

**Strategies of Teaching Design Process in Grade 9 Technology Subject**



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## DECLARATION


**MIRRIAM NONKULULEKO SITHOLE** declare that

This dissertation is entirely my original work. All sources were used or quoted have been dully referenced accordingly. This work has not been submitted elsewhere for any degree or examination. I have not copied text, graphics, or tables from the internet without proper acknowledgment.

  
\_\_\_\_\_  
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\_\_\_\_\_  
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28 May 2024

Date

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## **DEDICATIONS**

I dedicated this research to Myself for perseverance, and strength in this transformative journey. It was not easy but I was able to overcome challenges. This experience shaped not only my academics but also instilled resilience and determination for future pursuits.

## **ABSTRACT**

This qualitative case study explored teaching strategies for the design process in Grade 9 technology subjects. Conducted in rural areas of Richmond, the study focused on five selected schools, interviewing two teachers from each through reflective activities, semi-structured interviews, and observations. Its goal was to provide valuable insights for both participants and the broader educational community. Past literature highlights a common issue of outdated teaching methods in technology education, hindering learner's engagement and critical skill development. Research is needed to identify and promote effective strategies in Grade 9 Technology classes. Studies indicate that teachers are influenced by three types of experiences: rationale, societal, and professional when shaping their teaching strategies.

This study situated within an interpretive paradigm emphasizes understanding and interpreting the subjective meanings and perspectives of participants. In this approach, the researcher acknowledges that reality is complex and subjective, and aims to explore the multiple layers of meaning that individuals attribute to their experiences. The interpretive paradigm values context, culture, and the social construction of reality. Therefore participants (technology teachers) were convenience and purposively selected and interviewed in their comfortable setting. The findings shedding light on the prevalent use of traditional, non-digital teaching strategies by teachers highlight a crucial concern that impedes the advancement of teaching methods and also restricts our learners from fully developing their potential. Thus study presents types of strategies, horizontal (collaboration and skill), vertical (mastery and progression) and pragmatic strategies (real-world applicability), in order to bridge the gap between theory and practice. The study's goal is to identify diverse teaching strategies that hold a potential to enrich the learning experience for our learners.

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**ACRONYMS AND ABBREVIATIONS**

CAD	Computer-Aided Design
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CAPS	Curriculum Assessment and Policy Statement
CK	Content Knowledge
DBE	Department of Basic Education
DoE	Department of Education
KZN	KwaZulu-Natal
LMS	Learning Management Systems
OBE	Outcome-Based Education
PGCE	Postgraduate Certificate in Education
PCK	Pedagogical Content Knowledge
PK	Pedagogical knowledge
TPACK	Technological Pedagogical and Content Knowledge
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge

# CHAPTER 1

## RESEARCH OVERVIEW

### 1.1 INTRODUCTION

South African education has had a significant development in terms of ensuring the quality education (Le Grange, 2013). Technology education was introduced into South African schools to improve technology literacy for the modern world (Ankiewicz, 2021). In some respects, modern technology forces all of us to adopt and accept technology, including teachers.

According to the Curriculum and Policy Statement for Grade 7 – 9 Technology (DBE, 2011: 8):

Technology education was introduced into the South African curriculum in recognition of the need to produce engineers, technicians and artisans needed in modern society and the need to develop a technologically literate population for the modern world. The subject stimulates learners to be innovative and develops their creative and critical thinking skills. It teaches them to manage time and material resources effectively, provides opportunities for collaborative learning and nurtures teamwork. These skills provide a solid foundation for several FET subjects as well as for the world of work.

One of the specific aims of the Technology curriculum is to “Develop and apply specific design skills to solve technological problems” (DBE, 2011: 8). The design process is thus a key element of the technology curriculum (Sephoto, 2018). It defines everything that should happen in any particular technological endeavour, hence, the subject enables learners to extend their abilities to solve problems and develop creativity and critical thinking skills (Pillay & Appiah, 2016). This suggests that teachers have the responsibility to carefully incorporate relevant strategic skills in order to be effective in the teaching and learning of the Technology. The problem is that some teachers use modern ways of teaching the design process, for example, software programs such as Learning Management Systems (LMS) whereas other teachers stick to the traditional ways of teaching. While South Africa has made significant progress in ensuring that every learner has access to technology education, learning and teaching in the rural schools is limited by difficulties in terms of availability of technological resources, inadequate infrastructure and inadequate training of teachers (Dube, 2020).

Despite South Africa's strides in technology education, a global perspective emphasises the importance of technology in shaping economies, industries, and societies worldwide. The Fourth Industrial Revolution, characterized by the fusion of digital, physical, and biological technologies, emphasizes the critical role of technology literacy in preparing individuals for the future workforce (Schwab, 2016). As such, understanding global trends and perspectives on technology education is crucial for informing strategies to address challenges and harness opportunities in South Africa and beyond.

## **1.2 Purpose of the study**

The purpose of the study was to explore the strategies of teaching design process in Grade 9 Technology and understand what informs the choice of these strategies.

## **1.3 Location of the study**

This study was conducted in Richmond is a small municipality situated in the southern part of uMgungundlovu Education District in KwaZulu-Natal. Richmond is largely divided into two parts: rural and urban. The rural part of Richmond is characterised by a low level of basic services and facilities such as schools, technology, water and substantial unemployment. Large portions of land are used for agriculture which is also the largest employer of the municipal population. The urban centre is recognised as the main hub of social, welfare and education services to support the resident population of Richmond. Developmental actions to address the challenges in the areas are aimed at ensuring that the backlog in the provision of basic services especially in the rural areas is gradually improved and skills development programmes are provided. The municipality has made significant progress in terms of building small service centres and new schools. The following is the detailed Map of location (Richmond).



**Figure 1.3 Map Source : Map data @2024 AfriGIS (Pty) Ltd, Google South Africa**

#### **1.4 Rationale**

In year 1999, I was employed by my former school as the Technology teacher. I was unqualified. Hence, I depended on my colleagues for information on how to teach technology and which strategies to use. However, I was concerned about the fact that they seemed to not to have effective strategies for teaching Technology and had limited knowledge on how to develop teaching strategies that could be effective for teaching the technology design process. This disadvantaged learners who lacked skills development, and I had a challenge with teaching strategies of technology, in particular the design process; for instance, how to work with designing of drawings and how to evaluate these drawings. In mitigating this, I therefore embarked on a degree to enhance my teaching skills and I included technology education. I began to understand more elements and strategies on the teaching of technology and became a source of information on the technology learning area in the school. Other colleagues (unqualified teachers) often came to me for advice on the teaching of design process since it was a challenging section. However, others, especially those that were trained in teaching technology and qualified like me did not have many challenges in this section. Thus, some learners were performing well while others did not do well because of the various teaching

strategies used by teachers. This experience motivated me to explore strategies in the teaching of design process in Grade 9 Technology to understand how teaching strategies are used and the reasons for choosing a particular teaching strategy.

Teachers' approaches to teaching technology are influenced by a multitude of factors, including personal experiences, societal influences, and professional rationales (Khoza, 2015). The teaching of technology is a dynamic process where teachers continuously adapt their approaches to best meet the needs of their students and the expectations of the broader educational community. A teacher's personal beliefs, experiences and values play a significant role in shaping their approach to teaching. According to Thijs and Van Den Akker (2009), personal experiences and preferences can guide the selection of teaching methods. According to Makumane and Khoza (2020), the societal context also influences the choices made by teachers. Societal needs and expectations, as well as cultural and economic factors, can impact how technology and the teaching of content are taught. Consequently, a holistic integration of personal, societal and professional rationales is advocated for a broad and fruitful curriculum implementation process. Furthermore, Albion et al. (2015) posit that teachers operate within a professional background that includes educational standards, school policies and professional development requirements. These factors shape the choices teachers make in designing and delivering curriculum education.

### **1.5 Review of literature**

The inclusion of technology education in the South African school curriculum was motivated by the need for technological literacy in society (Chilliba, 2018). This would also ensure that South Africa is able to compete with other developing countries in terms of skills such as investigating, designing and solving problems (DBE, 2011). The CAPS for Technology views the design process as an experience-based educational programme that enables learners to extend their abilities to solve problems and develop creativity (Kola et al., 2019). As such, teachers need strategies to teach this section to learners so that curriculum goals can be achieved. Teaching strategies can be defined as a broad plan of action for teaching activities, and are essential in the development of education (Senthamarai, 2018). The successful implementation of the technology curriculum depends on teachers being able to decide on a teaching strategy, interpret the stipulations of the curriculum and go beyond expectations so as to develop appropriate strategies for the teaching of the design process Ankievicz (2021).

Consequently, this study seeks to understand the strategies for teaching the design process in Grade 9 Technology.

However, Singh-Pillay and Ohemeng-Appiah (2016) revealed that teachers display an inability to understand strategies that will work effectively when teaching the design process, and teachers continue to use the traditional teacher-centred teaching methods, which restrict the active engagement of learners. Mupa and Chinooneka (2015) mention that there are still problems in teaching the design process that include lack of trained teachers and lack of resources when teaching skills-based subjects. Sawyer (2017) provides evidence that some learners fail Technology because they do not understand this aspect of the curriculum but there is little research based on whether teaching strategies are the reasons for failure. However, Gaitas and Alves Martins (2017) mention that teaching strategies can influence learners' performance whether positively or negatively. Moreover, Makhubele et al. (2019) reveals that learners' opinions regarding teaching strategies are that ineffective teaching strategies do not provide them with the opportunity to grow. Teachers are still confronted with questions: how can teaching strategies be more engaging and relevant to the need of learners at a different level of the educational ladder? And how does one deal with other barriers that impede teaching strategies such as constant curriculum transformation?

A recent international study by Lange et al. (2022) that examined teaching strategies revealed that the top performing countries use a wide range of strategies that strengthen and enrich the ideas and activities connected to design education. These countries seem to use modern teaching platforms such as online learning, Moodle to deliver educational programmes. However, Munawaroh (2021) mentioned that across the world there are still some problems associated with teaching of the design process as teachers tend to overuse some strategies and ignore others. From above information, it seems that there is a need to explore what strategies are effective in teaching the design process.

Literature has revealed that different teaching strategies have a significant impact on learners' learning and can influence their achievement (Soliman, 2017). It has been noted that there are few publications that focus on teaching strategies for the design process in technology education. However, Janse van Rensburg and Rauscher (2021) suggested that teaching strategies for design process require a wider understanding of content to provide learners with necessary design skills and technological practices. Sephoto (2018) stated in his findings that some teachers have a misunderstanding of how to teach and carry out activities of the design

process. However, Lange et al. (2022) revealed that some teaching strategies do not inculcate the critical competences that learners need. The teaching strategies serve as both a blueprint for action and as a facilitator in fostering interaction among learners while nurturing the growth of essential social and personal qualities like communication, negotiation and teamwork (Soliman, 2017). (Makumane & Khoza, 2020) state that education and societal views are inseparable when developing teaching curriculum as it fulfils a variety of social purposes

Darling-Hammond (2017) reveal that some teachers focus on using traditional teaching methods where learners are expected to memorise tasks instead of focusing on building interpersonal skills. This suggests that teachers use methods like instructional and question-and-answer methods. However, Mpungose and Khoza (2022) state that, within the context of the industrial revolution and the increasing necessity for digital resources in education, certain teachers are adopting contemporary teaching methodologies to design the learning process. For instance, some teachers use software programs such as excel, PowerPoint to teach design process. International literature such as that of Senthamarai (2018) has found that teaching strategies serve as an important way for learners to establish critical thinking and that good strategy users know many strategies and know when and where to use them. Latter study also states that it is teachers' responsibility to devise strategies for achieving educational objectives. Furthermore, many teachers think that design process focuses more on the end result. This means mistakes can happen, but learning from these mistakes can lead to creative success. So, teachers need to include specific skills to address how to use mistakes as a platform for improvement when teaching and learning. This study aims to determine how different teaching strategies like vertical, horizontal, and diagonal teaching can contribute to effective teaching.

Not much has been done to link modern strategies and traditional strategies in the teaching of the design process. It is imperative to embark on this study in order to understand how various teaching strategies can be used and come up with the combined teaching strategies in the teaching of the design process.

### **1.7 Research objectives**

1. To investigate the strategies that are used in teaching of design process in Grade 9 Technology.
2. To explain ways in which the strategies in the teaching of design process in Grade 9 Technology are used.

3. To determine the reasons behind the strategies used in teaching of design process in Grade 9 Technology.

### **1.7 Research Questions**

1. What are the strategies of teaching the design process in Grade 9 Technology?
2. How are these strategies used in the teaching of the design process in Grade 9 Technology?
3. What informs teachers' choices of these strategies in the teaching of the design process in the Grade 9 Technology?

### **1.8 Research design**

This study adopted a qualitative case study design as the method of inquiry, allowing the researcher to thoroughly examine the events and actions of one or more people while they are engaged in an action (Alpi & Evans, 2019). Case studies have been largely used in the practice-oriented field such as education and is an empirical, inquiry-based technique that examines a phenomenon in its actual setting. In addition, case study design applications can be used to explain the presumptive underlying relationships in real-world interventions. Case study designs can be used to highlight circumstances where the intervention being assessed does not have a distinct set of outcomes. This study adopted a case study design with the aim of conducting an in-depth enquiry under the topic of exploring teaching strategies used by Grade 9 Technology teachers to teach the design process and to understand the reasons for choosing these strategies.

### **1.9 Research approach (Qualitative study)**

According to Creswell (2020), qualitative research is a type of research that explores and provides deep exploration from multiple perspectives of the complexity of a particular phenomenon. Qualitative research focuses on real-world occurrences or incidents and centres on the examination and exploration of the challenges presented by the phenomenon under study. However, Cohen et al. (2011) explains that research design is a detailed outline of how an investigation will take place in a scientific study. A case study is used to analyse and explore individuals or group of people; in this regard, this study intends to generate qualitative data to explore and understand teaching strategies used by Grade 9 Technology teachers to teach the design process in Richmond schools.

## **1.10 Research paradigm**

According to Bertram and Christiansen (2014), the interpretive paradigm involves the ability to understand the intended language, whether written or spoken. It involves using various creative approaches and drawing from technical, informational, scientific, historical and cultural sources. This approach aims to evoke emotional and intellectual engagement from readers, emphasising the significance of the interpreted material and aiming to elicit a response from them. According to Matheson (2019), an interpretive researcher needs strong empathic abilities, analytical thinking, and a deep understanding of cultural contexts to comprehend and interpret lived experiences effectively.. An interpretive paradigm was used in this research project to examine and comprehend the teaching techniques used by Grade 9 Technology teachers to teach the design process.

This paradigm enables the researcher to interact with situations from the perspective of the participants and recognises several ways that experiences might be interpreted. The interpretivist paradigm was appropriate for the study because it provided a profound understanding of phenomena through the meanings that people attributed to them. This is what inspired the researchers to use it in their work. The researcher will interview teachers in-depth about their practices.

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## **1.11 Data generation**

This study used three data collection methods, namely, a reflective activity, face-to-face semi-structured interviews and semi-structured observation.

### **1.11.1 Reflective Activity**

Reflective activities involve individuals contemplating and analysing their thoughts, experiences or actions to gain insights and enhance understanding. In an educational context, reflective activities are often used for professional development and critical self-evaluation (Dewey, 1835). Reflective activities as a data generation method in research studies provide a qualitative lens into participants' personal experiences, contributing to a more comprehensive understanding of the phenomena under investigation (Cohen et al., 2011). Cohen et al. (2017) further state that this method can take various forms, such as journaling, diaries or structured reflective exercises, allowing participants to express their thoughts in a narrative format.

### **1.11.2 Semi-Structured Interview**

Semi-structured interviews, according to Yazan (2015), allow participants to be at ease and allow the interviewer to see things from their point of view. In order to gather as much data regarding the studied phenomenon as possible and meet the goals and objectives of the research, semi-structured interviews were scheduled. The primary research question was presented by the researcher, after which the respondents were free to respond in any way they chose. The researcher asked certain questions as the respondents spoke, ensuring that the data was an honest and accurate reflection of their knowledge and experiences. Two Grade 9 teacher in each of five schools were interviewed.

### **1.11.3 Semi-Structured Observation**

Observations entail being present in a situation and recording impressions of what takes place, then interpreting the meaning of the observed behaviour (Bertram & Christiansen, 2014). The observation schedule focused on the following aspects: how the lesson was introduced; teaching strategies applied to teach the design process; how learners participated in the learning activities; and all the activities in which the learners were engaged Cohen et al. (2017) point out that observation potentially produces more valid or authentic data than that obtained through reading a second-hand account. Appendix D with the observation schedule provides a template for noting descriptions of what was happening in a lesson using short sentences and keywords. One Grade 9 teacher in each of five schools were observed.

These three techniques were used to gather data and improve its richness and quality and provide accurate data.

## **1.12 Data analysis**

According to Creswell (2012), data analysis is a technique for processing qualitative data so that what is learned can be communicated to others. A thematic approach was used to analyse the study's data. Thematic analysis offers a sound, organised framework for classifying qualitative data. Thematic content analysis is used to qualitatively analyse the data after it has been arranged into topics. Giving spoken words a written form, or transcribing, enables researchers to analyse data and immerse themselves further in it. Data analysis, according to Bertram and Christiansen (2014), is an ongoing process that occurs each time data is acquired. They also mention that the preliminary stage of data analysis should be validated and tracked

to see what results emerge in order to highlight areas that need to be followed up on. To examine each variable's source and accuracy as well as rectifying any inaccurate results, the researcher assessed the veracity of the data and identified missing information. The researcher created patterns to address the research questions and analyse, interpret and make sense of the data, which were used to transform the study's data into insights.

### **1.13 Trustworthiness**

The degree of confidence in data, interpretation and methodologies used to ensure the quality of a study is referred to as trustworthiness. Credibility is required for readers to consider the study (Connelly, 2016). The researcher adhered to the following standards, guidelines and procedures for this study:

- Credibility ensures the researcher presents findings from the participants' perspectives, involving continual examination of data to offer trustworthy and valid insights.
- Dependability reflects the consistency and stability of data over time and across diverse study scenarios. As per Cohen et al. (2017), in comparison to previous studies, disclosing data collection and analysis methods enhances dependability.
- Confirmability represents the extent to which findings are consistent and replicable. Transparency in the research process, such as providing participants with a concise study overview and maintaining openness about the study's aspects, contributes to improving confirmability.
- Transferability measures the applicability of findings to similar contexts or populations. This study's validation of consistent responses among various evidence coders allows for potential future researchers to produce comparable findings when using similar evaluation tools under similar conditions and with similar groups of people.

### **1.14 Ethical considerations**

Ethical issues arise in all aspects of research, and it is important that studies follow certain ethical principles. Cohen (2019) highlighted ethical principles that researchers need to follow when undertaking a study. Cohen (2019) claims that the process of data verification will be carried out according to these principles are autonomy, non-maleficence and beneficence. All participants' rights, confidentiality and safety will be protected and preserved. Participants will

understand the goals and objectives of the study, and their identities will not be revealed. The participants received a clear explanation of what was expected of them in the research study. A consent form was issued to participants in order to protect their privacy. Respect, anonymity, confidentiality, informed permission and privacy rights were emphasised.

Non-maleficence was adhered to prevent harm to the research participants. The researcher assured the participants of the confidentiality of information they supplied and names of participants were changed.

This study contributed to the development of teachers, learners and the education system as a whole; for example, teachers should gain knowledge regarding strategies for teaching the design process and learners should respond favourably to technology process after having been taught appropriately by the teacher.

Research facilities have limited access, researchers are not permitted to enter a study location without first receiving permission to do so (Bertram & Christiansen, 2014). This is the case for a variety of reasons, including the requirement to prevent illegal disclosure of information and harm to the institution's or organisation's reputation. To enter a research site, one must have permission from a representative of the institution or organisation. I formally requested this approval in writing from the designated individual or office, outlining the complete details of the research proposal in order to obtain the gatekeeper's consent.

The research upheld ethical standards by obtaining permission from gatekeepers and authorised individuals, including approval from the University of KwaZulu-Natal's research office, the Department of Education (DoE) in KZN, and school principals. Monitoring was conducted to ensure compliance with these permissions throughout the study.

### **1.15 Anticipated problems/limitations**

Creswell (2012) stated that using an empirical taxonomy identifying two types of human resource system, 'control' and 'commitment' that can become a limitation in the research study conducted by researcher because those are the aspects of research that the researcher cannot control. Creswell (2012) further explained that both control and commitment systems can influence the willingness of employees to participate in research activities or provide accurate information. Employees in control-oriented environments may be hesitant to disclose sensitive information or express dissenting opinions due to fear of reprisal or disciplinary action. Conversely, employees in commitment-oriented environments may be more inclined to engage

with researchers and provide honest feedback, but they may also be influenced by social desirability biases or organizational norms that discourage criticism. The researcher followed the research processes with the aim of exploring the teaching strategies used by teachers to teach the design process in the Grade 9 Technology class.

### **1.16 Dissertation Out-line**

**Chapter 1** Provides a summary of the study, outlining its focus, purpose, rationale, and a recap of the literature review on the investigated phenomenon (strategies). It also covers critical research questions and objectives, and any acknowledged limitations.

**Chapter 2 discusses** the literature relevant to the study's core topics. This encompasses research exploring the study's phenomenon (teaching strategies), defining teaching strategies, curriculum and technology and design process. It also delves into the knowledge needed for teaching the design process, addressing pedagogy, technology and content as essential components of the curriculum.

**Chapter 3** presents the theoretical framework used in the study, focusing on PCK (Pedagogical Content Knowledge). It provides a historical background and a detailed explanation of this framework. Additionally, it outlines the application of the PCK theoretical framework in the study and provides the reasoning behind its selection for this particular research.

**Chapter 4** presents the research design and methodology. It covers the selected research approach, paradigm and the process of generating and analysing data. The chapter also investigates into how ethical considerations were addressed and highlights the measures taken to ensure the credibility of the study.

**Chapter 5** centres on examining and analysing the research findings derived from participants in the study. The data was gathered through reflective activities, one-on-one semi-structured interviews and semi-structured observation. It's also discusses how certain themes emerged, reflecting the ways teachers teach the design process in Grade 9 Technology classes. It is based on the study's theoretical framework of PCK

**Chapter 6** reviews the primary aim of the research, assessing the extent to which it was effectively addressed. It also evaluates whether the research findings align with the study's purpose. Additionally, the chapter offers conclusions and recommendations tied to both the

research questions and the study's objectives, which focused on exploring the strategies of teaching the design process in Grade 9 Technology.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter presents the literature review and analyses several studies on teaching strategies of the design process in Grade 9 Technology. It aims to provide a deeper understanding of the topic and identify potential gaps in knowledge. Specifically, the chapter focuses on defining strategies, teaching strategies, and exploring a range of approaches such as vertical, horizontal, and diagonal teaching methods. Additionally, it discusses the principles underlying these teaching methods and their relevance to the curriculum. The chapter also examines the concepts of competence, performance, and pragmatic curriculum, providing a comprehensive outline to guide further research on teaching strategies in Grade 9 Technology classes.

#### **2.2 PHENOMENON: TEACHING STRATEGY**

##### **2.2.1 Defining Strategy**

Strategy has a varied meaning, encompassing a range of interpretations and applications. Collis (2019) states that the term strategy originated in the military affairs; it refers to a plan for action for implementing a large military operation. Tactics were the precise procedures adopted in the implementation plan. The Oxford Dictionary defines strategy as the approach of an officer responsible for the country's armed forces, organising and supervising of large-scale military movements and the entire operation of a campaign. This suggests that a strategy is all about the skill or technique of planning towards a desired goal in particular operation. In this study, strategy refers to the implementation of methods to attain learning and learning tactics are precise steps within a sequence that lead to the achievement of outcomes (Vermunt, 2020).

Furthermore, Bolisani and Bratianu (2017) define strategy as a detailed plan for achieving success in different situations. However, according to Karpati et al. (2017) the term 'strategy' and strategic discussion has moved beyond its historical origin in the art of war, and is now eminent in theories of organisations, business and education. Furthermore, Grant (2021) defines a strategy as the art of managing and using the resources of a nation to the end that its essential interests would be effectively promoted and it should outline the long-term goals and objectives of an entity. In other words, a strategy refers to a combination of ideas, thoughts, goals, experience, insight, expertise, memories and perceptions that gives guidance on how to

pursue the desired end. Thus, strategies ensure that daily operations enable the system to move in the appropriate direction.

Moreover, Helmold et al. (2019) argue that there is no definite answer about what strategy really is, but maintain that strategy determines the direction and scope of an organisation over the long term. Therefore strategy should determine how resources are organised to meet the needs of stakeholders. Helmold et al. (2019) state that the sole purpose of strategy is to enable a company to gain as efficiently as possible, a sustainable edge over its competition. However, in business there are different levels of strategy of which have a different focus and need different tools and skills. Researchers such as Porter and Heppelmann (2017) believe that strategy determines resources, skills and competence of the organisation. Navarrete (2019) agrees with the idea that strategy is about influencing the future and about having a skill to use any available resources to achieve desired goals. This suggests that even teachers should have a particular strategy in order to ensure smooth teaching and learning, and this requires them to act as an organisation developers and engage in strategic planning in their classrooms.

### **2.2.2 Defining Teaching Strategy**

In order to understand teaching strategy, one must understand the word teaching and also able to distinguish between the instructional activities and teaching strategy. Teaching is a broad concept. Banner and Cannon (2017) define teaching as the use of pre-planned behaviours, founded in learning principles and child development theory and directed toward both instructional delivery and classroom management, which increase the probability of affecting a positive change in learner behaviour. According to Depaepe et al. (2020), teaching refers to the act of consolidating understanding covering distinct knowledge domains, including subject matter, practice of teaching and context. The most widely accepted definition of teaching is the deliberate exchange of expertise typically structured within a particular field, and, more broadly, the act of stimulating someone else's intellectual and psychological development (Leinhardt, 2019). This is evidence that teachers' responsibility and purpose during teaching and learning is to engage learners in the active development of their own knowledge.

In order to generate a competitive advantage during the teaching and learning process, strategies help teachers to decide how to integrate resources, skills and competencies (Bailey et al., 2018). Thus, curriculum developers have a responsibility to look for meaningful teaching techniques while delivering content. Therefore, in an educational organisation, teaching is defined as the practice carried out by a teacher with the goal of imparting knowledge to a

learner, a student or any other audience (Cochran-Smith et al., 2018). Further to this, Rajagopalan, (2019) states that teaching is a process of paying attention to people's needs, experiences and feelings and intervening so that they learn. Banks and Banks, (2019) argue that in many modern usages, the concept of teaching is wrapped up with schooling and schools where teaching is the process of attending to people's needs, experiences, feelings and making specific interventions to help them learn in any situations. Such intervention takes the form of questioning, listening, explaining some phenomenon, demonstrating skills or processes, testing understanding and capacity and facilitating learning activities. To approach education and learning in a school setting, it is necessary to include strategic mechanisms.

The notion of teaching strategies is a fundamental concept in education. Mitchell and Sutherland (2020) define strategies as procedures teachers use to present material in a way that keeps students interested and actively practising new skills. In support of this, Etim (2018) outline that teaching strategies are a broad lesson plan that includes a structure, instructional goals and an outline of planned techniques. It is important to put these teaching strategies into practice to ensure that learners learn information and skills in a creative way. Senthamarai (2018) and Le Donné et al. (2016) support the use of effective teaching strategies. They state that teaching strategies should direct show how a teaching scenario should be treated. Senthamarai (2018) makes this argument by stating that teaching strategies are progressive educational practices that have evolved from traditional education to modern education. This implies that it is feasible to integrate methods from traditional and modern education in the process of knowledge transfer.

Moreover, Lawrence and Tar (2018) stated that combining modern and conventional teaching methods has both benefits and drawbacks. They emphasise that teaching approaches are multimodal and that the context in which they are used determines how effective they are. The way a teacher adapts and uses a teaching strategy in a supportive setting has an impact. In other words, teachers must choose several strategies depending on the unit's theme, grade level, class size and available resources.

Lamon (2020) indicates that teaching strategies such as monitoring, problem-solving, student research, and performance activities and providing encouraging feedback have been shown to have a favourable impact on the achievement of learners. He states that the teaching activities are organised and regular practised routines which include students and instructional materials (textbooks, workbooks, chalkboard, charts and overhead projectors) to support learners'

learning of content subject. These strategies involves lectures, small groups, and problem-solving, discussions led by the teacher and individual practice on exercises. Among other important influences are teachers' knowledge of subject matter, knowledge of pedagogy and PCK, curriculum in use, teachers' goals and related factors. This indicates that effective teaching strategies are not solely determined by a teacher's background, encompassing their perspectives and attitudes; instead, they should be considerate of learners' growth within the classroom setting and the overall school environment.

Armstrong and Taylor (2020) emphasise that, as there are number of teaching strategies that can be used or are used in teaching process, teachers need to analyse the needs of target learners in order to choose appropriate teaching strategies. However, Soliman (2017) states that the teaching strategy ought to align with national standards; for example, learners should be taught in terms of educational policy such CAPS. Van Leeuwen and Janssen (2019) note that combining teaching strategies that emphasise different skills may be beneficial to learners. For instance, in one lesson teacher may use two or more different teaching strategies with different end goals. For that reason, it is advisable for Technology teachers to explore a combination of vertical, horizontal and diagonal teaching strategies.

### **2.2.3 The Range of Strategies**

For learners to advance into the use of technological instructional software and hardware resources, alternative approaches must be established (Khoza & Mpungose, 2018). This emphasises that teachers should be aware of the numerous educational technology tools available, since these resources may have an impact on their teaching methods. The latter study showed that the representation of the curriculum such as vertical, horizontal and diagonal strategies had an impact on the kinds of teaching and learning practices used by teachers. This suggests that teachers should think about implementing vertical, horizontal and diagonal strategies when teaching in order to satisfy the diverse needs of all students. These techniques emphasised the need of teaching collaboration, which will benefit every individual involved.

#### **2.2.3.1 Vertical strategy**

Curriculum development involves a deliberate process that takes into account subject needs, educational aims and the specific needs and interests of students (DBE, 2009). A vertical strategy requires curriculum to specify the content to be taught, instructional methods, assessment strategies, and the sequence in which topics are covered (Du Plessis & Marais,

2015). Therefore, the curriculum informs the decision teachers make. The CAPS was established in 2012 to provide teachers with precise instructions on what to teach, how to assess learners and how to create learning activities and programmes. However, on the contrary, research has shown that the vertical strategy in curriculum design primarily focuses on the content to be taught, where teachers operate in a learning environment aligned with traditional learning principles, emphasising explicit content (Hordern, 2017). This suggests that vertical teaching methods may not consistently prioritise inclusive education, as they often involve teachers taking the primary role in students' learning processes, offering limited flexibility for addressing individual needs.

Muller and Hoadley (2019) indicate that in vertical strategy, a learner is expected to primarily receive information and knowledge from the teacher. They, therefore, have little control over learning and they become passive in their learning. The learner's role in this strategy often involves listening, observing and absorbing the content presented by the teacher through direct instruction. They are expected to follow instructions, complete assigned tasks and demonstrate understanding of the predetermined curriculum and learning objectives.

However, Nicholls and Nicholls (2018) emphasise that the curriculum aims to ensure that learners acquire and apply knowledge and skill that are meaningful to their own lives. In other words, learners' experiences must be taken into account in the process of learning. While this may be relevant to education, vertical strategies offer limited opportunities for learner participation, such as asking questions or engaging in brief discussions. Therefore, this strategy is not learner-centred and can limit learner engagement, critical thinking and creativity (Hordern (2017)). This shows that the whole process of learning is dependent on the teacher.

Curriculum theories provide valuable insights for curriculum designers that learners should have roles and responsibilities in the teaching and learning activities and ensuring that curriculum is relevant to their learner's needs, interest and experiences (Bernstein (2006)). Singh (2017) states the primary goal of teachers using vertical strategies is to plan and organise the subject matter to be taught, ensuring that it aligns with the intended curriculum and objectives. Teachers thus create the learning environment which is consistent with the principle of traditional learning. During instruction, the teacher presents information to the learners, through presentations and provides explicit explanations of concepts and content. This shows that the overall emphasis in vertical strategy is on the teacher's control and knowledge in structuring the learning experience.

Pedagogical Knowledge (PK) is specialised knowledge of teachers for creating an effective teaching and learning environment for all learners. It involves the collection, construction and transmission of knowledge within educational interaction. According to Mpungose (2020), teachers are required to possess profound expertise in their respective professional fields. They should use a blend of teaching techniques, diverse learning activities and assessments while actively cultivating new knowledge pertinent to their professional practice to address evolving teaching requirements. In vertical teaching, technological resources are limited; however, teachers may use strategies such as blending learning to combine online digital media and traditional methods. It is clear that teacher's knowledge has an impact on learners' achievements and on quality teaching. However, studies have indicated that, in a vertical strategy, the teacher takes on the central role in delivering content and guiding the learning process (Bernstein, 2018). It is evident that a vertical strategy separates the curriculum into subject areas and there is little link between formal school knowledge and everyday experiences. As a result, teachers' knowledge does not progress, and this hinders the overall effectiveness of teaching and learning processes.

In Sephoto (2018) research, the investigation delved into the efficiency of teaching strategies and highlighted that effective teaching methods are intertwined with valuable resources, as they establish connections with learners' existing knowledge and experiences. The teacher should use a wide range of learning resources such as textbook, plays, videos and audios to deliver knowledge to their learners (Rajagopalan, 2019). However, when implementing a vertical strategy in teaching, teachers use a limited range of teaching resources to support instruction and enhance learners' learning; for example, these teachers may use textbooks and worksheets aligned to the curriculum and subject-specific educational content. This suggests that in vertical strategy, teachers control and guide the use of learning resources (Khoza, 2019). Vertical teaching usually takes place in a formal classroom environment, where teacher has certain rules about how to learn and which strategy and activities to use. The physical space is organised to support teacher-led instruction, with students seated in rows or groups facing the teacher and being provided with instructional materials. Therefore, learners have little control over resources and the environment of learning and teaching.

Usman and Madudili (2019) examined the effect of learning environment on learners and revealed that a positive and supportive learning environment fosters engagement, motivation and effective learning and provides opportunities for active participation, collaboration, critical thinking and exploration. They emphasise the importance of creating learner-centred learning

environments where learners actively participate, collaborate and take ownership of their learning.

Assessment plays a crucial role in education as it determines the extent to which educational goals are being achieved and serves as a motivating factor in the teaching and learning process. However, according to Muller and Hoadley (2019), teachers using a vertical strategy primarily rely on summative assessments and textbooks as mandated by the school. These assessments are typically administered at the end of a specific period, semester or year, such as tests, mid-year exams or year-end exams. However, Houston and Thompson (2017) state that important to note that summative assessments may not always provide an accurate measure of a learner's understanding. Some learners may struggle due to poorly designed assessments or unfavourable testing conditions. This indicates that summative assessments can sometimes place undue stress on learners, leading to anxiety and potential failure. The vertical strategy used in assessment aims to capture learners' knowledge and identify areas of weakness at a specific moment in time. Consequently, learners may not fail assessments due to a lack of understanding the content, but rather due to factors such as timing, environment and the strategies used during the assessment process.

### **2.2.3.2 Horizontal strategy**

The CAPS policy emphasises the importance of active participation and engagement in the learning process (Green & Condy, 2016). On the other hand Daniel and Joseph (2019) asserts that horizontal strategy enhances the relevance of cooperative learning. Both approaches encourage knowledge sharing within peer groups. The horizontal strategy places a stronger emphasis on collaboration and participation, where learners engage in peer interactions, sharing their knowledge and insights with others.

Muller and Hoadley (2019) indicates that the horizontal approach helps foster interdisciplinary cooperation. Teachers using a horizontal approach facilitate teamwork among learners by including group activities such as pair discussions; role plays and project-based assignments into their teaching. In other words, these teachers help learners to develop a holistic understanding of the world and its challenges. Thus, this encourages learners to explore the connections between different subject areas and value real-world learning. Therefore, Bernstein (2018) clarifies that horizontal learning tends to be based on learners' experiences, as they have control over what, when and how they learn. This suggests that in the horizontal

approach, the teacher acts as guide to encourage learners to exchange ideas, resources and teaching strategies.

Curriculum theorists have various perspectives on the role of the learner in the curriculum. According to Dewey (1835), the curriculum should be designed to promote active engagement and allow learners to connect their prior knowledge with new concepts and skills while Pinar (2012) believes that learners acquire knowledge and skills through social interactions and collaboration with more knowledgeable others. Consequently, Bernstein (2018) claims that the horizontal approach promotes learner-centred education, that supports the diverse needs of learners and emphasises peer-to-peer learning. This indicates that the horizontal approach requires learners to participate in knowledge-sharing activities like cross-functional training sessions that include mentorship programmes and project management teams. This approach is commonly identified as a learner-centred approach because learners frequently engage in communication, ongoing learning and knowledge exchange. This also indicates that the horizontal strategy offers approaches that help learners acquire new knowledge and abilities, like communication, problem-solving and group decision-making.

Hattie and Clarke (2018) argue that PK is a crucial component of effective teaching, enabling teachers to create meaningful learning experiences and support learners' academic and personal growth. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) also acknowledges the importance of pedagogical knowledge and highlights the need for teachers to possess a deep understanding of teaching and learning processes to create an inclusive and effective learning environment (Wechsler et al., 2018). PK includes knowing a range of effective teaching methods and techniques to engage students, promote understanding and support learning. Moreover, Gao et al. (2022) describe horizontal strategy as a knowledge-sharing approach that fosters cross-functional communication and cooperation. These teachers share knowledge about how to differentiate instruction to fit varied learning styles, talents and interests. This is evidence that horizontal techniques improve the educational and personal growth of learners while encouraging meaningful learning experiences.

According to curriculum studies, a supportive learning environment that meets learners' varied needs and interests is best (Imms et al., 2016). The horizontal strategy appears to be encourage collaboration among learners, interaction, and shared learning and prioritises peer-to-peer learning (Shah et al., 2017). Khoza (2019) further states that horizontal settings enable virtual learning spaces where learning and teaching can occur. Moreover, Gunning et al. (2020) claims

that the use of LMS is a representation of how technology resources fit into the teaching and learning process. Therefore the horizontal strategy makes it possible for learners to access online knowledge. The teachers using the horizontal strategy support learners when necessary and exhort them to take charge of their own education. However, (Richardson & Mishra, 2018) argues that learning environment may include diverse perspectives, life experiences and backgrounds. However, with above-mentioned features of horizontal strategy, it means the approach promotes a rich and inclusive learning environment.

According to (Black & Wiliam, 2018), assessment in education refers to the different techniques teachers use to assess and measure the development of their learners and determine whether or not educational objectives are being accomplished. Double et al. (2020) claim that peer assessment emphasises a learner-centred approach and enables learners to examine the work of their peers in order to get a deeper understanding of their own work. In the horizontal learning strategy, learners actively participate in peer assessment, giving and receiving constructive criticism. Stronge (2018) adds that assessment helps teachers to evaluate the success of their instructional tactics and deepen learners' knowledge. The horizontal approach encourages learners to take an active role in assessing and supporting each other's learning. This indicates that the horizontal strategy encourages learners to reflect on their own work, evaluate it in light of the assessment criteria, identify areas for improvement and engage in feedback discussion.

### **2.2.3.3 Diagonal strategy**

Van den Akker et al. (2003) maintain that the curriculum should be designed to provide appropriate scaffolding and support for learners in their educational development. Therefore, the diagonal strategy focuses on practicality, relevance and real-world application of knowledge and skills. It emphasises the combination of theoretical concepts with hands-on experiences to prepare learners for the challenges they may face in their personal and professional lives. The diagonal strategy are sometimes called pragmatic curriculum, and according to Makumane and Khoza (2020) the pragmatic curriculum brings real-world contexts into the learning environment, enabling learners to understand the practical effects of their studies. Therefore, the diagonal strategy is assumed to combine the benefits of the vertical and horizontal approaches. Khoza (2015) agrees that a pragmatic strategy can be valuable when it comes to comprehending and addressing the digital curriculum. He further argues that this strategy facilitates coordination within society's various levels as a form of practical thinking

that does not adhere to fixed standards but instead promotes knowledge acquisition through active engagement.

Handelzalts (2019) defines the teacher's role as using educational techniques that involve increased awareness of their teaching practices, their students' learning processes, and the correlation between their teaching methods and students' learning outcomes. Jurkowski and Mueller (2018) suggest that employing the diagonal strategy transforms the teacher's role into a dynamic and research-oriented one, empowering students to actively engage in their learning. In a teacher-centred diagonal strategy, interactions between teachers and learners are limited, where learning in the classroom is primarily directed by the teacher. Teacher-centred learning is one in which the focus is primarily on the teacher: the teacher chooses everything such as topic, activities and resources (Chen, 2019). These teachers engage in research activities to enhance their teaching practices, improve learner's learning outcomes and contribute to the broader field of education. This implies that teachers using the diagonal strategy have the potential to drive educational transformations.

The literature indicates that the approach encourages teachers to adopt a reflective and evidence-based approach to their work, drawing on research methodologies to inform their instructional decisions and address classroom challenges. This suggests that teachers can become agents of change in education, and empowers teachers to be more intentional, reflective and effective in their instructional practices, ultimately benefiting their learners and the education community as a whole.

The role of a learner is central to the educational process (Pritchard, 2017). Therefore, learners are expected to actively engage with the learning process. However, in contrast, Jurkowski and Mueller (2018) state that the diagonal approach usually involves teacher articulating the aims of a lesson to the learners and they simply listen and follow the instructions. Studies show that learners learn more when lessons are supplemented with other activities such as discussions, group work and hands-on activities. Diagonal strategies foster cooperative learning by guiding teachers in communicating the what, how, and where of the learning process while also striving to address learners' needs throughout the lesson. This suggests that learners in the diagonal strategy have limited participation in their learning as the teacher is perceived as the expert and source of all knowledge.

The purpose of assessment is to collect relevant information about learner progress (Black & Wiliam, 2018). Different types of assessments can enhance the effectiveness of teaching and learning. However, teachers using diagonal strategies predominantly use formative methods of assessment to gain insights into learners' progress. Moss and Brookhart (2019) define formative assessments as planned activities that occur throughout the learning process, providing feedback and guiding instruction. According to Khoza (2019), the assessment methods and strategies used in a diagonal approach enable teachers to evaluate learners' practical skills and critical thinking abilities. Formative assessments encompass various methods, including quizzes, discussions, observations, group work and performance-based tasks. These methods inform teachers about necessary adjustments to their teaching strategies, instructional methods and learning activities to better meet learners' needs. The diagonal approach's flexibility in assessment methods allows teachers to adapt the teaching process to align with individual learners' aims and requirements.

The learning environment includes the physical, social and psychological aspects of education. These elements greatly influence and enhance the teaching and learning process (Richardson & Mishra, 2018). The diagonal teaching strategy favours a blended approach (Khoza, 2019). For example, teachers might select face-to-face instruction for hands-on projects and opt for online methods when teaching theoretical concepts. As a result, Jurkowski and Mueller (2018) claimed that the learning environment in a diagonal strategy often adopts an interdisciplinary approach and allows for a combination of strategies. The findings in Chilliba (2018) study indicate that the availability of relevant and up-to-date resources and materials is essential in the learning environment. This includes textbooks, digital resources, multimedia tools and hands-on materials that support the curriculum objectives and cater for different learning styles.

Khoza, (2019) argues that in modern curricula, incorporation of technology is becoming increasingly important. The learning environment should provide access to technology that enhances learning experiences, facilitates research and supports learner exploration and creativity; for example, Zoom, YouTube and Skype. Thus, teachers may use technological resources such as digital software. It is clear that the diagonal strategy aligns with learning environment and extends beyond the classroom walls.

### 2.3 Definition of the curriculum

The term curriculum is defined in various ways by numerous scholars and it is perceived and interpreted differently. Therefore, Pinar (2004) states that the word curriculum originates from the Latin word, *currere*, which means to run. The term *currere* was used for racecourses where chariots raced. Gradually, it came to represent a course of study, symbolising the educational path for learners. Muller and Hoadley (2019) define curriculum as a comprehensive plan of action that outlines the educational experiences, content, instructional strategies and assessment, and these elements are intended to achieve specific learning outcomes and goals. However, Tyler (2013) asserts that curriculum is all learning that is planned and directed by the school to achieve its educational goals. In simple terms, curriculum can be defined as a plan for learning (Khoza & Mpungose, 2018)

Pinar's (2019) perspective on curriculum revolves around the concept of autobiography. This suggests that curriculum encourages teachers to incorporate their own experiences into educational curriculum development and include techniques like regression, progression, analytical and synthetic methods involve recounting one's life history in education and envisioning potential future developments for self-comprehension in educational practice (Khoza & Mpungose, 2018). Consequently, curriculum also enables the integration of learners' life stories and personal concerns into the curriculum. This stresses that curriculum encompasses the interwoven nature of diverse educational encounters, providing the opportunity to re-evaluate and reconstruct past experiences.

Van den Akker et al. (2003) further define curriculum as a process that encompasses different levels of curriculum planning and implementation: According to Sanders and Stappers (2008), a teacher needs to be knowledgeable about the subject matter in Technology in order to keep up with new design trends and technical developments. According to Sephoto (2018), in some situations, the culture of the school or district may not value or emphasise ongoing professional development, which makes it less likely that teachers will participate in these activities. This occurs nationally or institutionally and shapes the educational direction, philosophies and guidelines. At the macro level, curriculum design narrows to specific subjects. A structured framework is developed, outlining core concepts, learning objectives and subject content. The meso level transforms the macro curriculum into practical teaching plans. Teachers break it down into manageable units, lessons and activities for effective classroom delivery. Implementation enters the micro level, where teachers execute the curriculum. Detailed micro

plans guide lessons, student engagement and real-time assessment. The nano level delves into individual learner experiences. It focuses on unique interactions, understanding and engagement with the content within the micro classroom setting. Pepin (2018) affirms that the above-mentioned levels ensure a meaningful learning experience.

The literature also categorises curriculum into three forms: intended (planned for learners), implemented (delivered to learners), and attained (experienced by learners). This logical progression aligns the vision, the medium and the impact of the curriculum (Ornstein & Hunkins, 2009). The execution of a curriculum significantly influences its core stakeholders: teachers, learners, parents and community members. This highlights the importance of effective communication among participants.

Marsh (2009) suggests that comprehending curriculum is an ongoing process, encompassing the planned, enacted and experienced curriculum. It is not a fixed concept but a dynamic, evolving entity that is refined and enhanced over time (Glatthorn et al., 2018). This signifies that curriculum extends beyond its written form and transforms into a dynamic, living experience, an interplay of instruction, interaction and inspiration.

The curriculum in its broadest sense, refers to the interactive system of instruction and learning with specific goals, contents, strategies and resources (Nicholls & Nicholls, 2018). This means that curriculum can be defined as a school plan of instruction of how, when and what learners will be taught, what will be covered and what learners ought to have learned after they have completed a specific grade. However, Ornstein and Hunkins (2009) point out that curriculum includes learning objectives, resources, the learning environment and assessment. This means teachers are expected to know how to structure, organise and deliver lesson in such a way that objectives of that particular lesson are achieved. For instance, one objective in the design process is for learners to be able to apply design skills; therefore, teacher should use a suitable strategy to execute the lesson.

Meyer et al. (2017) define curriculum as the content taught within a specific subject or course. Similarly, Du Plessis and Marais (2015), affirm that curriculum outlines the concepts learners need to be taught to meet national standards. This implies that the design process within technology education can be presented as content, requiring diverse methods to explain its concepts such as design, production and project presentation. In Grade 9 Technology, a variety of topics are covered, encompassing the design process, materials and structures, systems and control and electrical systems. It is the responsibility of educators to ensure comprehensive

coverage of this content, encompassing both theoretical understanding and practical application. Thus, content and process objectives can be achieved when learning tasks stimulate complex thinking and involve true collaboration among. Thus, the curriculum allows teachers to teach content, select strategies, activities and resources that support learners to learn from and with each other through shared experiences, discussions and interactions.

Miller (2019) characterises curriculum as a coherent body of knowledge that teachers need to convey, while having flexibility in choosing instructional strategies. Additionally, Du Plessis and Mestry (2019) concur that the curriculum encompasses all school activities. This suggests that Technology teachers can leverage tools like computer-aided design (CAD) software and simulations to enhance learners' comprehension. The CAPS underscores the fusion of theoretical understanding and practical skills (Du Plessis & Marais, 2015).

Grant (2018) defines curriculum as a central guide for effective teaching, ensuring each learner gains academic experience. Similarly, Glatthorn et al. (2018) emphasise that teaching strategies within the curriculum enhance learners' ability to grasp and apply knowledge. These strategies serve as instructional tools. Sephoto (2018) highlights the role of the design process in fostering problem-solving and innovative thinking. Thus, teachers should use methods encouraging hands-on learning, such as horizontal and diagonal strategies, to engage learners effectively. This highlights the importance of active engagement for genuine learning, and these viewpoints suggest using vertical, horizontal or diagonal strategies, individually or combined, to support understanding.

The curriculum is the expectation of what should be taught and what learners can do and which resources will be used in the programme of study. Therefore, teaching materials significantly impact the delivery of the curriculum and are carefully selected to implement and achieve the goals of the curriculum (Senthamarai, 2018). For example if the school has a certain books and requires a teacher to use them, those books will inevitably influence what gets taught and how teacher teach. Thus, the technological resources, in particular for the content of the design process, have the potential to influence the learning outcomes, hence the design process thrives on hands-on experience, prototyping and creative experimentation. Differentiated resources such as visualisation, cooperative and digital resources are essential in shaping learners' creative skills (Suprayogi et al., 2017). This suggests that teachers can incorporate the blending of strategy. For instance, the vertical strategy may be used to deliver instruction whereas the

horizontal strategy may be used to facilitate design concepts and the diagonal strategy may be adopted to research new knowledge.

Curriculum theorists have identified curriculum instruction and the learning environment as two major co-determinants of learner's educational outcomes (Grant, 2018). The teaching-learning environment encompasses the physical, social, and emotional context of learning Senthamarai (2018). In essence, the curriculum guides learning goals, while the teaching-learning environment creates the background for effective education. It is essential to adapt the curriculum to suit learners' needs and to create an environment that supports engagement, exploration and alignment with curriculum objectives. Thus, investigation is a vital aspect of the design process. This suggests that need to teacher foster an environment that encourages learners to think outside the box, explore unconventional ideas and embrace innovative thinking.

Furthermore, researchers have highlighted that a thoughtfully captivating curriculum and motivated learning environment can significantly enhance students' engagement, enthusiasm for learning, and overall academic achievement (Du Plessis & Mestry, 2019). Learners experiencing a flexible and inclusive educational environment tend to adapt more readily to the learning process. Nonetheless, Bowe et al. (2017) claim that variables like class size, resources, learner diversity and the chosen teaching approach have an impact in the execution of the curriculum. For example, if a curriculum emphasises hands-on activities yet lacks the necessary materials, adjustments would be unavoidable. This underlines that a well-structured curriculum, harmoniously integrated with the learning environment, empowers educators to opt for teaching strategies that resonate with learners, fostering substantial learning experiences.

Ornstein and Hunkins (2009) state that assessment serves to identify the strengths and weaknesses of the curriculum before, during and after teaching; it comprises formative, summative and peer assessment. Assessment is an integral component that bridges the gap between curriculum and teaching strategies (Black & Wiliam, 2018). It offers insights into the effectiveness of both the curriculum design and the chosen teaching strategies. This indicates that observing learner performance, competency or personal abilities can pinpoint areas where curriculum improvements might be necessary and where teaching strategies could be enhanced. Thus, feedback should be given on an ongoing basis to ensure that the learning experience remains relevant.

Miller (2019) defines curriculum as the social system within which formal teaching and learning takes place. Miller's definition of curriculum is a profound revelation that teaching and learning do not exist in isolation but within the context of a social system (Cooley, 2017). Educational policies, social values, political ideologies and economic demands all play a role in shaping the curriculum. From these perspectives, a curriculum is a multi-dimensional concept that extends beyond the mere content taught in classrooms, but has societal influences and dynamic characteristics. This is also relevant to the design process teachers who need to understand these external influences in order to keep curriculum relevant and responsive to emerging challenges and opportunities.

Curriculum adaptation might be essential based on requirements (Ennis, 2018). Contemporary investigations delve into the challenges arising from the COVID-19 pandemic, proposing substantial alterations to the curriculum (Hoadley, 2020). In the South African context, the COVID-19 pandemic brought about unprecedented challenges in education leading to substantial interruptions in curriculum execution which forced a swift modification. This highlights that the curriculum is a continual progression requiring, monitoring, assessment and adjustments to cater for the diverse participants involved.

The definitions mentioned above highlight the multifaceted nature of the curriculum. Despite this, it stands as a fundamental pillar in education, serving as a guiding framework for learning. Seemingly, there is no universally definition of curriculum. It a process that continually undergoes review, revision and change (Makumane & Khoza, 2020). In the background of this study, curriculum is interpreted as the collection of skills and knowledge that learners are intended to acquire in in order to equip them for lifelong competence. This includes both structured and unstructured learning experiences acquired within or beyond the confines of the classroom.

### **2.3.1 Presentation of Curriculum**

Marsh (2009) and Hoadley and Jansen (2013) suggest that the curriculum journey has three intertwined dimensions namely, intended, implemented and achieved. The intended curriculum guides teachers' goals, while the implemented curriculum turns plans into action and the achieved curriculum is where the curriculum's impact becomes evident. This journey requires teachers and policymakers to refine their strategies, ensuring the curriculum's enduring power to shape minds and futures.

Reimers and Chung (2019), highlights that in the intended phase, the curriculum is shaped through the establishment of goals, purpose and objectives, which provide clear direction and serve as a framework for subsequent efforts. This phase also considers the individual characteristics, needs and capabilities of learners. Hoadley and Jansen (2013) emphasise that the intended curriculum determines the content of the curriculum, including subjects, topics and concepts, which, in turn, influences teachers to adapt their teaching methods to cater for diverse learning styles and abilities. Glatthorn et al. (2018) further confirm that the intended curriculum lays the foundation for assessment methods used to measure learner progress. Additionally, Darling-Hammond (2017) notes that teachers' roles are defined based on the curriculum's vision, aim and objectives. In essence, the curriculum's vision, time frames, content and learning environment, all rooted in educational values, converge to create a meaningful and impactful educational journey. This implies that teachers have the potential to drive educational transformation by being purposeful, reflective and proficient in their teaching methods and approaches to learning.

According to Glatthorn et al. (2018), the successful execution of curriculum development hinges on the implementation phase, where carefully planned curriculum takes shape as tangible teaching practices and real classroom experiences. In this crucial phase, teachers and instructional leaders play pivotal roles by delivering lessons, actively engaging learners, and employing instructional methods as originally envisioned (Tomlinson, 2014). It is the teachers' responsibility to translate the intended curriculum into practical lessons for their students while staying aligned with the curriculum objectives, as noted by (Marsh, 2009).

This phase necessitates thoughtful design of learning activities and the use of differentiated classroom and teaching strategies to ensure an engaging and personalised approach to learning. For example, the design process may require incorporating hands-on activities, which means teachers should gather all necessary materials before the lesson begins. In essence, this emphasises the importance of thorough preparation and creative teaching methods to bring the curriculum to life effectively.

The curriculum's implementation phase empowers teachers with the flexibility to adapt their teaching approaches effectively. This flexibility arises from their deep understanding of their students' needs and abilities, enabling them to tailor the curriculum to meet individual learning requirements. According to Glatthorn et al. (2018), the implementation stage takes into account crucial elements such as essential resources and teaching approaches, all of which contribute

to enhancing curriculum delivery. Likewise, Hoadley and Jansen (2013) underscore that successful implementation seamlessly integrates the intended vision into practical educational experiences, driven by teachers' dedication to meaningful learning. This highlights the critical role of teachers' expertise in selecting appropriate instructional materials, crafting engaging learning experiences, and assessing learners' progress effectively.

Tight (2012) perspective underlines the significance of evaluating the curriculum and examining into how it is put into practice to determine if it achieves its intended objectives. This viewpoint is in alignment with Popham (2018), who asserts that curriculum development can be observed in the achieved curriculum, serving as a reflection of learners' accomplishments, their mastery of educational content, and their engagement with learning activities. Hattie and Clarke (2018), share a similar sentiment with McCormick and James (2018), highlighting that this stage involves a thorough evaluation of whether learners have successfully met the intended outcomes and if the curriculum's overarching vision has been effectively realised. This suggests that assessment results provide valuable insights into the extent to which learners have reached the targeted learning objectives, thus playing a crucial role in curriculum improvement.

Moreover, Hoadley and Jansen (2013) note that in the achieved stage, there is an examination of how the learning environment either supports or hampers learners' progress and accomplishments. It involves a consideration of various factors that can either facilitate or impede their educational journey. The allocation of time also emerges as a crucial element in shaping the attainment of learning objectives. According to Anderson (2018), the adequacy of time allocated for instruction and practice significantly influences the achievement of educational goals. Ultimately, the achieved curriculum serves as a testament to the success of the curriculum development process, reflecting the seamless interplay between intentions, implementation and the actual educational outcomes achieved. This emphasises the importance of educators designing assessments that align with the teaching strategies they have used to ensure a consistent evaluation of learners' learning progress.

Miller (2019) asserts that curriculum design significantly shapes learners' experiences and outcomes. Bernstein (2018) distinguishes types of curriculum, competence and performance. Dewey (1835) champions the pragmatic approach. Recent research also supports the pragmatic idea, including the perspective of Khoza (2019), which suggests that a pragmatic curriculum helps learners not only to understand concepts, but also to use them effectively in real-world

situations, promoting their personal and professional growth. The researcher examines different types of curricula, exploring their features, benefits, and real-life application.

### **2.3.2 Competence Curriculum**

According to Bernstein (2018) the competence curriculum adopts a holistic approach, emphasising broad competencies and capabilities. Mulder and Winterton (2017) note that this approach encompasses cognitive, and interpersonal domains. The competence approach equips learners for complexity, promoting adaptability and resilience. Freire (1985) ideas cited in Hoadley and Jansen (2013) align with this, underlining practical learning for critical engagement. Teachers foster a supportive environment for risk-taking, employing strategies like horizontal (inquiry-based learning, peer collaboration) and diagonal strategies (dialogue, project-based activities). This approach prepares learners for today's challenges and tomorrow's uncertainties.

Furthermore, a study by Kabombwe et al. (2020) examined the application of competence-based education in Zambia. Their findings reveal that the competence curriculum emphasises what learners should be capable of doing, rather than merely what they should know. This perspective supports personalised learning pathways, enabling learners to concentrate on subjects that align with their strengths and interests. As a result, the learning experience becomes more pertinent and engaging. Thus the competence-based approach encourages diverse viewpoints and problem-solving approaches. For instance, Grade 9 Technology teachers can empower learners to shape their projects based on their individual abilities, while achieving the desired learning outcomes.

### **2.3.3 Performance Curriculum**

Muller and Hoadley (2019) define performance curriculum as a specialised approach that focuses on mastering specific skills and tasks. They further state that the performance curriculum focuses on clear and measurable objectives for learners, enabling teachers to evaluate learners' ability through practical demonstrations and performance assessments. Dewey (1835) perspective also aligns with the performance curriculum, certainly since its teaching and learning focuses on real-world application and the cultivation of practical skills. This curriculum encourages hands-on learning and the acquisition of practical competencies. These ideas encourage teachers to set measurable outcomes that reveal the complexity of cognitive tasks and that learners should be able to perform. For instance, Technology teachers

might outline real-world problems and solutions by instructing students to create a bridge using cardboard, aiming to address problems and evaluate students' performance to ascertain the attainment of objectives. This is an indication that, technology teachers may teach the design process by incorporating the vertical strategy where learning is driven by objectives.

Moreover, Ankiewicz (2021) highlights that the DBE has embraced the philosophy of Outcome-Based Education (OBE). According to the DBE (2009), OBE is an educational philosophy centred on well-defined learning outcomes, harmonising all aspects of education such as curriculum, teaching methods and assessments. Lange et al. (2022) further explains that OBE places a significant emphasis on measurable objectives to ensure learners acquire specific skills and competencies by the end of their educational journey. Therefore, OBE provides a pertinent approach that equips learners with the necessary skills and knowledge for success in the contemporary world. For instance, in the case of the design process, for Grade 9, the curriculum aims to achieve specific objectives such as nurturing creative thinking, problem-solving abilities and practical application skills. Therefore, it means that curriculum development is rooted in the understanding that education should reflect the latest knowledge, advancements and societal shifts.

### **2.3.4 Pragmatic Curriculum**

Biesta (2018) emphasises that the pragmatic curriculum blends theory and practice to enhance understanding through real-life applications. Makumane et al. (2022), emphasise how this approach bridges academia and professions by merging concepts with practical experiences. They note that the pragmatic curriculum spurs critical analysis of real-world issues, fostering creativity (Makumane et al., 2022). This aligns with Freire (1985) and (Stenhouse, 1985) ideas, where education empowers learners to question oppressive systems.

Khoza (2019) highlights that the pragmatic curriculum is characterised by relevance, experiential learning and problem-solving and motivates learners to critically assess their societal surroundings and engage in transformative action. It aligns with Biesta (2018) perspective that advocates for active learner involvement. This curriculum values engagement, critical thinking and applying knowledge to real-world contexts. Consequently, Technology teachers should be flexible in amalgamating these curricular approaches. This fusion can result in a vibrant and enriching educational journey for learners. For example, within a design process lesson, learners could collaborate with teachers to co-design curriculum elements. This

partnership might include project design, resource selection and even suggesting instructional activities.

Additionally, Dumford and Miller (2018) explore the benefits and disadvantages of engaging in online learning. They uncover that every curriculum approach comes with its own strengths and limitations. Often, teachers blend components from various approaches to create a comprehensive and effective educational journey. The role of curriculum in education is multifaceted and indispensable, shaping the entirety of the teaching and learning process and so the selection of a curriculum approach depends on the educational experiences, objectives, and the context of the learning environment (Booyse & Du Plessis, 2014). This indicates that various curriculum approaches offer unique viewpoints on how to structure and execute educational programmes. This emphasises the need for teachers to accurately plan, remain adaptable, and possess an in-depth understanding of their learners' needs and the learning context. This way, they can strike a balance among diverse curriculum approaches.

#### **2.4 Chapter summary**

Chapter 2 explored into the relevant literature, exploring key concepts and studies related to the research topic (teaching Strategy). The concept "strategy" were unfolded, encompassing its varied meanings. The focus narrowed to teaching strategies, comprehending their diverse field and influence within the educational context. Furthermore, an examination of the fundamental aspects of "curriculum" was conducted, explaining its definition and its pivotal role in shaping education.

## **CHAPTER 3**

### **THEORETICAL FRAMEWORK (PEDAGOGICAL CONTENT KNOWLEDGE)**

#### **3.1 CHAPTER OVERVIEW**

This chapter explores the theoretical framework, specifically exploring Pedagogical Content Knowledge (PCK). The overview encompasses a detailed discussion on the historical background and explanation of PCK. It highlights the application of the PCK theoretical framework within the study's context, offering justification for its selection. This chapter sets the foundation for a comprehensive understanding of how PCK informs and shapes the study's exploration of teaching strategies in the context of the design process within Grade 9 Technology.

#### **3.2 THE THEORY OF PEDAGOGICAL CONTENT KNOWLEDGE**

Collins and Stockton (2018) assert that a theoretical framework is a structured set of interrelated concepts, theories and ideas that form the basis for understanding and explaining a particular phenomenon. Luft et al. (2022) emphasise that theoretical frameworks play a crucial role in research by offering a robust basis that shapes the development of hypotheses, the process of collecting and analysing data and the interpretation of findings. Therefore, it helps researchers to develop a deeper understanding of the subject, make meaningful predictions and contribute to the body of knowledge within their field. These researchers agree that theoretical frameworks are often represented as a conceptual model, which can be a visual representation, a flowchart, or a diagram illustrating the interconnections between the concepts (Varpio et al., 2020).

This research adopts PCK as its theoretical framework. The study aims to explore various teaching strategies of teaching the design process in Grade 9 Technology. This framework serves the purpose of addressing the research questions and objectives and clarifying the fundamental theoretical principles that underpin the study. This theoretical framework not only provides a foundation for the study but also strengthens the understanding of other pivotal elements within the strategies of teaching. These elements encompass the curriculum, content, learner, teacher, available resources, the learning environment, assessment methods and CK. Examining the interplay and significance of these elements within the context of PCK is crucial for comprehending how they collectively shape the learning process. The adoption of the

Pedagogical Content Knowledge (PCK) framework provides a comprehensive lens through which to understand how various teaching strategies interact with critical elements such as curriculum, content, learners, and teachers, enhancing the study's depth and clarity.

Shulman (1986) devised the PCK theory which has become a foundational concept in teacher education and professional development, guiding teachers to improve their teaching practices and enhance learner learning outcomes. The author claims that PCK emphasises effective teaching that goes beyond simply having expertise in the subject matter (CK) or knowing teaching methods and strategies (PK). Instead, it involves the combination and interaction of these two types of knowledge to create meaningful learning experiences for learners. Kind and Chan (2019) define PCK as a specialised knowledge that teachers possess at the intersection of CK and PK. It represents the understanding of how to effectively teach specific subject matter to learners. It is evident that a teacher with PCK possesses a unique and powerful set of skills that allows them to effectively bridge the gap between their subject matter expertise and their understanding of effective teaching methods.

Shulman's theory emphasises the need for teachers to possess multiple knowledge bases. The theory identified seven knowledge bases, which include CK, general PK, curriculum knowledge, PCK, knowledge of learners, knowledge of educational context and knowledge of educational outcomes. In contrast, Grossman (1992) argues that teachers only require four knowledge bases: pedagogy, PCK, school context and subject matter. Despite their differing views, both Shulman and Gross acknowledged the fundamental significance of subject matter knowledge and PCK in ensuring effective teaching practices. They believe that PCK is a critical aspect that concerns how teachers integrate their subject-matter knowledge (what they know about what they teach) with their PK (what they know about teaching). It addresses the manner in which subject-matter knowledge becomes a part of the process of pedagogical reasoning.

PK refers to the understanding and expertise that teachers possess about the art and science of teaching (Sonia, 2017). Latter studies indicates that PK plays a crucial role in shaping effective teaching practices that prioritise practicality, relevance and real-world application. In the diagonal approach, teachers use their personal PK to create a meaningful learning environment that aligns with the principles of the curriculum. According to Kind and Chan (2019), teachers with PK prioritise building positive relationships with their learners and understand the importance of a supportive and caring classroom environment in fostering learner growth and development.

Moreover, PCK influences the selection and application of teaching (Gess-Newsome et al., 2019). For instance, in teaching the design process, teachers with solid PCK recognises learner misconceptions and chooses strategies that correct them. This is an indication that teachers can choose strategies that break down the content into manageable pieces. Conversely, Niemelä and Tirri (2018) assert that PCK emerges from the intersection of content knowledge (CK) and pedagogical knowledge (PK), empowering teachers with a profound grasp of the subject matter. Thus, teachers equipped with PCK can adeptly teach the design process and its principles by adjusting the curriculum's content to match learners' developmental stages, existing knowledge and learning capacities.

PCK plays a pivotal role in shaping effective teaching strategies, especially in the realm of instructing the design process to Grade 9 Technology students (Van Driel et al., 1998). According to Mishra and Koehler (2006), PCK emphasises that teachers must possess a profound understanding not just of the subject matter (CK) but also of how to effectively convey that knowledge pedagogically. Applied to the design process, PCK involves acknowledging the sequential nature of design thinking and problem-solving, aligning teaching strategies accordingly. When applied to the design process, PCK involves recognising the sequential nature of design thinking and problem-solving and tailoring teaching strategies accordingly.

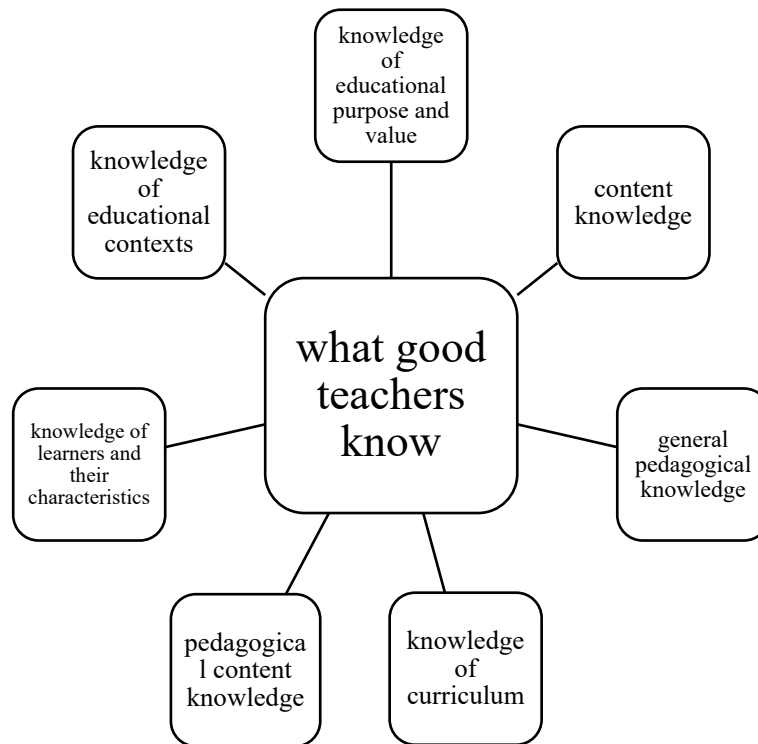
Furthermore, du Plessis and Marais (2015) indicate that strategies such as the vertical approach emphasise a structured progression; therefore, the strategy aligns seamlessly with the sequential and developmental nature of design thinking and problem-solving. This may also mean that the vertical approach ensures that learners systematically progress in their understanding, commencing with foundational principles and gradually advancing to more complex facets of design. For example, a teacher employing the vertical strategy might begin with a basic design challenge, like creating a paper airplane, to introduce fundamental concepts of aerodynamics and problem-solving, setting the stage for a progressively sophisticated exploration of design principles.

Denzin and Lincoln (2018) highlight the critical importance of teacher possessing a nuanced understanding of both content and effective teaching methods, further add that PCK makes connections within and beyond the subject matter. Teachers need to understand the interconnectedness of design with other fields and disciplines. Niemi, (2018) states that in teaching design, teachers should use interdisciplinary connections to demonstrate the relevance

of the design process. The horizontal strategy places a strong emphasis on collaboration and participation, where learners engage in peer interactions, sharing their knowledge and insights with others. This encourages teachers to bridge concepts from various fields, such as science, mathematics and engineering, enriching learners' understanding of design in a holistic manner. For instance, teachers can show how mathematics concepts are applied in measuring and scaling design prototypes or how scientific principles inform material selection.

Moreover, Mishra and Koehler (2006) assert that PCK empowers teachers to move beyond theoretical content understanding and integrate pedagogical strategies aligned with the practical realities of the classroom. This necessitates flexibility and responsiveness to diverse learner needs and emerging educational trends. Conversely, Darby and LaPrairie (2014) emphasise that diagonal strategies, a key aspect of PCK, enable teachers to dynamically navigate the curriculum, accommodating various learner needs and diverse learning styles and incorporating contemporary technologies. This approach allows teachers to adapt and customise their instruction, meeting the diverse needs of learners in real-world educational settings. For instance, a teacher employing the diagonal strategy might organise a field trip to a local manufacturing facility, providing students with a first-hand experience of the design process in action. This practical exposure enhances learners' understanding and appreciation of the real-world applications of design.

The foregoing discussion suggests that teachers must employ a combination of these strategies when teaching the design process. For instance, a teacher could start with a basic design challenge using classroom sessions (vertical strategy), integrate other areas concepts using peer discussion (horizontal strategy), and emphasise the real-world relevance by discussing careers in design or visiting a design studio (diagonal strategy). Thus, PCK involves the ability to present content in accessible ways, identify and address misconceptions and design appropriate instructional strategies to facilitate meaningful learning experiences. Shulman model is shown in the following figure 3.1.



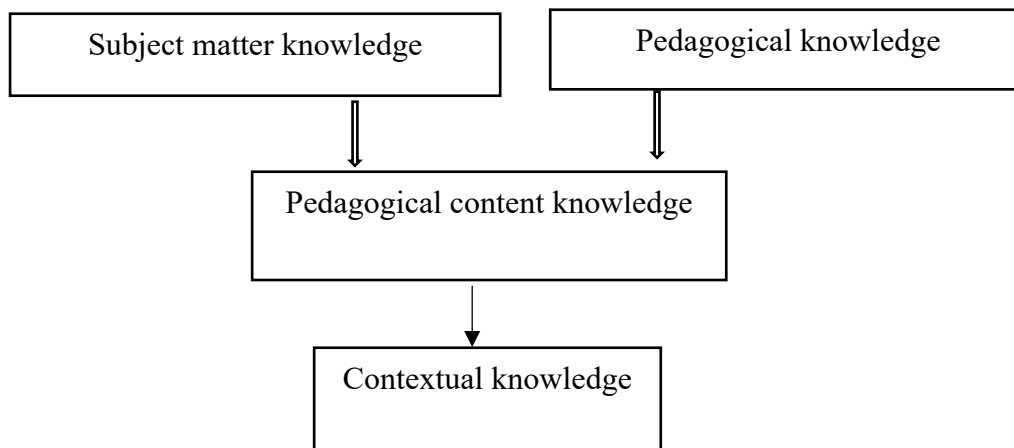
**Figure 3.2.1: Pedagogical content knowledge**

Source: (Shulman, 1987)

Shulman’ model claims that teachers equipped with PCK and a keen understanding of setting and achieving educational objectives are pivotal in guiding learners’ learning (Kind & Chan, 2019). Dalkir (2017) states that PCK blends subject expertise with effective teaching methods, while a grasp of educational goals involves establishing and aligning learning aims. The researchers indicate that teachers with PCK and goal-setting insight ensure their teaching plans match curriculum standards and learning outcomes, reinforcing the broader educational vision. This suggests that Technology teachers with PCK have the ability to set educational goals to create meaningful, organised lessons that support broader educational objectives. This aligns with Shulman’s PCK concept, which give emphasis to the importance of integrating CK and teaching strategies for successful teaching.

Furthermore, Suh and Park (2017) explored the relationship between PCK and science teacher, and found that science teachers who combine subject expertise with effective teaching methods to present learners with real-world problems succeeded in their teaching. This suggests that the Technology teachers can also create a balance between subject knowledge (technology) and twenty-first-century skills, such as problem-solving and design skills as these skills are needed to navigate an ever-changing world. Grossman (1992) systematises the components of the

knowledge base of teachers proposed by Shulman and characterised the concepts of PCK in transformative model, shown in Figure 3.2.



**Figure 3.2.2: A transformative model of teacher knowledge**

Source: (Grossman, 1992)

Grossman (1992) highlights that teachers who combine their PCK with an understanding of their learners can adapt their teaching strategy to cater for diverse learning styles, abilities and cultural backgrounds. This approach is in line with Vygotsky’s socio-cultural theory, which emphasises the importance of considering learners’ backgrounds and previous experiences (Vygotsky & Cole, 1978). This suggests that teachers can use their knowledge of their learners to determine the most effective ways to present information and engage them in meaningful learning. Teachers proficient in PCK and learner understanding can implement differentiated instruction, creating learning opportunities that accommodate various preferences and abilities, ultimately enhancing learner engagement and achievement (Tomlinson, 2014).

However, both Shulman and Grossman (1992) claim that teachers with PCK and a solid grasp of educational resources can have a transformative impact on teaching and learning. PCK combines subject expertise with effective teaching methods. Thus, the knowledge of resources involves selecting and using materials that enhance instruction. This means the teachers with this blend of knowledge can use a variety of teaching aids, such as multimedia, textbooks, digital platforms and real-world examples.

Williams and Barlex (2020) indicate that teachers who combine PCK with a deep understanding of instructional activities can have a significant impact on learners’ learning.

PCK blends subject mastery with effective teaching strategies, while knowledge of activities involves selecting and creating engaging learning experiences. Therefore the combination of PCK components provide a variety of learning opportunities, including group discussions, hands-on experiments, and project-based tasks

Le Donne et al. (2016) highlight the physical layout, emphasising that the connection between the classroom environment and effective teaching relies on teachers having knowledge of the learning environment. These teachers are able to satisfy to diverse learning needs, considering factors such as lighting, seating arrangements and accessibility, ultimately making learning more inclusive (Tomlinson, 2014).

Houston and Thompson (2017) argue that assessment methods must be in alignment with the specified objectives. Similarly, Suskie (2018) emphasises the role of teachers regarding the assessments procedures including ongoing feedback (formative assessments) and end-of-unit evaluations (summative assessments). Incorporating assessment knowledge into PCK helps teachers evaluate learning and enhance their teaching effectiveness (Black & Wiliam, 2018). This means that in teaching the design process, teachers can adopt assessment strategies such as formative, summative and peer assessment and monitor progress throughout the design process phases to ensure that the final achievements align with the initial intentions of curriculum.

Moreover, Gess-Newsome et al. (2019) state that teachers who are well-informed in both PCK and assessment skill can modify their instruction effectively by identifying learners' strengths and areas for improvement through assessments. The Technology subject consists of practical assessment tasks which may be summative or formative. This promotes learners' application of knowledge in the design process context as this is the essence of technology (De Jager, 2011). This suggests that teachers should consider a combination of formative and summative assessments throughout the course to monitor learners' progress. This includes assessment such as project-based, practical examinations and written assessments.

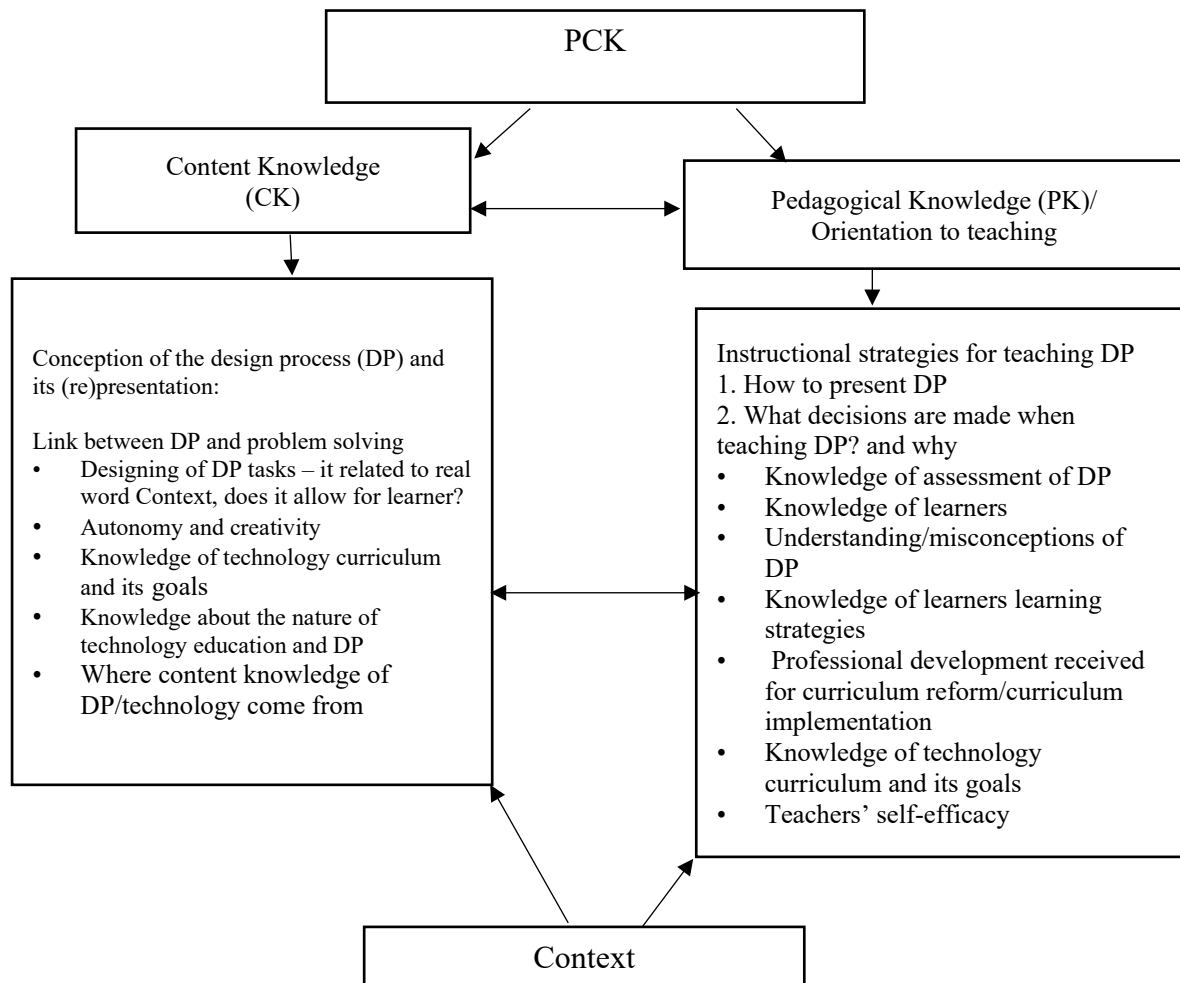
Effective time management skills play a pivotal role in enhancing the effectiveness of instruction (Stronge, 2018). However, Shulman (1986) model posits that PCK teachers seamlessly balance their mastery of subject matter with effective teaching strategies, while the skill of time management revolves around the wise allocation of instructional time for optimal learning outcomes. The CAPS suggest two hours per week for Technology. Therefore, teachers

have limited time for teaching the subject (DBE, 2009) This means that teachers must accurately design lessons that maximise the available time, staying true to PCK concepts.

Niemelä and Tirri (2018) emphasise the relevance of PCK in the teaching strategy of technology education. Their perspective is rooted in the idea that PCK serves as the convergence of CK and PK. Thus, it plays a crucial role in guiding teachers on how to proficiently convey technology content and related concepts such as investigation, design, production, evaluation and communication, as well as appreciating the significance of problem-solving and creativity, while understanding that design is an iterative process.

Singh-Pillay and Ohemeng-Appiah (2016) studied the interconnected relationships between subject-matter knowledge, PK, and the educational context in order to assist teachers in encouraging learners to engage in problem-solving, critical thinking and creativity during the design process. They list three essential components: familiarity with the objectives of technology curricula; knowledge of the nature of technology education; and knowledge of the design process and associated activities. They emphasise that teachers need a comprehensive grasp of the technology curriculum, serving as a pivotal bridge between content and pedagogical knowledge. This understanding enables them to adjust their instructional approaches, bolster students' self-assurance, and harmonise curriculum objectives with the stimulation of critical thinking and creativity, even amidst the balancing act of covering the curriculum while promoting design process skills.

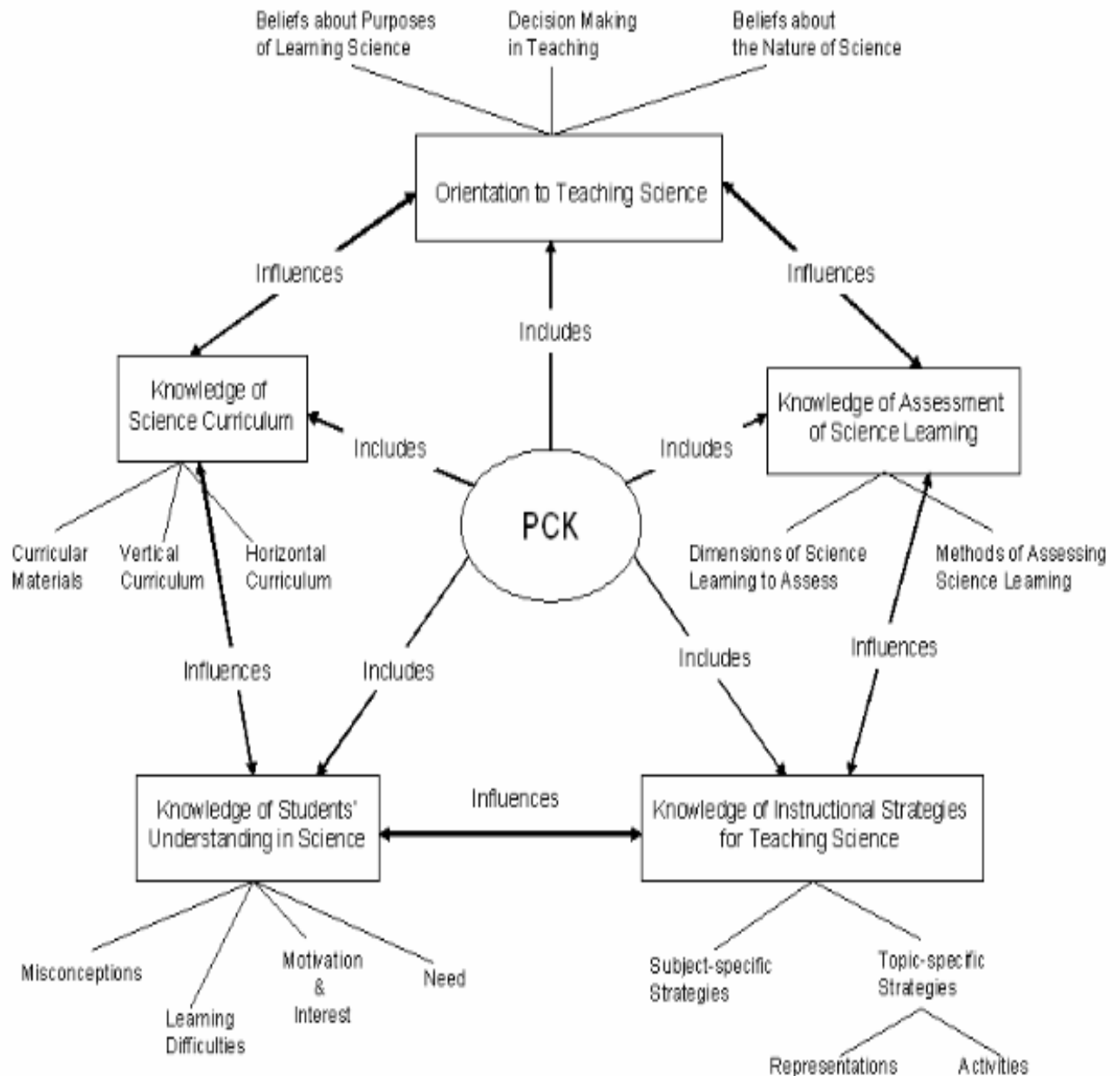
Singh-Pillay and Ohemeng-Appiah (2016) provide the following diagram as a visual summary of the key components of (PCK) when it is used within the context of the design process. Their viewpoints revolve around either grasp of CK pertaining to the design process, knowledge of effective teaching methods for the design process. Figure 3.3 represents PCK in the teaching of the design process



**Figure 3.2.3: Proposed model of PCK as applied to the design process**

Source: Singh-Pillay and Ohemeng-Appiah (2016)

Therefore, PCK in technology education enables teachers to bridge the gap between content expertise and effective pedagogy, ensuring that learners not only acquire technical knowledge but also develop critical thinking and problem-solving skills essential for successful design projects. This indicates that Technology teachers should focus on thoroughly understanding the design process, including critical thinking, innovation, skills, hands-on learning and must keep up to date with current developments and technological advancements.



**Figure 3.2.4: The pentagon model of PCK**

Source: Park and Oliver (2008)

Park and Oliver (2008) contributed to the advancement of the PCK model by focusing on the development and assessment of teachers' PCK in the context of science education. Their work emphasised the importance of teachers' understanding of learner thinking and misconceptions, suggesting that effective PCK involves the ability to diagnose and address learners' learning difficulties. Park et al. (2012) introduced the concept of "knowledge integration" within PCK, highlighting how teachers can integrate CK, PK, and knowledge of learners' learning styles to

design more effective instructional strategies. These advancements underscore the dynamic nature of PCK and its critical role in improving teaching and learning in specific subject areas.

Additionally, Fahrman et al. (2020) emphasise that PCK can serve as a theoretical framework for designing effective teaching strategies within the design process context. Hence, it refers to teachers' specialised knowledge about how to effectively convey specific subject matter to their learners. In light of this theoretical foundation, teachers can implement instructional approaches that accommodate diverse learners needs, transformative learning experiences. This chosen framework in the study centres on teaching strategies, considered to be the most appropriate by the researcher, and is used for analysing and conveying the research findings.

### **3.4 SHORTCOMINGS OF PCK**

Koehler and Mishra (2009) argues that the PCK framework falls short in addressing the complexities of teaching in an era defined by rapid technological advancements. They maintain that the rapid evolution of technology has fundamentally transformed education, requiring teachers to integrate technology effectively. They contend that PCK alone does not adequately prepare teachers for this task. Instead, they advocated for the addition of technological knowledge, changing the framework to Technological PCK (TPACK). The authors believe that TPACK offers a more comprehensive approach to understanding how content, pedagogy, and technology interact dynamically in modern education, providing teachers with a better framework to navigate the challenges and opportunities presented by technology in the classroom.

### **3.4 TECHNOLOGY AS A SUBJECT**

De Jager (2011) defines technology as the use of knowledge, skills and resources to address human needs and desires, as well as to identify and resolve challenges through the investigation, design, development and assessment of products, processes and systems. The incorporation of technology as a subject marks a significant advancement in contemporary education (Ankiewicz, 2021). This inclusion mirrors the ever-increasing significance of technology in our daily lives and prepares learners for an ever-evolving digital landscape.

The primary objective of technology education is to enhance technological literacy within educational institutions, enabling learners to apply pertinent technological knowledge ethically

and responsibly. This approach ensures that learners acquire essential skills such as investigative prowess, design thinking and problem-solving, as outlined by the (DBE, 2009).

Chiliba (2018) notes that the inclusion of technology as a subject cultivates creativity and innovation. Learners are given the opportunity to explore a variety of tools and software, fostering critical thinking and problem-solving abilities in diverse contexts.

Singh-Pillay and Ohemeng-Appiah (2016) stress that technology enables learners to shift from being technology consumers to creators, fostering problem-solving skills and self-confidence as they tackle real-world challenges. In addition, it establishes a strong foundation for future tech-related studies and careers, enhancing job market readiness. It is recommended that teachers receive adequate training and professional development in technology education.

Globally, technology in schools is seen as a cornerstone of modern education, and as a resource for preparing learners for the digital era and it has been recognised as an interdisciplinary field that fosters creativity, innovation and problem-solving (Binkley et al., 2012). This subject is viewed as pivotal for future careers, promoting digital literacy and enhancing global competitiveness. There is a growing emphasis on equity and inclusion, ensuring that all learners have access to technology education (Voogt et al., 2015). Many countries view technology education as interdisciplinary, integrating concepts from science, engineering, mathematics and design and beyond. It seems relevant in the job market, while addressing ethical and social considerations (Albion et al., 2015).

This is evident that improving technology is a step towards building a digitally competent and innovative generation. As technology continues to shape our world, incorporating it into education is a forward-thinking approach that benefits both learners and society as a whole. This suggests the need for teachers to be well-equipped to deliver effective lessons and support learners in their technological journey. This implies that by adhering to the CAPS guidelines and incorporating different teaching strategy practices, teachers have the potential to deliver an immersive and well-rounded learning journey for 9th-grade learners in the field of technology.

### **3.5 CONTENT KNOWLEDGE IN GRADE 9 TECHNOLOGY SUBJECT**

In the context of South Africa, Grade 9 Technology subject is included in the CAPS framework (Janse van Rensburg & Rauscher, 2021). The CAPS for Grade 9 Technology aims to provide learners with essential knowledge and skills related to technology and its applications (Chiliba, 2019).

Grade 9 Technology builds upon the knowledge and skills developed in earlier grades, ensuring continuity in learners' technological understanding (DBE, 2009). It is therefore designed to prepare learners for further studies in technology-related fields or for entry into the world of work. In accordance with CAPS, Grade 9 Technology covers various topics related to technology, including design and problem-solving processes, structures and mechanisms, electrical circuits and systems, energy and power, control systems and automation, materials and their properties and technological processes and techniques (Sephoto, 2018). The CAPS views the design process as part of an experience-based educational programme that enables learners to extend their abilities to solve problem and develop creativity skills (Kola et al., 2019).

The CAPS is largely in agreement with the epistemology of technology to. However, it falls short mainly in respect of the promotion of thinking processes and thinking skills. CAPS over-emphasises the impact of technology, possibly at the expense of aspects such as innovation, which is underpinned by thinking skills.

### **3.6 DESIGN PROCESS WITHIN TECHNOLOGY**

Pillay and Appiah (2016) describe the design process as a fundamental aspect that empowers learners to become problem-solvers and innovative thinkers. It encompasses a structured approach to tackling real-world challenges and creating solutions through a series of well-defined steps. Chiliba (2019) further explains that the content of the design process within technology education is rich and multifaceted, providing learners with a framework for exploration, creativity and hands-on learning. Sephoto (2018) emphasized that the essence of the design process revolves around identifying problems or needs. These studies emphasise that the phases of the design process stands as a pillar that fosters critical thinking, problem-solving, creativity and collaboration – skills that are increasingly essential in a rapidly evolving world. This indicate that the design process is the key element area of Technology.

According to Ohemeng-Appiah (2014), the design process is a well-organised and creative method of problem-solving. He outlines specific stages of the design process, including problem identification, research and investigation, design development, implementation, evaluation and communication and presentation. Each phase plays a vital role in guiding learners through a journey of exploration, idea generation and practical implementation. He highlights that the design process is integral in Grade 9 technology education as it fosters the development of diverse skills and mindsets in learners at this age. These skills encompass

problem-solving, critical thinking, creativity and collaboration, all of which contribute to a comprehensive and holistic approach to learning. As a results, teachers act as guides during these stages, to provide a solid foundation of CK.

Furthermore, Gerrike et al. (2017) states that these phases of the design process is crucial in conveying learners ideas, methodologies and technological aspects to a broader audience. This stage fosters public speaking skills, clarity of expression, and confidence in sharing one's work. Uerz et al. (2018) add that the design process teachers assumes the role of a facilitator of collaboration. Through the art of facilitation, the teacher ensures that every voice is heard, and each learner becomes an active participant in the design journey. This pushes the teachers to continue to refine and expand upon the content of the design process, so that technology education remains an empowering domain that cultivates the innovators.

### **3.7 Pedagogical Knowledge of design process in grade 9 technology subject**

Pedagogical knowledge encompasses the specialised expertise teachers hold in crafting and delivering successful educational experiences, which encompasses the selection of suitable teaching methods, evaluating learner advancement, and establishing an optimal learning atmosphere (Shulman, 1986).

In Grade 9 Technology, teachers' expertise in pedagogy and technology is crucial for effectively imparting knowledge about the design process (Ohemeng-Appiah, 2014). This knowledge makes the design process more accessible and engaging for Grade 9 learners. On the other hand, technological expertise, as emphasised by Koehler and Mishra (2009), encompasses a deep understanding of the tools and software relevant to design. Proficiency in using these tools allows teachers to seamlessly integrate technology into the curriculum, providing learners with valuable hands-on experiences and fostering a dynamic and skills-oriented learning environment. This suggests that teachers have to acquire knowledge in order to deliver effective the design process content.

Darling-Hammond (2017) and (Stronge, 2018) agree that PCK has an influence on the development of teaching. This includes the knowledge of curriculum goals, employing learner-centred strategies, effectively using resources, selecting appropriate instructional techniques, creating engaging learning environments, using diverse assessment methods, differentiating instruction, managing time efficiently and engaging in continuous professional development. This collective knowledge, according to Singh-Pillay and Ohemeng-Appiah (2016), equips

teachers to deliver effective design education that caters for diverse learner needs and fosters an engaging classroom atmosphere. This means that teachers must have deep understanding of pedagogical matters such as effective teaching strategies and the ability to create a dynamic and engaging learning environment for learners.

Moreover, Sephoto (2018) in exploring the teaching the design process in the Grade 9 Technology found that the design process demands a deliberate and engaging approach to enable learners to become inventive problem-solvers. This is because, with their extensive knowledge and expertise in design principles and technology, the teachers provide the foundation for investigation and inquiry. Kola et al. (2019) examined teachers' explanations of critical thinking, and found that Technology teachers sometimes lack sufficient knowledge or experience in instructing the design process. This indicates that adequate professional development opportunities and ongoing support are critically important in enhancing teachers' pedagogical and technical skills in this field.

### **3.8 Teachers content knowledge of design process in the grade 9 technology subject**

According to Shulman (1986), content knowledge is a teacher's deep understanding of the subject matter they teach, encompassing concepts, facts, theories, and skills.. Morrison emphasises the significance of teachers' CK in the Grade 9 Technology, particularly when considering teaching of design process. According to curriculum and Assessment Policy Statement (CAPS), content knowledge of the design process encompasses the stages of investigation, design, making, evaluation, and communication. This implies that teachers are expected to have a understanding and proficiency in these key components of the design process. This knowledge empowers teachers to effectively convey information, facilitate meaningful learning experiences, and address learners' questions or misconceptions. **Zuma (2020)** suggests that a teacher's in-depth subject knowledge empowers them to wisely choose effective teaching strategies. Cochran et al. (1993) propose that teachers' content knowledge enables the integration of principles from various fields like science, engineering, and mathematics.

Collins and Halverson (2018) emphasise the role of teachers in staying current with emerging technologies and trends in design. They claim that the diagonal approach such as speech acts and field work encourage teachers to explore alternative pedagogies, leverage digital resources and encourage students to think critically and adapt to evolving design challenges. A well-grounded CK empowers teachers to adopt various strategies by integrating emerging trends

and technologies into their lessons, creating a dynamic and engaging learning environment for Grade 9 learners (Clarke & Craft, 2019). This indicates that teachers' CK of the design process in Grade 9 Technology can be assessed through the vertical understanding of sequential stages, horizontal integration of interdisciplinary concepts, and diagonal adaptability to new technologies and teaching methods.

### **3.9 Teachers' technological knowledge of design process in the grade 9 technology subject**

According to Hopkins (2018), teachers' general knowledge of teaching Technology involves their comprehension of instructional methods and strategies designed specifically for the field of technology education. This knowledge encompasses the capability to proficiently communicate technological concepts, facilitate hands-on learning experiences and encourage the development of problem-solving skills among learners. The latter study suggests that staying updated on current trends and technological advancements is necessary for teachers

Technological knowledge plays a crucial role when teaching the design process. It involves a deep understanding of the tools, software, and equipment relevant to design, enabling teachers to effectively demonstrate and integrate technology into the curriculum (Koehler & Mishra, 2009). This knowledge empowers teachers to provide learners with practical experiences in applying technology to the design process, fostering a dynamic and skill-oriented learning environment. It bridges the gap between theoretical design concepts and real-world application, preparing learners for the demands of technology-related fields. It is suggested that teachers should enhance their technological skills to better fulfil their role and effectively integrate technology.

### **3.10 Debates on the teaching of design process**

Pillay and Appiah (2016) explored the interconnectedness of Technology teachers' perceptions of teaching of the design process to learners in Umlazi Districts (KZN) schools and state that teachers play a crucial role as facilitators of technology development. They oversee group work, encouraging effective communication and cooperative problem-solving among learners. However, the study revealed that teachers may have limited understanding of curriculum goals, learner needs, available resources and effective teaching.

Furthermore, in their book "Rethinking Education in the Age of Technology", Collins and Halverson (2018) note the barriers faced by Technology teachers in American schools. They

highlight the confidence gaps among teachers when it comes to teaching Technology. They reveal that some teachers lack confidence due to inadequate preparation and an unclear curricular framework in technology education. Similar findings resonate in a recent study by Adipat (2021) emphasising that teachers often lack confidence in their CK related to technology. This highlights the persistent challenges in teaching technology education, especially when it involves the use of technological equipment

Fernandez (2014) argues on the role of PK, which involves the aspects like learning goals, curriculum, learner engagement, resource utilisation, instructional activities, classroom environment, assessment strategies and time management in teaching. Ohemeng-Appiah (2014) explored teaching the design process in Chatsworth District (KZN) and revealed that most teachers encounter limited access to comprehensive professional development opportunities that specifically target these areas. Chilliba (2018) further mentions the issue concerning the time constraints, overwhelming workloads and insufficient support from educational institutions. This can hinder teachers' efforts to deepen their PK.

Grimus (2020) studied the use of emerging technology in Austria in which he addressed the issue of professional development stating that it is essential for teachers to grow their skills through collaboration among colleagues, the provision of mentorship opportunities and continual support. However, according to Chilliba (2018), teachers frequently struggle with time management issues as a result of their busy schedules, making it difficult to find time for additional training.

Nkosi (2020) also mentions that the design process gives teachers the ability to use a variety of technological resources and tools. These could consist of simulations, CAD software and other online resources. However, there are still problems, such as the unavailability of the most recent software and tools for design (Hauge, 2019).

According to Elbaz (2018), a teacher needs to be knowledgeable about the subject matter in order to keep up with new design trends and technical developments. Sephoto (2018) indicates that, in some situations, the culture of the school or district may not value or emphasise ongoing professional development, which makes it less likely that teachers will participate in these activities.

### **3.11 Goals of grade 9 design process class**

The concept of a goal is central to education, serving as a guiding force that shapes curriculum, instruction, and assessment (Glatthorn et al., 2018). The design process aims to cultivate learners' abilities to comprehend, retell, and implement innovative solutions to real-world problems (Education, 2011). However, various studies offer diverse perspectives on the nature of educational goals. Some emphasise the importance of clearly defined, measurable objectives to facilitate effective teaching and assessment while others advocate for broader aims and holistic development. However, Seider et al. (2017), in their work on understanding the design process, stress the importance of establishing clear learning goals and objectives as a foundational element in the instructional design process. The overarching goal is to produce outcomes that are both functional and aesthetically appealing.

Brent (2016) indicates that the choice of educational goals ultimately reflects the philosophical underpinnings of an educational system, with some prioritising standardised outcomes and others valuing individual growth, creativity and critical thinking. This indicates that educational goals strive to strike a balance between specific, measurable objectives and broader, encompassing aims, all of which contribute to a comprehensive and meaningful learning experience.

### **3.12 Teachers role in facilitating grade 9 design process**

Teachers play a pivotal role in facilitating learners learning and development (Gillies, 2016). Thus, (Pillay & Appiah, 2016) reveal that teachers guide learners through the various stages of the design process, offering expertise, mentorship and support. Equally, Richardson and Mishra (2018) highlight the importance of teachers in fostering a conducive learning environment, encouraging creativity, critical thinking, and problem-solving skills and helping learners to apply design principles to real-world challenges. Teachers are expected to support learners for the quest of new knowledge and also to prepare them for the world outside school, Fostering an inclusive environment that encourages creativity and collaboration is another facet of their role, promoting diverse perspectives and ensuring every learner feels valued

### **3.13 Learners in the design process class**

A learner is an individual engaged in the process of acquiring knowledge, skills and understanding through educational experiences (Marzano, 2017). In the design process content,

a learner is characterised as an individual actively immersed in the acquisition of knowledge and skills associated with design principles and methodologies (Sanders & Stappers, 2008). The learners engage in design to explore their cognitive and creative capacities, fostering creativity, problem-solving skills and critical thinking. This shows that that Grade 9 learners, are at a stage of rapid cognitive and creative development, and can actively participate in the design process, and able to tackle design challenges.

Furthermore, the curriculum, as outlined by the DBE (2011), highlights the learner's role in cultivating a profound understanding of design principles, their practical application and the consideration of ethical and sustainable dimensions in design. This stage serves as a foundational platform, empowering learners to evolve into innovative thinkers poised to contribute meaningfully to the field of design and technology. Thus, learners in the design process are dynamic individuals who actively apply their knowledge and skills to address complex design challenges.

### **3.14 Design process activities**

Teaching activities refer to the various exercises and tasks used by teachers to engage learner in the learning process and achieve specific educational objectives (Starko, 2021). (Sephoto, 2018) indicates that the design process activities for learners should be engaging and aligned with their developmental stage and should enhance creativity and critical thinking. Activities like design challenges, reverse engineering, and case studies offer learners opportunities to apply design principles in practical scenarios (DBE, 2011). Prototyping activities, which involve creating physical models, are particularly beneficial in helping learners visualise and refine their design ideas (Press & Cooper, 2017). This indicates that a variety of activities can provide Grade 9 learners with a comprehensive and enriching learning experience in the field of design.

### **3.15 Teaching resources for design process**

Teaching resources encompass a wide range of materials, tools and aids that educators use to facilitate effective learning experiences in the classroom (Glewwe et al., 2021). Teaching the design process to Grade 9 learners requires access to a range of up-to-date and diverse resources. Gillett-Swan (2017) adds that online platforms and educational software can provide interactive lessons, virtual design tools and access to design simulations. However, Grabe and Stoller (2019) state that reading resources and printed materials like textbooks and design

journals still offer foundational knowledge and reference materials for learners. This suggests that access to a variety of resources, both digital and physical, ensures that learners have the tools and materials needed to explore and master the design process effectively.

### **3.16 Assessment of the design process**

Brookhart (2018) defines assessment as the systematic process of gathering, analysing and interpreting evidence to make informed judgements about learners' knowledge, skills and abilities. He highlights the importance of using a multifaceted assessment approach, including formative and summative methods. Assessing the design process involves evaluating learners' ability to apply design principles, critical thinking, problem-solving and creativity. Rubrics and assessment criteria should align with learning objectives and consider not only the final product but also the iterative design process itself (Hsu et al., 2018).

Jones et al. (2017) indicate that both formative assessments such as term tests and written assignments and summative assessment such as project and portfolio submission can be used alternatively in the assessment of the design process to guide learners' improvement. This implies that a balanced approach to assessment should consider formative and summative methods and authentic assessments that address both individual and societal goals, aiming to support effective teaching of the design process and foster meaningful learning experiences.

### **3.17 Environment where teachers teach the design process**

The environment where teachers teach plays a significant role in shaping the learning experience. According to the DBE (2011), it is a space in which learners feel safe and supported in their pursuit of knowledge as well as inspired by their surroundings. Noting the practical nature of the design process, it is therefore important to create a conducive learning environment that promotes active engagement and hands-on learning experiences.

Furthermore, (Rogoff et al., 2016) emphasise the perspective that a learning environment functions as a social context, where cognitive development is enriched through interactions with both peers and more knowledgeable individuals. (Deci et al., 2017) study of self-determination theory emphasises the significance of creating learning environments that nurture autonomy, competence and learner engagement. This suggests that the choice of a learning environment, whether it be physical or virtual, structured or open, traditional or innovative, reflects the foundational philosophies of educational practices, and it has a

profound impact on the engagement and motivation levels of learners, influencing the overall effectiveness of the learning experience.

### **3.18 Allocated time for teaching the design process in grade 9 according to CAPS**

The CAPS for Grade 9 technology in South Africa, as outlined by the (Education, 2011), recommends a specific time allocation for teaching the subject. According to CAPS, the technology should be taught for a minimum of two hours per week. It is crucial to recognise that the actual time allocated for teaching may vary based on individual school schedules and curriculum implementations. However, the importance of following CAPS guidelines for time allocation is emphasised (Booyse & Du Plessis, 2014). This ensures comprehensive coverage of the design process curriculum and effective development of learners' design skills.

### **3.19 Chapter summary**

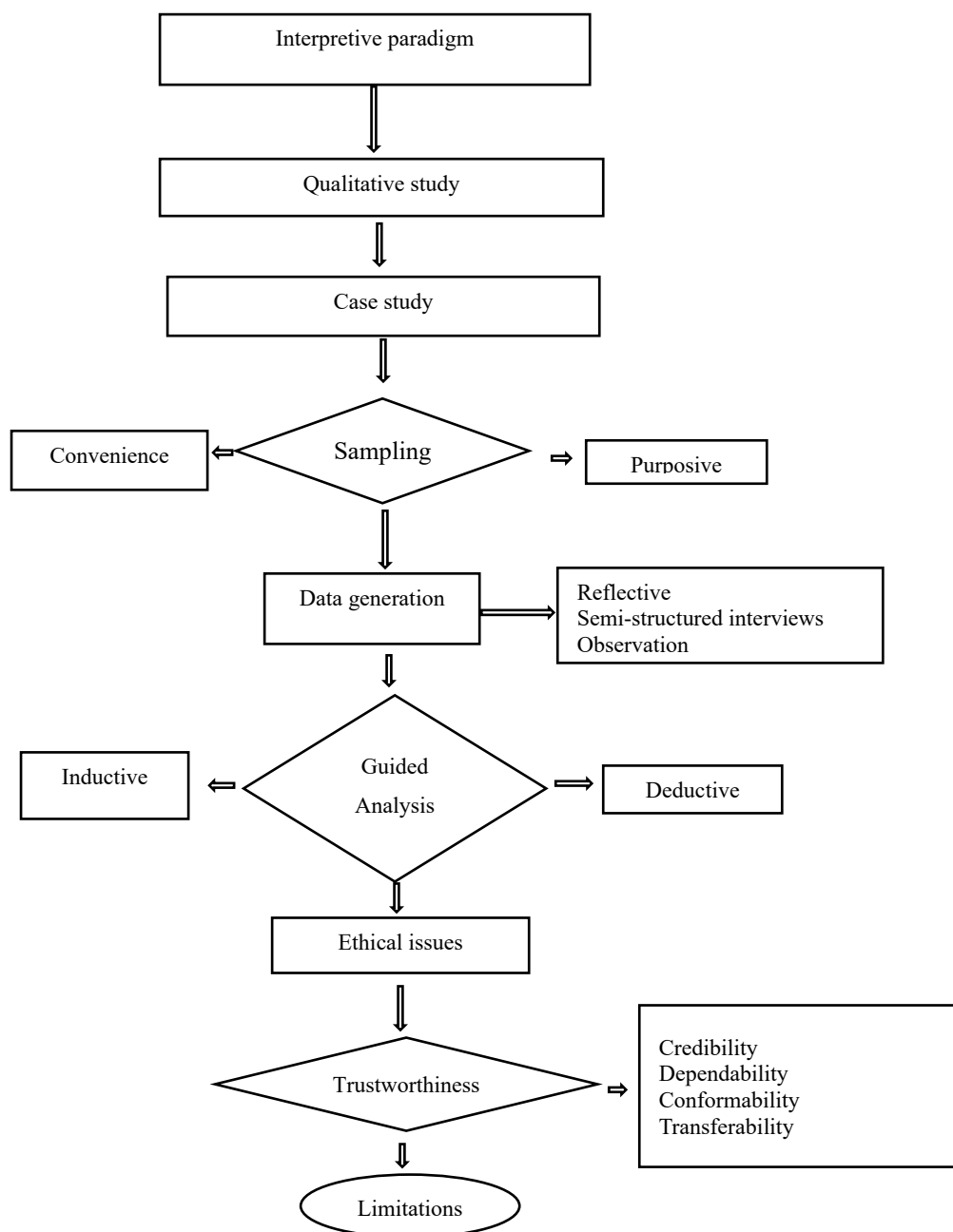
This chapter lays the groundwork by enquiring into the theoretical framework, PCK. Through a detailed exploration of its historical background, explanation and application within the study, the researcher has justified the selection of PCK. This sets the stage for a deeper understanding of how PCK guides and informs the study's exploration of teaching strategies in the context of the design process within Grade 9 Technology.

## **CHAPTER 4**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **4.1 CHAPTER OVERVIEW**

This chapter provides insights of the research approach used to address the research objectives and questions. It outlines how and where the study was conducted, including the chosen research design, approach and methods used to address the research questions or objectives. This chapter explores the ethical basis guiding the study which follows the interpretivist approach. It also explains why specific methods, like interviews and observation were chosen and how they are suitable for capturing the required data. Furthermore, the chapter discusses the sampling strategy, procedures for collecting data and the questioning techniques applied. This thorough exploration of research design and methodology ensures that the study is clear, rigorous, and reliable, creating a solid foundation for valuable insights and scholarly contributions. Figure 4.1 depicts the methods and approach used in this study.



**Figure 4.1: Diagrammatic representation of research methods and approach to this study**

## 4.2 Location of the study

The study was conducted in Richmond, a small municipality situated in the southern part of uMgungundlovu Districts in KwaZulu-Natal. Richmond is notably divided into two distinct areas: the rural and urban parts. The rural part faces challenges such as limited access to basic services like schools and technology, water scarcity, high unemployment rates and a significant reliance on agriculture as the primary source of employment. On the other hand, the urban centre serves as a core for social, welfare and education services, aiming to support the local

population. Despite existing developmental efforts to address these challenges, there is ongoing work to improve basic service provision, particularly in rural areas and to implement skills development programmes.

In this study, the focus was on the rural part of Richmond, specifically within schools, to gather high-quality data. The research explored strategies of teaching the design process in Grade 9 Technology. The researcher carefully selected five schools for in-depth exploration, conducting interviews and observations with two Grade 9 technology teachers from each these schools. This approach aimed to offer valuable insights into the teaching practices in the rural context of Richmond, contributing to the academic discourse on effective strategies for technology education.

### **4.3 Interpretive paradigm**

Bertram and Christiansen (2014) define a research paradigm as a collection of shared beliefs, values and assumptions that direct and mould the way research is conducted within a specific field or discipline. They further explain that a paradigm serves as a foundational structure that guides the overall approach to research, influencing the researcher's worldview, methodology and interpretation of findings. Similarly, Cohen et al. (2011) define a paradigm as a set of shared rules in research that guides how people in a specific field think and work but it is not a concept that fits all research situations uniformly. Instead, they suggest the need for each study to have its own paradigm. In other words, the paradigm adopted should align with the unique characteristics and requirements of the study at hand. This implies that researchers should carefully select or develop a paradigm that aligns with the nature and goals of their specific research inquiry.

Lincoln and Guba (1985) as well as Thanh and Thanh, (2015) define three fundamental beliefs that characterise a paradigm: methodology, (addressing the approach to inquiry and research methods), ontology (which deals with the nature of reality) and epistemology (concerning the nature of knowledge).

According to Cohen et al. (2017), methodology acts as a structured plan that guides the researcher in conducting a study. They outline the steps and procedures that will be followed to gather, analyse and interpret data, ensuring a structured and rigorous approach to the research process. Moreover, Guba and Lincoln (1994) indicates that methodology addresses fundamental questions related to the research, such as what aspects of the phenomenon are

being studied, why certain methods are chosen, where and when the study takes place, and how data is collected, analysed and interpreted.

Ontology refers to the branch of philosophy that explores the nature and existence of reality (Scotland, 2012). Ontology explores questions about the nature of the social world and the entities within it. According to Alharahsheh and Pius (2020), there are different views based on their ontological perspective. Some believe in an objective reality independent of human perception while others argue that reality is subjectively constructed by individuals. Therefore, ontology can be understood as the study of being or existence and is concerned with developing an individual's understanding and interpretation of reality. This view suggests that researchers are expected to consider and define their stance on whether they believe in an objective reality existing independently or if reality is shaped subjectively by individuals.

Epistemology is the study of knowledge that explores how we acquire and understand information (Cohen et al., 2011). Thus, epistemology revolves around the nature of knowledge and the criteria for its validation. It involves questioning the relationship between the seeker of knowledge and the knowledge itself. Creswell, (2012) explores different epistemologies, such as positivism, (which concerns knowledge advancement through observation), realism (which acknowledges social processes beyond human control) and interpretivism, which focuses on understanding the perspectives of individual about a phenomenon.

Therefore, this study, adopts and interpretive epistemology to guide the research. Interpretive epistemology, emphasising an in-depth exploration of lived experiences, is relevant to acquiring comprehensive information from participants (Technology teachers) on strategies for teaching the design process in Grade 9 Technology. This approach recognises the complexity inherent in social phenomena, allowing the researcher to delve deeply into the perspectives and meanings associated with teaching strategies in the specified context. Ontology is also used in the study to explore subjective knowledge on the use of teaching strategy. In employing interpretivism, I aimed to capture the richness of experiences and understand the diverse ways in which teaching strategies unfold in Grade 9 classrooms, contributing to a more nuanced and contextually rich understanding of the phenomenon.

Cohen et al. (2011) maintain that the interpretive perspective leads to a stronger emphasis on what has become known as naturalistic research, meaning that research is conducted in naturally occurring contexts with the researcher aiming to be non-intrusive. The interpretivist approach is underpinned by the idea that people's behaviour is context-dependent (Lincoln &

Guba, 1985). Therefore, I conducted this study in a natural setting. Thus, I spent 45 minutes conducting one-on-one interviews and 45 minutes in the classroom observing how the teachers delivered the design process lesson to the Grade 9 learners, with the aim of understanding the issue of strategies used during teaching. I did this taking into account the larger social, cultural and political context. The findings were derived solely from the limited number of participants involved in the study and were not generalised, although they remain available for other researchers to consider (Creswell & Creswell, 2017).

#### **4.4 Qualitative research approach**

Creswell and Clark (2004) and Creswell and Báez (2020) describe qualitative research as an inquiry approach that focuses on the exploring and understanding of phenomena within their natural settings. This involves a deep and contextual examination of subjective experiences, meanings and perspectives, using methods such as interviews, observations and content analysis. They explain that the goal of qualitative research is to uncover the depth of human experiences and gain insights into the social and cultural context of the studied phenomenon. Taking a qualitative approach, this study aimed to delve into teaching strategies concerning the Grade 9 Technology design process. This method was chosen as it offered valuable insights into the real experiences of Grade 9 Technology teachers and the diverse nature of teaching strategies within the design process.

Furthermore Merriam and Tisdell (2015) assert that the qualitative approach provides opportunities for collaboration by fostering a deep engagement with participants, enabling the co-creation of knowledge and a richer understanding of the studied phenomenon. Thus, collaboration also gave me the opportunity to engage with teachers in a manner that allows for a more comprehensive exploration of effective teaching strategies, ensuring that the research benefits from diverse perspectives and experiences. The qualitative research can take various forms including case study, action research and critical research. Each approach offers distinct methodologies and perspectives, catering to the specific needs and objectives of the research (Bertram & Christiansen, 2014). This study employed a qualitative case study to gain a broad understanding of the strategies used in teaching the design process in Grade 9 Technology.

#### **4.5 Research design**

Harrison et al. (2017) state that a case study is an investigation of a single subject, entity, event or phenomenon within its real-life context. A case study design is a research methodology that

involves an in-depth and comprehensive examination of a specific subject, entity, or phenomenon, aiming to explore its complexities, context, and intricacies within its natural setting or real-life context. Cohen et al. (2017) and Yazan (2015) state that case study research methodology is often designed to illustrate a more general principle. A case study centres on a person, may be a teacher or learner or may be a group (community or a class of learners). According to Cohen et al. (2017), a case study is descriptive in nature and offers a detailed and contextualised description of what it is like to be in a specific situation. Thus, in the context of this study on teaching strategies for the design process in Grade 9 Technology, the descriptive case study allows for a comprehensive exploration of specific instances of teaching strategies used by teachers. It enabled me to obtain a detailed and understanding of how these strategies are implemented, their effectiveness and the contextual factors influencing their application.

Furthermore, Schoch (2020) suggests that case studies are particularly valuable when researchers seek a holistic perspective, exploring the details of a unique case to generate detailed and contextually rich findings. Hence, my purpose was to capture comprehensive information from the teachers in their schools. I asked and observed ten Technology teachers from five different schools using multiple data sources, such as reflective activity, interviews and observations. This gave me a good understanding of what they believe about teaching strategies and how they use strategies in practice and get an idea as to what extent there was a fit between what they said and what they did. Bertram and Christiansen (2014) describe a case study as naturalistic as it focuses on understanding a way of life. Thus, the case study in this project was conducted in a natural context (schools and classrooms) in an attempt to understand participants' point of view. Case studies use a mix of qualitative data collection methods.

A qualitative case study was chosen in this research for several compelling reasons. Harrison et al. (2017) assert that the qualitative case approach provides a holistic understanding of specific cases in their natural context, allowing researchers to explore multifaceted issues. Therefore choosing a qualitative case study approach for investigating the strategy of teaching the design process in a Grade 9 technology class allowed for an in-depth exploration of the teaching strategy within its real classroom context, where learners engaged in practical design tasks, enabling me to observe and analyse how the teaching strategies unfolded in real-time. This methodological choices provided valuable insights into the dynamic interactions between the teacher, learners and the curriculum. Qualitative case studies can provide ongoing insights that support a process of continuous improvement. However, according to Queirós et al. (2017) qualitative case studies have limitations in that they have limited generalizability due to their

context-specific nature. This means the finding from this study cannot be generalised to whole teacher population but could be used in a different context to determine if they are applicable.

## **4.6 Sampling**

Sampling is described by Sharma (2017) as the systematic process of selecting a subsection of individuals or cases from a larger population to participate in a research study. Berndt, (2020) asserts that sampling is a purposeful process in research, undertaken with specific objectives in mind and is intended to provide insights into particular characteristics, behaviours or attributes within a population. Practical factors like time, expenses and accessibility shape the choice of a sampling method in research, impacting the study's potential effectiveness. Therefore, the chosen subset, referred to as the sample, is chosen with the intention of representing the characteristics of the entire population. Different sampling methods, such as random sampling, purposive sampling or snowball sampling, may be used depending on the study's objectives and design. The ultimate aim of sampling is to enhance the external validity and reliability of research outcomes by ensuring that the selected sample is a meaningful and accurate reflection of the broader population.

Sampling methods in educational research can be broadly categorised into probability and non-probability sampling. Probability sampling which is used with quantitative studies includes simple random, stratified random and systematic sampling while non-probability sampling is used in qualitative research and includes purposive, convenience and snowball sampling (Bertram & Christiansen, 2014). This study used non-probability sampling, specifically purposive and convenience sampling.

### **4.6.1 Purposive Sampling**

Purposive sampling allows for the deliberate inclusion of participants with expertise and experience related to the subject matter being researched (Campbell et al., 2020). This study used purposive sampling, selecting participants based on specific criteria relevant to the study's focus. The use of purposive sampling aimed to gather targeted and meaningful insights from individuals with expertise in Grade 9 Technology education, ensuring a rich understanding of the strategies used in teaching the design process to learners. Five schools were selected in the Richmond district and targeted two Grade 9 technology teachers in each school to ensure a diverse representation and a comprehensive understanding of teaching strategies across different educational settings.

These sampling methods were chosen due to practical considerations and the desire to include participants who could provide valuable insights into the teaching strategies for the design process in Grade 9 technology. As a result, all selected teachers possess the qualifications and experiences necessary for providing informed and relevant answers, ensuring the appropriateness of their responses to the study's objectives. The selected participants were also chosen for convenience, taking into consideration factors such as accessibility and willingness to participate in the study.

#### **4.6.2 Convenience Sampling**

The researcher used convenience sampling to make participant selection practical, considering factors like accessibility and availability. Various studies concur that convenience sampling is a practical method often used in research due to its ease of implementation and accessibility to participants (Campbell et al., 2020). Thus, the participants (Grade 9 technology teacher within Richmond district) were chosen because it was easy for me to reach to them, As a Technology teacher in the area at that time, and still teaching Technology in Grade 9. Nonetheless, convenience sampling, is not without limitations. Its main drawbacks include the potential for selection bias and a lack of representativeness, making it challenging to generalise findings to the broader population (Creswell & Creswell, 2017). However, the findings from this study were not intended to be generalised to the entire population. Instead, the focus was on obtaining in-depth insights and understanding within the context of the Richmond district, recognising the limitations in generalisability to the whole population. Therefore, the researcher ensured the reliability of convenience sampling by selecting qualified and experienced Grade 9 Technology teachers, aiming to enhance the credibility and relevance of the insights gathered.

#### **4.6.3 The Sample**

The choice of these participants was purposeful, aiming to gain insights from experienced teachers actively involved in teaching the design process. The goal was to obtain a nuanced understanding of the strategies used by these teachers in the context of Grade 9 Technology education. By focusing on these specific teachers, the study sought to explore and analyse the diverse teaching approaches and methodologies used in the design process, contributing to a comprehensive exploration of effective instructional strategies in Grade 9 Technology.

Table 4.6.3 reflects the demographic characteristics of the 10 participants. This overview provides insights into the participants' background, include information such as their age, gender, teaching experience and educational background.

**Table 4.6.3: Demographic characteristics of the ten participants**

<b>Name</b>	<b>Gender</b>	<b>Ethnic group</b>	<b>Qualifications</b>	<b>No. of years in teaching Technology</b>
<b>T1</b>	Male	Black	Bed degree	11
<b>T2</b>	Male	Black	Bed degree	08
<b>T3</b>	Female	Black	PGCE	22
<b>T4</b>	Female	Black	Bed degree	15
<b>T5</b>	Male	Black	Honours degree	10
<b>T6</b>	Female	Black	PGCE	16
<b>T7</b>	Male	Black	PGCE	04
<b>T8</b>	Female	Black	Bed degree	12
<b>T9</b>	Female	Black	Honours degree	09
<b>T10</b>	Male	Black	Master's degree	17

\*PGCE = Post-Graduate Certificate in Education

#### **4.7 Methods of data generation**

Bertram and Christiansen (2014) define data generation as the systematic process of gathering information for research, particularly in qualitative studies. This involves employing diverse methods like interviews, observations and document analysis to collect contextually rich and meaningful data. This study used three methods of data generation, a reflective activity, one-on-one semi-structured interviews and semi-structured observation.

### **4.7.1 Reflective Activity**

Reflective activity, as described by (Hendricks, 2017) refers to the process where teachers engage in thoughtful examination and analysis of their own teaching practices. This reflective approach allows teachers to continuously improve and adapt their teaching methods, fostering professional growth and effective pedagogy. Thus, in this study, reflective activity was used as a method for data generation from Technology teachers, with the aim of gaining deeper insights into their personal experiences and professional practices. This approach aimed to stimulate insights into the strategies used in teaching the design process to Grade 9 learners and contribute to a deeper understanding of effective pedagogy in technology education. For instance, what is the primary focus of the design process content in Grade 9 technology education? These activities encouraged participants to consider the meaning and effects of their experiences,

### **4.7.2 One-on-One Semi-structured Interviews**

This study used one-on-one semi-structured interviews as a research method where I had individual conversations with participants using open-ended questions. (Bertram & Christiansen, 2014). Semi-structured interviews are defined as formal conversations between the researcher and the respondents, in which the interviewer asks the participants questions to collect data needed, and to learn about ideas, opinions, experiences, views, beliefs and behaviours of the participants. The semi-structured nature of the interviews permits flexibility, enabling the researcher to adapt questions based on the participant's responses, leading to a better understanding of the research topic.

I found one-on-one semi-structured interviews to be suitable for the study because they allowed teachers to provide detailed and context-specific answers about strategies of teaching the design process in Grade 9 Technology. I ensured a relaxed and informal setting for the one-on-one interviews, promoting open and honest discussions. I formulated the same set of questions for the 10 participants, ensuring they matched the study's theoretical framework (PCK) and included relevant educational concepts. I discussed the interview schedule with participant's beforehand, providing clarity on the topics and ensuring their comfort and preparedness. Each interview took about 45 minutes.

Roulston and Choi (2018) mention that semi-structured interviews provide an opportunity for clarification and follow-up questions. For example, one question inquired about the

participants' interest in teaching Technology. However, additional questions arose gradually during the interview process which allowed for greater clarification.

Bertram and Christiansen (2014) notes that conducting semi-structured interviews can be time-consuming due to the in-depth and conversational nature of the interactions, especially when exploring allowing participants to elaborate on their responses. To avoid this, I gave them enough time to read and reflect on the questions before the actual interview to ensure that the interview covered essential aspects while staying within a reasonable time frame.

#### **4.7.3 Semi-structured Observation**

Observation means that the researcher goes to the site of the study and observe what is actual happen there (Bertram & Christiansen, 2014). This means that in the observation the researcher obtains the first-hand data. Semi-structured observation is described by (Kallio et al., 2016) as a research method that involves thoroughly observing and recording behaviours and interactions in setting. Semi-structured observation in research refers to a method where the observer follows a flexible guideline or a loose structure during the observation process. Unlike structured observation, which involves a predetermined and rigid set of criteria, semi-structured observation allows for some flexibility in the observation approach. Thus, semi-structured observation provides a flexible framework with key points of interest, allowing the researcher to capture the richness and context of observed behaviour while maintaining some structure in the data collection process. I, therefore, scheduled the dates of observation with the 10 participants ahead of time to ensure their availability on the day. I conducted 10 observations. I spent 45 minutes for each lesson observation.

Spradley (2016) affirms that the observation schedule is purely descriptive; in other words, the researcher may describe experience, emotion, situation and person. For instance, I may record information about how teachers sound when giving instructions to the classroom. I drafted key points on concepts of interest that guided the observation process which included questions on PK such as how and what strategy was used to engage learners in a lesson? In observing CK, I asked: does the teacher effectively convey key concepts and ideas of the design process content?

However, Bertram and Christiansen (2014) identify few limitations of observation. First, it is impossible for any researcher to observe everything that is happening in a classroom especially when there are interactions going on; second, the presence of the researcher may influence the

teacher and learner behaviour, and last, the observer may interpret findings according to their own view of the world. To reduce these problems, I narrowed my attention to specific key phenomenon concepts such as strategies of teaching and content. With the participants' permission, I also used video recordings to capture actual behaviors without directly affecting the dynamics between teachers and learners.

#### **4.8 Data analysis**

Hair et al. (2019) refer to the data analysis as the process of inspecting, cleaning, transforming, and modelling data to discover useful information, draw conclusions and support decision-making. Miles et al. (2014) suggest that qualitative data analysis is an approach that involves the examination and interpretation of non-numerical data to uncover patterns, themes and meanings within a given context and further describe four data analysis activities, namely, data reduction, data display, drawing conclusions and verification. In the context of this study, I used a reflective activity, semi-structure interviews and semi-structured observation. Therefore, I selected, simplified, abstracted and transformed data that appeared in the interview transcriptions and field notes and organised and assembled information and began to draw conclusions when I started the data collection.

In this study, data was analysed thematically. Thematic data analysis, according to Nowell et al. (2017) is a method that thoroughly examines written or visual data to reveal patterns and themes. The process involves coding data, generating initial themes, reviewing and refining themes and finally, reporting the findings in a coherent manner. This allowed me to identify the similarities and differences in Technology teachers' experiences, perspectives or responses. Moreover, themes were generated and reviewed in accordance with the theoretical framework of the study.

Miles et al. (2014) contended that although thematic data analysis is a valuable method, it is not without limitations; in particular the transcription process can be time-consuming. To overcome this limitation, I personally did the transcription, which allowed me to capture the context of the interviews and observations more effectively and ensure accuracy and fidelity to the original data.

## **4.9 Trustworthiness**

Trustworthiness provides confidence in the integrity of the research and the validity of the insights gained (Creswell & Creswell, 2017). Shenton (2004) defines trustworthiness in research as a measure of the quality and reliability of a study's findings. Anney (2014) affirms that trustworthiness assures readers that a study is worth reading. Connelly (2016) added that trustworthiness acts as a stamp of quality, encouraging readers to engage with the study and consider its findings with confidence. Guba (1981) and Cohen et al. (2017) state that in evaluating the rigour and reliability of qualitative studies, the criteria for doing so include credibility, transferability, dependability and conformability.

### **4.9.1 Credibility**

Credibility refers to the degree to which the research can be deemed authentic and accurate. Amankwaa (2016) states that credibility means making sure that the study's results accurately represent the participants' real experiences. This suggests that trustworthy data contributes to the overall quality of the research. Connelly (2016) indicates that to enhance credibility, researchers often employ strategies such as member checking, where participants verify the accuracy of the findings, and triangulation, using multiple sources or methods to validate results. To ensure credibility, I used methods like reflective activities, semi-structured interviews and semi-structured observation.

### **4.9.2 Dependability**

Creswell and Creswell (2017) state that dependability relates to the stability and consistency of the research process over time. It entails showing that the procedures and methods of the study are dependable, replicable and can be applied in various situations. Anney (2014) notes that to ensure dependability in research requires implementing strategies that guarantee the study's consistency and reliability over time. In this study, I presented a detailed review of the generated data and documented each step of the research. The participants were also given the chance to review the study to ensure that their perspectives and experiences were accurately represented.

### **4.9.3 Conformability**

Bertram and Christiansen (2014) concur with Creswell and Báez (2020) in that conformability in research refers to the degree to which the findings are neutral and free from the researchers'

preferences. The latter studies emphasise the importance of maintaining impartiality throughout the research process which includes keeping a clear notes for every research process and engaging. To pursuit research conformability, I checked if the participants qualified to participate; for instance, whether they were qualified Grade 9 Technology teachers and how long they been teaching. I kept all documented notes and recordings to ensure conformability in the research process.

#### **4.9.4 Transferability**

Transferability in research refers to the extent to which the findings and insights of a study can be applied to different settings beyond the specific study (Bertram & Christiansen, 2014). This approach allows for a greater understanding by readers who can assess for themselves the applicability of the findings in similar situations. I generated data from experienced participants (Grade 9 Technology teachers) in their natural settings. This allowed them to providing detailed and context-rich information about their experiences.

#### **4.10 Ethical issues**

According to (Cohen et al., 2017), ethical considerations in research demonstrate a dedication to maintaining principles and standards that ensure the responsible and respectful treatment of all individuals involved in the research process. Khan (2016) assert that managing the ethical landscape is vital to conducting responsible and trustworthy research. This suggests the need for participants' consent for ethical research practices. Therefore, I adhered to ethical standards, I received permission to conduct a research from the University of KwaZulu-Natal's research office, the Department of Education (DoE) in KZN, and school principals. I also provided participants with thorough information about study procedures and any potential risks or benefits. They also signed the agreement consent form. Jobin et al. (2019) further suggest the essential ethical considerations include obtaining non-maleficence, beneficence, anonymity and autonomy.

##### **4.10.1 Non-maleficence**

Bertram and Christiansen (2014) define non-maleficence in research as the principle of do no harm. (Cohen et al., 2017) elaborate on this ethical principle, emphasising that it requires researchers to prioritise ethical considerations and proactively reduce potential harm arising from the research process. This requires a comprehensive assessment of potential risks,

meticulous consideration of research methodologies, and the implementation of measures to safeguard the safety and well-being of participants. Therefore, in this study I demonstrated the commitment to protect participants' confidential information; for instance, I avoided asking uncomfortable questions and I ensured that their identities remain undisclosed.

#### **4.10.2 Beneficence**

Cohen (2019) understand beneficence as the ethical principle of promoting well-being and maximising positive outcomes of research participants. Cohen et al. (2017) claim that this principle goes beyond the idea of avoiding harm (non-maleficence) and emphasises actively seeking ways to enhance the participants' welfare. In this research, I applied this principle by designing semi-structured interviews and semi-structured observation in a way that avoided asking invasive questions that could cause distress. According to Creswell (2012), beneficence is rooted in the ethical responsibility to contribute positively to the lives of participants and society as a whole through the research endeavour. Therefore, I provided them with clear and complete information during the informed consent process to empower participants with the knowledge needed to make informed decisions about their involvement.

#### **4.10.3 Anonymity**

Ngozwana (2018) studied ethical dilemmas in qualitative research, claiming that anonymity is a crucial ethical consideration that protects participants' identities and ensures confidentiality. According to (Cohen et al., 2011), maintaining anonymity means that the identity of participants is kept confidential, and their responses or data cannot be traced back to them. This principle fosters an environment in which participants feel secure and are more likely to provide honest and candid information. Hence, in this research I used T1 to T10 instead of their names to acknowledge the principle of anonymity.

#### **4.10.4 Autonomy**

Autonomy in research ethics refers to respecting the rights of individuals to make their own informed decisions about participating in a study (Greenwood, 2016). Furthermore, Ngozwana (2018) indicates that autonomy recognises the participants' right to self-determination and the freedom to decide whether or not to be involved in research, To ensure autonomy, I gave them the opportunity to think in order to make to make voluntary and well-informed decisions and I asked them for their informed consent, where participants confirmed whether they agreed to

participate. I provided participants with the freedom to withdraw from the study at any point without facing repercussions if they wished to do so.

#### **4.11 Chapter summary**

This chapter discussed design and methodology of research carefully. It is guided within the interpretive research paradigm, using a qualitative approach. It clearly identifies the study location, ensuring proper relevance, and employs purposeful sampling for thoughtful participant selection. Acknowledging practical considerations, convenience sampling is incorporated. The chapter highlights the demographic characteristics of the ten participants, offering insights into sample diversity. Detailed methods of data generation, including reflective activity, interviews and observations, enhance understanding. The alignment of the chosen research design with the interpretive paradigm is clarified, along with a description of data analysis procedures. Ethical considerations prioritize participant rights and confidentiality, strengthening the study's integrity

## CHAPTER 5

### RESEARCH FINDINGS AND DISCUSSION

#### 5.1 CHAPTER OVERVIEW

This chapter presents the research findings obtained through a multifaceted approach that included reflective activities, semi-structured interviews and semi-structured observations. The triangulation of these methods aimed to capture a complete understanding of the research topic. Through reflective activities, participants engaged in thoughtful self-examination, providing unique insights into personal experiences. Semi-structured interviews facilitated in-depth conversations, allowing for exploration of perspectives. Meanwhile, semi-structured observations provided real-time context to complement the gathered data.

#### 5.2 THEMATIC ANALYSIS

##### 5.2.1 Theme 1 Rationale

##### **Question: Why do you have an interest in teaching Technology?**

The findings indicate that the teachers' enthusiasm for teaching technology is strongly tied to their personal experiences.

##### 5.2.1.1 Verbatim quotes

**T1:** I'm passionate about teaching technology... because it equips learners with practical skills for the digital era. It's not just about theory; it's hands-on, preparing them for the demands of today's world and fostering innovation. It's a gateway to real-world readiness.

**T2:** I fell in love with technology when... I did my PGCE in the university. The interactive demonstrators, real-world examples and mentorship programmes connecting me with industry professionals.

**T3:** Growing up in a setting with limited resources generated my passion for teaching technology and... in my early education, we faced challenges with outdated computer labs and limited access to modern technology.

**T4:** As a technology teacher... I love the active nature of technology and teaching; it allows me to nurture interest and adaptability in learners. Seeing them creatively solve tech challenges is incredibly rewarding.

**T5:** My interest in teaching technology was... kindled by my brother's excellence in the subject. Witnessing his achievements made me to also love the subject.

**T6:** Teaching technology became my passion because of a remarkable teacher during my school years. Her... innovative teaching methods influenced my love for the subject.

**T7:** My interest in teaching technology was deeply influenced by my upbringing in a rural community where access to technology was limited. Growing up without steady access to computers or the internet... and I said to myself... I will do technology when I grow up.

**T8:** I develop the love of technology... when I was doing teaching practical then I decided to enroll technology module at the university because, I was fascinated by how it transforms the world.

**T9:** I love teaching technology because, as a learner back then, I enjoyed the subject. The teachers who inspired me used creative and interactive strategies that combined theory with practical applications, making learning enjoyable and impactful.

**T10:** I became interested in technology in my high school years while I was doing Grade 11 because of a retired teacher who held extra classes after school. Her unique and enjoyable way of explaining complex concepts ignited my passion for the subject.

#### **5.2.1.2 Discussion**

Most responses highlighted the influence of personal experiences on their passion for teaching technology. However, the cognitive and psychological factors of T2, T8 and T9 contributed to their educational experiences, focusing on the practical aspect of technology. Thus, the intersection of these perspectives forms a collective dedication among the teachers.

The responses from the technology teachers (T1 to T10) showed a range of rich personal experiences driving their passion for teaching technology. Common themes emerge, highlighting diverse sources of inspiration. For instance, T1 and T4 stressed the practical side of technology education, highlighting hands-on learning to equip learners with real-world skills for the digital era: *"I'm passionate about teaching technology because it equips learners with*

*practical skills for the digital era.*” Their focus on fostering innovation and preparing learners for contemporary challenges reflects a shared dedication to real-world readiness.

Moreover, other participants attributed their passion to influential figures in their educational journey. T2, T6 and T10 were inspired at university, engaging with interactive facilitators and mentorship programmes. T6 mentioned that she found passion through a remarkable teacher during her school years, influenced by innovative teaching methods. On the other hand, T2 mentioned that *“I fell in love with technology when I did my PCGE in the university.”*

The responses of T3 and T7 indicated that they drew inspiration from personal challenges, navigating limited resources in rural communities with restricted technology access. These challenges motivated them to advocate for technology education and bridge the gap. T3 stated *“Growing up in a setting with limited resources sparked my passion for teaching technology.”*

T5 and T8 credited family influence and personal teaching experiences for their passion. T5 was inspired by a brother’s excellence, while T8’s fascination with technology’s transformative power led to enrolling in university technology modules. As T5 mentioned, *“My interest in teaching technology was kindled by my brother’s excellence in the subject.”* Lastly, T9 recalled enjoying technology as a learner, attributing her passion to teachers who used creative and interactive strategies. She explained that *“I love teaching technology because, as a learner back then, I enjoyed the subject. The teachers who inspired me used creative and interactive strategies that combined theory with practical applications, making learning enjoyable and impactful.”* Each person’s unique perspective added depth to the collective understanding, fostering an environment where diverse insights enhanced the teaching of technology.

Rationale is the reasoning or justification behind a decision, action or belief. It is the thought process or principles that support a specific course of action or set of ideas (Tyler, 2019). Khoza (2015) notes that rationale in education represents a conscious and reasoned foundation for decision-making, influenced by a combination of internal factors, such as personal beliefs, and external factors, including institutional policies and societal expectations. In essence, the convergence of these perspectives forms a collective dedication among the teachers, emphasizing the multifaceted nature of their passion for teaching technology and the diverse factors that contribute to their pedagogical approaches. However, teachers are noted to rely less on the Curriculum and Assessment Policy Statement (CAPS) for professional understanding. They mostly influence by personal influences.

### 5.2.2 Theme 2: Goals

**Question: What goals did you plan to achieve when teaching Technology, in particular the design process.**

These teachers were united in their commitment to delivering an inclusive and impactful technology education that extends beyond theoretical concepts.

#### 5.2.2.1 Verbatim quotes

**T1:** My goal is to instil a culture of innovation among learners, ensuring they not only grasp theoretical concepts but also acquire hands-on skills that prepare them for the demands of the modern world.”

**T2:** I aim to use the design process as a bridge, connecting learners with industry professionals. By providing real-world examples and mentorship programmes, I intend to enhance learners’ understanding and expose them to practical applications.

**T3:** Teaching the design process is my way of empowering learners to navigate and creatively use technology, particularly in settings with limited resources. My goal is to foster resilience and resourcefulness.

**T4:** My objective is to highlight the practical side of technology education, emphasising hands-on learning. By doing so, I aim to foster a culture of innovation and ensure students are well-prepared for real-world challenges.

**T5:** My goal is to inspire learners by showcasing the transformative power of technology, I want them to set high standards for themselves and strive for excellence in the field.”

**T6:** My goal is to create an engaging environment that sparks their passion for technology, encouraging them to think creatively and critically.

**T7:** My goal is to bridge the gap in technology education, specifically in rural communities with limited access. I teach the design process with the aim of advocating for equal opportunities, ensuring that technology education is accessible to all.

**T8:** My objective is to explore the transformative power of technology through the design process. I want learners to see beyond theoretical aspects and apply their knowledge in meaningful ways that contribute to positive change.

**T9:** I aim to create a positive and memorable learning experience using creative and interactive strategies.

**T10:** My goal is to make technology fun and exciting by teaching the design process

#### **5.2.2.2 Discussion**

Grant (2018) defines an education goal as a measurable outcome guiding educational activities. The DBE technology education goals include fostering digital literacy, cultivating critical thinking in technology use, and preparing learners for a technologically-driven society. Koehler and Mishra (2009) emphasise meaningful technology integration through TPACK. This indicates the need for technology teachers to align goals with effective technology use, pedagogy, and subject-specific knowledge, ensuring a complete approach to achieving educational objectives in technology education.

Participants expressed a range of goals, each contributing to a comprehensive and enriching educational approach. For instance, T1, T2, T4, T6, T8 and T10 all highlighted the importance of practical skills and innovation. As T1 is indicated *“My goal is to instil a culture of innovation among learners, ensuring they not only grasp theoretical concepts but also acquire hands-on skills that prepare them for the demands of the modern world.”* Their responses resonated with CAPS’ emphasis on fostering critical thinking and problem-solving skills, encouraging learners to apply their knowledge in meaningful ways that contribute positively to society. T6 stated: *“My goal is to create an engaging environment that sparks their passion for technology, encouraging them to think creatively and critically.”* This suggests that the goals expressed by the teachers aligned with the objectives of technology education outlined by CAPS. The emphasis on instilling a culture of innovation suggests a broader objective of fostering critical thinking and problem-solving skills among learners.

T4 and T8 shared a similar objective of emphasising the practical side of technology education and highlighting the transformative power of technology. T8 said, *“My objective is to explore the transformative power of technology through the design process.”* On the other hand, T7 addressed the technology education gap in rural communities. T7 stated: *“My goal is to bridge the gap in technology education.”* The perspectives of T7 and T9 aligned with CAPS’ commitment to equal opportunities and accessibility in education. T9 placed importance creativity and interactive strategies in saying, *“I aim to create a positive and memorable learning experience.”*

The teachers mentioned that when creating their lesson plans, they included the goal or objective of the lesson. This practice helped them ensure a comprehensive and well-rounded lesson plan. This suggests a thoughtful and intentional approach to lesson planning, ensuring that each lesson serves a clear purpose within the broader educational objectives.

### **5.2.3 Theme 3 Resources**

**Question: What resources are available for technology teachers at the schools to teach the design process and what are your experiences in the use of these resources?**

The findings showed that a variety of teaching resources were used by teachers in teaching the design process.

#### **5.2.3.1 Verbatim quotes**

**T1:** I normally use learner's textbooks, and hands-on project equipment in schools such as cardboard, modelling wire, clay and coloured paper. My experience with these resources has been positive; they enhance the teaching of the design process.

**T2:** I am using textbook as a basic resource... and fortunately we have small computer lab I often use online platforms such as YouTube, slides to show learners a different designs... and if the content requires learners to design project on the computer... I facilitate the mentorship programmes as a technology teacher.

**T3:** I commonly use textbook and interesting chart... and when content need demonstration...I use hands-on tools, like introduce basic woodworking tools for projects involving wood, cardboard, clay fostering skills in craftsmanship and design.

**T4:** I often depend on textbooks and study guides as essential resources and have developed comprehensive workbooks for class activities and homework

**T5:** I have incorporated multimedia resources like audiovisual aids such as video, cinemas and guest speakers and technology showcases in the schools... For example, I invite a guest speaker who is an industry expert to discuss cutting-edge technologies or organising a technology showcase where learners can interact with innovative tools and applications.

**T6** I commonly use learner textbooks, charts, chalkboards and past question papers as essential teaching tools in the classroom...I sometimes use recyclable materials such as plastic bottles, egg cartons for crafts or as paint palettes.

**T7:** I mainly rely on textbooks, chalkboards, and worksheets for both in-class notes and activities to be completed at home... For decorative projects. I am using paint, buttons and beads.

**T8:** I am using case studies from textbook... where I read for learners and develop questions from the case study... I also develop gamifying resources such as educational games designed for the subject matter such as a quiz.

**T9:** I use materials like clay, foam or cardboard for quick and low-cost prototyping, allowing students to iterate and refine their designs easily... I also write instructions on the chalkboard.

**T10:** It depends on the content that I am teaching like for example design... I am using cardboard boxes for shapes and figures cut from cardboard for various arts and crafts projects and clay for sculpting and moulding... I use worksheets for instruction and homework activities.

### **5.2.3.2 Discussion**

All participants relied on textbooks as a foundational hardware resource, offering a structured basis for instruction. T1, T2, T3, T4, T6, T7 and T8 said *“I often depend on textbooks and study guides as essential resources and have developed comprehensive workbooks for class activities and homework.”*

However, T2 and T5 mentioned, software resources, online platforms (YouTube, slides), small computer lab, and visual aids as stated... *“I am using textbook as a basic resource... and fortunately we have small computer lab I often use online platforms.”* T5 shared that, *“I have incorporated multimedia resources.”* However, the findings revealed that there is a widespread reliance on textbooks, hands-on project equipment, encompassing versatile materials like cardboard, clay, modelling wire and coloured paper. T9 mentioned, *“I use materials like clay, foam or cardboard.”*

This suggests that technology teachers commonly rely on textbooks and hands-on projects for learning experience. While only a few teachers used online platforms, the incorporation of technology, seen in the use of online platforms and educational games means a shared awareness of the changing educational landscape. However, it seems that the teachers and learners did not have enough resources to support learners to use tools, build and modify their solutions. According to DBE (2011), it is the responsibility of the school to provide each learner with the tools and materials to meet the needs of the subject, and to develop the teachers’

knowledge and skills. The absence of practical resources implies that Technology teachers face challenges in adequately instructing learners about the design process.

In the responses, it seems that most that teachers relied on traditional tools like textbooks and chalkboards, possibly due to uncertainty about integrating modern resources in technology. Mpungose (2017) argues that modern resources are effective in education generally, but there is a need for incorporation of contemporary tools such as LMS like Moodle, YouTube and Google classroom which can provide dynamic and interactive learning experiences.

However, Dube (2020) highlights a challenge in this transition in pointing out the disparity in resource availability among schools. Some institutions face disadvantages in acquiring the necessary resources. Some teachers indicated that learners sometimes brought resources from home. This issue might hinder the effective implementation of modern teaching resources, especially in technology-related subjects. Thus, the findings highlight the imbalance between traditional and modern teaching tools. This suggests the potential benefits of integrating dynamic resources in technology education.

#### **5.2.4 Theme 4 Teaching Strategy**

**Question: What are teaching strategies you use when teaching the design process in the technology class?**

Findings indicated that teachers were still trying to find a balance between using vertical and horizontal teaching strategies. For example, only one teacher used WhatsApp group conversations.

##### **5.2.4.1 Verbatim quotes**

**T1:** When teaching the design process... I sometimes present a real-world design challenge, such as creating a product to address a specific need. I firstly explain theoretical aspects of design thinking and problem-solving, and then I guide learners through hands-on activities where they apply these principles to develop their solutions.

**T2:** I always make sure... that I prepare for my classes with a well-aligned lesson plan. I engage learners through discussions, encouraging active participation and maintaining a dynamic learning environment. An effective strategy of mine is to include hands-on tasks, such as... the Mini-Practical Assessment, allowing learners to apply theoretical knowledge in real-world scenarios.

**T3:** I combine theory and practice in my teaching by building on a strong theoretical foundation ...and I guide learners through hands-on activities, specifically involving circuit connections, allowing them to apply theoretical concepts in a practical setting. Including peer assessment enhances the learning experience, encouraging collaboration

**T4:** I thoroughly prepare for my classes, starting with a carefully shaped lesson plan that aligns with the CAPS document... this preparation guarantees a clear focus, especially in addressing the energy topic. By following this structured framework, I aim to deliver effective instruction, creating a well-organised and purposeful learning experience for my learners

**T5:** I usually rely on textbooks for creating lesson content, but... I often struggle to have a well-structured lesson plan due to limited resources like paper and typing machines. And my classroom space is insufficient, as I have to share it with other teachers and accommodate a large number of learners, around 63 in my class. This situation makes it challenging to engage learners effectively, especially during practical tasks where I may need to go outside due to space constraints. Unfortunately, these limitations sometimes hinder my ability to capture learners' interest and create a more dynamic and interactive learning environment

**T6:** I use the resources available to me, including old technology books and workbooks that I created for learners. However, due to being the sole technology teacher for grades 7 to 9, time constraints often limit my ability to include interactive elements like pictures or group activities. As a result, I find myself mostly explaining concepts during my teaching sessions not engaging learners for practical activities.

**T7:** I plan lessons ahead with the necessary resources, opting for face-to-face interactions due to learners' unfamiliarity with online systems. I use a mix of oral, written and visual materials to suit diverse learning styles. In class, I pause to ask questions, provide worksheets for activities and facilitate while simultaneously marking and correcting to ensure understanding.

**T8:** I... usually plan my lessons in advance... and begin by incorporating learners' understanding of previous work and providing scenarios for research. Then gave instructions through paper or WhatsApp groups on what is expected of them in the task. During assessments, learners present their projects orally and also allow for peer assessment. I also conduct evaluations and informal assessments to measure overall understanding and learning outcomes.

**T9:** I use the available resource like chalk board, textbook to teach... I recognise that learners learn at different paces. Offer resources for self-paced learning or provide additional challenges for those who grasp concepts quickly. I believe individualization keeps everyone on their toes.

**T10:** I delivery and engagement learner in my lesson...and during in-class activities or exercises... I correct misconceptions or errors on the spot. This ongoing feedback provides instant clarification and prevents the reinforcement of incorrect information.

#### **5.2.4.2 Discussion**

In the educational context, teaching strategy refers to the deliberate and systematic approach used by teachers to facilitate learning and achieve specific educational objectives. It encompasses a range of methods, techniques, and instructional practices designed to engage learners, enhance understanding and promote meaningful learning experiences. According to recent research, effective teaching strategies involve a combination of theoretical and practical elements, aligning with the responses provided by teachers T1 to T10. For instance, Hattie (2015) spoke about the importance of visible learning strategies, where teachers make the learning process transparent, engaging learners actively in the learning process. This aligns with the hands-on activities, discussions and interactive elements mentioned by the teachers.

In the pedagogical practices outlined by teachers T1 to T10, a comprehensive analysis reveals a common thread of commitment to an interactive and applied learning approach. Teachers T1, T2, T3 and T4 prioritised the integration of theoretical and practical components in their teaching methodologies, employing hands-on activities to solidify understanding. This is exemplified through real-world design challenges, circuit connections and the inclusion of practical assessments like the Mini-Practical Assessment. T4, in particular, highlighted the importance of aligning lesson plans with curriculum documents, as saying, *“I thoroughly prepare for my classes, starting with a carefully shaped lesson plan that aligns with the CAPS document,”* showcasing a dedication to structured and purposeful teaching. However, challenges emerged for T5 and T6, where resource constraints, limited space and time constraints hindered the implementation of ideal instructional strategies. Despite these limitations, T7 and T8 showed adaptability, opting for face-to-face interactions and incorporating a mix of oral, written and visual materials. Furthermore, T9 and T10 highlighted a commitment to recognising diverse learning styles and providing immediate feedback, contributing to a more inclusive and dynamic learning environment.

Moreover, the challenges highlighted by teachers T5 and T6 regarding resource constraints and limited space resonate with discussions on inclusive teaching strategies. Stronge (2018) stresses the need for teachers to adapt their strategies to diverse learning environments and use available resources effectively. The adaptive approaches mentioned by T7 and T8 are reflective of these recommendations. In light of these findings, teachers can further enhance their teaching strategies by incorporating technology, collaborative learning platforms and seeking professional development opportunities to overcome resource and space limitations. .

### **5.2.5 Theme 5 Assessment**

#### **Question: How do you assess the design process in technology?**

The findings suggest that teachers use formative assessment when assessing the design process content.

#### **5.2.5.1 Verbatim quotes**

**T1:** I lean towards project-based assessments... learners demonstrate their understanding by applying the design process to real-world problems... I assess learners focusing on how well the design aligns with the problem statement... and then I do formative assessment to assess learner's final product.

**T2:** I commonly use on going testing while I am teaching... asking learners questions about the topic to check if there are with me, and if it's hands-on and practical activity... I assess how well the design meets the needs of the target viewers and I use formal assessment at the end of topic.

**T3:** I informal assess learners through scenario planning... I have to plan a project, where learners have to solve the problem... and I develop a forward-thinking assessment, to check if the design allows for growth and adaptation over time.

**T4:** I give them opportunity for brainstorming to check learner's prior knowledge... also do continuous assessment by give them oral and written class activity...and I give formal assessment that are specified by caps at the end of the topic...

**T5:** I use competence assessment to identify problems with learner and to correct those issues need to optimise their designs for performance and resource utilisation. I look at metrics like response time and resource usage.

**T6:** I use peer evaluations...learners assess the work of their peers... for instance if they are doing project, they have check each other project and give comments at different stages of the design project... and I also administer assignment and formal test.

**T7:** Technology is mostly practical subject... so I do formal assessment for oral presentation of task...learners present their designs in a way that highlights the innovative aspects... It could be a pitch, a demo or any creative format that showcases their unique approach. Innovation and creativity are my focus. Does the design bring something new to the table? And I want to see how well learners develop technological knowledge.

**T8:** I sometime do give informal assessment... I observe the learners as they learn... and give learners an opportunity to discuss tasks and also give them projects that will be evaluated at the end of the term.

**T9:** I do question and answer assessment, learners have to answer planed question before they even begin with the topic... to evaluate how thoroughly knowledge of the technology has been tested... lastly, I assess formal assessment through test and project presentation.

**T10:** I use class activity... I simulate various scenarios, then after I will them questions and also give learners homework, they will write test that are specific by our policy document.

#### **5.2.5.2 Discussion**

According to Black and Wiliam (2018), assessment is a multifaceted process involving the systematic gathering and evaluation of information to measure learners' knowledge, skills and understanding. It plays a crucial role in informing instructional decisions, tracking learners' progress and ensuring meaningful learning experiences. The varied assessment practices described by teachers T1 to T10 reflect a comprehensive approach to gauging learners' learning in the context of technology and design education.

Black and Wiliam (2018) highlight the significance of formative assessment practices, such as ongoing testing, questioning, and informal assessments, in promoting learners engagement and learning. This is evident with the strategies used by teachers T2, T4, T8 and T10, who emphasized continuous evaluation, questioning and informal assessments throughout the learning process. The emphasis on project-based assessments and scenario planning for teachers T1 and T3 resonates with the idea of genuine assessment. Koh (2017) posits that authentic assessments involve tasks that mirror real-world challenges, providing learners with

opportunities to apply their knowledge and skills in meaningful contexts. Moreover, Baird et al. (2017) emphasis the significance of peer assessment in fostering collaboration and enhancing critical thinking skills among learners, supporting the findings of noted on the positive impact of peer assessment on self-regulated learning skills. This suggests that peer assessment emerges as a valuable tool to enhance learners' self-regulated learning skills.

Teachers assessing the learning of the design process in technology used both common and different methods. Commonalities include a focus on real-world application, with T1 and T2 using project-based assessments, while T7 focuses on practical presentations for showcasing innovation. Continuous assessment was a dominant theme, acknowledged by T2, T4, T6, T8 and T10, offering a dynamic evaluation strategy to track progress and address learning gaps. Formal assessments, such as tests and presentations, were widely used by T2, T4, T6, T9 and T10.

### **5.2.6 Theme 6 Learning Environment**

**Question: How do you create a positive and inclusive environment for teaching the design process in Grade 9 technology?**

Findings indicated that despite teachers' efforts, limited school resources and learner behaviors can hinder the development of an ideal learning environment. Addressing these external factors is crucial to create a setting where learners can thrive and maximize their learning potential

#### **5.2.6.1 Verbatim quotes**

**T1:** In Grade 9 technology... I create a positive, inclusive vibe with a strategic classroom setup... and arrange flexible seating to accommodates diverse learning styles and... making the space welcoming for learners to express their design ideas comfortably.

**T2:** I create positivity through... flexible design assignments, celebrating diverse achievements, and... I ensure fair and inclusive access to resources.

**T3:** In my class... inclusivity is promoted by providing various design examples, ensuring accessible tools, and... I incorporating diverse cultural influences in projects.

**T4:** In my class, I sustain positivity by fostering a supportive environment, encouraging open dialogue, and... I recognise the different strengths each learners contributes to the design process.

**T5:** I... establish a positive environment in Grade 9 technology by... ensuring an equitable sharing of resources in the classroom. Each learner has access to the necessary tools and materials, promoting a sense of fairness and inclusivity.

**T6:** In my Grade 9 technology class... I create a positive, inclusive space by arranging the classroom for peer interaction... and cooperative workspaces and project areas to encourage teamwork and support among learners.

**T7:** In Grade 9 technology... I increase positivity by giving awards and appreciations to standout learners in the design process. This recognition motivates everyone and encourages active participation.

**T8:** I maintain a positive atmosphere... using accessible tools, encouraging teamwork and ensuring that design projects cater to various interests and abilities.

**T9:** In my class... inclusivity is promoted through open dialogue, flexible assignments and recognising and celebrating the diverse design approaches of each learner.

**T10:** I create a positive learning atmosphere by... encouraging group effort, using general language and modifying design challenges to diverse learning styles and preferences.

#### **5.2.6.2 Discussion**

A learning environment refers to the physical, social and psychological context in which learning takes place, encompassing the various factors that influence learners' educational experiences and outcomes (Barrett et al., 2015). It includes both formal settings like classrooms and informal settings such as online platforms or community spaces. According to (Machado et al., 2018), the learning environment plays a crucial role in shaping learners' engagement, motivation and overall learning experiences. This encompasses not only the physical infrastructure but also the interactions among learners, teachers and the broader cultural and institutional context.

A dominant theme centred around the development of flexible approaches, for instance teachers (T2, T4, T8, T9, T10) continuously highlighting flexibility across various dimensions, including design assignments, seating arrangements and the provision of accessible tools. For instance, T2 said, "*I create positivity through...flexible design assignments, celebrating diverse achievements.*" This suggests that teachers are dedicated to being adaptable to addressing the varied learning styles and preferences of their learners.

Equally significant is on inclusivity through resource distribution, as noted by multiple teachers (T3, T5 and T6). Ensuring equitable access to tools and materials is featured as a crucial element in fostering fairness and inclusivity, promoting an environment where each learner has the necessary resources for the design process. As T5 indicated, *“I am ensuring an equitable sharing of resources in the classroom.”* Moreover, recognition and appreciation emerged as pivotal factors for promoting positivity and motivation, as articulated by teachers T2, T7 and T10. T7 stated that, *“I increase positivity by giving awards and appreciations to standout learners in the design process.”* This shows that incorporation of awards, appreciations and recognition serves to reinforcing a positive learning atmosphere.

The feedback from T6 and T10 stress the significance of peer interaction and collaboration as crucial elements in fostering an inclusive environment. T10 stated, *“I create a positive learning atmosphere by... encouraging group effort, using general language and modifying design challenges to diverse learning styles and preferences.”* T3 stood out by infusing diverse cultural influences into design projects, enhancing the learning experience and promoting inclusivity. Moreover, T9 prioritised open dialogue and recognised diverse design approaches for inclusivity, while T10 talked about group effort and adapted design challenges for diverse learning styles, showing their commitment to inclusiveness. This implies that the design process teachers employ a diverse and thoughtful approach to meet the varied needs of their learners.

### 5.2.7 Theme 7 Teacher’s Role

#### **Question: How do you describe your role as a Grade 9 the design process teacher?**

Findings suggest that most teachers understand their role as teachers and as technology teachers.

#### **5.2.7.1 Verbatim quotes**

**T1:** My role as the design process teacher, I guide learners in real-world problem-solving through the design process, ensuring alignment with problem statements. I use ongoing testing, hands-on activities, and formal assessments for a thorough understanding

**T2:** I am a facilitator... when I’m teaching the design process content, I use ongoing testing and hands-on activities to ensure learners understand the design process, with formal assessments at the end

**T3:** I position myself as a facilitator, guiding learners in planning projects and assessing adaptability in solving problems over time using the design process.

**T4:** I see my role as the mediator of a lesson...I encourage a supportive environment, and open dialogue, and... also recognizing the different strengths each learner contributes to the design process

**T5:** As a class organizer... I prepare the classroom... like put chart on wall, arrange desk, suitable resources and plan diverse assessments.

**T6:** When...I teach the design process content... I guide learners in applying the design process to real-world problems...and evaluating alignment with problem statements... I also use peer evaluations and formal tests to assess both individual and group design efforts,

**T7:** I define my role as a facilitator... I arrange practical presentations to evaluate innovation, creativity and technological knowledge development in the design process.

**T8:** As the design process teacher, I often observe learners, facilitate discussions and evaluate projects to ensure a comprehensive understanding of the design process.

**T9:** I sometimes become an instructor... I guide them through instructions and explanations to enhance their understanding of the design process.

**T10:** As the design process teacher and facilitator, I... use class activities and resources to generate more ideas and enhance understanding... for example, during a class activity, learners engage in a hands-on design project where they brainstorm ideas, work together and use various resources.

#### **5.2.7.2 Discussion**

Tomlinson (2014) indicates that teacher's role in the curriculum is multifaceted, encompassing the designer, implementer and assessor, facilitator, administrator of educational content. According to Pudi (2008), teachers play more than one role at a time. The responses indicated that selecting suitable instructional strategies, resources and assessments is also a teacher's responsibility.

Overall, the teachers collectively knew their roles which include a role of facilitator, mediator, class organizer and instructor. However, the role of facilitator was a central theme among Grade 9 design process teachers, with T1, T2, T3, T7 and T10 discussed their responsibility in

guiding learners through the application of the design process. This involved hands-on activities and assessments to ensure a thorough understanding. T3 indicated, *“I position myself as a facilitator...”* T7 said, *“I define my role as a facilitator...”*

Additionally, the establishment of a supportive environment was highlighted by T4, T8 and T9. T4, as a mediator, encouraged open dialogue and acknowledged learners’ strengths, while T8 focused on observation and facilitating discussions for comprehensive understanding. Hands-on activities took precedence for T1, T2, T6 and T10 dwell on practical application of the design process in real-world problem-solving. For instance, T2 stated, *“I am a facilitator... when I’m teaching the design process content...”*

Noteworthy differences emerged, such as T9 occasionally adopting an instructor role for guiding learners through instructions, and T5, who uniquely assumed the role of a class organiser, preparing the physical classroom and planning diverse assessments. Assessment methods varied, with T6 introducing peer evaluations for both individual and group design efforts. She said, *“I also use peer evaluations and formal tests to assess both individual and group design efforts...”* In essence, these diverse roles and methods collectively contribute to a complete and dynamic educational experience for Grade 9 learners.

However, teachers could further enhance their role by exploring innovative teaching methodologies, leveraging technology for interactive learning experiences and embracing continuous professional development opportunities. This would not only cater for the developing needs of learners but also contribute to a stronger and more effective curriculum delivery.

### **5.2.8 Theme 8 Content (CK)**

**Question: What are the foundational concepts that learners need to understand in the learning of the design process?**

The findings suggested that teachers had knowledge and understanding of the design process.

#### **5.2.8.1 Verbatim quotes**

**T1:** In technology, the design process involves analysing problems and finding ways to improve existing situations. As a teacher, I guide learners in these investigative processes to enhance their problem-solving skills... the main focus is on introducing learners to the foundational concepts of identifying design problems and applying critical thinking.

**T2:** Design process is a core area of technology... as a teacher, I understand that I need to guide students through its various stages, fostering creativity and problem-solving skills.... I focus on teaching learners how to design solutions to real-world challenges using the design process.

**T3:** The focus of the design process is to guide learners in planning and executing projects through... systematic design thinking. This involves introducing them to foundational concepts, such as analysing design problems and applying critical thinking skills

**T4:** I would say the design process... revolves around fostering creativity, open dialogue and diverse strengths within the design process, especially in the planning and making stages.

**T5:** Because the design process is practical... I organize the learning experiences to ensure hands-on engagement, real-world application, and active participation in various stages, promote a tangible learning environment for learners

**T6:** The primary focus is on guiding learners to apply the design process to real-world problems, with a specific emphasis on evaluating through peer assessments.

**T7:** It's about arranging practical presentations to evaluate innovation, creativity and technological knowledge within the design process, and teach them the presenting stage.

**T8:** The focus is on observing learners, facilitating discussions and evaluating projects to ensure a comprehensive understanding of all stages of the design process.

**T9:** I, as the instructor... I gather essential information about the project, and... facilitate learners in looking for reusable resources to design the projects... it can be animal shelters or bridges.

**T10:** The primary focus is on using class activities and resources to generate ideas, foster creativity and enhance understanding within all stages of the design process.

### **5.2.8.2 Discussion**

Glatthorn et al. (2018) posits that teaching technology encompasses the organised presentation of subject matter, knowledge and skills designed for learners' learning. In the specialised domain of technology education, content extends to the knowledge and skills pertinent to technology, notably including the design processes, technical principles and practical applications. This involves a comprehensive scope ranging from the principles of design and engineering concepts to technological innovations, computer programming and digital literacy.

The careful selection and organisation of this content aligns with educational objectives, standards and the specific needs of learners within the technology education context. Teachers in the technology education sphere exhibited a profound understanding of technology content, particularly within the realm of the design process. They emphasised key principles such as problem analysis, critical thinking, creativity and real-world application. This collective approach reflects a nuanced comprehension, incorporating diverse perspectives on stages, hands-on engagement, peer assessments, resource utilisation and an inclusive understanding aligned with the multifaceted nature of the design process in education.

Effectively delivering the design process content in the technology curriculum necessitates strategic planning and instructional methodologies. A recommended strategy, congruent with the constructivist theory of learning, according to Voogt et al. (2018), involves the incorporation of hands-on, project-based learning approaches. This strategy actively engages learners with the design process, fostering experiential learning crucial for deep understanding and skills development. Additionally, the integration of real-world examples and case studies enhances the relevance of the design process content by contextualizing theoretical concepts within practical, everyday scenarios (Merrill, 2017).

Across all responses, from T1 to T10 there was a shared emphasis on guiding learners through analytical processes, specifically in exploring design problems and applying critical thinking. The responses covered various aspects such as problem analysis, critical thinking, solution design, systematic planning, and fostering creativity, recognising diverse strengths, classroom organization, resource accessibility, assessment planning, real-world application, peer evaluation, practical presentations, innovation and technology knowledge evaluation. As T1 stated, *“I emphasise guiding learners in these investigative processes to enhance their problem-solving skills.”* T2 said, *“The design process is to guide learners in planning and executing projects through...”* Teachers consistently recognized the practical nature of the design process, focusing on real-world applications. This was evident in T5’s, *“I organise the learning experiences to ensure hands-on engagement, real-world application.”*

Moreover, creativity was a common theme among teachers, whether through recognising diverse strengths, organising practical presentations or using class activities to generate ideas. Hence both T4 and T7 indicated that, *“the design process... revolves around fostering creativity, open dialogue.”* However, T9 uniquely spoke the instructor’s role in gathering

essential information and helping learners to find reusable resources for projects, demonstrating a distinct approach to resourcing within the design process.

### **5.3 Observations**

I used observation as a data generation method, outlined in Chapter 4, to investigate the teaching strategies of the design process in Grade 9 technology. One lesson was observed in each school to explore the teaching and learning dynamics. The observation section is structured as follows: the context is discussed first, followed by a summary of each observation. Lastly, the results are discussed in detail. I positioned myself at the back of the classroom, recording the presentation and attentively took notes. The focus was on teachers' practices and their application of teaching strategies to enhance learners' design skills. Key concepts, such as teaching strategies and content, were closely observed.

In this observation, the expectation was for the teacher to effectively implement teaching strategies in the context of the Grade 9 Technology, with a particular emphasis on the design process. I looked for a clear and adept use of teaching methods suited to the complexities of design education. This involved the teachers' ability to explain concepts, engage learners effectively and employ creative approaches to boost their design skills. The desired conclusion was to see strategies that created a dynamic and favourable learning atmosphere, ensuring learners understood the details of the Grade 9 technology design process.

The primary aim of the observations was to address the following research questions:

Q1: Did the teacher have a well-structured lesson plan and were learning objectives clearly stated in Grade 9 Technology classrooms?

Q2: What teaching strategy did the teacher use during the lesson?

Q3: Did the teacher able to support learner to understand lesson technology concepts?

#### **5.3.1 The Observed Lessons**

##### **5.3.1.1 T1 Class observation**

T1 waited for learners to enter the class, resulting in noise and disruptions as learners searched for seats. The overcrowded space restricted T1's movement, and despite having a loud voice, maintaining order seemed challenging. T1 had no lesson plan, as she commenced the session as an instructor, leading to a prolonged duration of 45 minutes dedicated to reading and

explaining the lesson on mechanical systems. The focus on revising levers and calculating mechanical advantage encountered hurdles, with the lack of a clear calculation formula causing confusion among the learners. Learners were not given an opportunity to engage in a lesson, they were asked to open the next page in their books with minimal time to complete tasks.

### **5.3.1.2 Analysis of the lesson observed**

The observed class highlighted substantial challenges for the teacher. The lesson started with T1 waiting for learners to enter the class. While this might be necessary to ensure order, it could potentially affect the overall time available for the lesson. The lack of a structured lesson plan left the class without a clear direction, affecting the overall organisation and coherence of the session. Additionally, the absence of textbooks hindered the teacher's ability to provide comprehensive content, potentially compromising the depth and quality of instruction.

Moreover, the under use of pedagogical strategies and limited engagement with interactive teaching methods reflected a stagnant class environment. This absence of vitality could impede the learners' ability to grasp concepts effectively, especially considering diverse learning styles. In conclusion, addressing these resource deficiencies, encompassing structured lesson plans, access to textbooks and a more varied pedagogical approach is imperative for fostering an environment conducive to meaningful learning experiences.

### **5.3.1.3 T2 Class observation**

T2 had with him a technology file with a lesson plan, the CAPS document, subject school policy, work schedule and annual teaching plan. T2 presented a topic about electrical systems and control. The lesson plan clearly stated that at the end of lesson, learners should be able to present solutions to a problem concerning wiring of electric connections. T2 referred the learners to the previous lesson, started by asking question, allowed short discussions and debates about electricity. The required resources were available such as electric component parts which the teacher had asked learners to bring to class for illustrations and demonstrations on how to assemble the part. While presenting the lesson, T2 asked learners if they understood, then allowed them to do their tasks in groups (Mini-Practical Assessment), facilitated all group and give feedback to struggling groups, and allowed peer assessment. T2 collected all projects for formal assessment.

#### **5.3.1.4 Analysis of the lesson observed**

T2 delivered a well-prepared lesson on electrical systems, using a structured framework from a technology file. The aim was for learners to present solutions to wiring problems. This also aligned with CAPS. T2 connected the current lesson to a previous one, encouraging engagement through discussions and debates. Notably, T2 effectively used learners-contributed electric parts for hands-on illustration. Regular check-ins, group tasks (Mini-Practical Assessment), and peer assessment ensured understanding. T2's commitment to collecting all projects for formal assessment highlighted a dedication to evaluating learners' mastery. These approaches contributed to a student-centred and experiential learning environment, enhancing comprehension, critical thinking and practical skills in Technology.

#### **5.3.1.5 T3 Class observation**

T3 was on electrical systems and control. This was the practical lesson. In a previous lesson, T3 had already taught learners about electricity and how to connect electric circuit components, then instructed learners to brought electrical component to class, so they would do it in the class room. T3 gave out a worksheet with instructions on how to do electric connections and a picture of a complete circuit. The class had 47 learners and the learners were organised into groups of five. They were tasked to connect the devices of electric circuit. T3 facilitate the groups and learners were allowed to ask for assistance. Each group was given time to present their work in class. Out of nine groups, only four presented, but more could have presented if time allocation had been managed properly. However, the teacher allowed for peer assessment, where learners were allowed to comments on and evaluate other groups' work which showed some interesting insights.

#### **5.3.1.6 Analysis of the lesson observed**

T3 led a practical lesson on electrical systems, building on a theoretical foundation. Following T3's instruction to bring components, learners engaged in hands-on circuit connections in groups of five. T3 provided worksheets with instructions and images, facilitating the activity and offering assistance as needed. During the presentation phase, only two out of five groups shared their work due to potential time constraints. However, the presentations were followed by valuable peer assessments, allowing learners to comment on and evaluate each other's work. The two presenting groups provided insightful demonstrations, highlighting the effectiveness

of the hands-on, collaborative learning approach. Overall, T3's lesson successfully integrated theory and practice, fostering engaging and assessed learning.

#### **5.3.1.7 T4 Class observation**

T4's technology master file revealed that each year, the teacher prepared a lesson plans for each lesson and the CAPS document was used to align the lesson. The observed topic was energy. The lesson plan for the lesson observed indicated that the specific aim was clearly defined. However, T4 introduced the lesson by explaining everything to learners, no questions were asked and learners were not given the opportunity to ask questions. The class was dominated by the teacher for the entire duration of 60 minutes. There was no practical activity. Learners were instructed to take their books and write notes from the board.

#### **5.3.1.8 Analysis of the lesson observed**

T4's lesson on energy exhibited both positive and negative aspects. On the positive side, the technology master file indicated a well-prepared teacher who regularly created lesson plans aligned with the CAPS document. The specific aim for the observed lesson was clearly defined. However, the lesson had some drawbacks. T4 introduced the topic by explaining everything to the learners without engaging them through questions or providing an opportunity for them to ask questions. The teacher dominated the class for the entire 60-minute duration, limiting learner participation and interaction. Additionally, the absence of a practical activity restricted hands-on learning experiences. Learners were instructed to take notes, which might have hindered their engagement and understanding.

#### **5.3.1.9 T5 class observation**

T5 conducted an engaging lesson on gear systems, using both the teacher textbook and learner workbooks. In a previous session, T5 had assigned a group homework task where learners sourced old gears from neighborhood mechanics for visual presentations in class. Learners sat in groups, displaying the gears they had found, and T5 prompted discussions by asking questions about the types of gears and their effects. However, there was a lot of noise in the classroom as most learners were not paying attention. Sometimes, it was difficult for the teacher to hear learners when they were responding to questions. T5 actively circulated through the classroom to ensure knowledge sharing. Following the theory and demonstration phase, T5 incorporated a practical task (Mini-Practical Assessment) involving gear making. T5 provided clear instructions and evaluation criteria for the task, spanning several days and encompassing

key design process principles such as investigation, evaluation and presentation. This multifaceted approach not only enriched theoretical understanding but also allowed for hands-on application, promoting a comprehensive learning experience.

#### **5.3.1.10 Analysis of the lesson observed**

T5 skillfully engaged learners through a practical group homework task, sourcing gears for real-world application, adding relevance and practicality to the lesson. The interactive learning environment was evident as learners actively participated in group discussions, sharing insights and findings about gears. T5's multimodal teaching approach, incorporating textbooks, workbooks, discussions and a hands-on task, catered for diverse learning styles, promoting a holistic and comprehensive understanding of the subject matter. While T5 prompted discussions, there was room for improvement in encouraging more open-ended inquiry, allowing learners to explore concepts independently and fostering a deeper level of critical thinking. Additionally, the practical task spanning several days may have presented challenges in terms of time management, requiring careful consideration to maintain an effective and well-paced lesson structure.

#### **5.4 Reflective activity analysis**

The findings from reflective activity indicates that Grade 9 technology teachers, are committed to fostering effective and inclusive teaching practices. Their responses goes through an analytical process of self-observation and self-evaluation. In exploring the role of resources in teaching the design process, few teachers stressed about the availability of essential tools such as computer labs, design software, 3D printers, and textbooks within school settings. While some teachers expressed satisfaction with the existing resources, challenges surfaced, particularly concerning outdated software. This suggest the need for ongoing support and updates to ensure teachers have access to current and effective tools for imparting design principles.

Defining their goals in teaching Technology, especially the design process, teachers articulated a multifaceted approach. Common themes encompassed fostering creativity, honing problem-solving skills, preparing learners for future careers, and nurturing a genuine passion for technology. This goal-oriented perspective aligns with a broader vision of holistic CAPS. Moving to teaching strategies, teachers revealed a diverse collection of methodologies aimed at effectively imparting of the design process. Emphasizing hands-on activities, project-based

learning, collaborative exercises, and real-world applications, teachers understand the dynamic and interactive nature of their instructional approaches. The recurrent theme of integrating technology throughout these strategies speaks to the essential role of technological proficiency in contemporary education.

Moreover, teachers showcased the understanding of assessment, they use a combination of formative and summative methods. Project evaluations, presentations, peer reviews, and written exams were integral components. Describing their role, teachers positioned themselves as facilitators, mentors, and guides. Emphasizing subject expertise, technological proficiency, and adaptability, teachers give the emphases to the importance of supporting learners, providing guidance, and cultivating an inclusive atmosphere. This multifaceted role illustrates the diverse skill set required of technology teachers. Finally, when discussing content knowledge, teachers mentioned foundational concepts taught in design process content such as problem identification, research, ideation, prototyping, and evaluation within the design process. This comprehensive approach reflects a commitment to preparing learners for the complex and dynamic challenges of technology design fields.

## **5.5 Chapter summary**

This chapter explored the experiences of 10 technology teachers, focusing on how they taught the design process in Grade 9 Technology. The analysis included of eight themes from the interviews and observing and analyzing five lessons. The intention was to classify themes and lessons, with the goal of addressing fundamental questions and achieving the objectives outlined in the study.

## CHAPTER 6

### SUMMARY AND RECOMMENDATIONS

#### 6.1 Chapter overview

This chapter outlined key themes derived from interviews with 10 Technology teachers in Richmond municipality, covering aspects such as rationale, goals, resources, teaching strategy, assessment, learning environment, teachers' role, and content. Additionally, findings from lesson observations were analyzed. The study aimed to investigate teaching strategies and the factors guiding teachers' decisions to identify effective approaches for teaching the design process in Grade 9 Technology classes, with the overarching goal of enhancing technology education in schools. The chapter evaluates how well the study's findings align with the research questions and concludes with recommendations based on these findings to address the main research objectives

##### 6.1.2 Goals

The findings revealed that teachers understand the goals of the design process content. They taught to achieve broad goals of equipping learners with technological skills; however, some of them did not give learners the opportunity to develop and design skills to solve technological skill as detailed in CAPS document. Teachers focused more on theory part of the subject which hindered learner creative development.

Grant (2020) asserts that clear and well-defined goals serve as a roadmap, guiding teachers in making informed decisions about content, methods and assessments. The findings indicate that while teachers comprehend the broader goals of the design process content, there is a tendency to prioritise theoretical aspects, neglecting the hands-on development and design skills aligned in the CAPS document.

##### 6.1.3 Resources

The findings revealed a predominant reliance on traditional teaching tools, such as textbooks, chalkboards and hands-on project equipment, among technology teachers. However, some teachers incorporated modern resources like online platforms and multimedia. This suggests a potential hesitancy to integrate contemporary tools in technology education which may be the results of limited access.

Dube (2020) addressed the resource disparities among schools to facilitate the seamless integration of modern teaching tools. Additionally, Dumford and Miller (2018) emphasise the need to provide training and support for teachers to confidently incorporate online platforms and multimedia resources could enhance the adaptability of technology education

#### **6.1.4 Teaching Strategies**

The findings highlighted a common commitment to interactive and applied learning approaches among teachers, despite challenges like resource constraints and limited space affecting the ideal implementation of teaching strategies for some. Le Donné et al. (2016) refer to a teaching strategy as a plan or an approach that teachers employ to facilitate learning and achieve instructional goals in the classroom. The respondents described how they planned their teaching, starting with the core content in the technology curriculum, the pupils' current understanding and the abilities to develop. Among mentioned strategies were direct, differentiated, inquiry-based learning and lecture-based instruction.

Furthermore, in line with policy guidelines, learners were assigned the Mini-Practical Assessment Task (mini-PAT) each term, with the expectation that it be carried out within the classroom setting. This approach providing opportunities for learners to engage with the design process and enhance their problem-solving skills.

#### **6.1.5 Assessment**

According to Black and Wiliam (2018), assessment is a multifaceted process integral to systematically gauging learners' knowledge, skills and understanding. The findings indicated a diverse range of formative assessment methods used by technology teachers to evaluate the design process content. Notable approaches include project-based assessments, continuous assessments and formal assessments such as tests and presentations. Some teacher used peer assessment. The diversity in assessment practices observed indicates a holistic approach to evaluating learning within the realm of technology and design education.

However, the absence of summative assessments is a potential limitation as they provide a comprehensive overview of learners' overall understanding and proficiency. While formative assessments offer ongoing insights, summative assessments are crucial for summarising and evaluating learning outcomes. Kibble (2017) posit that summative assessments are essential to

capture the full spectrum of learners' achievements in the design process and ensure a well-rounded evaluation of their performance and understanding.

### **6.1.6 Learning Environment**

The study findings reveal that teachers predominantly use a face-to-face learning environment when teaching the design process. Learning environment is more than classroom, it is a space where learners feel safe and supported in their pursuit of knowledge (Eryilmaz, 2015). One teacher used WhatsApp to share assignments with learners. Teachers understood the need for creating a learning environment that catered for diverse, physical, social and psychological needs.

### **6.1.7 Teacher's role**

Findings indicated that Grade 9 Technology teachers perceive their role as multifaceted, encompassing facilitation, mediation, organisation and instruction. The predominant finding was that teachers acted in the role of a facilitator, guiding learners through the design process activities and assessments. Alvunger (2018) states that teachers play a vital role in translating educational objectives into engaging experiences and may play more than one role at a time. This implies that teachers act as all-rounders to bridging the gap between curriculum goals and the actual learning experiences learners encounter.

### **6.1.8 Content**

Findings from the responses indicated that teachers have a knowledge of the content covered in technology including the design process. Some teachers indicated that the content they cover was stipulated in the CAPS. However, their responses raised concerns as only a few teachers recognised the design process as a core aspect of technology development. According to Chiliba (2019), the design process serves as the backbone of technology, providing a structured framework for innovation and problem-solving. It could indicate a gap in understanding or implementation of technology curriculum.

Shulman (1986) posits that effective teaching and meaningful learning experiences depend on teachers having vital CK. Among the responses, only one teacher was observed to engage learners in collecting essential information and guiding them to discover reusable resources for projects. According to Glatthorn et al. (2018), this teaching approach signifies a deep understanding of technology content, particularly in the domain of the design process.

However, this observation suggests that the majority of teachers may lack a comprehensive understanding of technology content, especially in the context of the design process.

## **6.2 Summary of the observation**

### **6.2.1 Lesson 1**

Findings from the observation reveal significant challenges in the observed Lesson 1, including the lack of a structured lesson plan, limited engagement with interactive teaching methods, and resource deficiencies such as the absence of teachers' textbooks. A lack of was PK noted. Fernandez (2014) states that PK involves a deep understanding of how learners learn, the effective use of teaching resources, and the continuous adaptation of teaching approaches. The teacher's approach, waiting for learners to enter without a clear plan, contributed to disruptions and a lack of direction. The absence of a calculation formula and minimal time for activities further hindered the effectiveness of the lesson. The teacher showed deficiencies in interactive teaching methods and the absence of the teacher's textbook suggest a potential gap in the teacher's pedagogical toolkit.

### **6.2.2 Lesson 2**

Findings from the observation of Lesson 2 class indicate a well-prepared and structured lesson on electrical systems. The participant demonstrated effective use of a technology file with a detailed lesson plan, connecting the current lesson to previous ones and fostering learner engagement through discussions and debates. Anderson (2018) suggests that a lesson plan file that incorporates the Annual Teaching Plan and CAPS document is crucial for delivering effective lessons. The documents should specify what content should be covered, the desired outcomes and the suggested teaching methodologies.

The learner-centred approach in Lesson 2 prioritised learner participation, collaboration, align well with BED 2011 and CAPS document. It reflects a thoughtful approach to aligning individual lessons with broader educational objectives.

### **6.2.3 Lesson 3**

Findings from lesson 3, a practical lesson on electrical systems, revealed a well-integrated approach to theory and practice. The teaching strategies used by the participant included collaborative groupwork, experiential learning and demonstrations. In a broad sense, this

participant used vertical, horizontal and personal strategies in the classroom. According to Etim (2018), a combination of these strategies can be used to create a dynamic and effective learning environment. He further states that choosing the appropriate teaching strategy often depends on factors such as the learning objectives, the subject matter and the preferences and needs of the learners.

Peer assessments were noted in this lesson (horizontal) and guided instruction was demonstrated (vertical strategy). The teacher used a blended teaching strategy that effectively integrated theory and practice and personal experience during the practical lesson on electrical systems. However, digital strategies such as educational apps, multimedia presentations were used in the lesson. Khoza and Mpungose (2018) maintained that modern technology strategies can create an effective learning environment that meets the diverse needs of learners.

#### **6.2.4 Lesson 4**

Findings from the observed Lesson 4 indicated both positive and negative aspects. On the positive side, the teacher demonstrated a well-prepared approach with a clear lesson plan aligned with the CAPS document. However, the lesson had drawbacks, including the teacher dominating the class (vertical strategy) without engaging learners through questions or providing opportunities for them to ask questions. The lessons were driven by objectives and a focus on content. This means that teacher did not diversify her instructional methods.

The absence of a practical activity in the observed lesson stands in contrast to the endorsed principles in design education. The DBE (2011) through the CAPS collectively advocate for the integration of hands-on experiences within the design process to foster active application and reinforcement of design principles. The CAPS suggests that technology teachers should incorporate relevant knowledge and skills that foster creativity as assign to the policies. This highlights the need for a balanced approach that can enhance the overall educational experience if a learner.

#### **6.2.5 Lesson 5**

In lesson 5, the technology teacher conducted an engaging lesson, used a variety of strategies as an instructor, facilitator and assessor of a lesson. The teacher also incorporated both teacher textbooks and learner workbooks, practical activities and homework tasks were given. PK was shown where teacher maintained a balance between cooperative discussions and independent

exploration. However, the inability of time management was shown especially for the practical activity. The CAPS document specifies hours for each subject. Anderson (2018) suggests that teacher should plan according to subject allocated time.

In Lesson 5, continuous assessment was used through oral questions during the lesson which affirmed the importance of ongoing evaluation in education. This practice enables teachers to adapt their teaching strategies and offer timely support based on immediate feedback. Various studies support the notion that ongoing assessment, integrated into daily instruction, contributes to a responsive and learner-centred learning environment, facilitate continuous improvement and an understanding of learner progress (Black & Wiliam, 2018).

### **6.3 LIMITATIONS**

Some limitations were observed in this study; for instance, the potential interruptions and time constraints, because two of the participants were also school principals. They had office duties and unexpected interruptions, which affected the interview schedule, leading to rescheduling and delays. However, to address this, I rescheduled interviews and observations to ensure the smooth progression of the study while respecting the participants' work commitments.

### **6.4 RECOMMENDATIONS**

The following recommendation are made based on the conclusions:

- Teachers should approach curriculum development with a well-rounded perspective, acknowledging the interconnectedness of personal, societal and professional influences to create an effective and responsive educational experience for their learners.
- Teachers should reconsider their instructional approach to align more closely with the detailed goals outlined in the CAPS document. The study suggests that teachers should regularly review and align teaching practices with the requirements and guidelines outlined in precise documents. Technology teachers need to preplan their lessons timeously.
- Teachers should attend workshops, training sessions or collaborative discussions with experienced teachers to acquire new instructional techniques, strategies and insights. Ongoing training initiatives would address such challenges, ensuring adherence to policy guidelines and promoting consistent enhancements in teaching strategies, particularly in the practical application of technology through the design process. Targeted professional

development programmes should be implemented for teachers to enhance their understanding and implementation of the design process in technology education. It is crucial to bridge the gap in recognition and application of the design process as a core element.

- The study recognises the need for a balanced approach, considering both traditional and modern resources to create dynamic and effective learning experiences. It is important to find a middle ground between traditional and modern tools to ensure comprehensive and equitable technology education. The primary recommendation is for teachers to proactively integrate technology into their pedagogical approaches.
- The instructional methods the teachers used depend on their pupils' needs and teachers should use different strategies in order to address barriers into the classroom (DBE 2010). The findings showed that effective teaching goes beyond a singular approach; it involves a strategic combination of methodologies that considers both the content to be taught and the context in which it is delivered. Teachers should maintain a thoughtful and adaptable approach, ensuring that their instructional strategies remain responsive to the challenges and opportunities presented in their unique educational environments. Pragmatic or personal teaching strategies should be used when teaching the design process. This strategy would allow teachers to use their own expertise to enhance the understanding and application of design principles (Khoza, 2019).
- Despite teachers formally integrating the mini-PAT as an assessment task, the challenge of non-compliance with the in-class completion policy is notable. Teachers should use a diverse range of assessment methods, including formative assessments for real-time feedback, summative assessments for overall understanding, and peer assessments for collaborative learning experiences.
- According to the DoE, teachers have seven distinct roles. For Grade 9 technology teachers, this implies that their responsibilities go beyond traditional instruction. They may take on roles such as motivators, mentorship encouraging learners to tap into their creativity and problem-solving abilities during the design process. Grade 9 Technology teachers should embrace and actively adopt these diverse roles.

To summarise, the recommendations emphasise professional development, resource diversification and flexibility in teaching approaches to enhance the overall learning experience for learners.

## **6.5 CONCLUDING STATEMENT**

The study aimed to explore strategies of teaching the design process in Grade 9 Technology and to explain way in which these strategies were used. It also aimed to find reasons that informed Grade 9 Technology teachers' use of these strategies when they teach the design process to achieve these objective. I formulated three research questions: What are the strategies of teaching the design process in Grade 9 technology subject? How are these strategies used in the teaching of the design process in Grade 9 Technology? And what informs teachers to choose these strategies in the teaching of the design process in the Grade 9 Technology?

In addressing question 1, three significant teaching strategies namely vertical, horizontal and diagonal teaching were identified as design process-based methods. However, the findings showed that diagonal teaching strategies were not used much in the observed setting. This suggests a potential need for teachers to incorporate these strategies more widely.

A combination of strategies should be used to create a dynamic and quality learning environment. Therefore, to answer the second question, teachers may use two or more different teaching strategies to teach the design process depending on the unit's theme, grade level, class size and available resources.

In response to the third question, in choosing teaching strategies for the design process in Grade 9 technology, teachers need to consider factors like learning objectives, learner needs, curriculum requirements and the practical relevance of the strategies. The decisions are influenced by a commitment to promoting engagement, aligning with educational objectives and accommodating the diverse learning styles of learners.

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## Appendix A

### CONSENT LETTER FOR TEACHERS

**Title of the study:** Strategies of Teaching Design Process in Grade 9 Technology Subject



Curriculum Studies,  
School of Education,  
College of Humanities,  
University of KwaZulu-Natal  
Edgewood Campus  
August 2023

Dear Teacher

#### INFORMED CONSENT LETTER

My name is is Mirriam Nonkululeko Sithole. I am a Masters candidate at the University of KwaZulu-Natal, Edgewood Campus school of Education. This letter serves to invite you to be part of the research study that I am conducting for my Master's degree in the Department of Curriculum studies, under the supervision of Dr CB Mpungose. The title of my research is Strategies of Teaching Design Process in Grade 9 Technology Subject

The implementation of technology education into the South African school curriculum was due to the need of technological literacy in the society (Chilliba, 2018). The main purpose of the study is to explore the strategies of teaching design process in grade 9 technology subject.

#### **The study further intends to achieve the following objectives:**

- To understand the strategies that are used in teaching design process in grade 9 technology subject.
- To explain ways in which the strategies in the teaching of design process in grade 9 technology subject are used.

To know the reasons behind the strategies used in teaching of design process in grade 9 technology subject

You are invited to please participate in the study because you are a technology teacher who is teaching grade. Should you agree, your participation in the study I will ask you some questions through reflective activity and semi-structured interview that will take an hour or less in duration and also do a lesson observation when you are teaching your grade 9 learners. The date and time will be negotiable to ensure that it does not affect your duties.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee.

**Please take the time to read the following information carefully.**

- You are given a choice to participate or not participate in this study.
- The interview may last for 60 minutes.
- Your confidentiality is guaranteed as your input will be generated in person and data will be stored in a secured storage and kept confidential.
- When reporting findings, pseudonyms (false name) will be used instead of your full real name.
- Your involvement is purely for academic purposes, there are no financial benefits for you.
- You are free to withdraw from the research at any time if by any chance you feel like, without any consequences.
- If you are participating in the interview session, please indicate (by ticking) whether you agree to the audio recording of the session.

Thank you

**Yours sincerely**

Mirriam Nonkululeko Sithole

Please contact the researcher if there is anything that is not clear or if you need more information

Researcher's contact details:

**Mirriam Nonkululeko Sithole**

**Email address: 222121660@stu.ukzn.ac.za**

**Cell phone: 0761361093**

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

Supervisor's contact details:

**Dr Cedric B. Mpungose**

**Email address: mpungosec@ukzn.ac.za**

**Cell phone: 031 260 3671**

You may also contact the Research Office at:

**University of KwaZulu-Natal**

**Humanities and Social Sciences Research Ethics**

**Govan Mbeki Centre**

**Tel +27312604557**

**Email: HSSREC@ukzn.ac.za**

Thank you for your contribution to this research study

## **DECLARATION OF CONSENT**

I ..... (Full name of the participant) hereby confirm that I have been informed about the study entitled Strategies of Teaching Design Process in Grade 9 Technology Subject 'by Mirriam Nonkululeko Sithole. I understand the consent of this document and the nature of the research project, and I consent to participate in the research project.

- I understand the purpose and procedures of the study.
- I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.
- I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without negative consequences.
- I voluntarily give permission for the interviews to be audio-recorded.
- My identity will not be disclosed, and pseudonyms will be used to protect my identity
- If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher at:

**Mirriam Nonkululeko Sithole**

**Email address: 222121660@stu.ukzn.ac.za**

**Cell phone: 0761361093**

- If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researcher, then I may contact:

**University of KwaZulu-Natal**

**Humanities and Social Sciences Research Ethics**

**Govan Mbeki Centre**

**Tel +27312604557**

**Email: HSSREC@ukzn.ac.za**

## Appendix B: Reflective Activity

<b>Strategies of Teaching Design Process in Grade 9 Technology Subject</b>
--

### Rationale

Question 1	Why do you have an interest in teaching Technology?
Rationale	

### Pedagogical Knowledge

Question 2	What resources are available for technology teachers at the schools to teach the design process and what are your experiences in the use of these resources
Resource	

Question 3	What goals did you plan to achieve when teaching Technology, in particular the design process
Goals	

Question 4	What are teaching strategies you use when teaching the design process in the technology class?
Teaching strategy	

Question 5	How do you assess the design process in technology?
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Assessment	
------------	--

Question6	How do you create a positive and inclusive environment for teaching the design process in Grade 9 technology?
Learning environment	

Question 7	How do you describe your role as a Grade 9 the design process teacher?
Teachers' role	

### **Content Knowledge**

<b>Question 8</b>	What are the foundational concepts that learners need to understand in the learning of the design process?
<b>Content</b>	

### Appendix C: Semi-structured interview

<b>Major question</b>	Why do you have an interest in teaching Technology?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• Why did you choose to teach Technology?</li> <li>• How do you share your love for the subject to inspire your learners?</li> </ul>

<b>Major question</b>	What resources are available for technology teachers at the schools to teach design process?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• What are your experiences in the use of these resources?</li> <li>• How do you ensure access to adequate resources for your teaching?</li> <li>• What ways do you adapt your lesson plans based on the available resources?</li> </ul>

<b>Major question</b>	What goals did you plan to achieve when teaching Technology, in particular the design process
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• What are your aims of teaching design process?</li> <li>• What are objectives of design process?</li> </ul>

Major question	What resources are available for technology teachers at the schools to teach the design process?
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Sub-questions	<ul style="list-style-type: none"> <li>• What do you think about technological resources in the teaching of design process?</li> <li>• What software have you use for instructional purpose in grade 9 technology class?</li> <li>• What are your experiences in the use of these resources?</li> </ul>
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<b>Major question</b>	What are teaching strategies you use when teaching the design process in the technology class?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• How do your teaching strategies help your grade 9 learners to learn design process</li> <li>• What teaching strategies do you find most effective for engaging learners in the learning process?</li> <li>• How do you adjust your teaching to meet diverse student learning needs?</li> </ul>

<b>Major question</b>	How do you assess the design process in technology?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• What types of assessments do you find most effective to assess design process?</li> <li>• Which assessment methods you used to measure learning of design process in technology subject?</li> <li>• What types of assessments do you find most effective in gauging student learning?</li> <li>• How do you provide constructive feedback to help learners improve their performance?</li> </ul>

<b>Major question</b>	How do you create a positive and inclusive environment for teaching the design process in Grade 9 technology?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• How do you create a positive classroom atmosphere?</li> <li>• In what ways do you encourage learners' engagement and participation during practical lessons?</li> </ul>

<b>Major question</b>	How do you describe your role as a Grade 9 the design process teacher?
<b>Sub-questions</b>	<ul style="list-style-type: none"> <li>• Which role you prefer when teaching design process?</li> <li>• How do you facilitate practical activity?</li> </ul>

<b>Major question</b>	What are the foundational concepts that learners need to understand in the learning of the design process?
<b>Sub questions</b>	<ul style="list-style-type: none"> <li>• What is your understanding of design process content in grade 9 technology subject?</li> <li>• What approaches do you use to relate the subject matter to real-world applications and relevance?</li> </ul>

## Appendix D: SEMI-STRUCTURED OBSERVATION CHECKLIST

<b><u>Rationale</u></b>	<b><u>YES</u></b>	<b><u>NO</u></b>	<b><u>Comments</u></b>
<ul style="list-style-type: none"> <li>• <u>Does the teacher showed interest in a subject or lesson</u></li> </ul>			
<ul style="list-style-type: none"> <li>• <u>How do you share your love for the subject to inspire your learners?</u></li> </ul>			
<b><u>Pedagogical Knowledge</u></b>	<b><u>YES</u></b>	<b><u>NO</u></b>	<b><u>Comments</u></b>
<ul style="list-style-type: none"> <li>• Did the teacher have a well-structured lesson plan and were learning objectives clearly stated?</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teachers used teaching strategy? Does any of the following strategy included; vertically, horizontal and diagonal strategy?</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teacher have resources of teaching design process?</li> </ul>			
<ul style="list-style-type: none"> <li>• Is there any practical activities included in a lesson?</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teacher create a positive and inclusive classroom environment</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teacher able to support learner to understand lesson?</li> </ul>			

<ul style="list-style-type: none"> <li>• Are assessment methods aligned with the learning objectives?</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teacher provide constructive and timely feedback to learners?</li> </ul>			
<ul style="list-style-type: none"> <li>• Did the teacher maintain a professional demeanour throughout the lesson</li> </ul>			
<b><u>Content Knowledge</u></b>	<b><u>YES</u></b>	<b><u>NO</u></b>	<b><u>Comments</u></b>
<ul style="list-style-type: none"> <li>• Does the teacher demonstrate a deep understanding of the subject matter being taught?</li> </ul>			
<ul style="list-style-type: none"> <li>• Can the teacher explain complex concepts clearly and accurately?</li> </ul>			
<ul style="list-style-type: none"> <li>• Are learners given opportunities to apply their knowledge to solve problems?</li> </ul>			

## Appendix E: Ethical Clearance



**UNIVERSITY OF  
KWAZULU-NATAL**  
INYUVESI  
YAKWAZULU-NATALI

27 July 2023

**Miriam Nonkululeko Sithole (222121660)**  
School Of Education  
Edgewood Campus

Dear MN Sithole,

**Protocol reference number:** HSSREC/00005819/2023  
**Project title:** Strategies of teaching design process in grade 9 technology subject  
**Degree:** Masters

**Approval Notification – Expedited Application**

This letter serves to notify you that your application received on 10 July 2023 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**.

**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 27 July 2024.  
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.

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

Yours sincerely,

-----  
**Professor Dipane Hilelele (Chair)**

/dd


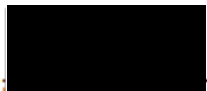
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**Humanities and Social Sciences Research Ethics Committee**  
Postal Address: Private Bag 304001, Durban, 4001, South Africa  
Telephone: +27 (0)31 260 8350/4557/3587 Email: [hr-vc@u-ukzn.ac.za](mailto:hr-vc@u-ukzn.ac.za) Website: <http://www.humanities-ukzn.ac.za/Research-Ethics>

Founding Campuses: ■ Edgewood ■ Pietermaritzburg ■ Medical School ■ Pietermaritzburg ■ Westville

**INSPIRING GREATNESS**

## Appendix F: Gate keepers letter

 <b>KWAZULU-NATAL PROVINCE</b> EDUCATION REPUBLIC OF SOUTH AFRICA	<b>OFFICE OF THE HEAD OF DEPARTMENT</b>
Private Bag X9137, PIETERMARITZBURG, 3200 Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201 Tel: 033 392 1051	
Email: Phindile.duma@kzndoe.gov.za	
<b>Enquiries:</b> Mrs B.T. Ntuli	<b>Ref.:</b> 2/4/8/7476
Mrs Miriam Nonkululeko No. 23 Tyrone Road <b>PINETOWN</b> 3609	
Dear Mrs Sithole	
<b>PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS</b>	
Your application to conduct research entitled: "STRATEGIES OF TEACHING DESIGN PROCESS IN GRADE 9 TECHNOLOGY SUBJECT:.", in the KwaZulu-Natal Department of Education institutions has been approved. The conditions of the approval are as follows:	
<ol style="list-style-type: none"><li>1. The researcher will make all the arrangements concerning the research and interviews.</li><li>2. The researcher must ensure that Educator and learning programmes are not interrupted.</li><li>3. Interviews are not conducted during the time of writing examinations in schools.</li><li>4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.</li><li>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.</li><li>6. The period of investigation is limited to the period from 31<sup>st</sup> May 2023 to 31<sup>st</sup> December 2025.</li><li>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.</li><li>8. Should you wish to extend the period of your survey at the school(s), please contact Mrs Buyi Ntuli at the contact numbers above.</li><li>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.</li><li>10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.</li></ol>	
 _____ Mr Gw Ngcobo Head of Department: Education Date: 31 <sup>st</sup> May 2023	
GROWING KWAZULU-NATAL TOGETHER	

## Appendix G: Letter from editor



### Blue Diamonds Professional Editing Services (Pty) Ltd

Polishing your brilliance  
Email: [jacquibaumgardt@gmail.com](mailto:jacquibaumgardt@gmail.com)  
Website: [www.jaybe9.wixsite.com/bluediamondsediting](http://www.jaybe9.wixsite.com/bluediamondsediting)

13 December 2023

#### Declaration of editing

**Strategies of Teaching Design Process in Grade 9 Technology Subject**

By

**Miriam Nonkululeko Sithole**

I declare that I have edited and proofread this report. My involvement was restricted to language usage and spelling, completeness and consistency. I did no structural re-writing of the content. I did not do a reference check or attend to the technical formatting.

I am qualified to have done such editing, being in possession of a Bachelor's degree with a major in English, having taught English to matriculation, and having a Certificate in Copy Editing from the University of Cape Town. I have edited more than 500 Masters and Doctoral theses, as well as articles, books and reports.

As the copy editor, I am not responsible for detecting, or removing, passages in the document that closely resemble other texts and could thus be viewed as plagiarism. I am not accountable for any changes made to this document by the author or any other party subsequent to the date of this declaration.

Sincerely,



Dr J Baumgardt  
UNISA: D. Ed. Education Management  
University of Cape Town: Certificate in Copy Editing  
University of Cape Town: Certificate in Corporate Coaching



