study was conducted by Mthembu (2018) on the perceptions of teachers of the integration of computer technology in school in Grade 10. The main aim of the study was to understand the

perceptions of teachers of the integration of computer technology in school. The study also reminded that the data generated from qualitative research cannot be related to other contexts. In short, qualitative research believes that the data generated in a particular context is only applicable to that context. This study has no intention of generalizing − it aims for a natural setting based on the interpretation of the data generated, therefore not generalizing the findings.

These scholars (Rahman, 2020; Ramnarain & Hlatswayo, 2018; Williams, 2019; Xu et al., 2018; Zawacki-Richter, 2018) agree with Pham (2018) that researchers taking the qualitative approach are grounded in or centred on the lived experiences of people. A qualitative case study grounded in the interpretive paradigm was conducted by Khoza (2019) on curriculum managers' perspectives on managing the curriculum in schools of King Cetshwayo District. The study pointed out that qualitative researchers are informed by the pragmatic and interpretive paradigm which in turn is informed by existing practices of human beings. In addressing this limitation, this research has added data using the relevant literature.

CHAPTER 6

DATA PRESENTATION AND INTERPRETATION OF FINDINGS

6.1 INTRODUCTION

Chapter 5 has explained the research design and methodology that has been integrated into this study. This chapter will present the research findings that were generated through Skype one-on-one semi-structured interviews, online reflective activities, and Zoom focus groups. The findings are presented through the TPACK framework that has been used for this study. The TPACK framework concepts are taken as themes in this chapter which present the data. The 10 participants (refer to Figure 6.1) from 5 schools used for data generation are here referred to as participants P1, P2, P3, P4, P5, P6, P7, P8, P9, and P10. In presenting the data, direct quotations from participants are included to support the research findings and discussions.

This study aims to answer the following research questions:

4. Which technological resources do teachers integrate into the curriculum in the 4IR?
5. How do teachers integrate technological resources into the curriculum in the 4IR?
6. What informs teachers to integrate technological resources into the curriculum in the 4IR the way they do?

Table 6.1: Participants' Profiles

Participants	Years of Experience	Number of subjects teaches	Number of leaners in a phase	Phase	Gender	Race
P1	10	3	104	Foundation	Female	Indian
P2	5	1	234	Intermediate	Male	African
P3	5	2	333	Intermediate	Male	African
P4	3	3	537	Senior	Female	Indian
P5	15	1	325	Senior	Female	African
P6	13	2	177	Intermediate	Female	Indian
P7	2	1	435	Intermediate	Female	Coloured
P8	1	1	543	Senior	Female	Coloured
P9	3	4	234	Senior	Male	Indian
P10	12	4	407	Intermediate	Female	Indian

6.2 The Findings and Discussion of Data from the Qualitative Skype One-on-one Semi-structured Interviews, Online Reflective Activity, and Zoom Focus Group.

The findings and discussion are displayed in Table 6.2 guided by the TPACK framework concepts and their propositions using thematic analysis as explained in Chapter 3. The 10 themes were developed by Koehler and Mishra (2013) to address the integration of technological resources into the curriculum in the Fourth Industrial Revolution. These themes

were used to generate the data from teachers to find answers to the researcher's main questions. The themes are: Rationale/vision (Why do you integrate technological resources into the curriculum?); Goals (Which goals do you intend to achieve when integrating technological resources into the curriculum?); Content (Which content do you integrate with technological resources into the curriculum?); Activities (For which teaching activities do you integrate technological resources into the curriculum?); Role (How do you identify your character when integrating technological resources into the curriculum?); Accessibility (How do you integrate technological resources into the curriculum, in terms of financial, cultural, and physical access?); Resources (Which technological resources do you integrate into the teaching curriculum?); Location (Where do you integrate technological resources into the curriculum?); Time (What is the time allocation for each aspect (topic) when integrating technological resources?); and Assessment (How do you assess your subject in integrating technological resources?) (Koehler & Mishra, 2013).

Table 6.2: Teachers' Integration, Propositions, Questions, and Themes framed by TPACK Framework

Themes	Prepositions	Research Questions
Technological Knowledge		
Resources	• Hardware • Software • Ideological ware	What technological resources do you integrate in the teaching curriculum?
Rationale	• Constructive • Unconstructive • Personal	Why do you integrate technological resources into the curriculum? (reasons)
Content Knowledge		
Content	• Topic • Subtopic • Experiments	Which content do you integrate with technological resources into the curriculum?
Pedagogical Knowledge		
Accessibility	• Physical • Financial • Cultural	How do you integrate technological resources into the curriculum, in terms of financial, cultural, and physical access?

Goals	• Aims • Objectives • Outcomes	Which goals do you intend to achieve when integrating technological resources into the curriculum?
Activities	• Formal activities • Informal activities • Continuous activities	For which teaching activities do you integrate technological resources into the curriculum?
Roles	• Manager • Facilitator • Leader	How do you identify your character when integrating technological resources into the curriculum? (teacher's role)
Location	• Face-to-face • Online • Blended	Where do you integrate technological resources into the curriculum? (location/environment)
Assessment	• Formative assessment • Summative assessment • Continuous assessment	How do you assess your subject integrating technological resources?

Figure 6.1 below elucidates the connections of themes, research questions, and the categories. The themes outlined below emerged from the data generated from participants acquired during interviews and focus groups.

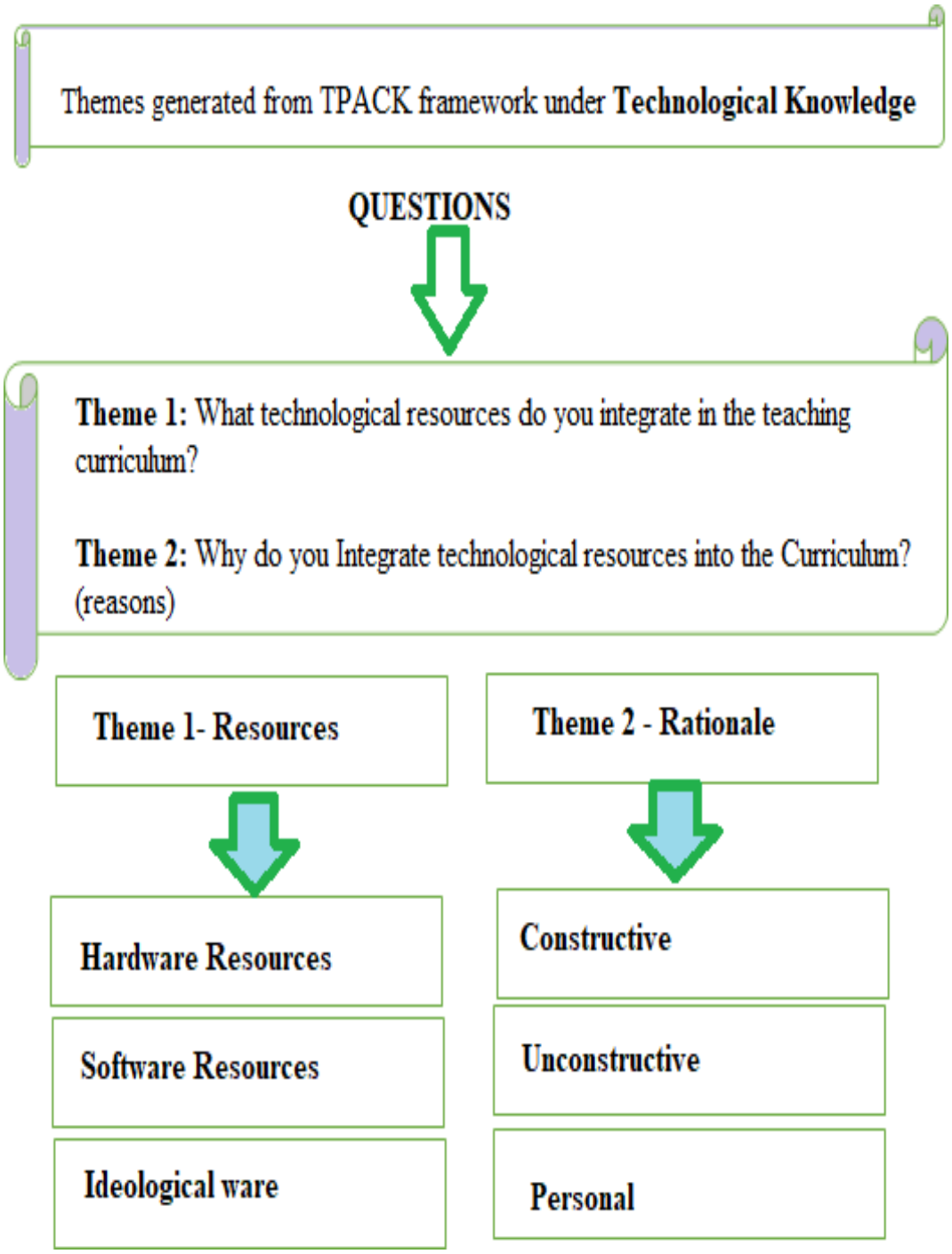


Figure 6.1 Themes generated from TPACK framework under technological knowledge

6.2.1 Theme 1: Resources

Zuma (2020) proposes that resources are tangible and intangible materials that teachers integrate into the classroom to support teaching and learning. Resources are drawn from three categories: hardware, software, and ideological-ware (Figure 6.2). These resources are aligned with each level of integration as indicated in Chapter Two. Hardware resources are aligned with constructive integration; software resources are aligned with unconstructive integration, and ideological-ware is aligned with personal integration. In an attempt to understand the technological resources that teachers integrate into the teaching of the curriculum, Skype, one-on-one semi-structured interviews, online reflective activity, and the Zoom focus group were used to gather this data. Participants in the semi-structured interviews attempted to address the descriptive question of which technological resources teachers integrate into the teaching of the curriculum. This is how participants responded to the descriptive question of which technological resources are integrated into teaching and learning.

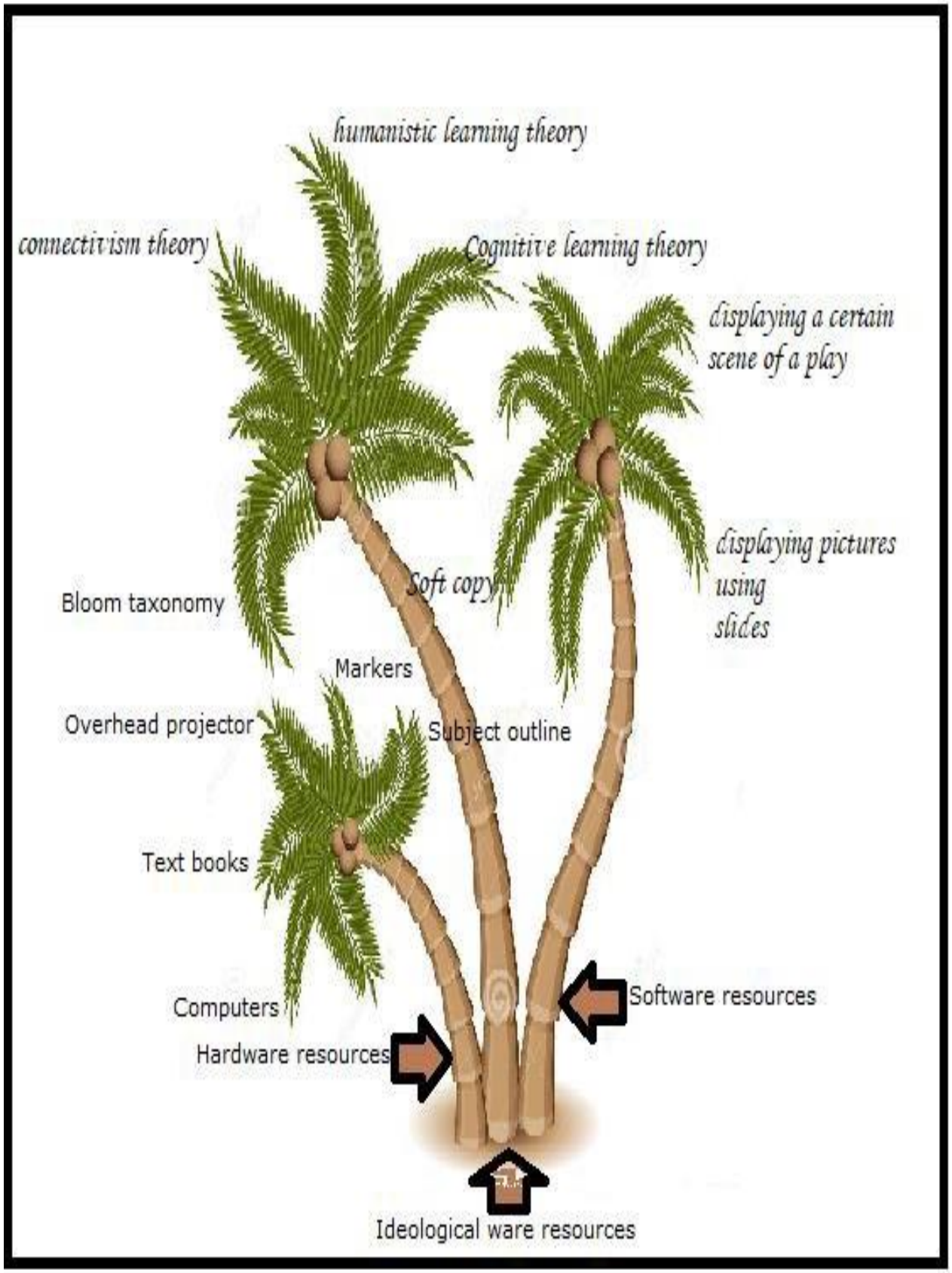


Figure 6.2 Integrated teaching aids in the curriculum

Data Presentation

6.2.1.1 Hardware resources integrated into the curriculum

Based on hardware resources this is how participants responded:

P5:

The hardware that I use includes computers, textbooks, and projectors. But, as natural science and technology teacher it also depends on the content and topic… when I'm teaching a topic that deals with the electrical circuit I normally use a battery as input because it provides the energy for the whole circuit and connecting wire that conducts energy from the battery… I also use objects like a light bulb that is considered as an output. Further to this, when I am teaching a topic that needs a demonstration of these elements moon, earth, and sun then I normally use projectors to demonstrate for learners and the model called planet earth and also use my laptop

P7:

Hardware resources that are available in the school are Globe and textbooks that I integrate when teaching geography… when I do physical education I use charts to do mind games, I also use Mr Smook's laptop only to type the test and examination and use my USB to print my work. The school has Wi-Fi, projector, tablets, and laptops but some of us as teachers have no access to it because we are not trusted

P4:

so I have my textbook as my hardware resource, chalkboard, or whiteboard and I sometimes bring a model for my learners for example if we learn surface area and worksheet. Further to this, I also bring my projector and laptop from home but it is difficult to use them because you have to move and go to different classrooms

P10:

well in grade R we learn through playing, so for indoor playing, we have got toys and have a fantasy area where there is a shop, clinic, and a police station. So for outdoor playing, we have hardware resources like skipping ropes, and scoters

The data from the participants has revealed that various hardware resources were used during teaching and learning in this era. The findings from the semi-structured interviews revealed that teachers are fully aware of hardware resources such as computers, textbooks, projectors. Studying the data, there was a general view from P5, P7, and P4 that the dominant resources are computers and textbooks. Participants demonstrated that they understand the difference between the various types of hardware useful in teaching and learning. Deduced from the data is that computers and textbooks are the only resources easy to integrate into the curriculum. Further to this, see P7 stating… "*I also use Mr Smook's laptop only to type the test and examination and use my USB to print my work"*. This shows that teachers use both computers and USBs in their teaching.

6.2.1.2 Software resources integrated into the curriculum

When it comes to software resources this is how participants responded:

P9:

Usually, when I am teaching English I use softcopies, Google, newspapers, magazines, radios, projectors and cell phones, and my laptop. They are a lot of software I use to ensure that teaching is effective. We also have tablets with different application software but due to the overcrowded of the classroom, we are not able to use tablets. We also communicate with our learners and other teachers using WhatsApp due to covid-19

P2:

In our school we have computers with software applications, but not enough for our learners. So we share links with learners to watch videos. So I am currently teaching social science so in case I give them an assignment we use computers to search for information. Last week we had a Zoom meeting discussing one of the topics and I was so amazed by the support I received from parents and colleagues.

P3:

well, it's the textbook, and like with math I make a lot of posts in the classroom. I play games with them. But I would like to use PowerPoint in my class but the problem is computers are only in the computer room and not enough. I sometimes ask them to watch videos of other teachers on Facebook to learn more about math.

The data from P9, P2, and P3 indicates that participants go the extra mile, integrating software resources to ensure that teaching is effective. The findings suggest that the software resources allow teachers and learners to interact at any time using WhatsApp, Facebook, and Zoom. The data suggests that teachers integrate software resources to achieve a common goal of supporting learning in the Fourth Industrial Revolution, improving learner performance. Barriers preventing the effective use of software resources include that there are not enough technological resources. Shifting towards digital learning is the solution to all problems the Department of Education is facing. P9 outlined, "*We also have tablets with different application software but due to the overcrowded of the classroom we are not able to use tablets".* This suggests that schools have the means of integrating software resources; however, due to overcrowded classrooms it becomes impossible for teachers to integrate software resources into their curriculum.

6.2.1.3 Ideological-ware resources integrated into the curriculum

Participants' response to ideological-ware resources:

P1:

I connect a lot with connectivism theory recently because this theory suggests that we need to look at learning differently, particularly the use of technology. Thus, I use my cell phones and laptops to search for information, but not all our teachers believe that technological resources play a vital role in the curriculum in our school and that they can help us to enhance our teaching. So I use my cell phone to research relevant certain theories and give that information to our learners. So the internet is used for laptops and cell phones

P8:

I strongly believe in humanistic learning theory says that learning is a way for us to fulfill our full potential. Therefore, when I teach my children currently, for example when I teach math I use the multimedia projector to download pictures of objects and show that math is not about multiplication and division. But I want them to understand maths very well because when you go to the shop and lack the basics of math you will not get the right change at the shop.

P6:

Well, I rely on Cognitive learning theory because it focuses on thought. So for me, it all starts in understanding Bloom's taxonomy so you can understand the cognitive of a child you dealing with, even when setting question papers.

The findings from participants suggest that ideological-ware resources are informed by teaching and learning theories such as the cognitive learning theory, the humanistic learning theory, and the connectivism theory. Participants demonstrated an understanding of ideological-ware resources that can be integrated into the curriculum in this era. This suggests that participants have received proper training from universities that equip teachers on the learning theories. From the participants' responses, it was evident that participants integrate Bloom's taxonomy when conducting assessments. Thus P6 … "*So for me, it all starts in understanding Bloom's taxonomy so you can understand the cognitive of a child you dealing with, even when setting question papers."* This shows that participants are guided by the CAPS document in support of Bloom's Taxonomy when teachers are setting examination papers.

Theme 1: Discussion

Scholars (Dlamini, 2019; Khoza, 2018; Mpungose, 2017; Msibi & Mchunu, 2013) declare that resources are teaching aids integrated into the curriculum. Mlilo (2019) concurs with Mthembu (2018) that hardware resources are teaching aids that teachers can see and touch to communicate teaching such as computers, laptops, and textbooks. This is supported by the findings of this study: teachers revealed that they integrate textbooks and computers as hardware resources into the curriculum. As a result, hardware teaching aids are informed by a vertical curriculum. Teachers are constructively integrating technological resources guided by a prescribed document such as the CAPS document (Zulu, 2020). In short, teachers' actions are informed by content knowledge.

On the other hand, Khoza (2016) declares that software resources are teaching aids with various application software integrated into the curriculum to display certain activities; and these aids work hand in hand with hardware resources. Teachers can display an experiment per a YouTube video (software) from the internet using a projector (hardware). This is in line with the findings of this study. Teachers outlined that they used tablets in the classroom with various application software to display information to learners. Teachers thus do rely on technological knowledge. Software aids are informed by a horizontal curriculum in which teachers are unconstructively integrating technological resources guided by teaching methods

such as enquiry-based learning (Peter, 2019). Further to this, Mpungose (2020a) agrees with Mthabela (2019) that ideological aids are any teaching method that teachers use in the class such as questioning and answering methods, cooperative learning and a flipped classroom. Moreover, ideological-ware is one of the resources that drives any lesson, when teachers integrate technological resource relying on pedagogical knowledge (Paul, 2019). The findings also reveal that teachers rely on theories when teaching and learning takes place, such as the humanistic learning theory. As a result, ideological aids are informed by a diagonal curriculum in which teachers integrate technological aids personally, relying on theories (Mwalongo, 2018).

The CAPS document postulates that teachers must use all resources in school for effective teaching and learning. Findings have revealed that some schools have access to the Wi-Fi, projector, tablets, and laptops; however, these resources are not used because of conflicts teachers have with their leaders. This conflicts with the policy (CAPS) document. Such poses frustration to learners if some teachers are not integrating resources because of their agendas in the school. Moreover, the imbalance in the use of these resources disrespects the CAPS document which shares the idea that all resources must be integrated into the curriculum. Further to this, findings revealed that some teachers do indeed integrate computers and USBs into their teaching. This questions the CAPS document which is silent on the use of computers, USBs, cellphones, and tablets.

6.2.2 Theme 2: Rationale

Integration of technological resources is fundamental to executing the prescribed curriculum. Teachers understood why they integrated technological resources, and relied more heavily on constructive, unconstructive, and personal rationale, as indicated in (Figure, 6.3). Participants indicated that to gain digital natives' attention, technological resources (cellphones, computers, projectors, TVs and more) play an enormous role. The data generated from participants, and the issues raised suggest that teachers' integration of technological resources is drawn from the constructive, unconstructive, and personal rationales. To understand the reasons that teachers integrate resources into the teaching of the curriculum, Skype, one-on-one semi-structured interviews, online reflective activities, and Zoom focus groups were used to gather this data.

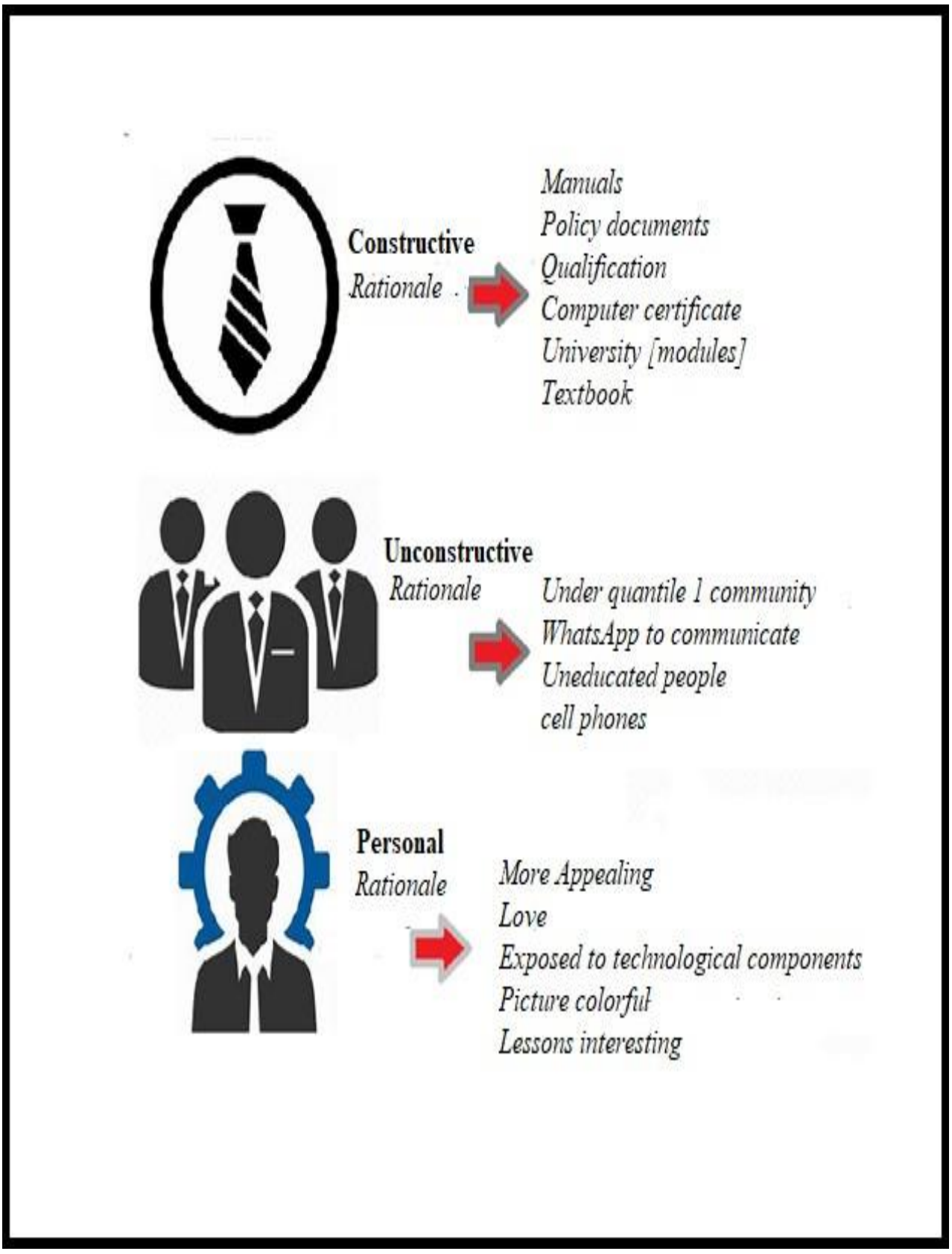

Constructive
Rationale
Manuals
Policy documents
Qualification
Computer certificate
University [modules]
Textbook
Unconstructive
Rationale
Under quantile 1 community
WhatsApp to communicate
Uneducated people
cell phones
Personal
Rationale
More Appealing
Love
Exposed to technological components
Picture colorful
Lessons interesting

Figure 6.3 Constructive, unconstructive and personal rationale integrated into the curriculum

Data Presentation

6.2.2.1 Personal reasons for integrating technological resources

P10:

it is more Appealing, I found these resources more appealing to them, so if you want to grab their attention it is better to use technology because the old methods don't seem to be effective with these learners.

P4:

I use these resources because, in our days, learners are exposed to technological components. For instance; learners these days are good at visualization, and learners are very much hands-on in technological resources, and these resources make things easy for them to understand.

P6:

I feel that our content is very restricted to our textbook, the way information and life have transformed we need technological resources to enhance teaching. We can't only teach what is in the textbook but we need to go the extra mile for our learners and resources helps us to understand current issues.

P2:

it is because with my personal experience with teaching I have seen that learners learn best when technology is involved, so the practical part is important for learners. After all, you can speak the entire lesson only to find that learners did not understand. So learners like pictures and things that are colorful, I am trying new ways or strategies to make my lessons interesting and technology offers that

The data from the participants has revealed that they integrate technological resources because learners are exposed to technological components. Participants strongly believe that these resources attract learners' attention during teaching and learning. P10 mentioned, *"if you want to grab their attention it is better to use technology…"* This is evidence that technological resources make teaching and learning more effective. Participants were confident in the use of these technological resources. P2 stated, "*I have seen that learners*

learn best when technology is involved…" This suggests that participants' experiences have also assisted them to see the benefits of using technological resources and become confident with its use. From these findings, one can deduce that the integration of technological resources plays a vital role in gaining learners' attention when it is informed by love of technology.

6.2.2.2 Societal reasons for integrating technological resources

P7:

Not at all, but maybe they are not supportive because I am working under quintile 1 community they sustain their life with grant money. so it is not easy at all because even learners I am teaching in my classroom receive no support at home.

P3:

The community has been willing, so they have been keen to support us because we use WhatsApp to communicate with them. So when we have an assessment and things that need to be done we communicate with them and they respond

P1:

society is not supportive; I think this is because the society is dominated by uneducated people. Well parents only think that their cell phones are for Facebook and WhatsApp and do not understand that these phones can help learners

It was crucial and worth noting for participants to acknowledge the role played by society in supporting teachers to integrate technological resources in schools. The societal rationale is central to the integration of technological resources as it endorses the culture of teaching and learning in schools. The participants were resolute that the goal of the curriculum cannot be achieved without the support of parents. See P7 who offered, *"…it is not easy at all because even learners I am teaching in my classroom receive no support from homes,"* This is a clear indication that schools need to advance the interests of society to achieve the goals of integrating technological resources into the curriculum. The findings from P7 and P1 suggest that parents are not taking the responsibility of supporting teachers in the integration of technological resources. As P1 stated, "*Not at all, but maybe they are not supportive because I am working under quintile 1…".* This situation poses a threat and will affect the intended curriculum implementation. Teachers in schools must learn to integrate technological resources into the curriculum without support from society. On the other hand, P3 reveals that

they do receive support from society even during assessment time. Thus P3 remarked, *"…So when we have an assessment and things that need to be done we communicate with them and they respond."* This suggests that teachers can receive support from society if different application software is used to communicate with members.

6.2.2.3 Professional reason to integrate technological resources

P5:

No, I don't have any qualification that guides me to use these resources, but my qualification as a teacher has taught me how to use these resources and how dangerous are they. So I do know how to use these resources since I have a computer certificate. However, Mr Singe helps me when I get confused.

P8:

No, I don't have a specific qualification related to the use of resources, but while I was at the university one of the module covered the aspect of technological resources. Further to this, doing my honors and master's has helped me to understand how to use these resources very well, and hoping one day I will have a qualification that teaches how to use these resources

P9:

So I am a Unisa graduate, so I did do integration of technology as a module, but it was the basics of technology

The finding demonstrates that all participants have operational knowledge of technological resources gained from the university. However, the participants seem also to be incompetent to integrate these technological resources into the curriculum. Participants are silent about manuals and policy documents provided by the Department of Education. This compromises the enacted curriculum which must be implemented proficiently if teachers rely upon other teachers at the expense of department documents and manuals provided. For instance, P5 averred, "… *Mr Singe also helps me when I get confused".* This is in line with P9 and P8. This demonstrates that teachers are not well versed in the knowledge of integrating the latest application software and the use of resources such as 5G and blockchain. This poses a serious threat to the integration of technological resources into the curriculum. Teachers will have to develop themselves and gain a broader knowledge of the integration of technological

resources. In short, teachers must value continuous professional development which will help them understand the integration of technological resources.

Theme 2: Discussion

Al-Samarraie (2019) concurs with these scholars (Mwalongo, 2018; Mwendwa, 2017; Naidoo, 2011; Nani, 2019) that personal rationale is informed by individual actions. For instance, teachers may be driven by love to integrate technological aids such as computers into the curriculum. This is in line with the findings from this study because teachers revealed that resources are more appealing to them. Thus, Mthabela (2019) argues that personal rationale is influenced by the diagonal side of the curriculum and pedagogical knowledge; teachers personally integrate technological teaching aids to ensure that teaching is running smoothly and effectively. Mthabela (2019) adds that teachers solve the problem and plan individually when they are informed by personal rationale. Integration of technological resources from the data has shown that teachers are integrating technological resources informed by personal rationale. It is noticeable that teachers are passionate about integrating these resources into the curriculum. A qualitative interpretive case study was conducted by John (2015) on the integration of information technology into higher education. The main aim of the study was to understand the faculty's attitude towards IT adoption in the teaching process. The study argued that unconstructive rationale addresses society's needs; in this case, teachers are integrating technological resources to enrich and support the community. However, the findings of this study reveal that society is not supportive of the use of technological resources. Such makes it difficult for teachers to address society's needs. The scholars (Magwanyana, 2018; Mbele, 2019; M. Nelson, 2019; Nene, 2019) posit that unconstructive rationale is influenced by the horizontal side of the curriculum and technological knowledge in which teachers unconstructively integrate the technological resources to uplift society.

A qualitative interpretive case study was conducted by Misirli (2016) on integrating technology into teaching and learning using a variety of models. The study argued that constructive rationale occurs when teachers follow a constructive way of integrating technological resources into the curriculum by reading policy documents and manuals. However, teachers revealed from the findings that there is no specific qualification that they have that guides them on how to integrate technological resources into the curriculum − they rely on their colleagues. Moreover, these scholars (Khoza, 2019; Williams, 2019; Windschitl

& Sahl, 2002; Zuma, 2019) remark that constructive rationale is influenced by the vertical side of the curriculum and content knowledge − teachers constructively integrate technological resources guided by certain documents in schools. Dladla (2020) suggests that teachers integrate technological resources into a curriculum informed by the intended curriculum CAPS. Such guides them with specific skills, content knowledge, and professional experience. Teachers are driven by a constructive rationale therefore by constructive integration. Teachers use manuals and policy documents to integrate technological resources into the curriculum. Furthermore, Figure 6.4 below explains the connections of Theme 3, research questions, and the categories of the content. The theme given below emerged from the data generated from participants from interviews and the focus group.

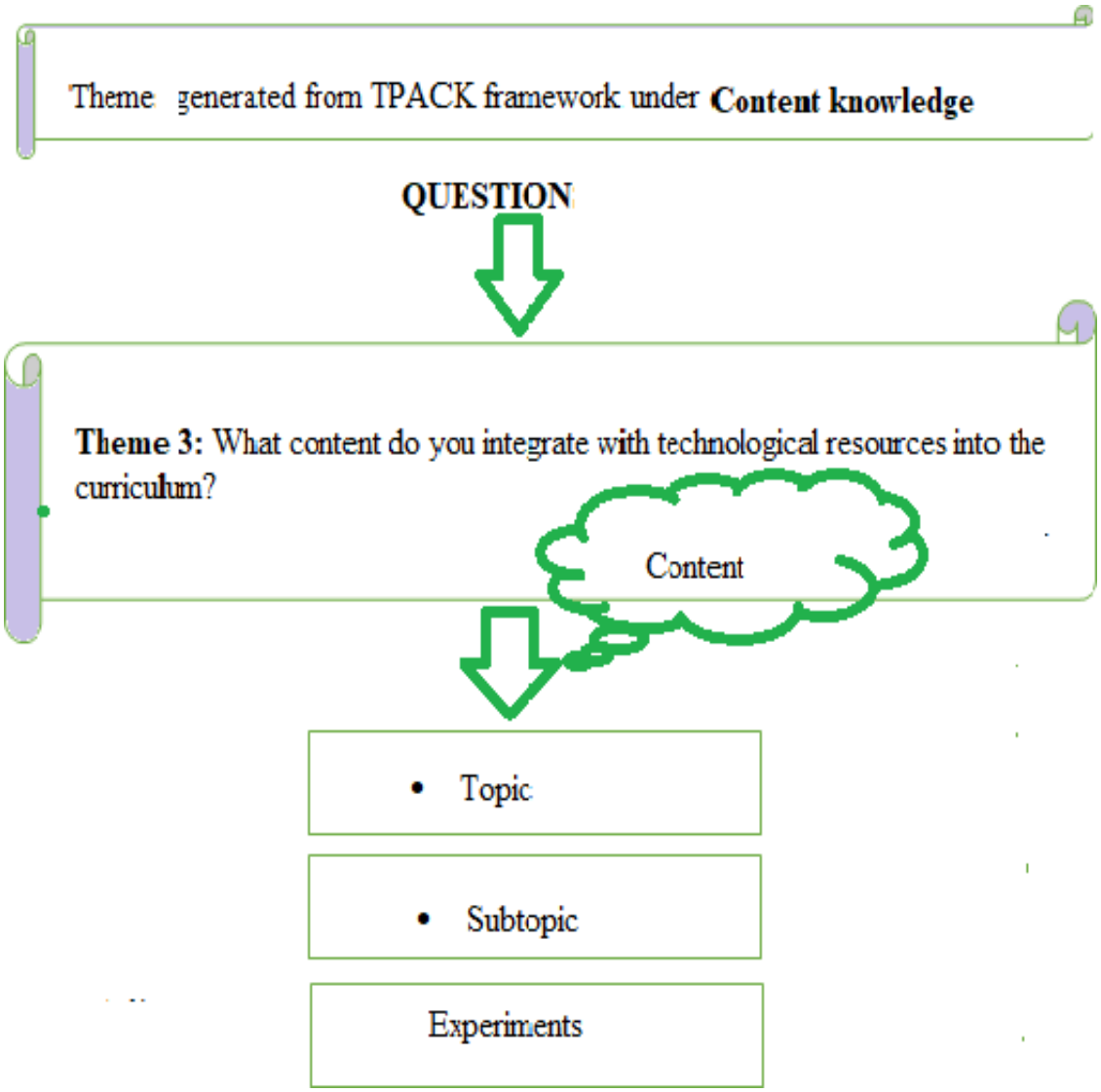


Figure: 6.4 Theme generated from TPACK framework under content knowledge

6.2.3 Theme 3: Content

Magalhães, Ferreira, Cunha, and Rosário (2020) maintain that content is a set of prescribed or selected knowledge aspects into which teachers can integrate technological resources. Content can be classified as topic knowledge, sub-topical knowledge, and experimental knowledge, as indicated in Figure 6.5. Content in this study is aligned with levels of integration. For instance, constructive integration is aligned with topic knowledge;

unconstructive integration is aligned with experimental knowledge; personal integration is aligned with sub-topical knowledge. Further to this, the following are the responses from participants:

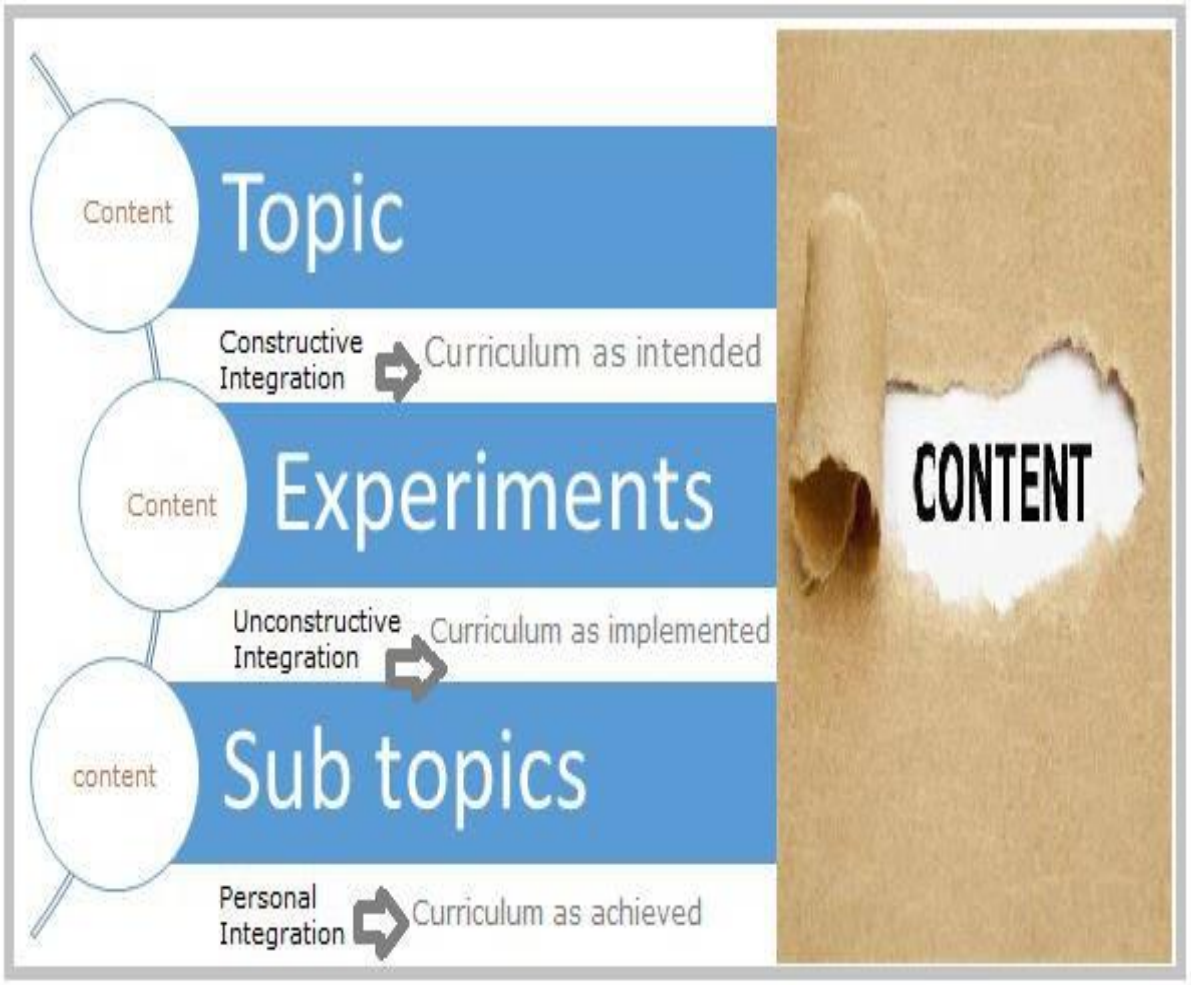


Figure 6.5 Content integrated with teaching aids into the curriculum

Data Presentation

6.2.3.1 Topic integrated into the curriculum

P9:

well in the isiZulu language, we have this topic UKUFUNDISA KWEZINDABA ZAKUMABONAKUDE where I bring the radio to listen to the news or when I teach topics like UKULALE NOKUFUNDA KWENDABA, I always bring projector and radio for listening skill.

P8:

The subjects that I teach are history and geography, in history as I mention one of the chapters' focuses on the perimeter, and then in geography weather patterns because when you talk to kids about whether they don't watch TV so I will have to print pictures and demonstrate to them.

P7:

when we look at social sciences we need resources for the topic that talks about climate weather, so we have so many projects that we do with learners like the wind direction, sometimes we do map where I will be expected to use atlases and globe.

Teachers serve as primary sources of the content topic of their subject. The expectation is that teachers understand all parts of the main topic into which they integrate technological resources. The data from the participants revealed that teachers do understand that technological resources can be integrated with topics they teach, and into all subjects taught in school. For instance, P9 indicated that "*well in the isiZulu language, we have this topic UKUFUNDISA KWEZINDABA ZAKUMABONAKUDE where I bring radio to listen to the news…"* P8 provided further clarity, "*I mention one of the chapters' focuses on the perimeter, and then in geography weather patterns…"* P7 further reflected "*when we look at social sciences we need resources for the topic that talks about climate weather…"*

6.2.3.2 Subtopics integrated into curriculum

P5:

Frequently history, when we look at the European sub-topic in term 2. But mostly history because it is a boring subject but it makes things interesting when using these resources

P6:

I love it, so any chance I get I use technology. Any slot that is available at the computer lab I use it. So for social science, they are two components geography and history so I love to use technology when teaching these subjects.

P4:

In Mathematics, I use these resources mostly when I teach Surface area, Volume, perimeter, and geography because they are a lot of general knowledge, so I use pictures.

The data from the participants is in line with the literature review on sub-topics. A literature review has revealed that sub-topical content refers to various literature. Participants

demonstrated an understanding of the sub-topic into which they integrate technological resources in the curriculum. P5 indicated, *"Frequently history when we look at Europeans sub-topic in term 2…"* This is in line with P4 who revealed, *"In Mathematics, I use these resources mostly when I teach Surface area, Volume, perimeter…"*

6.2.3.3 Experiments integrated into curriculum

P10:

As I have mentioned before, I use all these components in natural science and technology because they are chapters that need these resources, For Instance, the boiling point of the water requires a thermometer, beaker, wire gauze, and tripod stand"

P2:

Yes, in history Grade 7 we do separation of the mixture in natural science, so if you teach about separation of mixture you need these resources, sieve, magnet, filter, Gauze mat, and beaker.

P3:

Mostly when I am teaching common fractions, so I make a post for them to understand what are fractions with examples. Then after the lesson, I make examples where I will expect them to find the answer on their own using the methods I have been teaching them"

The data generated from teachers shows that teachers were confident that technological resources work for them when doing experiments. This is evident when P2 firmly explained, *"…separation of mixture you need these resources, sieve, magnet, filter, Gauze mat, and beaker".* This suggests that the availability of these resources ensures that experiments on the prescribed curriculum are executed. In addition to the above, P10's response is similar to that of P2, *"…For Instance, the boiling point of the water requires a thermometer, beaker, wire gauze, and tripod stand".* This gives a clear picture that technological resources also play a vital role in executing prescribed experiments in the CAPS document.

Theme 3: Discussion

Teachers' responses revealed that they do understand content knowledge as indicated in the CAPS document. Teachers do possess the content knowledge as suggested by the literature in Chapter 2. These scholars (Dlamini, 2018; Khoza, 2021b; Mpungose, 2021; Mthabela, 2019) define content as a set of selected information/knowledge to be taught in a specific subject,

integrating technological resources. Topic content relates to the core subject knowledge, for instance, economics and management science topics [assets, liability, and battering]. Teachers are then driven by constructive integration and content knowledge when teaching the intended curriculum, relying on documents such as CAPS and manuals (Mthembu, 2018). Scholars (Msibi & Mchunu, 2013; Muriithi & Masinde, 2016; Mvune, 2020) define experiment content as the practical part of the lesson, for instance, a teacher demonstrating a boiling point experiment with learners. Such topics have informed teachers to be driven by unconstructive integration and technological knowledge − they are teaching the curriculum as implemented. Furthermore, Moya et al. (2011) argue that sub-topical content refers to various literature. This results in teachers being driven by personal integration and pedagogical knowledge when integrating technological resources into the curriculum. Achievement of such depends on teachers' perception and preference. Further to this, Figure 6. 6 below enlightens on the connections of pedagogical knowledge themes, research questions, and the categories. The themes given below emerged from the data generated from participants during interviews and focus groups.

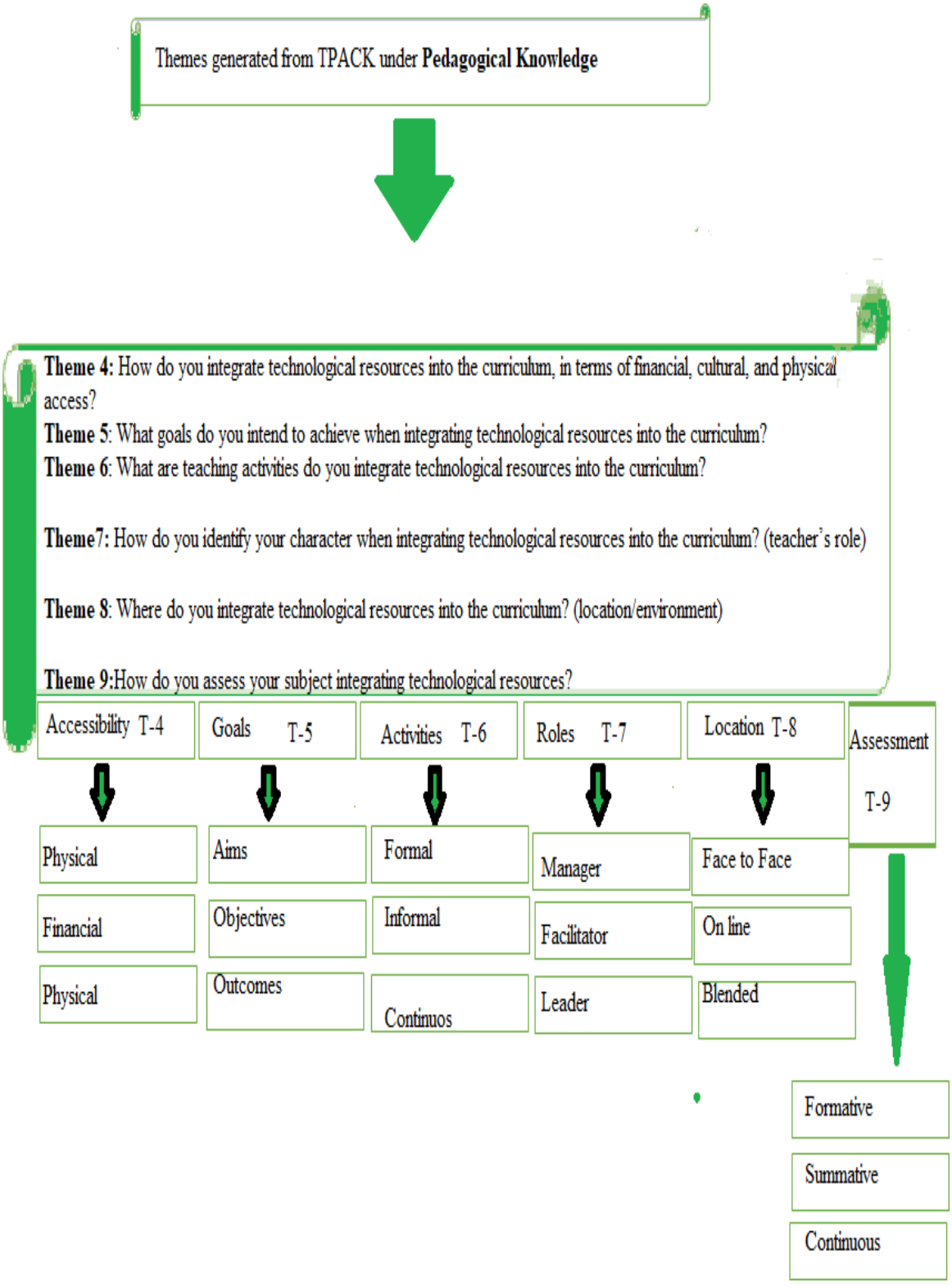


Figure: 6.6 Themes generated from TPACK framework under pedagogical knowledge

6.2.4 Theme 4: Accessibility

Learners and teachers stand a good chance of achieving the goal of curriculum if technological resources are accessible, such as computers, laptops, stationary, the internet, and school buildings. The Constitution of South Africa affirms that accessibility to education is an essential right. Consequently, teachers and learners have the right to access education, regardless of race, gender, sex, cultural background, and financial background. The data generated from participants and issues that are raised suggest that accessibility is drawn from financial, physical and cultural background, as indicated in Figure: 6.7.

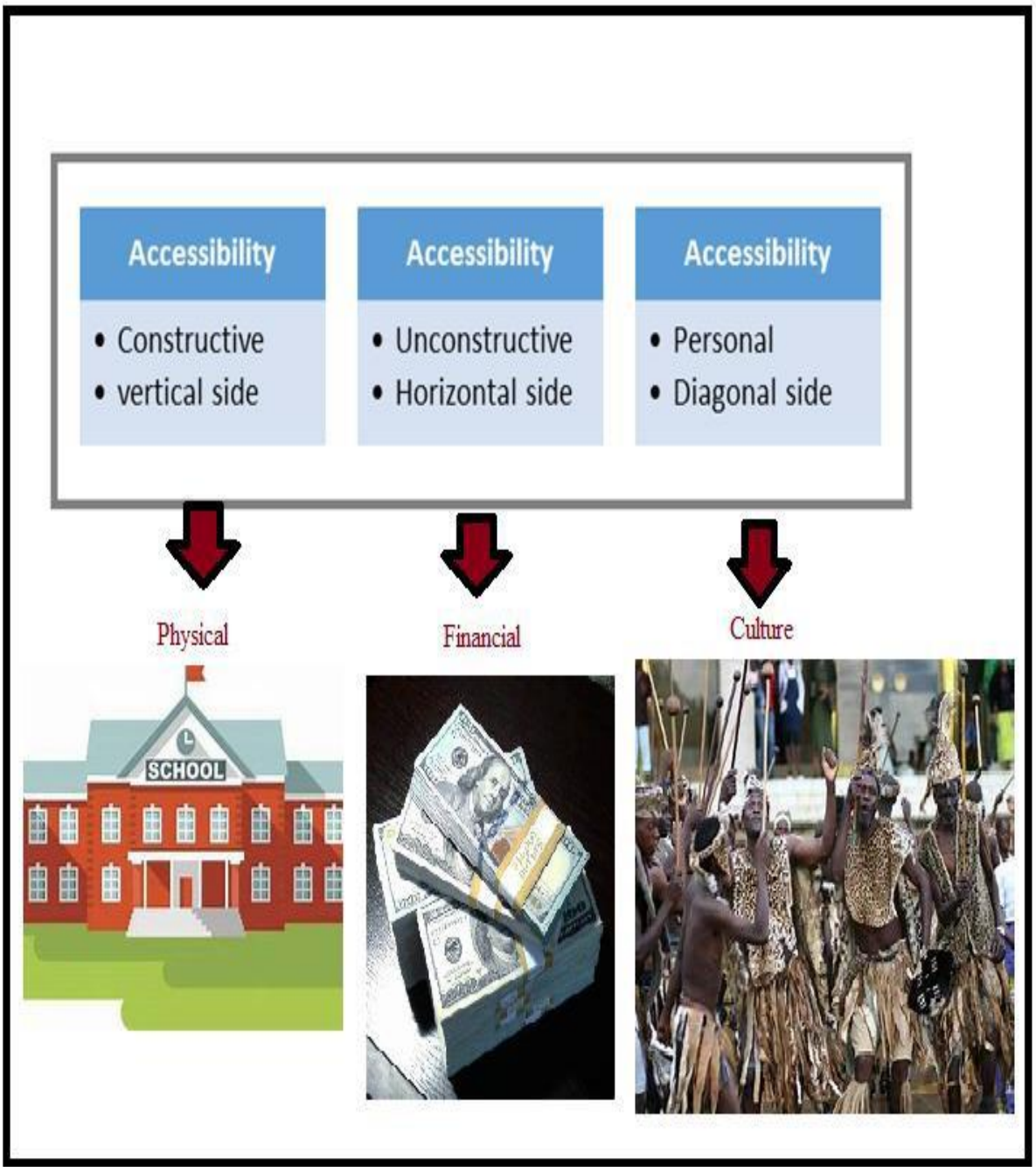


Figure: 6.7 Accessibility to integration of technological resources into the curriculum

Data Presentation

6.2.4.1 Physical assess to integrate technological resources

P6:

I bring my learners to the computer room all the time when there is a free slot, For the last team I was teaching them the basics of using the computer keyboard

P9:

Well I take my radio and projector to class and make sure that learners are participating during my lesson

P8:

The only effective technological recourse that is communicated with learners in our school is DSTv channels, DStv channels 319 and 260 are educational

It is worth noting that the teachers' responsibility is to ensure that learners have access to technological resources in schools regardless of any physical barriers. It is common knowledge that employees in the department use their own technological resources to ensure that the curriculum is implemented as planned. P9 stated, *"Well, I take my radio and projectors to the class…".* This is evidence that our schools do have not sufficient technological resources; nevertheless, teachers use what they have to achieve the goal of the curriculum. P8 revealed, "*The only effective technological recourse that is communicated with learners in our school is DSTv channels…".* This poses a threat to curriculum implementation when teachers refer learners to DSTV educational programmes − not all learners have DSTV at home.

6.2.4.2 Financial access to integration of technological resources

P10:

I would say the department neglects us because at some point they send us links to attend the workshops that are not useful, where you will be expected to use your data at home to join that Zoom meeting

P2:

Yes, when I will have to attend the workshops and use my own money for petrol and sometimes even make calls for parents to explain some of the things to them when learners are confused.

P7:

Yes, like in history to search for pictures, I will use my data and the phone. Then I will show learners the picture on the phone because even to print it out in the school I need to notify them two days before the actual date of delivery

P4:

*You know because the department is expecting teachers to advance themselves all the time to earn **CPTD** points. So I do short courses at my expense and also watch YouTube videos about how to advance yourself and this is done at my own expense*

P5:

Yes, when I am in school and we have load shedding I use my data to search for information and at home. When I go to the workshop in distance areas and I also use my petrol and car, the school doesn't pay us for attending workshops.

It is understandable that teachers have to make difficult choices to ensure that technological resources are integrated into the curriculum. All participants have revealed that they use their own finances to ensure that the curriculum is implemented, using technological resources. P 10 reflected, "…*where you will be expected to use your data at home to join that Zoom meeting".* This leaves teachers frustrated and angry and can result in a reluctance to integrate technological resources. Teachers have to attend workshops in distant areas, travel using their cars, and not be supported with petrol. ThusP5 stated, *"…When I go to the workshop I also use my petrol and car".* This suggests that teachers are not happy, which may well affect the integration of technological resources into the curriculum.

6.2.4.3 Cultural access to integration of technological resources

P1:

In our school we have an enrolment of 1250 learners, thus our school comprises various race groups such as blacks, Indians, and colored. But we are dominated by learners speaking isiZulu.

P3:

Well, it become hard to make relevant examples because our school has 80% Africans and 20% Indians. This results at some point having many learners not understanding because we are not allowed to explain in isiZulu their language.

The data from participants revealed that the dominant ethnic group in these schools are learners speaking the isiZulu language. However, teachers integrate technological resources into the curriculum demonstrating or speaking in English because the language of teaching and learning is English. P3 clarified, "…*This results at some point having many learners not*

understanding because we are not allowed to explain in isiZulu their language." P1 explained, *"…But we are dominated by learners speaking isiZulu."* P3 added, *"Well, it become hard to make relevant examples because our school has 80% Africans and 20% Indians…"* This may hinder the progress of integrating technological resources if teachers are forced to use English when schools are dominated by learners who only understand isiZulu. Teachers indicated that it is difficult for learners to understand English.

Theme 4: Discussion

A qualitative interpretive case study was conducted by Mpungose (2021) on lecturers' reflections on the use of Zoom VCT for e-learning at a South African university during the lockdown resulting from the COVID-19 outbreak. E-reflexive activities and one-on-one semi-structured Zoom interviews were used for data generation. The study argues that financial accessibility is informed by the affordability of teachers to integrate available resources into the curriculum in the schools. This type of accessibility is driven by unconstructive integration and technological knowledge in which teachers integrate technological resources not funnelled by any written documents (Al-Shammari, 2020; Dladla, 2020). Cele (2019) agrees with Mbele (2019) that in this type of accessibility teachers are driven by the horizontal side of the curriculum. This suggests that when teachers are struggling to access technological resources they will not achieve the horizontal side of the curriculum goals.

These scholars (Nani, 2019; Ntombela, 2020; Xie, Nelson, Cheng, & Jiang, 2021; Xu et al., 2018; Zhou et al., 2020; Zulu, 2020) allow that physical accessibility refers to the contact time teachers take when integrating technological resources in a teaching and learning environment with learners. Xie et al. (2021) agree with Zuma (2020) that this type of accessibility obliges teachers to be informed on constructive integration and content knowledge in which their actions are guided by documents prescribed by the Department of Education. A pragmatic case study was conducted by Khoza (2021a) titled: Can teachers' identities come to the rescue in the Fourth Industrial Revolution? Eleven teachers registered for a master of education degree at a university in South Africa, were purposively selected for this study. The objective of this study was to understand teachers' identities when teaching mathematics in the 4IR. Focus-group discussions, reflective activities, and one-on-one semi-structured interviews were used for data generation. The study findings denoted that in this type of accessibility teachers are driven by the vertical side of the curriculum in which

teaching and learning is prearranged. Lastly, scholars (Williams, 2019; Yurtseven Avci et al., 2020; Zulu, 2020) accept that cultural accessibility refers to the backgrounds of learners, which may influence teachers' integration of technological resources into the curriculum. Hence, cultural accessibility is informed by personal integration in which teachers implement a diagonal curriculum driven by their own opinion.

6.2.5 Theme 5: Goals

The Department of Education's goal is to ensure that children acquire and apply knowledge and skills in ways that are meaningful to their own lives. In this regard, the curriculum promotes knowledge to be integrated using technological resources in schools. Participants' responses indicated that they have differing goals regarding the integration of technological resources into the curriculum, as can be seen below.

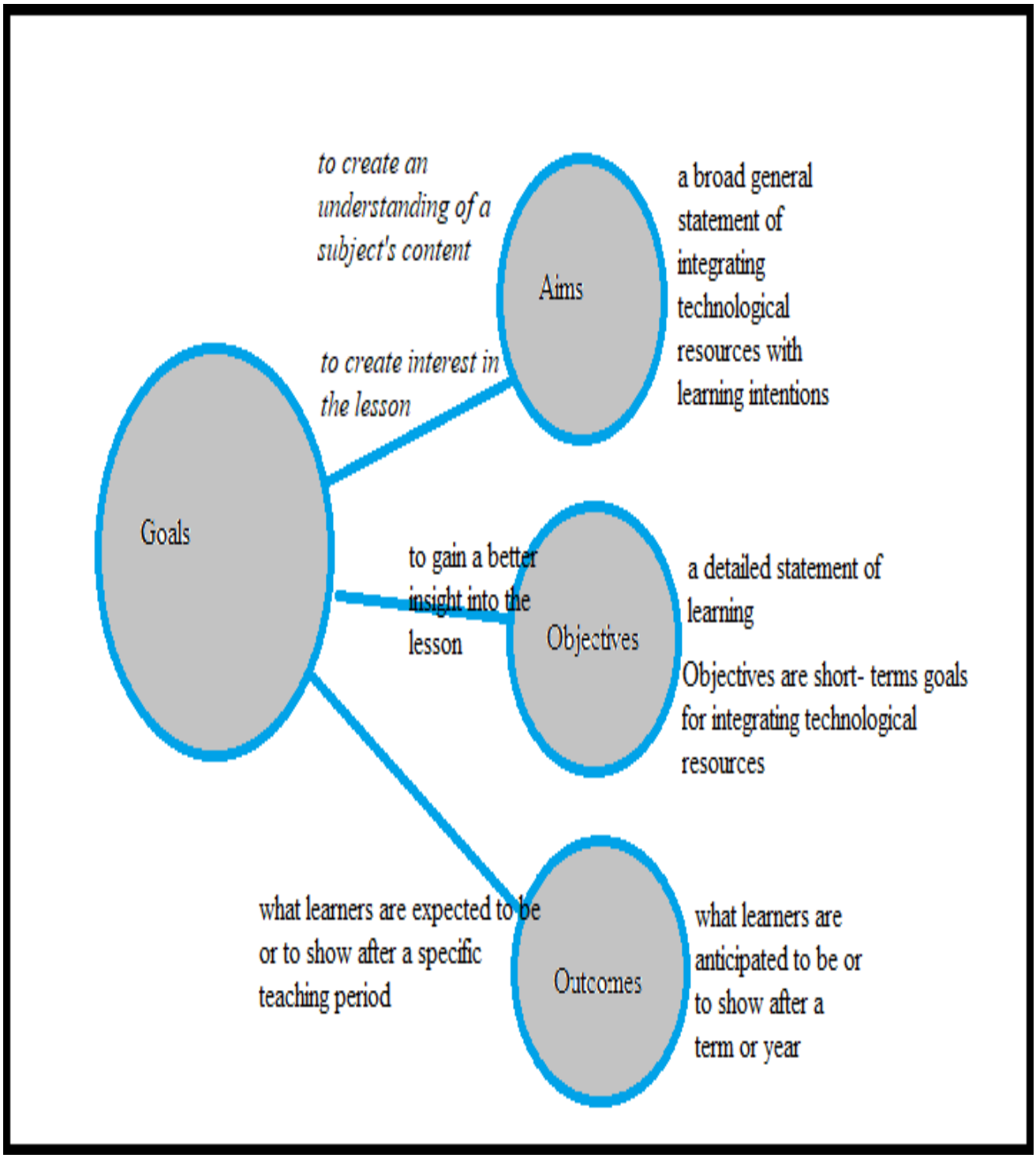


Figure: 6.8 Goals for integration of technological resources into the curriculum

Data Presentation

6.2.5.1 Aims for integration of technological resources into the curriculum

P2:

I aim to create interest in the lesson, capture learners' attention, and facilitate a meaningful understanding of the content. So I try to make everything I teach relevant in a context that they will understand

P5:

well it is about making an interest besides me just talking and writing on the chalkboard, so I aim to bring a different perspective to them

P7:

I want them to become more familiar with technology as a whole because it makes life easier, so I just want them to turn up and use the computer. So I sometimes project notes on the board and ask them to type the notes using the computer. so I have seen a lot of improvement from them

P4:

The main aim is to create an understanding of a subject's content, you know in the teaching we have to link the gap between what we teaching and what learners know. And what learners know are current things, for example in English Oscar phitorias in grade 4 did not know who he was because when his tragic accident happened when they were just born at that time. So children know what happening now and are clueless about the thing that happened years back, so technology helps to understand things that happened years' back

The Department of Education aims to integrate technological resources into the curriculum to develop and maintain good habits that can increase teachers' and learners' ability, confidence, and self-esteem. The data from the participants has revealed that teachers have analogous aims for integrating technological resources into the curriculum. For instance, P2 indicated, "*I aim to create interest in the lesson, capture learners' attention, and facilitate the meaningful understanding of the content…"* On the other hand, P7 claimed, *"I want them to become more familiar with technology as a whole because it makes life easier…"* This suggests that teachers' aims are in line with the CAPS document in wanting to develop and increase learners' ability to use technological resources.

6.2.5.2 Objectives for integrating technological resources

P3:

My objective is to ensure that learners understand the content

P6:

To gain a better insight into the lesson or the content that I am teaching

P10:

So my main objective is to create a memory for all learners of what I am teaching

The Department of Education's objective of integrating technological resources into the curriculum is to ensure that learners understand the curriculum by the end of the year. The data from the participants shows that staff agree with the Department of Education. For instance, P3 stated, "*my objective is to ensure that learners understand the content"* in line with P6 who responded, *"to gain a better insight into the lesson …"* This suggests that teachers' objectives to integrate technological resources into the curriculum are in line with the CAPS document.

6.2.5.3 Outcomes of integrating technological resources

P8:

I will say the outcome is that learners understand how to use these technological resources and apply the knowledge I am teaching them

P1:

to achieve excellence in the child's performance and ensure that he/she understands that education is broad

P9:

exceptional behaviour and results in my children because grade R is all about development, for example, cognitive development, physical development

Outcomes are what learners are expected to show after a specific teaching period once technological resources have been integrated and implemented. The overall findings indicate that the majority of the participants' outcomes rest on learners' performance which is in line with the CAPS document. Thus P1 explained, "*to achieve excellence in the child performance…"* This is in line with P9 who stated, *"exceptional behaviour and results in my*

children because grade R is all about development...". This suggests that the outcomes of integrating technological resources can be seen after a specific teaching period.

Theme 5: Discussion

These studies (Dlamini, 2018, 2019; Khoza, 2021a; Kumar, 2018; Lee & Kim, 2020; Mbele, 2019) agree that aims may be viewed as a broad general statement on integrating technological resources with learning intentions. Further to this, Cele (2019) states that the aims of integrating technological resources may be achieved in the long term. Aims cause teachers who have integrated technological resources into the curriculum to be driven by personal integration. Teachers have well-developed aims for integrating technological resources (Biyela, 2018). This suggests that teachers are informed by the diagonal side of the curriculum and pedagogical knowledge when integrating technological resources. Here their goals are unique and will be achieved in the long run (Whitehead, 1967).

Studies by (Noddings, 2007; Ntombela, 2020; Parisi & Society, 2009; Paul, 2019; Peter, 2019) define objectives as a detailed statement of learning. When teachers integrate technological resources they rely on written documents. For instance, teachers integrate technological resources into their lesson using textbooks, study guides, question papers, inter alia. Nene (2019) further argues that objectives are short-term goals that teachers want to achieve for integrating technological resources into the curriculum. Zulu (2018) affirms that objectives require teachers to integrate technological resources; teachers are driven by constructive integration and content knowledge informed by the vertical side of the curriculum. Lastly, Thabede (2017) further explains that the outcomes of integrating technological resources into the curriculum are what learners are anticipated to show after a term or year. This suggests that teachers are driven by unconstructive integration and technological knowledge because the implementation of the curriculum to achieve outcomes is informed by the horizontal side of the curriculum.

6.2. 6 Theme 6: Activities

The smooth execution of activities demands effective integration of technological resources by teachers. The findings revealed that teachers integrate technological resources in diverse activities as indicated in (Figure: 6.9) below. This shows that there was a mixed response from the participants.

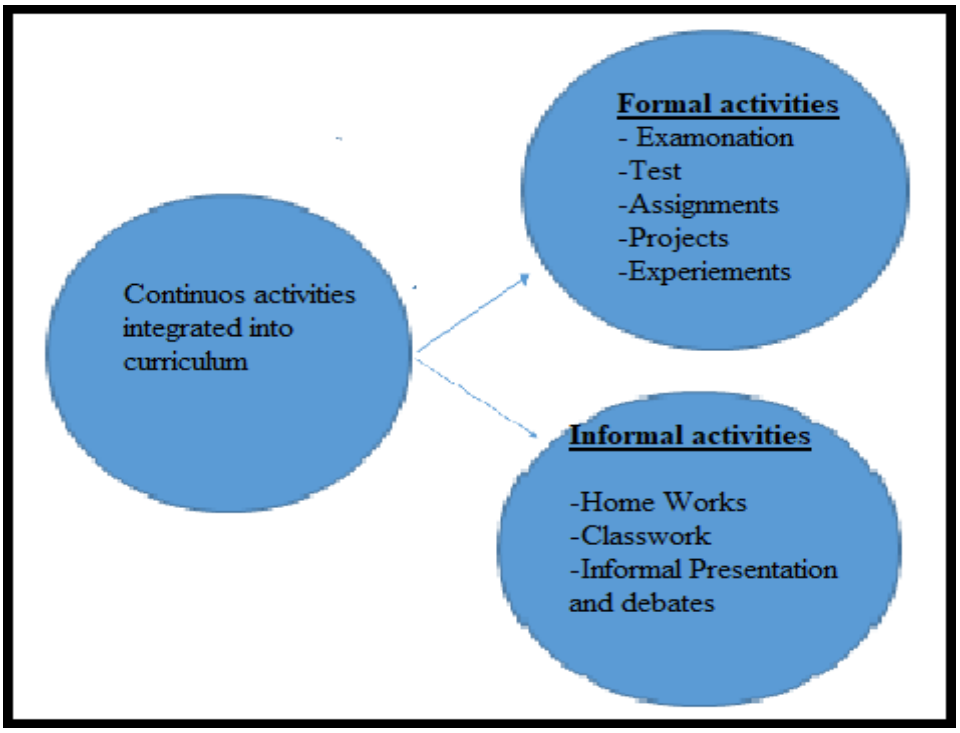


Figure: 6.9 Activities integrated technological resources

Data Presentation

6.2. 6.1 Formal activities integrated into the curriculum

P8:

We do go to the computer room and write formal tests and assignments, but it has a lot of challenges like, some learners are not yet well equipped with the use of computers

P7:

We use the tablets provided by sunlum to play games with the grade R and if the child can play the game we give marks for that

P6:

As I speak we are doing math examinations on our tablets to develop learners' cognitive levels, sometimes we also go to the computer room and so assignments

The data from the participants revealed that technological resources are integrated by teachers in a variety of activities in schools. A small number of teachers are strongly conscious of formal activities such as tests, examinations, and assignments, etc. For instance, P8 revealed, "*we do go to the computer room and write formal test and assignments…*" On the other hand, P6 remarked, "*As I speak we are doing math examination in our tablets to develop learners'*

cognitive levels." This suggests that technological resources also play a part in developing learners' level of thinking. However, it was noticeable that the data generated from the participants showed that teachers feel more contented when integrating technological resources into informal activities. These activities prepare learners for control tests and examinations.

6.2. 6.2 Informal activities integrated into curriculum

P10:

There are class activities that we always do with learners but we also have homework that allows learners to bring their resources to class, so we focus on class activities and home works. But we also have projects like a circuit where they bring all technological components

P3:

I prefer informal activities because they prepare learners for formal activities, when we do formal activities we don't use resources because of time and we select topics to use these resources

P4:

informal activities, because formal activities have to do with test and examination so I use them in informal activities

P5:

informal activities, because of the time and limited resources that we have in school. More to this, I always encourage my learners to go to the computer room during their spare time.

The data from participants suggest that they are more contented to integrate technological resources into informal activities at the expense of formal activities. As such, P3 responded, "*I prefer informal activities because they prepare learners for formal activity…"* and P4 added, "…*because formal activities have to do with test and examination…"*. P5 further reflected that due to time constraints and limited resources it is preferable to integrate technological resources into informal activities. This suggests that teachers prioritize informal activities in schools when integrating technological resources into the curriculum. These activities are not for grading purposes, but only to show progress of the lesson taught.

6.2. 6.3 Continuous activities integrated into curriculum

P9:

I would say I use these resources in continuous, when we use resources in continuous activity we are training for formal activity but this is done when we get time. I always prefer to say learners must watch educational channels on DSTV's.

P1:

well, I integrate resources in informal and continuous activities to teach learners. When I do continuous activities it is when I want to see if learners did understand what I was teaching them or not.

P2:

There are not many activities for learners to engage indirectly because of limited resources but from watching a video for example in history we did mapholo, so after watching a video I will put 5 questions on the board and they answer questions based on the video

The data from participants suggest that teachers are not aware that continuous activities play a huge role in preparing learners for formal and informal activities. See, P1 who firmly explained the reason for integrating technological resources into continuous activities, "…*When I do continuous activities it is when I want to see if learners did understand what I was teaching them or not*". Continuous activities are therefore only engaged in when teachers must decide whether learners understand. The data generated showed that teachers put more effort into formal and informal activities when integrating technological resources into the curriculum, while ignoring the essence of continuous activity. It was also noticeable that the data generated from the participants shows that very few teachers can see the need to integrate technological resources into continuous activities.

Theme 6: Discussion

Van den Akker et al. (2009) argue that activities are the core business of what is happening on the school premises to equip learners with the knowledge, skill, and values of integrating technological resources. Williams (2019) also asserts that activities are informed by teachers' interactions to enhance learning. Furthermore, studies (Baleni, 2017; Xu et al., 2018; Zhou et al., 2020) indicate that teachers may integrate technological resources into diverse activities such as examinations, classwork, homework, amongst others. Teachers should well be

capable of integrating technological resources into all kinds of activities (formal, informal, and continuous). However, findings seem to differ in that teachers prefer to integrate technological resources into informal activities at the expense of continuous and formal activities. In other words, teachers are driven by pedagogical knowledge at the expense of content and technological knowledge. For instance, participants revealed that they prefer to integrate technological resources into informal activities because this prepares learners for formal activities. This attitude may be detrimental to quality of education if participants believe that continuous and formal activities consume too much time when integrating technological resources. An imbalance in the use of technological resources is thus created. It was evident from the data generated from the participants that there is no balance of activities when integrating technological resources into the curriculum. Consequently, this study advocates for the balanced use of levels of integration so that all activities will be executed equally.

Further to this, the CAPS document is silent on the use of technological resources such as computers, Wi-Fi, projectors and SMART boards during teaching and learning. The curriculum document emphasises the number of activities that must be achieved under summative and formative assessment (Mlilo, 2019). However, findings revealed that schools have access to the Wi-Fi, projectors, tablets, and laptops and teachers do use these resources. This conflicts with the CAPS document, the CAPS document being silent on the latest technological resources. This poses frustration and confusion to teachers who do not understand how to use these resources and to select the relevant activity to integrate such resources, making them available in our schools. Further to this, findings revealed that some teachers advise learners to watch educational channels on DSTV. This conflicts with the CAPS document which is silent on educational channels on DSTV.

6.2.7 Theme 7: Role

Participants' responses show that they play different roles when integrating technological resources into the curriculum. From the data generated, teachers seem to understand their roles when integrating technological resources into the curriculum. However, integrating technological resources as a leader at the expense of being a facilitator or manager might affect the integration of technological resources.

Data Presentation

6.2.7.1 Role of a leader in the integration of technological resources

P5:

well I see myself as a leader because I am leading the learners to new knowledge and understanding of what I am teaching them during that day

P4:

well I would say I see myself as a leader because as a leader you need to do something so people that you are leading will imitate what you are doing

P7:

I see myself as a leader because I am trying to get the message across and inspire the kids to see that even by watching something from the internet or YouTube you can learn something

The data from the participants suggests that teachers are certain that they are leaders when integrating technological resources because they are leading learners and inspiring learners. For instance, P5 revealed, "*I see myself as a leader because I am leading the learners to new knowledge*…" This is in line with P4 who provided further clarity, "*I see myself as a leader because as a leader you need to do something…"* and P7 who stated, *"I see myself as a leader because I am trying to get the message across and inspire the kids…"* However, this conflicts with the literature review in that a leader is someone who integrates technological resources into the curriculum over a stipulated period, and covers the prescribed content for that particular subject.

6.2.7.2 Role of a facilitator in the integration of technological resources

P1:

you know when using these types of things, especially in school you need to see yourself as a leader, facilitator, and manager. So if you don't see yourself in these roles that will mean that you lacking somewhere, and most of all you need to also see yourself as a motivator in the classroom and create a conducive environment

P2:

facilitator, for me I want to lead and work with them, I want to see their mistakes and assist them then we work together

P6:

facilitator because I also want them to them get engaged in the lesson and understand what they are doing

P10:

perhaps a facilitator because I had to support and monitor my learners, just to monitor them and assist them where they need me as a teacher

The data from the participants suggests that teachers become facilitators because when they integrate technological resources they support and monitor learners. P6 opined, "*facilitator because I also want them to them get engaged in the lesson…"* P 10 remarked, "*perhaps a facilitator because I had to support and monitor my learners…"* This is in line with P1 who stated, "…*and most of all you need to also see yourself as a motivator in the classroom and create a conducive environment".* Teachers' responses are in line with the literature review because teachers who integrate technological resources into the curriculum placing learners at the centre are facilitators.

6.2.7.3 Role of a manager in the integration of technological resources

P3:

as a subject teacher, when using these resources, I see myself as a manager because I have a task to ensure that learners are following all the guidelines and instructions. So I am overseas for all the activities

P8:

I see myself as a manager and a leader because I need to lead and come up with good examples in the classroom. I need to try and associate that primitive era with this time we are in. so I manage and try to lead, but I always involve learners

P9:

I will say when I am teaching in the classroom I see myself as a leader, manager, and facilitator because I need to monitor if learners are using resources very well and lead with the example of how to use these resources in the classroom

P3:

I see myself as a manager because I have a task to ensure that learners are following all the guidelines and instruction.

P8: *I see myself as a manager and a leader because I need to lead and come up with good examples in the classroom.*

P9: I see myself as a leader, manager, and facilitator because I need to monitor if learners are using resources.

The participants' responses are in line with the literature. A manager is the only one who provides the information during the integration of technological resources in the classroom.

Theme 7: Discussion

A qualitative case study was conducted by Xie et al. (2021). The study examined changes in teachers' perceptions of external barriers and internal barriers, and their integration of digital educational resources across two years through variable-centred and person-centred approaches. The study findings indicate that teachers play different roles when integrating technological resources into the curriculum. The study further asserts that a teacher may play any kind of role in the integration of technological resources; however, the fundamental role is the transmission of knowledge to learners. These studies (Khoza, 2018; Mpungose, 2019, 2020a; Mthembu, 2018; Nani, 2019; Zuma, 2020) indicate that when a teacher plays a role of a leader, the teacher's action is informed by the intended curriculum and content knowledge. The teacher integrates technological resources into the curriculum over a stipulated period, and covers the prescribed content for that particular subject. Leaders' roles in the integration of technological resources relies on constructive integration − content covered in the subject is documented (CAPS, textbook, and study guides) (Khoza & Mpungose, 2018). Further to this, these studies (Baleni, 2017; Dlamini, 2019; Khoza & Mpungose, 2018) argue that when the teacher plays the role of the manager in the integration of technological resources, the actions are informed by the curriculum as achieved and pedagogical knowledge: the teacher is the only one who provides the information. Thus the manager's role in the integration of technological resources relies on personal integration because the teacher's knowledge is informed by his beliefs (Glanz & Heimann, 2019).

These studies (Biyela, 2018; Glanz & Heimann, 2019; Zondi, 2013; Zulu, 2020) further argue that, when the teacher plays a role of a facilitator, the teacher's engagements are informed by the curriculum as implemented. Technological knowledge, when the teacher integrates technological resources into the curriculum places learners at the centre. Facilitators' roles in

the integration of technological resources rely on unconstructive integration. The teacher facilitates the process of teaching and learning instead of spoon-feeding learners knowledge or information (Zulu, 2020). In short, the facilitator role allows learners to understand how to use technological resources through social interaction with others.

6.2.8 Theme 8: Location and time

The location and the time of any school make it convenient for the integration of technological resources (Carneiro et al., 2018). Almost all participants have revealed that although they do have the option of integrating technological resources online (refer to Figure 6.10.1) they prefer to teach face to face (refer to Figure 6.10) at the expense of blended learning (refer to Figure 6.10.2) These studies (Cele, 2019; Dladla, 2020; Dlamini, 2018; Doll, 1992) reflect that the teaching location is much more than simply the classroom in which the teacher integrates technological resources; it includes school grounds and the library, inter alia.

Figure 6.10 Face-to-face teaching and learning context

Theme 8 Data Presentation

6.2.8.1 Learning on face-to-face platform/environment

P6:

due to the parent being busy most of the time, we prefer to use these resources face to face. Our school has opted to do things face to face to avoid complaints from parents without WhatsApp

P1:

well I use these resources in the school because our learners are still young, if we were at high school I was going to create a WhatsApp group and educate them while I am at home, more to this, our school has parents that do not value education"

P8:

well currently with the covid-19 situation, you know everyone is doing it online where people are conducting classes, but with our kids it is impossible. Because with our children if you think they will do the work at home they not going to do it. So in our situation, it is better to do it face to face in the classroom than online

P3:

well for me I prefer live interaction in school because the online platform is not possible. After all, the child will never be responsible like an adult, so when it comes to online it demands a lot of things like data that might be a problem. But I do understand that online is also good but I believe in spoon-feeding learners in the classroom

Mpungose (2021) reveals that the integration of technological resources can take place anywhere inside the school building. The literature further implies that the integration of technological resources on school premises is supposed to be reflected in the 7 hours teachers work a day. This is in line with P6 who stated, "*Our school has opted to do things face to face to avoid complaints from parents without WhatsApp…"* thus P1 expressed, "*well I use these resources in the school because our learners are still young…"* P8 explained, "…*So with our situation, it is better to do it face to face in the classroom than online"* P3 remarked, "*well for me I prefer live interaction in school because the online platform is not possible because the child will never be responsible like an adult…"*

Figure 6.10.1 Online teaching and learning context

6.2.8.2 Learning on an online platform

P10:

Due to Covid-19, I think it is better to use these resources online, but I have more experience doing face-to-face than online.

P2:

We are in the fourth industrial revolution, and our system is shifting towards online. Therefore, I always prefer using these resources online.

P5:

I am comfortable using these resources face to face. however, since pandemics and the development of technology forces us as teachers to use these resources online, like WhatsApp and other software applications that make me prefer online learning

These scholars (Yurtseven Avci et al., 2020; Zulu, 2018) have revealed that the integration of technological resources in implementing the curriculum can take place anywhere. Meanwhile the policy document (CAPS) does not specify the location where teaching and learning should take place. The PAM document is only concentrating on time which is the 7 hours per day minimum time Monday to Friday. This was confirmed when P10 opined, *"Due to Covid-19 I think it is better to use resources online…"* P2 revealed, "*We are in the fourth industrial revolution, and our system is shifting towards online…"* P5 stated, *"development of technology forces us as teachers to use these resources online…" This* suggests that the integration of technological resources can also take place virtually, since the CAPS document is silent about the venue/environment.

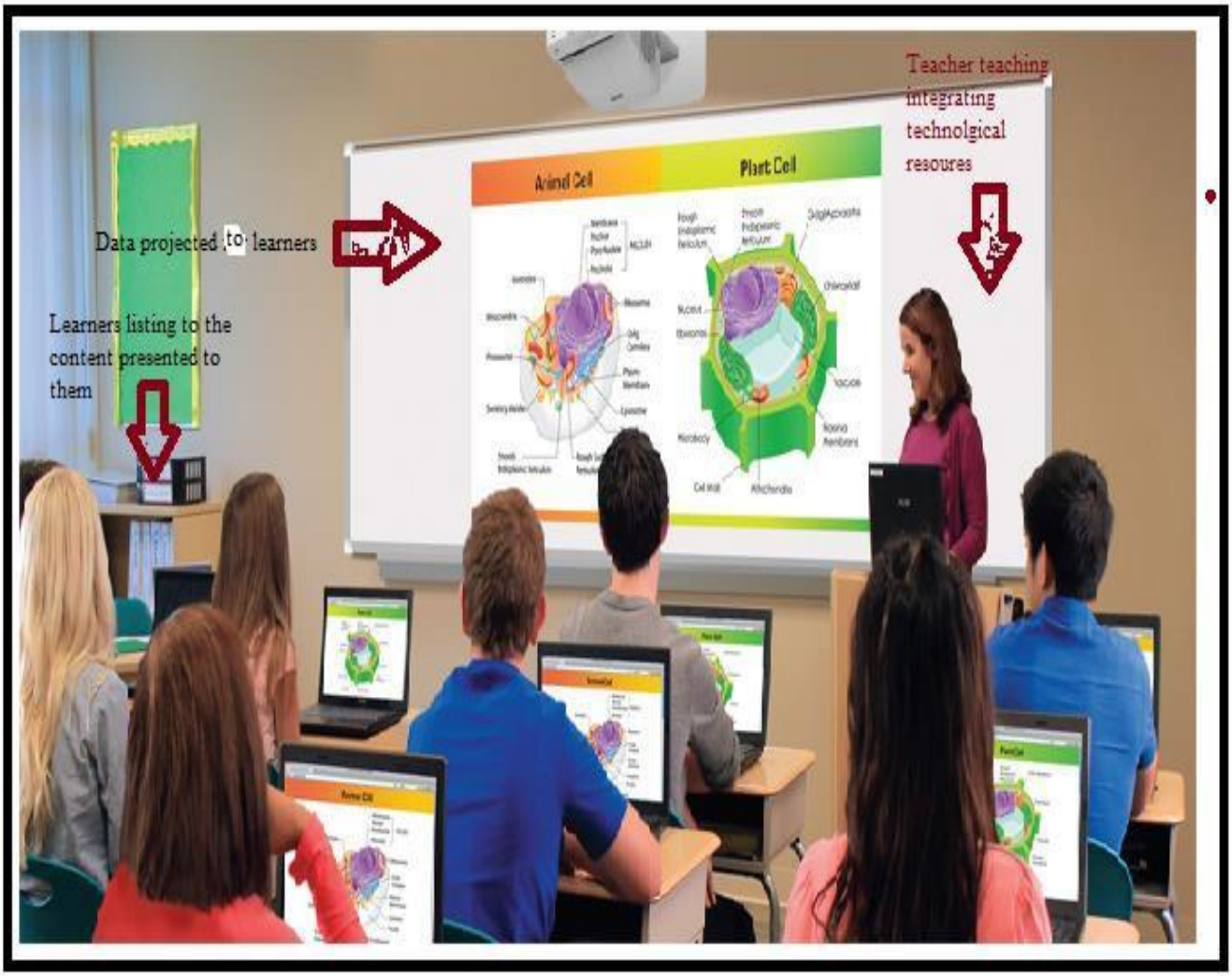


Figure 6.10.2 Blended teaching and learning context

6.2.8.3 Blended learning

P9:

I do both because the child benefits more and I find that teaching child online makes them more focused compared to face to face.

P7:

Face to face and online work for me and always keeps me updated, but I would say I have more experience doing face to face have experience than online, but I can do it online

P4:

I would say both because this allows us as teachers to complete the content that need to be covered, but I prefer to use resources face to face reasons being is that other learners might not have resources at home. So it is better if it faces facing for now

The CAPS document is silent about blended learning when integrating technological resources. However, some teachers are interested in integrating technological resources through blended learning. For instance, P9 indicated, "*I do both because the child benefits more…"* P7 shared, *"Face to face and online works for me and always keeps me updated …*" P4 contended, "*I would say both because this allows us as teachers to complete the content that needs to be covered …*" This suggests that content that must be completed every term can be achieved through blended learning to ensure that learners learn everything important to learn.

Theme 8: Discussion

A qualitative interpretive case study was conducted by Mpungose (2021) on lecturers' reflections on the use of Zoom VCT for e-learning at a South African university during the lockdown resulting from the COVID-19 outbreak. E-reflexive activities and one-on-one semi-structured Zoom interviews were used for data generation. The study indicated that the integration of technological resources into the curriculum can take place physically or in an online environment. This was supported by Msibi and Mchunu (2013) who aver that integration of technological resources can take place face to face. When teachers focus on the traditional way of teaching, the teacher and learners meet in person to exchange information integrating technological resources into the school. Thus, when teachers meet learners in person, the teacher is driven by the vertical side of the curriculum. The teacher integrates technological resources by referring to a particular document (textbook) (Nani, 2019). Teachers who integrate technological resources face to face require such to be guided by constructive integration and content knowledge. Teachers are led by transcribed documents when integrating technological resources into the classroom (Oke, 2020).

These studies (Msibi & Mchunu, 2013; Mthabela, 2019; Mthembu, 2018; Mwalongo, 2018; Mwendwa, 2017) further delineate online learning as learning that occurs through technological resources. This type of learning is guided by the horizontal side of the curriculum. The teacher conducts the lesson or exchanges the information, not meeting the learners physically. For instance, the teacher shares information with learners using various online platforms such as WhatsApp, Facebook, and blockchain (Mpungose, 2021). Thus,

Mohamed and Ahmad (2019) state that this requires teachers to rely on unconstructive integration and technological knowledge when teaching using these technological resources. These studies (Dladla, 2020; Dlamini, 2018; Goradia, 2018) outline that blended learning is the mixture of traditional learning with online learning when integrating technological resources. This type of learning requires teachers to be driven by personal integration. Teachers are expected to use their pedagogical knowledge to integrate technological resources. Therefore, teachers are driven by the diagonal side of the curriculum − integration of technological resources takes place both online and traditionally (Dladla, 2020).

6.2.9 Theme 9: Assessment

There were mixed responses on how teachers assess their subjects by integrating technological resources. From the findings, it was noted that teachers are reluctant to integrate technological resources into the curriculum when assessing their subjects.

Data Presentation

6.2.9.1 Integrating technological resources into a formative assessment

P10:

It is not easy to integrate technological resources in assessment because were not taught how to do it, but I play a game called online carwhoo hoot with learners as a form of formative assessment

P1:

As I have said early on, we focus on class activities and homework when time is available to assess them using these resources

P2:

I try to adjust it according to what the assessment wants. I can only use the resources if it is the assessment that requires the resource"

The data generated from participants has revealed that teachers are not aware that formative assessment aims to provide clear feedback on the learning progress, which is valuable to teachers and learners. The findings revealed that teachers are unenthusiastic to integrate technological resources into formative assessment. Thus P10 shared, *"It is not easy to integrate technological resources in assessment because were not taught how to do it…"* On the other hand, other teachers prefer to integrate technological resources into certain

activities. P1 referred to the following, *"we focus on class activities and homework when time is available to assess them using these resources.* This suggests that teachers are not aware that technological resources play an enormous role when integrated during formative assessment.

6.2.9.2 Integrating technological resources into summative assessment

P4:

Only if the department can set on line examination for us. I normally use questions and rubrics to assess learners maybe after listening to a particular poem played on the radio in the classroom

P5:

Yes, we do have a grade R spreadsheet that says they can now see and recognize things, so we assess term 4 to prepare and evaluate them for the next Grade of is Grade 1

P3:

No, we use the old method to assess learners in the school but we do have computers, the problem is we don't have anyone who can do online tests and examinations for us.

P7:

like everything we do in school is restricted with time, we don't have enough time because we have so much to finish, math is so extreme you will not believe it, it 50 pages per term double side of a page. So it is not possible

The data from the participants has reflected that teachers still believe in the old method when conducting summative assessments despite having computers in schools. P3 stated, "*No, we use the old method to assess learners in the school but we do have computers…"* Teachers appear to be ignorant on and reluctant to integrate these resources when a summative assessment is administered. P4 opined, *"Only if the department can set online examination for us…"* In line with this P7 revealed, *"like everything we do in school is restricted with time, we don't have enough time because we have so much to finish…"* This suggests that the correct actions are not taken by teachers when conducting the summative assessment.

6.2.9.2 Integrating technological resources into continuous assessment

P6:

Formal assessments are not done using resources but technological resources are used to prepare for formal assessments for example technological resources to search for the information that will assist learners' in informal assessment

P9:

As I have mentioned I teach using videos and slides. thus, at the end of the lesson I recap and ask learners what was taught, and what have they learned.

P8:

it is not easy to assess learners using resources, so I prefer to use resources when I am teaching because resources are limited in the school

The data from the participants has reflected that technological resources are used by teachers for different assessments. The findings from teachers revealed that teachers are effusively sentient of continuous assessment. Therefore P6 stated, "*I use technological resources to search the information that will assist learners' in informal assessment…"* P9 explained, "*Like I have mentioned I teach using videos and slides. …".* This suggests that technological resources play an enormous part in continuous assessment to prepare learners for formal and informal assessment and to develop learners' level of thinking. However, it was noticeable that the data generated from the participants shows that teachers are struggling to integrate technological resources in continuous assessment.

Theme 9: Discussion

Assessment is viewed by various scholars as a tool teachers use to evaluate whether the goal of teaching and learning has been met at the end of the term or year (Weeden, Winter, & Broadfoot, 2002; Zhou et al., 2020; Zulu, 2020; Zuma, 2019). Ntombela (2020) asserts that these assessments also assist teachers to decide whether the learners have understood the content taught when teaching and learning take place after integrating technological resources. The latter studies further argue that summative assessment is guided by Bloom's taxonomy. Learners are assessed on both simple and complex questions. This type of assessment (summative) is informed by the curriculum as intended; it determines whether learners are ready to progress to the next grade or term (Nene, 2019). Consequently, summative assessment causes teachers to be driven by constructive integration and content

knowledge. Summative assessment is based on certain criteria. For instance, a teacher can set a test/examination guided by the content taught during the term. Furthermore, Nani (2019) avers that teachers may integrate formative assessment into teaching and learning to prepare learners for a final evaluation. Formative assessment is informed by the curriculum as achieved, and by pedagogical knowledge, evaluation occurring during teaching and learning. Teachers thus rely on personal integration since learners may ask questions, engaging the teacher during the teaching and learning process (Biyela, 2018). Mpungose (2021) reminds us about continuous assessment, in which learners evaluate one another's work in preparation for the final examination. Continuous assessment is guided by the curriculum as implemented and by technological knowledge on which teachers evaluate their strengths and weakness for improvement purposes. Thus, teachers rely on unconstructive integration. The above suggests that teachers should well be capable of integrating technological resources for all kinds of assessments (formative, continuous and summative). However, Mlaba (2020) finds that teachers in primary schools are reluctant to integrate technological resources into the curriculum solely because they are digital immigrants.

In line with findings, teachers are struggling to integrate technological resources into all forms of assessment equally. The findings from teachers revealed that teachers are fully aware of continuous assessment at the expense of summative and formative assessment; however, they have no knowledge of how to integrate these resources. For instance, examinations, tests and classwork are not conducted using technological resources. This, therefore, creates an imbalance in the use of technological resources during the assessment. Consequently, this study advocates for the balanced use of levels of integration so that all forms of assessment are treated equally. The CAPS document is silent on integration of technological resources such as computers, Wi-Fi, projectors and SMART boards during assessment in schools (Almekhlafi & Almeqdadi, 2010). However, findings show that schools do have access to the Wi-Fi, projectors, tablets, and laptops; yet teachers are unable to integrate these resources during assessment. Teachers have themselves not become conversant with technology use. This position hinders teachers from knowing how to integrate these resources during assessment.

CHAPTER 7

SUMMARY, MAJOR FINDINGS RECOMMENDATION, IMPLICATIONS, AND CONCLUSION OF THE STUDY

7.1 Introduction

Chapter Six presented and discussed the findings in terms of themes that occurred and emerged from the data generated in response to the research questions through semi-structured interviews and focus groups. In this concluding chapter, the findings of the theory of the study are discussed.

The study pursued to explore integration of technological resources into curriculum in the Fourth Industrial Revolution (4IR): the context of primary schools in Pinetown District using the following research questions:

1. What technological resources do teachers integrate into the curriculum in the 4IR?
2. How do teachers integrate technological resources into the curriculum in the 4IR?
3. What informs teachers to integrate technological resources into the curriculum in the 4IR the way they do?

To achieve the right results, the study analytically engages sufficient literature. This significantly helped in classifying integration (phenomenon) into three levels, namely, constructive integration, unconstructive integration, and personal integration. The above levels work as a single component in driving comprehensive integration. The study employed an interpretivism paradigm that has contributed positively to this study. Thus, this study aimed to explore the integration of technological resources into the curriculum in the Fourth Industrial Revolution. This chapter presents the summary, recommendations, and conclusion derived from the data analysis and discussions. It begins with a summary of each of the previous chapters, and then discusses the major findings of my study, followed by suggestions for further research and the recommendations made by this study, ending with the conclusion.

7.2 Overview of Previous Chapters

7.2.1 Chapter 1 - Overview

The study starts with a stimulating topic: “Integration of Technological Resources into Curriculum in the Fourth Industrial Revolution (4IR): The Context of Primary Schools in Pinetown District.” This project title has arisen in that there are few studies conducted about integration of technological resources into curriculum in the Fourth Industrial Revolution (4IR), especially in primary schools. The curriculum in schools demands that teachers shift from paper-based methods (traditional) to technologically based methods to meet the demands of the 4IR. This study is qualitative: it aims for teachers’ understanding of the use of technological resources in the 4IR era. The background of the topic supported the choice of the research paradigm, which is an interpretive paradigm. This paradigm was not simply selected: critical research objectives and research questions were considered to conclude this study. Furthermore, this study was framed by the technological pedagogical content knowledge (TPACK) theory. This theory was engaged on the basis that it captures almost all aspects of the curriculum and the topic being studied as a whole. Lastly, three methods of data generation were applied – Zoom focus group, emailed reflective activity, and online one-on-one semi-structured interviews. These methods were selected based on the need to fully answer the research questions of the study.

7.2.2 Chapters 2 and 3 - Overview

The literature review has categorized integration into three levels, namely, constructive integration, unconstructive integration, and personal integration. These levels have been aligned with the curriculum origins. These curriculum origins have been defined from a different point of view in this study. Curriculum origins comprise accessibility, goals, content, activities, teaching aids, role, location, time, and assessment. More to this, technological resources, as tools that have been used in various schools have been discussed and aligned with the curriculum and integration levels. The study further gets on arguments extensive with scholarly ideas and personal interpretation and understanding. This has given more significance to this study. Further to this, the literature pointed out two main definitions of curriculum. A curriculum is defined as the constructive plan which is the “plan for learning” (intended stage) (Van den Akker et al., 2009). Moreover, a curriculum is defined as an unconstructive plan “plan for learning” (implemented and achieved) (Pinar, 2010). Lastly,

The TPACK concepts are raised as curriculum origins to this study. Those origins are aligned with constructive integration, unconstructive integration, and personal integration.

7.2.3 Chapter 4 – Overview

The theoretical framework this study adopted was the TPACK by Shulman (1986). This theory was engaged on the basis that each component of TPACK is accommodated or may be aligned with levels of integration and also with curriculum origins. For instance, constructive integration is aligned with content knowledge and informed by a vertical curriculum. Unconstructive integration is aligned with technological knowledge and informed by horizontal/competence curriculum. Personal integration is aligned with pedagogical knowledge and informed by a pragmatic curriculum. The TPACK theory was the only theory that was suitable for this study in exploring the study phenomena. As with other theories, the TPACK theory has its limits and encounters that have been discussed lengthily in the previous chapter.

7.2.4 Chapter 5 – Overview

With the prominence of the interpretive paradigm and phenomenological research in this study, I have the assurance that the interpretive paradigm fills teachers with knowledge of significant current issues. The empowerment of teachers with current knowledge ensures that teachers gain an understanding of curriculum origins, since before this study teachers were not aware of curriculum origins. Furthermore, teachers have developed a sense of understanding of the world of integration, which was the most interesting aspect of learning during data generation. Teachers were enabled to find their identity with the curriculum as they integrated technological resources. Qualitative research has been instrumental in this study, ensuring that teachers understand integration and are aligned with the relevant levels of integration.

7.2 Alignment of Teachers' Accounts, and Levels of Integration

Table 7.1 below demonstrates the relationship between themes and levels of integration. These scholars (Mthabela, 2019; Mthembu, 2018; Nani, 2019; Ntombela, 2020; Peter, 2019) argue that, to achieve goals of integration, teachers need to understand the alignment of integration levels with curriculum origins.

Table 7.1: Themes, Alignment of Teachers' Accounts, and Levels of Integration

Themes (Curriculum origins)	Alignment of Teachers' Accounts	Levels of Integration
ACCESSIBILITY	PHYSICAL	Constructive integration
	FINANCIAL	Unconstructive integration
	CULTURE	Personal integration
GOALS	OBJECTIVES	Constructive integration
	OUTCOMES	Unconstructive integration
	AIMS	Personal integration
CONTENT	TOPIC	Constructive integration
	EXPERIMENT	Unconstructive integration
	SUBJECT KNOWLEDGE	Personal integration
ACTIVITIES	FORMAL	Constructive integration
	INFORMAL	Unconstructive integration
	CONTINUOUS	Personal integration
RESOURCES	HARDWARE	Constructive integration
	SOFTWARE	Unconstructive integration
	IDEOLOGICAL-WARE	Personal integration
ROLE	INSTRUCTOR	Constructive integration
	FACILITATOR	Unconstructive integration
	MANAGER	Personal integration
LOCATION	FACE TO FACE	Constructive integration

	ONLINE	Unconstructive integration
	BLENDED	Personal integration
TIME	WEEK	Constructive integration
	DAY	Unconstructive integration
	HOUR	Personal integration
ASSESSMENT	SUMMATIVE ASSESSMENT	Constructive integration
	CONTINUOUS ASSESSMENT	Unconstructive integration
	FORMATIVE ASSESSMENT	Personal integration

The Zoom focus group, emailed reflective activity, and online one-on-one semi-structured interviews were helpful in categorising the three levels of integration. The data-generation methods were in line with curricular origins, producing a group of concepts that formulated a balanced curriculum. The Zoom focus group was aligned with the first research question. Emailed reflective activity was aligned with the second research question. The online one-on-one semi-structured interview was aligned with the third research question. The findings of this study indicate the need to frame the curriculum within the three propositions of integration; notably all curriculum origins, as indicated in the table above. Within the findings, the curriculum is not balanced when it is being dominated by one or two propositions. These scholars (Cele, 2019; Dlamini, 2019; Khoza, 2021b; Khoza & Mpungose, 2018) affirm that a balanced curriculum is one that addresses these three levels of integration: constructive, unconstructive, and personal.

7.3 Summary of Findings and Recommendations

The study has focused on what is known by teachers about the integration of technological resources into the curriculum in 4IR. Curriculum origins were used to categorise teachers' responses. The data gathered has shown that teachers were ignorant of levels of integration and curriculum origins. Using the Zoom focus group, emailed reflective activity, and online

one-on-one semi-structured interviews has led us to the conclusions drawn as follows on each of the concepts of the curriculum origins.

7.3.1. Resources

Figure 7.1 below demonstrates the imbalance in levels of resources when teachers integrate technological resources into the curriculum in the 4IR era.

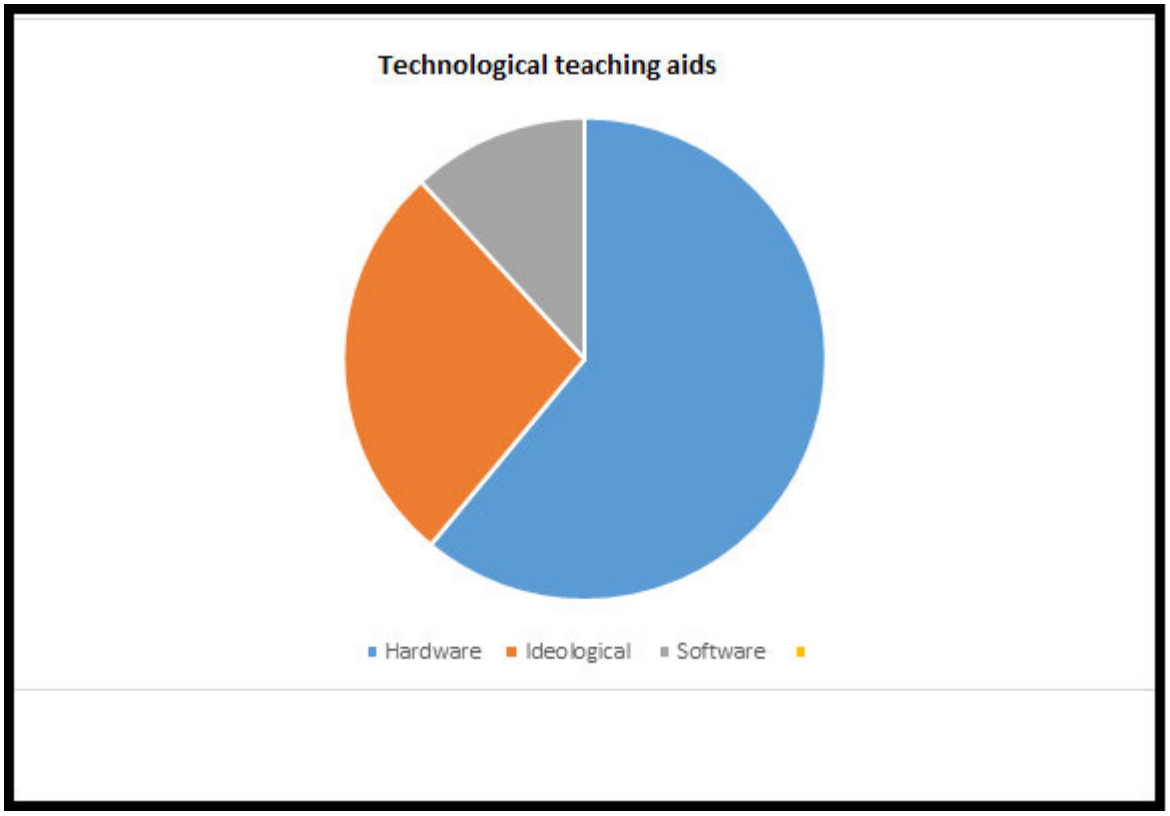


Figure 7.1 Resources integrated into the curriculum

In an attempt to understand which technological resources teachers integrate into the teaching of the curriculum, the findings from the semi-structured interviews revealed that teachers are good at hardware resources such as computers, textbooks, and projectors. On the other hand, findings from emailed reflective activity attest to teachers not being good at, and even struggling with software resources such as Zoom meetings, team meetings, Skype, WhatsApp, Facebook, because they are not trained to use these programmes. For instance, teachers in schools cannot create Zoom meetings although computers are at their disposal. Participants also demonstrated little understanding of ideological-ware resources that can be integrated into the curriculum in this era; such as the question-and-answer method. These findings suggest that constructive and personal levels of integration are more dominant, while

unconstructive integration is less dominant during the teaching learning process. Teachers thus rely more on content knowledge and pedagogical knowledge and less on technological knowledge when integrating technological resources into the primary school curriculum. Therefore, this study recommends that curriculum developers, with ICT team specialists, work in collaboration to train and develop teachers in schools on software and ideological-ware resources. This will ensure continuous teaching and learning in a paperless form, especially during times of pandemics (such as with COVID-19). Curriculum developers should be given five months to revise and review the policy document and manuals that teachers rely on when integrating technological resources in schools.

7.3.2 Rationale

What emerged during data generation is that teachers integrating technological resources into the curriculum are driven by personal reasons which come from within. For instance, participants have revealed that they integrate technological resources driven by passion. Teachers are exposed to technological components, strongly believing that these resources attract attention during teaching and learning. On the other hand, teachers are struggling for societal reasons during teaching and learning. Participants cited parents not taking the responsibility of supporting teachers in the integration of technological resources. Not all parents are well educated and the majority of parents are digital immigrants. The findings from the semi-structured interviews revealed that teachers have little knowledge of professional reasons for technological integration. Findings demonstrate that teachers have little operational knowledge of technological resources gained from the university. Most participants were incompetent to integrate these technological resources into the curriculum. Teachers were also silent about the use of manuals and policy documents provided by the Department of Education for their teaching. Overall, these accounts suggest that teachers are more driven by personal reasons and less driven by societal reasons, including professional reasons, when teaching subjects. Teachers' actions during integration of technological resources are driven by personal integration at the expense of constructive and unconstructive integration. See below Figure 7.2 demonstrating the imbalance in reasons for teachers integrating technological resources according to the findings. The above suggests that teachers depend on pedagogical knowledge and less on content and technological knowledge. This study therefore recommends that universities and colleges offer short courses for teachers on how to integrate technological resources into the curriculum to advance them professionally. The short courses or modules must focus on current information such as

blockchain, 5 G, Zoom meetings, revolution of technology, WhatsApp chat groups, inter alia. Further to this, this study recommends that Department of Education work in collaboration with parents to equip and develop parents on the importance of using technological resources.

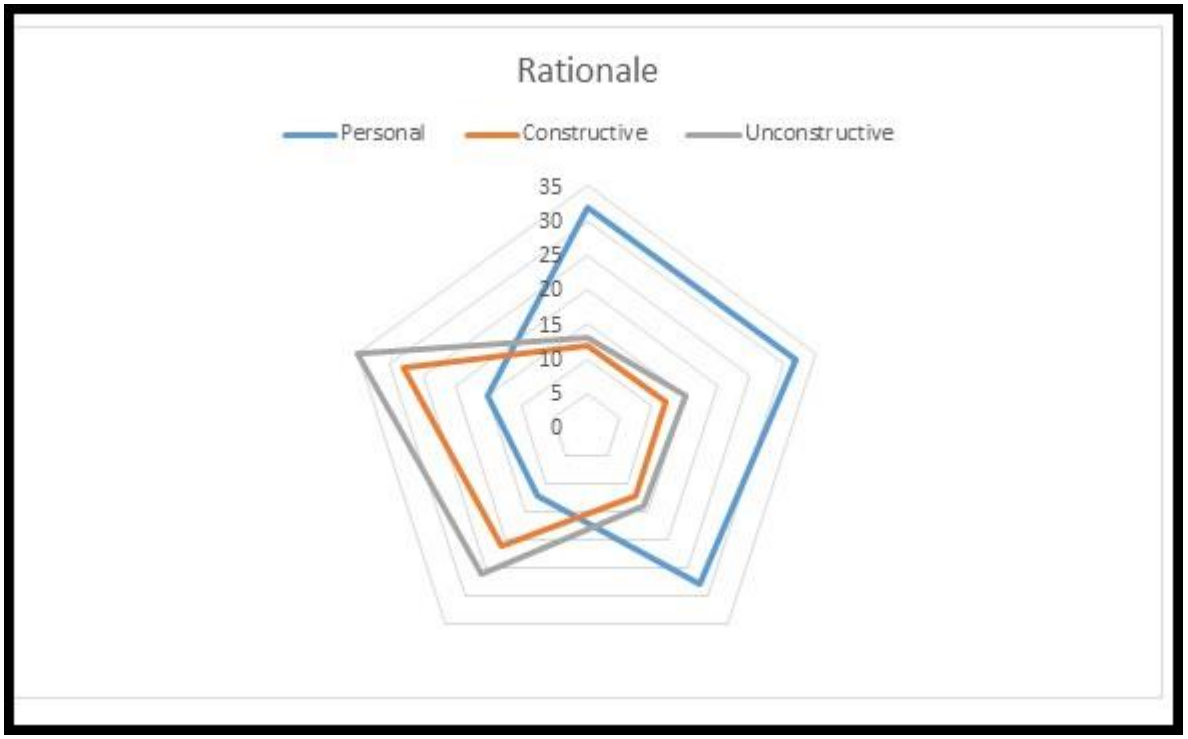


Figure 7.2 Reasons for integrating technological resources

7.3.3 Content

The findings suggest that teachers are aware of all categories of content during teaching and learning. The data from the participants revealed that teachers do understand that technological resources can be integrated into the topics they teach, and into all subjects taught at school. Social sciences teachers admitted that the main topic for which they use technological resources when teaching is weather patterns. During online one-on-one semi-structured interviews, natural sciences teachers exhibited that they are confident that technological resources work for them when conducting experiments such as separation of mixtures that need the following technological resources: sieve, magnet, filter, gauze mat, and beaker. The findings further suggested that teachers do understand the importance of integrating technological resources with the sub-topic during teaching and learning. For instance, history teachers consider the subject Europeans as a sub-topic in Term 2. On the other hand, mathematics teachers also mentioned that in Term 2 they focus on surface area, volume, and perimeter as sub-topics. Teachers are therefore equally driven by all levels of

integration. Teachers are equally motivated by all levels of knowledge when integrating technological resources into content. See Figure 7.3 below representing balanced content when teachers integrate technological resources.

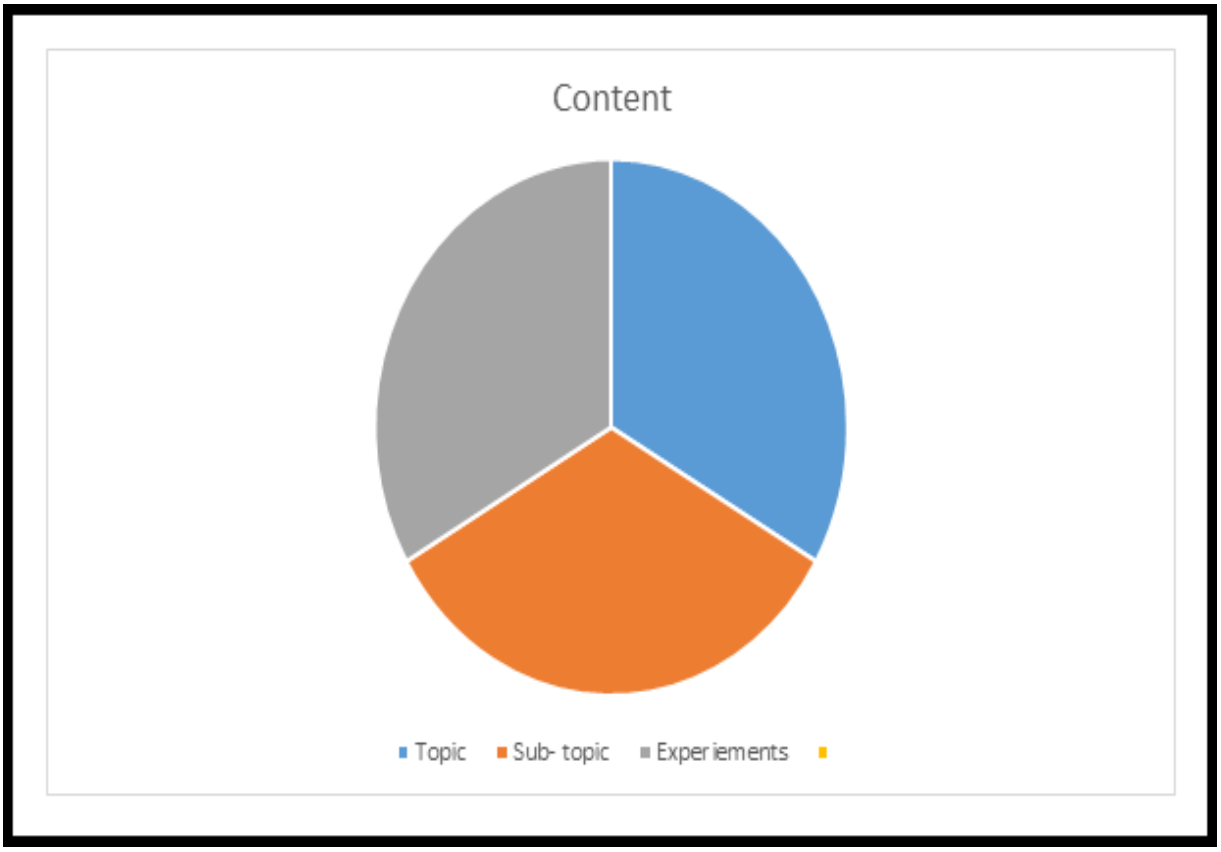


Figure 7.3 Content integrated into curriculum

7.3.4 Accessibility

What appeared from the data is that the dominant category in accessibility is physical accessibility. For instance, teachers revealed that, to ensure physical accessibly of technological resources in school, they use whatever is at their disposal to achieve the goal of the curriculum, such as radio, laptop, cellphones and projectors in class. On the other hand, teachers revealed that they are stressed when it comes to financial accessibility because they have to make difficult choices. Teachers attend workshops from distant areas using their own financial resources for travel costs. This leaves teachers frustrated and angry because they are not compensated by the Department of Education. Participants also further demonstrated a need for cultural accessibly, the dominant ethnic group in these schools being learners

speaking the isiZulu language. However, teachers are required to integrate technological resources into the curriculum demonstrating or speaking in English because the language of teaching and learning is English. The above findings suggest that constructive level of integration is dominating at the expense of unconstructive and personal integration. See Figure 7.4 below representing imbalance in accessibility of technological resources when teachers integrate technological resources. The above findings suggest that teachers rely on content knowledge and less on technological and pedagogical knowledge when integrating technological resources in primary schools. This study recommends that the Department of Education move from running workshops face to face to running workshops online to avoid financial issues. This will ensure that all teachers in schools are equipped with current knowledge every day or every week at least. Curriculum developers must be given five months to revise the policy document ensuring that it accommodates all ethnic groups, especially the isiZulu learners, because schools in KZN are dominated by learners speaking the isiZulu language.

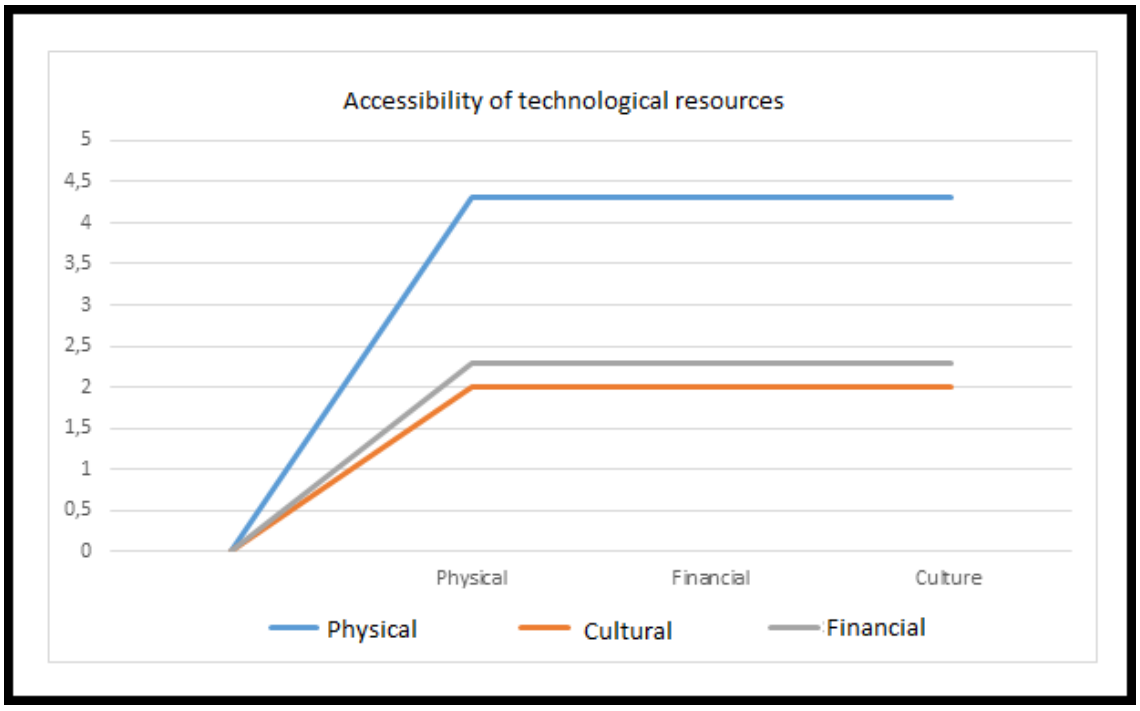


Figure 7.4 Accessibility of technological resources

7.3.5 Goals

The findings suggest that teachers are aware of all categories of goals during teaching and learning. The data from the participants revealed that teachers do understand that the Department of Education's idea on integrating technological resources into the curriculum is to develop and maintain good habits that can increase teachers' and learners' ability, confidence, and self-esteem. Teachers expressed that their aim was to create interest in the lesson, to capture learners' attention, and to facilitate the meaningful understanding of the content. During online one-on-one semi-structured interviews participants exhibited that their objective is to ensure that learners understand the content. This is in line with the Department of Education's objective of integrating technological resources into the curriculum to ensure that learners understand the curriculum by the end of the year. Participants further demonstrated that their outcomes hinge on learners' performance which is in line with the CAPS document. For instance, teachers mentioned that their intended outcomes are the achieving of excellence in the performance of the learners. Teachers are equally motivated by all levels of knowledge when integrating technological resources into the content. Figure 7.5 below represents balanced goals when teachers integrate technological resources.

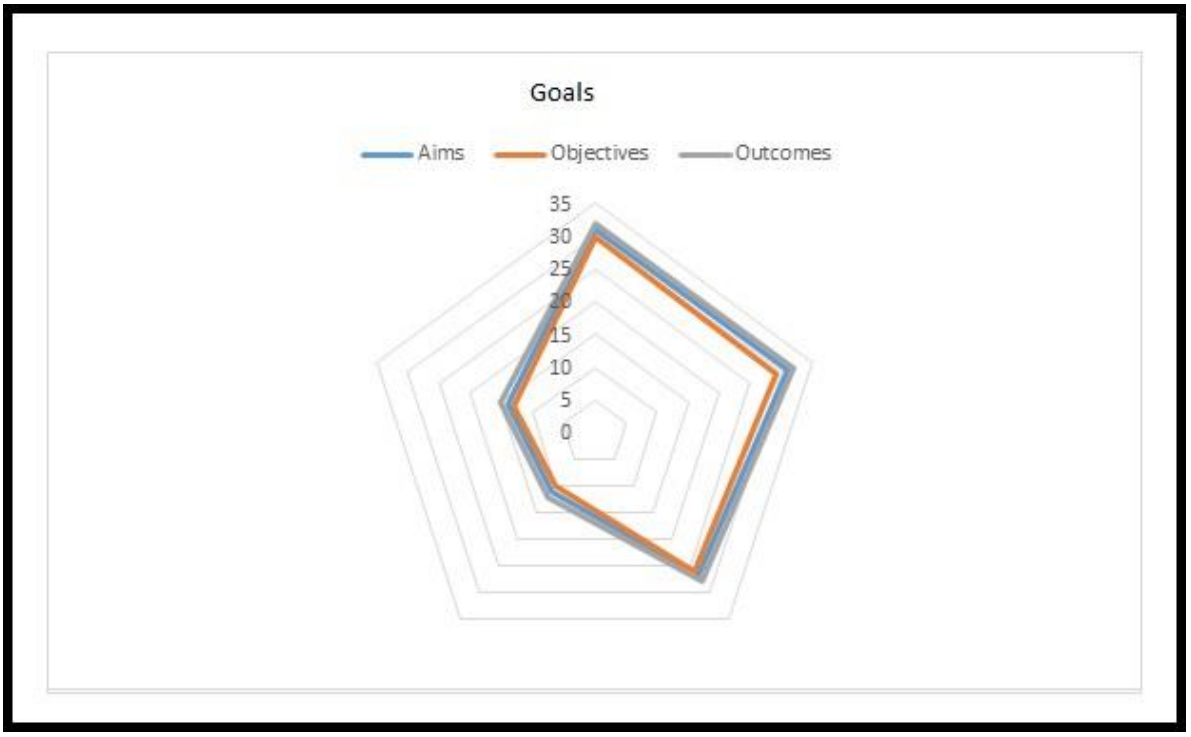


Figure 7.5 Goals integrated into curriculum

7.3.6 Activities

In an effort to understand activities into which teachers integrate technological resources, the findings revealed that teachers enjoy integrating technological resources into informal activities such as classwork. Teachers reveal that they prefer informal activities because these prepare learners for formal activity such as examinations. Teachers added that, due to time constraints and limited resources, it is preferable to integrate technological resources into informal activities. On the other hand, the findings reveal that a small number of teachers integrate technological resources into formal activities such as tests and examinations. However, they much prefer integrating technological resources into informal activities. Teachers focus on informal activities such as classwork and debates, because they want to save time. Participants also revealed that they integrate technological resources into continuous activities when they want to see whether learners understand the topic. The data generated showed that teachers put more effort into informal activities when integrating technological resources into the curriculum, while ignoring the essence of continuous activities. The above findings suggest that teachers depend on the unconstructive level of integration at the expense of constructive and personal integration. See Figure 7.6 below representing the imbalance of activities**.** The above findings suggest that teachers are influenced by technological knowledge and less by content and pedagogical knowledge when integrating technological resources in primary schools. This study therefore recommends a policy that will ensure that technological resources are integrated into all activities in schools. More so, the policy document (CAPS) under the resources section must include all available resources in schools such as computers, tablets, overhead projectors, notepads, smartphones, televisions, making it compulsory to integrate these resources. Furthermore, the policy document must include practical examples on how to integrate these resources (step by step) giving teachers hands-on support.

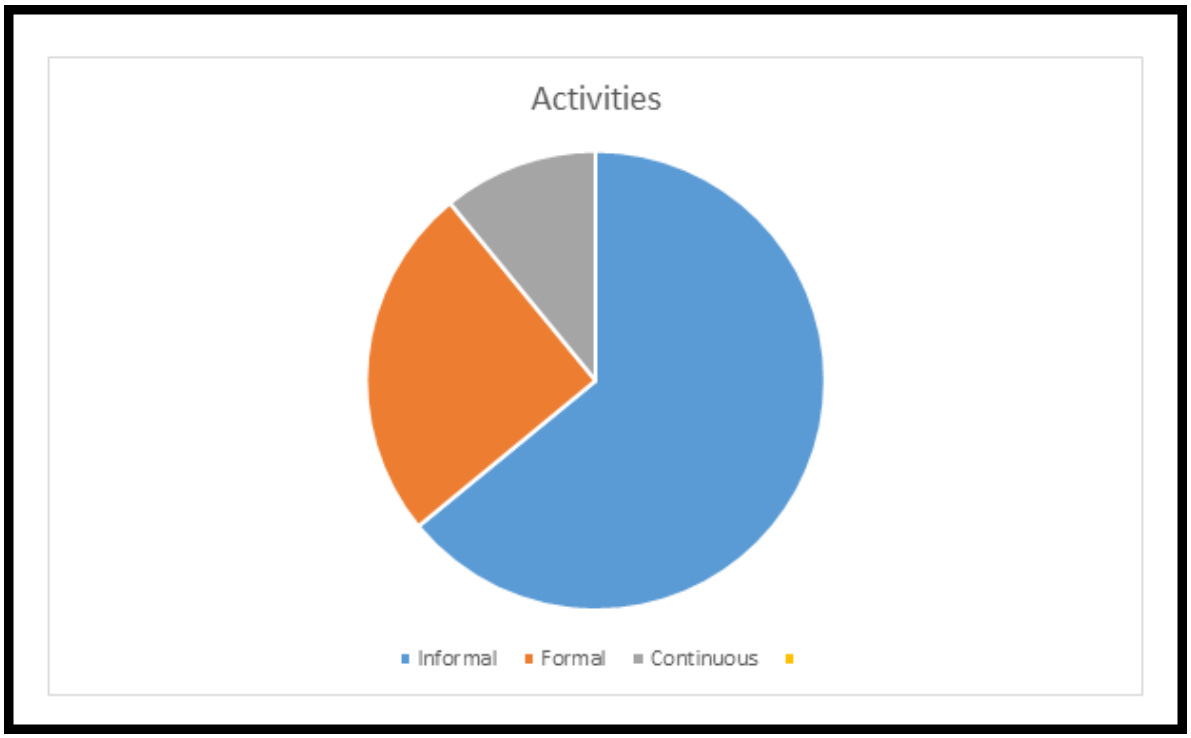


Figure 7.6 Activities integrated into curriculum

7.3.7 Role

See Figure 7.7 below demonstrating the unbalanced levels of roles when teachers integrate technological resources into the curriculum in the 4IR era.

Figure 7.7 Roles integrated into curriculum

In trying to understand the roles teachers play when integrating technological resources into curriculum, the findings were examined. Findings reflected that teachers are good in playing a facilitator role when integrating technological resources. Teachers stated that they see themselves as facilitators because they have to support and monitor learners' work during the teaching process. Teachers' responses are in line with these studies (Amory, 2010; Mwalongo, 2018) because teachers who integrate technological resources into the curriculum placing learners at the centre are indeed facilitators. Teachers demonstrated confusion and frustration when they had to answer whether they see themselves as leaders. Teachers believe that they are leaders when leading learners to new knowledge. This contradicts with these studies (Khoza & Mpungose, 2018) in that a leader is someone who integrates technological resources into the curriculum over a stipulated period, and covers the prescribed content for that particular subject. Participants further demonstrated little understanding of a manager when integrating technological resources into curriculum. Teachers evince very little understanding that a manager must ensure that learners are following all the guidelines and instructions. These findings suggest that unconstructive and personal levels of integration are more dominant; while constructive integration is less dominant during teaching and learning.

Teachers rely more on technological and pedagogical knowledge and less on content knowledge when integrating technological resources into the curriculum. This study therefore recommends that short online courses be developed for teachers on teachers' roles when integrating technological resources into the curriculum.

7.3.8 Location and time

Figure 7.8 below demonstrates the unbalanced levels of location and time when teachers integrate technological resources into the curriculum in the 4IR era.

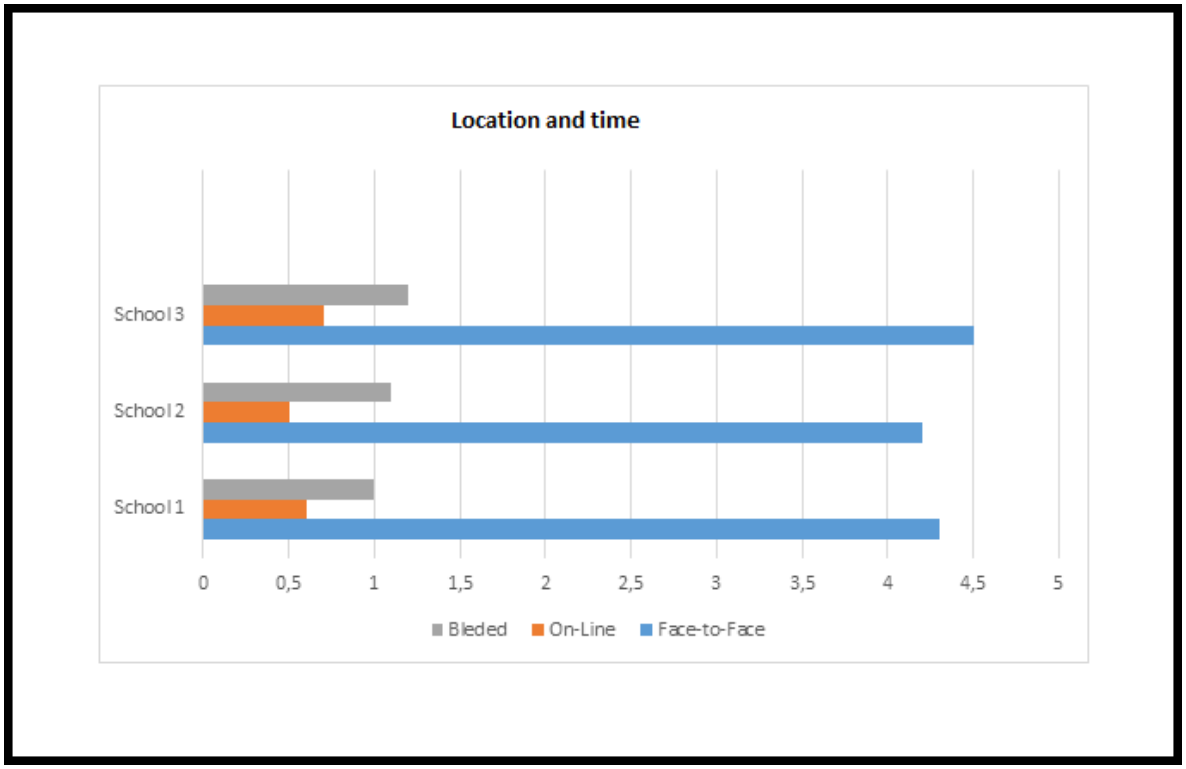


Figure 7.8 Location and time

What arose from the findings is that teachers prefer to integrate technological resources face to face during teaching and learning. From the data, teachers revealed that, due to the parent being busy most of the time, they prefer to use these resources face to face. Participants opted for face-to-face teaching to avoid complaints from parents. Further to this, teachers revealed that they prefer live interaction with learners in school because the online platform is not possible. The child will never be as responsible as an adult. On the other hand, teachers revealed that they are not good at integrating technological resources online because they are

not equipped to do so. It is also expensive to use these resources such as creating Zoom meetings with learners. Participants demonstrated little understanding of and interest in blended learning. These findings suggest that unconstructive and personal levels of integration are less dominant, while constructive integration dominates during teaching and learning. Teachers thus rely more on content knowledge and technological and pedagogical knowledge when integrating technological resources. This study therefore recommends that the Department of Basic Education organize workshop with manuals that equip teachers to integrate technological resources both online and blended. Universities and colleges also need to offer modules that equip teachers on both online and blended learning.

7.3.9 Assessment

What appeared from the findings is that the dominant category in assessment is continuous assessment. Teachers' responses showed that they see a need to integrate technological resources into continuous assessment. Teachers revealed their use of continuous assessment when learners work in groups to execute a task. Integrating technological resources saves time during teaching and learning. Moreover, the findings generated from teachers further demonstrated that teachers are struggling to integrate technological resources into formative assessment. Teachers are not taught or skilled on how to integrate technological resources into formative assessment to provide prompt feedback during the learning progress. Teachers are struggling to create WhatsApp groups by which to send work to learners. Furthermore, the data generated from teachers revealed that teachers still believe in the old method when conducting summative assessments, whereas they do have computers in schools. Teachers stated that they can integrate technological resources into summative assessment only if the Department of Education can set online examinations for them. This means that teachers are ignorant about and reluctant to integrate these resources when summative assessment is administered. Teachers are thus not equally driven by all levels of integration. Constructive and personal levels of integration are less dominant, while unconstructive integration is more dominant during teaching and learning. Referring to Figure 7.9 below demonstrates the imbalance in levels of assessment when teachers integrate technological resources into the curriculum in the 4IR era. Thus, the above data suggest that teachers rely more on technological knowledge and less on content and pedagogical knowledge when integrating technological resources into the curriculum. This study therefore recommends a policy that will ensure that technological resources are integrated into all assessments at school. Moreover, the policy document (CAPS) under the assessment section must include all

available resources in schools such as tablets, overhead projectors, notepads, smartphones, televisions computers, so that it will be compulsory to integrate these resources. Furthermore, the policy document must include practical examples on how to integrate these resources into assessment.

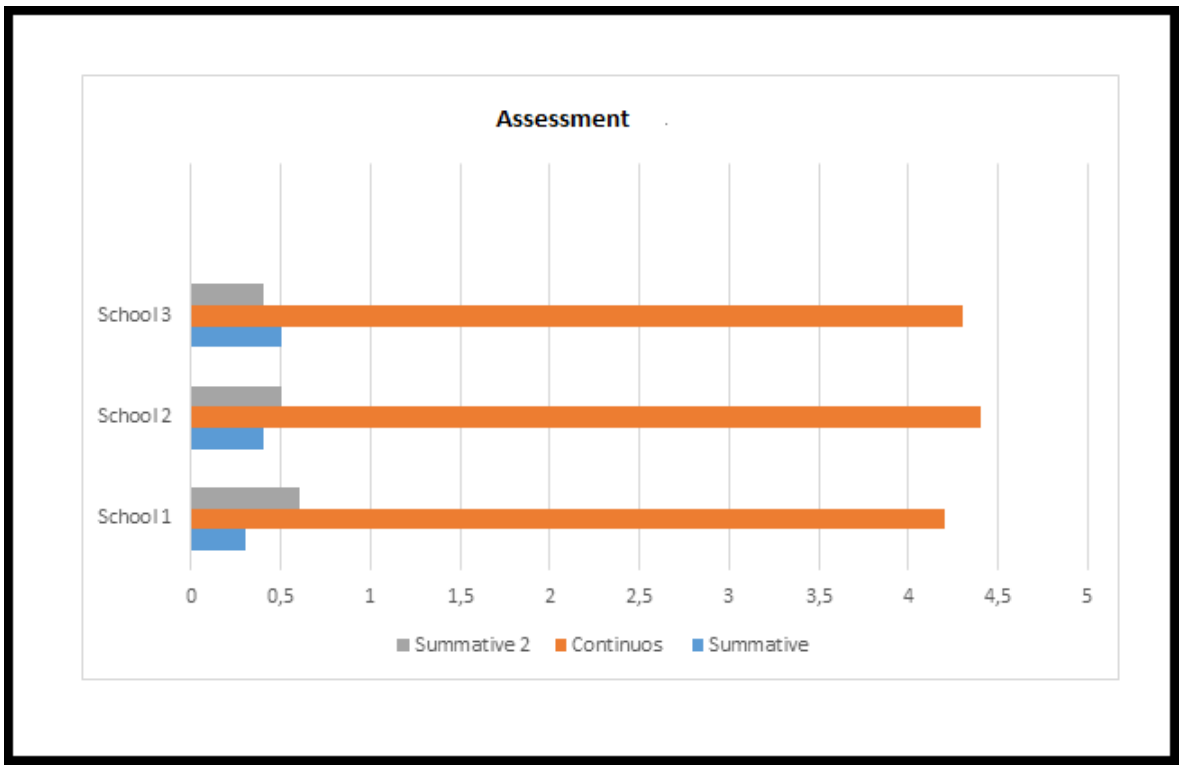


Figure 7.9 Assessment integration into the curriculum

7.4 Addressing the Research Questions

This qualitative study has been conducted to respond to three main research questions. The study aimed to explore the integration of technological resources into the curriculum in the Fourth Industrial Revolution (4IR) to respond to research questions of what (description), how (operation), and why (philosophy). This research is shaped by existing literature and data generated which is guided by the concepts of the TPACK framework. Moreover, this case study was conducted to further attempt to respond to the questions though the use of Zoom focus group, emailed reflective activity, and online one-on-one semi-structured interviews. As such, the following research questions were addressed separately. Thus, the first research question (the first question posed): What technological resources do teachers integrate into the curriculum in the 4IR? was intended to address the first research objective:

To explore technological resources integrated into the curriculum in the 4IR. In addressing the first question, the findings of the study suggest that teachers integrate various types of technological resources ranging from HW, SW, and IW resources into the curriculum. Hardware resources are tools integrated into the curriculum to meet teaching and learning needs, such as tablets, overhead projectors, notepads, smartphones, televisions, and computers (Khoza & Govender, 2009; Mlaba, 2020; Mlilo, 2019). These tools are divided into two groups: external hardware (tools attached to the main computer) − examples may be speakers, mouse, keyboards, monitors, and printers. Then there is internal hardware (these are essential for the computer to work or operate) which includes a hard drive and motherboard (Mlaba, 2020; Mpungose, 2019, 2020b). Furthermore, the software is any material that is manufactured for the hardware to display information or communicate learning, such as antivirus programmes, emails, internet browsers, learning management systems, social media sites and application software (presentations, MS word) (Javaid et al., 2020; Jhurree, 2005; Salehi & Salehi, 2012). Lastly, ideological-ware resources are strategies and theories used when constructivism, and connectivism are integrated into teaching and learning (Biyela, 2018). According to the findings of this study, HW resources were more used by teachers when teachers integrated technological resources, at the expense of SW and IW. Teachers in schools seem more driven by content knowledge when integrating technological resources at the expense of technological and pedagogical knowledge. Nonetheless, the study found that teachers are integrating these technological resources as they please. The CAPS document has insufficient knowledge or is silent about these technological resources. As a result, the Department of Basic Education's curriculum goals are not attained because teachers are not guided by any document on integrating technological resources (Heyberi, 2013; Makumane & Khoza, 2020). Since the CAPS document displays insufficient knowledge on how to integrate computers and tablets into the curriculum, teachers use tablets and computers for communication purposes with parents, instead of engaging learners through chat activities such as Facebook, WhatsApp, Instagram, and Twitter. Moving further, the presence of policy documents that guide teachers on how to integrate technological resources into the curriculum can give proper direction to teachers (Shahroom, Hussin, & Sciences, 2018). This will result in teachers who are integrating technological resources into curriculum to the maximum potential.

The second question (How do teachers integrate technological resources into the curriculum in the 4IR?) was posed to address the second research objective outlined as: To explain the

lessons that can be learned when teachers integrate technological resources into the curriculum in the 4IR. Thus, this study found that the integration of technological resources by teachers is influenced by three levels of integration, namely, constructive, unconstructive, and personal integration. Teachers were able to cover various curriculum origins of integrating technological resources. The findings of the study suggested that teachers were driven by all levels of integration. As such, it was found that teachers' actions were informed by all levels of integration but not equally treated. This confirms that teachers were integrating technological resources into the curriculum at the level of constructive and unconstructive integration rather than that of personal integration, as indicated in Figure 7.10 below. Teachers thus depend on policy documents (CAPS) that are expected to provide straightforward user guides and procedures on how to integrate technological resources. However, according to the findings of this study, the CAPS document has insufficient information assisting teachers to understand procedures on how to integrate hardware resources. This, then leads to the reluctance to integrate technological resources into the curriculum. The prescribed document (CAPS) does not enlighten on how to integrate technological resources into the curriculum. Teachers were also driven by unconstructive integration that involves teachers sharing ideas about the integration of technology during workshops, cluster meetings, staff developmental meetings, and more. However, the findings of this study revealed that schools are still dominated by digital immigrant teachers, which means that sharing information among teachers is not enough. Lastly, teachers were less driven by personal integration that focuses on self-tuition and is based on individuals' choices and preferences. This then creates an imbalance between constructive integration (prescribed document), unconstructive integration (unprescribed document), and personal integration (out of love). Teachers are not relying on all levels of integration.

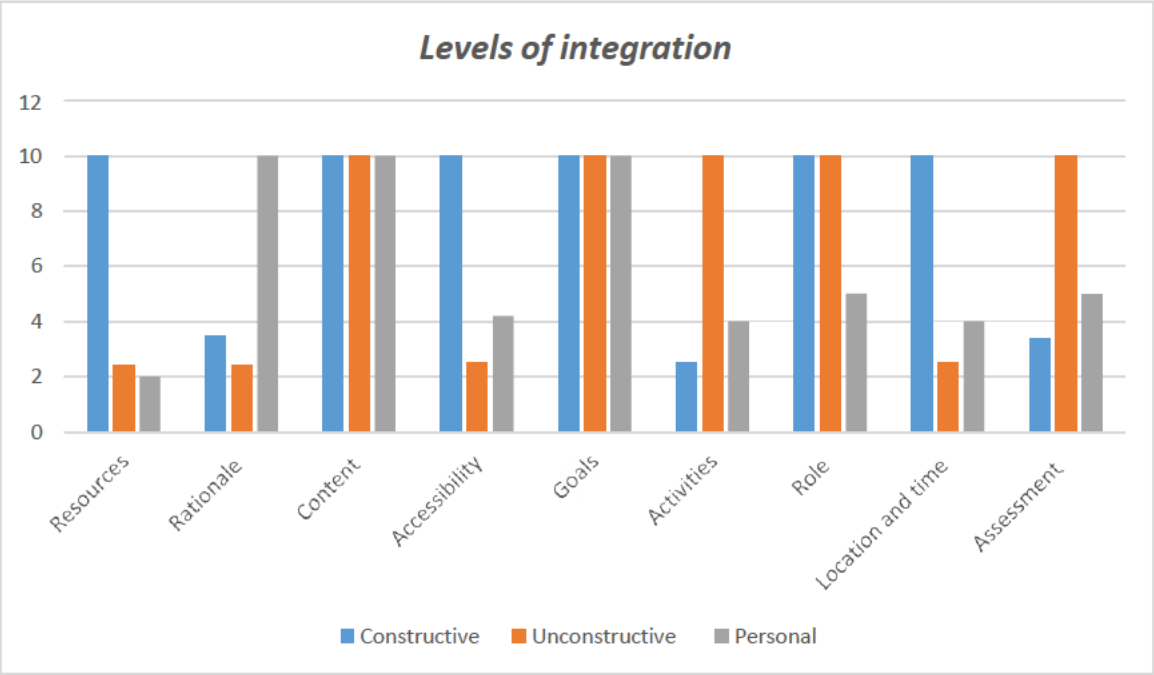


Figure 7.10 Dominant levels of integration

Regarding the last question of this research, "What informs teachers to integrate technological resources into the curriculum in the 4IR the way they do?" the reason for this question was to answer the following objective: Understand the reasons that inform the teachers' integration of technological resources into the curriculum in the 4IR. The study found that the Department of Basic Education is encouraging teachers to integrate technological resources in school using a policy document (CAPS) offering insufficient information. As a result, teachers have no enthusiasm for integrating technological resources. Teachers and learners are obliged to use the available technological resources in schools, irrespective of whether they understand how to use them. The study found that teachers are only good at integrating hardware resources but not good at integrating software and ideological-ware resources. As a result, teachers pay more attention to hardware resources. The study further discovered that the majority of teachers are digital immigrants and have no qualification that guides them when integrating technological resources. Such brings confusion and frustration to teachers. The study further found that parents are not taking the responsibility of supporting teachers in the integration of technological resources – not all parents are well educated, and the majority of parents are also digital immigrants. As a result, teachers integrate technological resources without any support from parents, which affects teachers who become frustrated and angry. What also appeared from the data is that teachers attend the workshops from distant areas, paying for their own transport. This leaves teachers

frustrated in that they are not compensated by the Department of Education. Thus, teachers have no eagerness to develop themselves when not compensated for their efforts. The study further found that teachers enjoy integrating technological resources into informal activities such as classwork; however, they do this at the expense of formal and continuous activities. Thus, continuous and formal activities are neglected because teachers believe that such wastes their time. This study advocates for the creation of a balanced theory of integration, so that all curriculum origins will be considered by teachers when integrating technological resources into learning and teaching.

7.5 Towards the creation of the balanced theory of integration

These scholars (Mbele, 2019; Mlaba, 2020; Mthabela, 2019; Mthembu, 2018; Mvune, 2020) concur that the constructive level of integration is the most vital level, particularly when it comes to the integration of technology into the curriculum. The constructive level seeks teachers to draw from the vertical curriculum during teaching and learning. The latter studies further affirm that a vertical curriculum is prescribed; all teachers' actions are expected to follow the official document during the teaching and learning process. Thus, the constructive level requires teachers to be prepared in advance for good teaching and learning to take place (Ntombela, 2020). The findings of this study also revealed the importance of the constructive integration level. Teachers were informed by the curriculum that contains all prearranged content to be learned at a particular time of year. Therefore if the content to be taught is known and planned before the lesson, teachers have the opportunity of selecting the required hardware resources (laptops, cellphones, textbooks, and others) to be used during teaching and learning. These scholars (Mthabela, 2019; Mthembu, 2018; Pinar, 2010; Zulu, 2020) further argue that the constructive level requires teachers to become instructors when integrating technological resources into the curriculum. This is evident from the findings in that teachers showed that they had much control over the pace of teaching and learning process. Weekly activities were set in advance for learners. The findings of this study revealed that teachers driven by a constructive level of integration during teaching and learning normally prefer a face-to-face environment. This suggests that the objectives (goals) of the subject can easily be attained. Moreover, these scholars (Mlaba, 2020; Mwalongo, 2018; Nani, 2019) point out that a constructive level of technology integration plays a very vital role in executing summative assessment. In support of this, findings revealed that

teachers exposed learners to different types of summative assessment ranging from examinations, control tests, projects, to others. In summary, construction integration seeks teachers to integrate technological resources in a professional manner according to what is written in the policy document. As such, the CAPS policy document does mention various hardware resources to be used for teaching and learning. It also prescribes various types of sections and assessment tasks to be used as executed per content (Cele, 2019; Dlamini, 2019). However, the constructive level is not constructed as an entire package for all educational levels. For instance, levels of education are not the same from primary schools to university level; levels of integration (constructive, unconstructive, and personal) will not be integrated in the same way in every case.

Unconstructive integration is concerned with technical knowledge that involves social technological platforms (WhatsApp, Facebook, Instagram, and other social platforms) in the process of implementing a curriculum. Thus, teachers draw from a horizontal curriculum (Baleni, 2017; Dlamini, 2019; Kumar, 2018). Hammou and Elfatihi (2019) concur with (Luik et al., 2018; Mlaba, 2020; Mlilo, 2019) that horizontal curriculum success relies on pupils being given informal activities based on relevant content taught in school. As a result, the findings of this study revealed that a horizontal curriculum can be attained when pupils are given informal activities such as homework, case studies, and classwork on a daily basis in school. Thus, Khoza (2021b) posits that teachers in the horizontal curriculum are driven by unconstructive integration. Learners' assessment (continuous assessment) tasks may be conducted to meet learners' needs, irrespective of their location (rural/urban). Moreover, the findings of this study also revealed that continuous assessment is informed by unconstructive integration. Continuous assessment is completed to support learners in understanding the content regardless of the location. These scholars (Luik et al., 2018; Mlaba, 2020; Mlilo, 2019; Mpungose, 2020b; Mthabela, 2019) believe that unconstructive integration is an encirclement on the Internet of Things. Thus, Gordon (2019) argues that, irrespective of learners' financial constraints when attending schools, an online discussion platform can be created in which learners will share their ideas and opinions to ensure that the horizontal curriculum is executed. Thus, the findings of this study revealed that teachers may integrate any available software applications in the process of teaching and learning when their actions are informed by unconstructive integration. This means that unconstructive integration allows self-government among learners who must share their ideas about the content. Lastly, the findings of this study revealed that unconstructive integration allows teachers to be malleable,

because the process of integrating technological resources may take place (after hours) at any time, not necessarily at the time stipulated in the school's time table. Teachers in the horizontal curriculum will be free to integrate technological resources whichever way they decide, at their own pace. However, personal integration levels also play a crucial part when teachers integrate technological resources in their own way.

The personal integration level assists teachers to identify the amount of knowledge the learner has to attain during the process of teaching and learning because it is driven by a pragmatic curriculum (Nani, 2019; Nkosi, 2014; Ntombela, 2020). Thus, Mohamed and Ahmad (2019) state that a pragmatic curriculum requires teachers to integrate technological resources driven by the subject aims for the sake of the learner's growth. The findings of this study reveal that the pragmatic curriculum supports teachers to evaluate their work and improve on their curriculum implementation style/strategy as managers. The pragmatic curriculum drives teachers to become managers, thus providing continuous activities to learners in their respective areas (Pyneandee, 2018). A pragmatic curriculum plays a crucial role in both the horizontal and vertical curriculum in determining learners' understanding of formative assessment. In short, the pragmatic curriculum acts as a bridge between a vertical and a horizontal curriculum (Ntombela, 2020; Peter, 2019). This is evident from the findings because personal integration requires time (spare time) to monitor learners' progress when teachers integrate technological resources, assisting with the pedagogical knowledge to ensure that learners grow and make improvements in learning, such as with homework and class activities. These scholars (Prisecaru, 2016; Pyneandee, 2018; Rao & Prasad, 2018; Reali, 2018; Williams, 2019) argue that personal integration is informed and measured by the achievement of the learning results of learners. Thus, personal integration detects whether the horizontal and vertical curriculum has been achieved (Ramnarain & Hlatswayo, 2018). Mpungose (2017) avers that personal integration of technological resources in the process of teaching and learning is not all about the vertical and horizontal curriculum; however, it involves subject knowledge, teaching and learning activities that cannot be seen and touched, such as theories, when the pragmatic curriculum is implemented. Consequently, the pragmatic curriculum obliges teachers to integrate technological resources, having an understanding of theories such as the cultural historical activity theory, and learner/teacher-centred methods during the process of integration (Misirli, 2016). As such, a pragmatic curriculum creates a blended environment and offers feedback for both the vertical and horizontal curriculums.

7.6 Challenges resulting from Uncomprehensive Integration Levels

The literature and the findings of this study point to the actions of the majority of teachers, when integrating technological resources being informed by constructive integration. Constructive integration occurs when teachers are compelled to follow a prescribed document such as a CAPS document, manuals, etc. (Mbhele, 2018). This becomes an issue if teachers rely solely on prescribed documents (CAPS) and not on interacting and sharing information with their colleagues. As result, constructive integration only drives teachers to use face-to-face learning on their subjects to activate their subject objectives weekly. Further to this, the findings from Skype one-on-one semi-structured interviews are also in line with the literature review that few teachers in schools integrate technological resources informed by the unconstructive level. Unconstructive integration occurs when teachers' actions are motivated by their social experience; this means that teachers share information (Khoza, 2018). If teachers are only relying on their social experiences to integrate technological resources this brings confusion and reluctance, because teachers are not following any document. Thus, teachers tend to rely on online learning to achieve the daily outcomes of their subjects. Additionally, online reflective activity also revealed that few teachers integrate technological resources, and their actions are informed by personal integration. Personal integration occurs when teachers apply the knowledge that they have taught themselves; and it is based on individual understanding. This also becomes an issue if teachers are using personal knowledge, knowledge not gained from universities or colleges. This means that teachers at this level (personal level) use self-taught knowledge to achieve the aims of their subjects during their spare time. It becomes a challenge when teachers' actions are not equally informed by all levels of integration when integrating technological resources. This leads to poor implementation of the intended curriculum. When teachers are not treating these levels equally (constructive, unconstructive, and personal) in their integration they are not doing justice to the integrating of technological resources. Comprehensive integration is the main factor ensuring the success of the implementation of the intended curriculum, increasing the quality of content delivery. In other words, if teachers are not relying on comprehensive integration when integrating technological resources into the curriculum in the 4IR, the quality of education will decline, and teachers will not manage to face global competition.

What emerged from the literature and added to the findings of this study is that the levels of integration are not balanced (refer to Figure 7. 11 below).

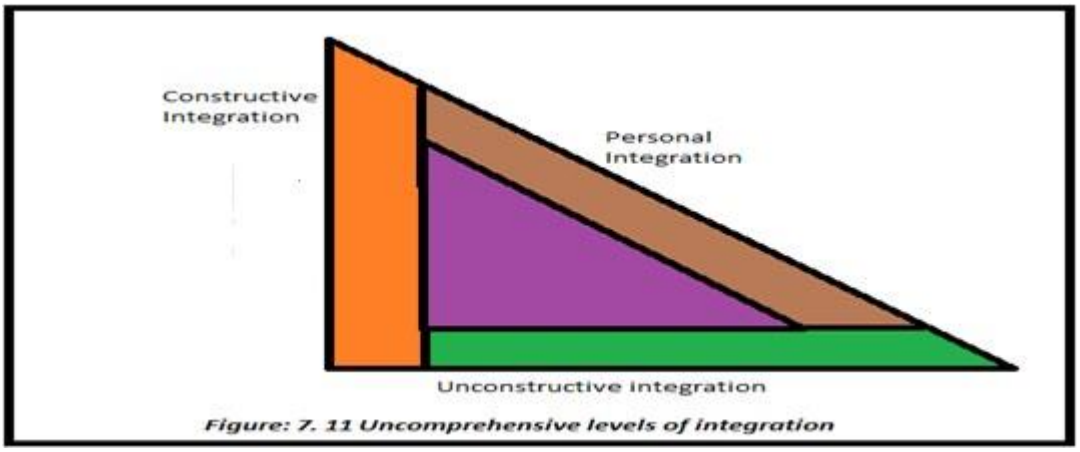


Figure: 7.11 Uncomprehensive levels of integration

7.7 Towards the Creation of Comprehensive Integration of the Technological Resources Framework

This study argues for the comprehensive integration of the technological resources framework (CITR framework), Refer to Figure 7. 12 below. Thus, if teachers' actions are driven by the CITR framework, the implementation of the curriculum can advance, and teachers in schools can manage to face global competition. In addition, the CITR framework can increase the quality of content delivery, and the quality of education. Thus, the CITR framework pursues any technological resources (tablets, overhead projectors, notepads, smartphones, televisions, and computers) to address all curriculum levels (vertical, horizontal, pragmatic), bringing enlightenment. The CITR framework provides a solution to the uncomprehensive integration of technological resources into the curriculum by teachers during the teaching process.

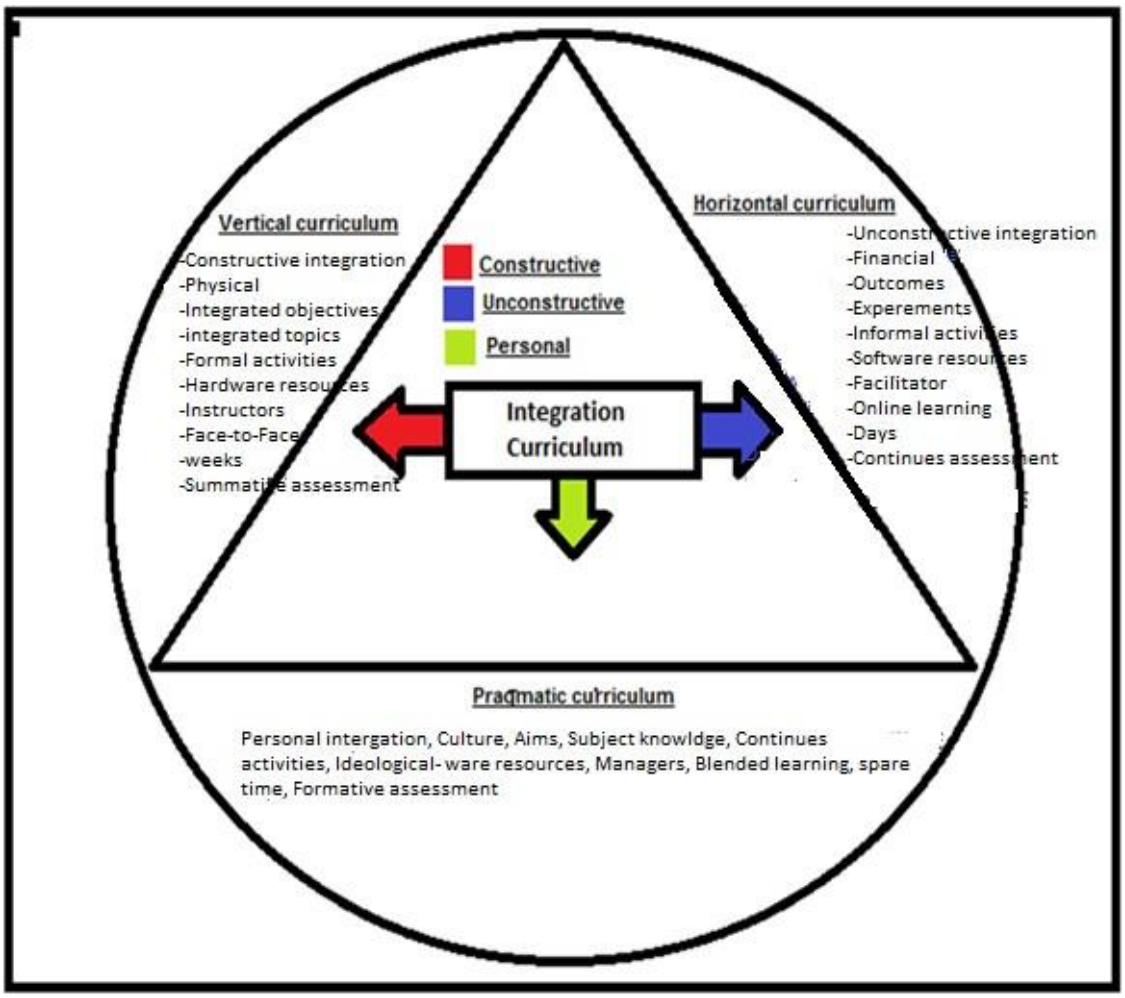


Figure: 7.12 Comprehensive integration of technological resources framework

Firstly, the constructive integration level addresses the formal/vertical side of the curriculum, informed by curriculum origins that include physical, topical, formal, hardware, instructor, face-to-face, weekly, and summative assessment (Nene, 2021). Thus, the constructive integration level seeks to address subject needs through the process of the vertical curriculum (Oke, 2020). Secondly, the unconstructive integration level seeks to address horizontal curriculum signals which include learning outcomes, software resources, continuous assessment, facilitators, financial access, day, online learning, and societal-centred activities (Pyneandee, 2018). This suggests that the unconstructive integration level addresses the needs of society/learners using technological resources (Ramnarain & Hlatswayo, 2018). Lastly, the personal integration level addresses these curriculum origins: culture, aims, subject knowledge, ideological-ware, manager, blended learning, hour, and formative

assessment (Pinar, 2012). In other words, the personal integration level addresses the individual personal needs (identity) of teachers integrating technological resources (Almekhlafi & Almeqdadi, 2010). This study confirms that there is a lack of comprehension of three levels of integration when teachers integrate technological resources. This is also the cause of teachers being reluctant to integrate technological resources into the curriculum. The CITR framework can therefore be used as the lens through which the integration of technological resources is scrutinised. The CITR framework can be the armament that can create the maximum potential for integrating technological resources.

Integration is placed at the centre for two main reasons: first, because it is the study phenomenon, therefore the study must demonstrate understanding from beginning to end. Second, the curriculum cannot take any direction or be comprehensive when integration is not at the centre, or if it is misunderstood, or misrepresented. Integration is the point of exit irrespective of the type of curriculum that is evolving. Integration is applied by personal integration, which evolves into a pragmatic curriculum − unconstructive integration, which evolves into a horizontal curriculum − and constructive integration, which evolves into a vertical curriculum. These three categories of integration and curricula are underpinned by curriculum element origins as identified in Table 7.1. A balanced curriculum must embrace all three levels of integration.

7.6 Conclusion of this Study

The main purpose of this study was to explore the integration of technological resources into the curriculum in the Fourth Industrial Revolution (4IR): the context of primary schools in Pinetown District. Exploring this topic was essential in answering the three research questions, namely: 1) Which technological resources do teachers integrate into the curriculum in the 4IR? 2) How do teachers integrate technological resources into the curriculum in the 4IR? 3) What informs teachers to integrate technological resources into the curriculum in the 4IR the way they do? These questions were informed by three research objectives, namely: to explore technological resources integrated into the curriculum in the 4IR; to explain the lessons that can be learned when teachers integrate technological resources into the curriculum in the 4IR; and to understand the reasons that inform the teachers' integration of technological resources into the curriculum in the 4IR.

To achieve the above objectives, the best-constructed literature on the phenomenon of the study, giving the closest understanding for the readers, was adopted. The literature affords a

clear understanding of the curriculum and concepts that encompass the curriculum. The study was geared more to the constructive level, in which the findings gained may be regarded as reality or truth. Additionally, to achieve the objectives of this study, the employment of an interpretivism paradigm involves a phenomenological research study, and the use of the TPACK theory. Three methods of data generation were applied – the Zoom focus group, emailed reflective activity, and online one-on-one semi-structured interviews. These methods were selected based on the need to fully answer the research objectives of the study. The study was set on a personal level; the knowledge gained was grounded (to my mind) in terms of selecting what to integrate. Likewise, the needs of teachers were taken into account when I integrated the Zoom focus group, and when I relied on their schedule. This took the position of an unconstructive level.

The study has recognized the gaps between the three levels of integration. Curriculum developers are silent on the available technological resources in schools. Currently, schools do not have any policy that guides teachers on how to integrate technological resources into the curriculum. This means that the constructive level is abandoned. Likewise, the personal level, relating to the needs of the teachers, is neglected. As a result, teachers may be unsuccessful in establishing their identity within technological resources and for the curriculum they teach from. Nevertheless, this study has been able to close that gap among teachers by integrating a phenomenological research study aimed at acquitting teachers. Grouping of curriculum origins and integration levels was then initiated. This grouping was conducted to balance the horizontal, vertical, and pragmatic curriculums, aiding teaching success. To teachers, these three levels of integration are important, because all needs are represented within the curriculum. I therefore suggest that teachers balance the curriculum they teach without compromising themselves.

In this study, clear alignment of chapters with their diagrams was designated, which gave readers an inclusive understanding of this study. Chapter One gives the research synopsis. In this chapter, the summary of the study is indicated. Chapter Two reflects a constructive literature review that enlightens on the research phenomenon, curriculum, and technological resources. Chapter Three deals with curriculum origins that are used to frame themes. Chapter Four presents the theoretical framework (TPACK). Chapter Five is about the methodology of the study. Chapter 6 offers data presentation and interpretation of findings. Chapter 7 concludes the study.

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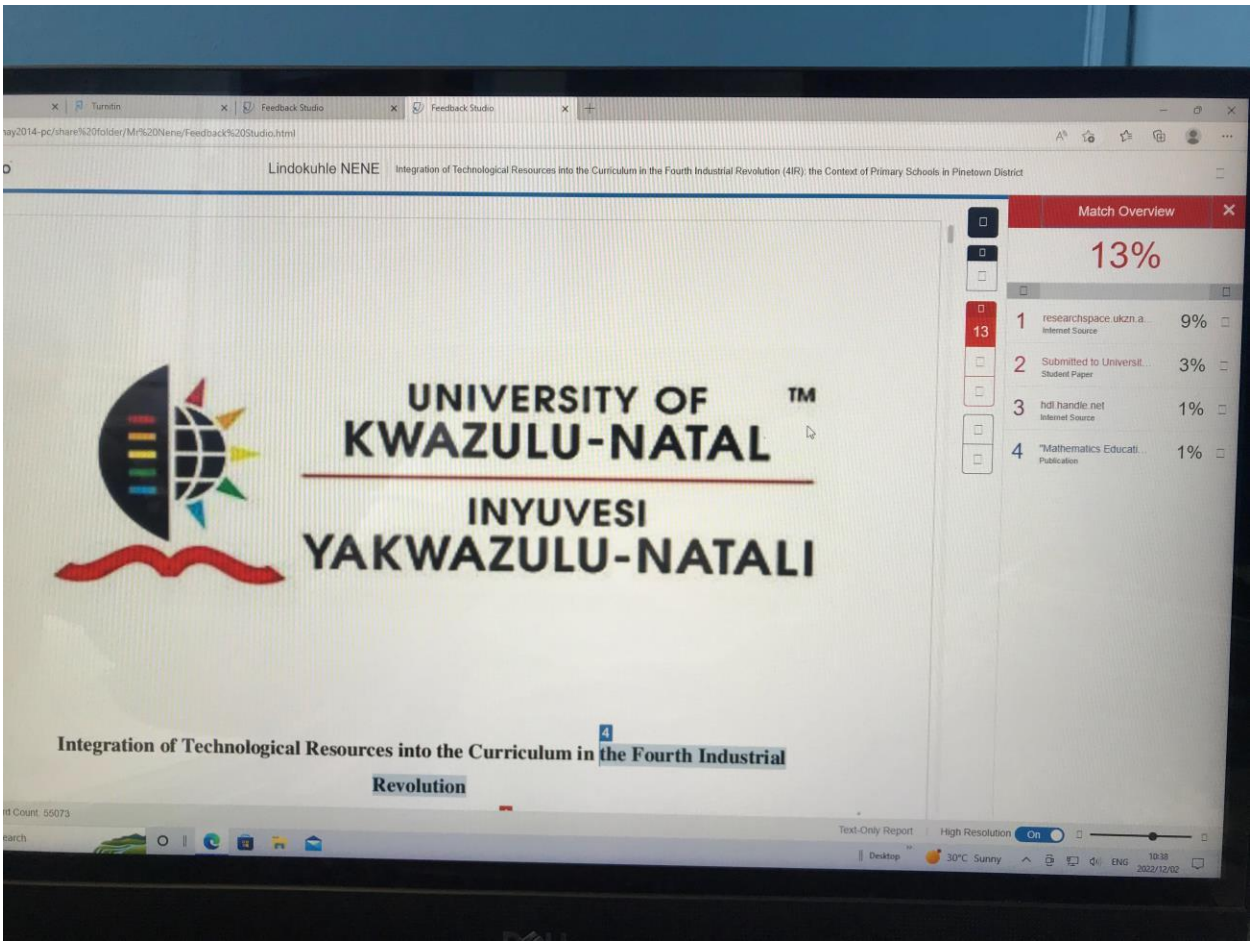
Annexure A: Turnitin report



Annexure B: Ethical clearance letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

18 November 2020

Mr Lindokuhle Gary Nene (213534582)
School Of Education
Edgewood Campus

Dear Mr Nene,

Protocol reference number: HSSREC/00002082/2020
Project title: Integration of Technological Resources into Curriculum in the Fourth Industrial Revolution: The Context of Primary Schools in Pinetown District
Degree: PhD

Approval Notification - Expedited Application

This letter serves to notify you that your application received on 29 September 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL** on the following condition:

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the **discipline/department for a period of 5 years.**

This approval is valid until 18 November 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Annexure C: Gate keepers letter

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201
Tel: 033 3921062 / 033-3921051
Email: Phindile.duma@kzndoe.gov.za
Buyi.ntuli@kzndoe.gov.za

Enquiries: Phindile Duma/Buyi Ntuli **Ref.**:2/4/8/6005

Mr L Nene
PO Box 8
ESHOWE
KWAZULU-NATAL
3815

Dear Mr Nene

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"INTEGRATION OF TECHNOLOGICAL RESOURCES INTO CURRICULUM IN THE FORTH INDUSTRIAL REVOLUTION (4IR): THE CONTEXT OF PRIMARY SCHOOLS IN PINETOWN DISTRICT",** in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 11 August 2020 to 10 March 2023.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma/Mrs Buyi Ntuli at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

[redacted]

Dr. EV Nzama
Head of Department: Education
Date: 12 August 2020

Annexure D: Consent letter

Curriculum Studies, School of Education,

College of Humanities,

University of KwaZulu-Natal,

Edgewood Campus,

Dear participant

INFORMED CONSENT LETTER

I am Nene Lindokuhle Gary and I am conducting a research as a requirement at the University of KwaZulu-Natal towards a Degree of Doctor of Philosophy. The title of the research is Integration of Technological Resources into Curriculum in the Fourth Industrial Revolution (4IR): The Context of Primary Schools in Pinetown District. The objectives of the study are:

1. To explore technological resources teachers integrate into the curriculum in the (4IR)

2. To explain the lessons that can be learned when teachers integrate technological resources into the curriculum in the (4IR)

3. Understand the reasons that inform the teachers' integration of technological resources into the curriculum in the (4IR)

The study will focus on the is Integration of Technological Resources into Curriculum in the Fourth Industrial Revolution (4IR). This letter intends to elucidate the purpose of the study and to request your participation in the study.

Please note that:

• Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.

• The interview and focus groups discussions may last for about 35 minutes, relevant documents will be analysed, and the reflective activity will be sent to you via e-mail.

• Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.

• There will be no limit on any benefits that you may receive as part of your participation in this research project;

• Data will be stored in secure storage and destroyed after 5 years.

• You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.

Annexure A: Consent letter for the participants (teachers).

• You are free to withdraw from the research at any time without any negative or undesirable consequences to yourself;

• Real names of the participants will not be used, but symbols such as A, B, C, D, E and F will be used to represent your full name;

• Your involvement is purely for academic purposes only, and there are no financial benefits involved.

• If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	Willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:

Email: lindokuhle04@gmail.com

Cell: +27 71 053 6543

My supervisor is Dr. Cedric Bheki Mpungose who is located at the School of Education, Edgewood Campus of the University of KwaZulu-Natal. Contact details:

Email: mpungosec@ukzn.ac.za

Phone: +27 31 260 3671.

Cell: +27720 645 5606.

Discipline Co-ordinator is Prof. Labby Ramrathan

Curriculum Studies, School of Education,

Edgewood College, University of KwaZulu-Natal

(Tel) 031 260 8065, Email: Ramrathanp@ukzn.ac.za.

You may also contact the Research Office through:

P. Mohun

HSSREC Research Office,

Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za

Thank you for your contribution to this research.

Data Generation instruments

Online Reflective activity

Online reflective activity

Project title: Integration of Technological Resources into Curriculum in the Fourth Industrial Revolution (4IR): The Context of Primary Schools in Pinetown District

Name of the participant: _____

School: _____

This Reflective Activity is for exploring integration of technological resources into Curriculum in the fourth industrial revolution (4IR). You may use various sources to complete this activity. Presents your reflections/experience by following the TPACK frame work components as follows

Technological Knowledge

Question 1.1	**What technological resources do you integrate in teaching curriculum?**
Resources	

Question 1.2	**Why do you Integrate technological resources into Curriculum? (reasons)**
Rational	

Content Knowledge

Question 1.3	**What content do you integrate with technological resources into curriculum ?**
Content	

Pedagogical Knowledge

Question 1.4	How do you integrate technological resources into the curriculum, in terms of financial, cultural and physical access?
Accessibility	

Question 1.5	What goals do you intend to achieve when integrating technological resources into curriculum?
Goals	

Question 1.6	What are teaching activities do you integrate technological resources into the curriculum?
Activities	

Question 1.7	How do you identify your character when integrating technological resources into the curriculum? (teacher's role)
Roles	

Question 1.8	Where do you integrate technological resources into curriculum? (location/environment)

Location	

Question 1.9	**What is the time allocation for each aspect (topic) when integrating technological resources? (time)**
Time	

Question 1.10	**How do you assess your subject integrating technological resources?**
Assessment	

Annexure B: Data Generation instruments

Skype One-on-one (individual) semi-structured interviews

Question 1.1	*What technological resources do you integrate in teaching curriculum?*
Sub questions	• What software resources do you integrate into Curriculum? • What hardware resources do you Integrate into curriculum? • Which model ware that guide you to integrate technological resources into curriculum ?
Question 1.2	*Why do you Integration of Technological Resources into Curriculum? (reasons)*
Sub questions	• What constructive reasons that made you to Integrate Technological Resources into Curriculum? • What unconstructive reasons that made you to Integrate Technological Resources into Curriculum? • What are your personal reasons that made you to Integrate technological Resources into Curriculum?
Question 1.3	*What content do you integrate with technological resources into curriculum ?*
Sub questions	• What is the subject/topic content do you integrate technological resources? • What experiment do you integrate technological resources?
Question 1.4	*How do you integrate your pedagogical knowledge with technological resources into the curriculum?*
Sub questions	• How do you integrate technological resources into the curriculum, in terms of financial, cultural and physical aspects? • How do you ensure justice when integrating technological resources into curriculum? (goals to be achieve) • What teaching activities do you integrate technological resources into the curriculum? • How do you perceive your character when integrating technological resources into the curriculum? (teacher's role) • Where do you integrate technological resources into curriculum? (location/environment) • What is the time allocation for each aspect (topic) when integrating technological resources? (time)

	• How do you assess your subject, integrating technological resources ?

Zoom Focus group discussion

Names of the participants: _____

Time: _____

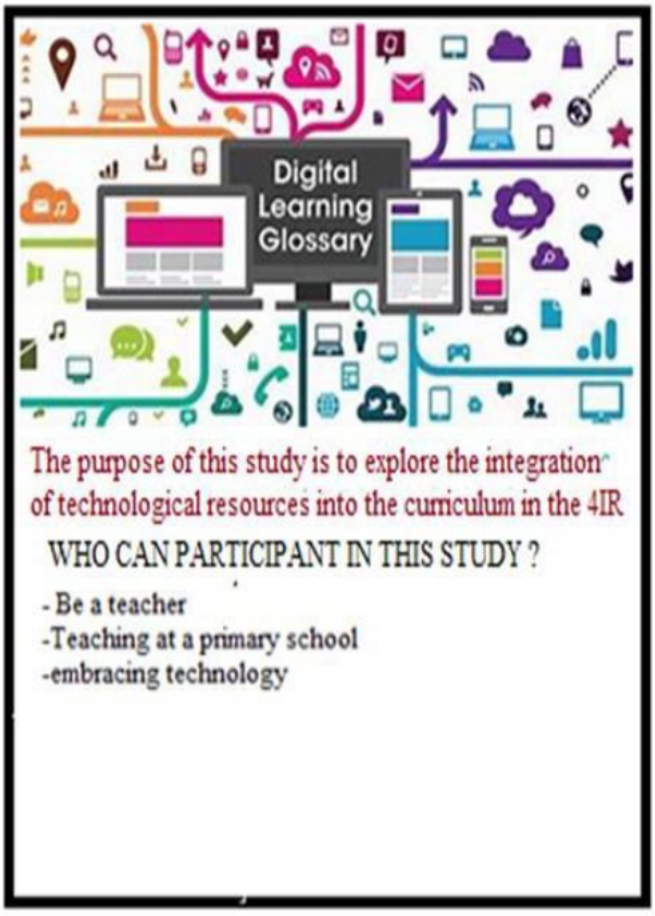
Date: _____

1. What technological resources do you integrate in teaching curriculum?
2. Why do you Integrate Technological Resources into Curriculum? (reasons)
3. What content do you integrate with technological resources into curriculum?
4. How do you integrate technological resources into the curriculum, in terms of financial, cultural and physical aspects?
5. How do you ensure honesty when integrating technological resources into curriculum? (goals)
6. What are teaching activities do you integrate with technological resources into the curriculum?
7. How do you perceive your character when integrating technological resources into the curriculum? (teacher's role)
8. Where do you integrate technological resources into curriculum? (location/environment)
9. What is the time allocation for each aspect (topic) when integrating technological resources? (time)
10. How do you assess your subject, integrating technological resources?

Annexure H: fliers for recruiting participants

UNIVERSITY OF KWAZULU-NATAL

EMBRACING TECHNOLOGICAL RESOURCES



To know more about this study : Please contact :
Mr Nene : 0710536543
Email : lindokuhle04@gmail.com

Dr Mpungose : 0670819942
Email: Mpungosec@ukzn.ac.za

PLEASE PARTICIPACT TO THE STUDY TO SHARE YOUR EXPIRENCE AND REFLECTING ABOUT INTEGRATION OF TECHNOLOGICAL RESOURCES INTO THE CURRICULUM

Annexure I: Proofreading

Lydia Weight
NTSD English Specialist
SACE No: 11135129

E-mail: lydiaweight@gmail.com

Pinpoint Proofreading Services

40 Ridge Rd
Kloof
Durban
3610
1 December 2022

To whom it may concern

This is to certify that I, Lydia Weight, have proofread the document titled: Integration of technological resources into the curriculum in the Fourth Industrial Revolution: the context of primary schools in the Pinetown district, by Lindokuhle Gary Nene. I have made all the necessary corrections. The document is therefore ready for presentation to the destined authority.

Yours faithfully

[redacted]

L. Weight