Teaching Strategies Employed by Grade 4 Natural Sciences and Technology Teachers in the Mopani West District: A Case Study of Makhutswe Circuit.

By

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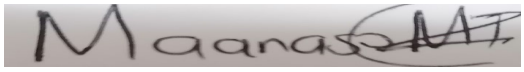
Researcher signature:  date: 02 February 2026

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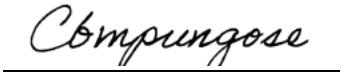
Supervisor signature:  date:11 February 2026

Prof C.B Mpungose

Dedication

I first give thanks to God of Mount Zion for the strength, guidance, and perseverance He granted me throughout this academic journey.

- I dedicate this work to everyone who supported me during my studies. A special appreciation goes to my family, particularly my parents, who were always there for me. This achievement would not have been possible without their prayers, love, and unwavering support.
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Abstract

This study explored the teaching strategies used by Grade 4 teachers in teaching Natural Sciences and Technology in selected primary schools within the Makhutswe Circuit of the Mopani West District. The study was prompted by concerns about learners' understanding of Natural Sciences and Technology concepts at the intermediate phase. An interpretive paradigm and a qualitative case study research design were adopted to gain an in-depth understanding of teachers' instructional practices. The study involved six (6) Grade 4 Natural Science and Technology teachers who were purposively selected from the participating schools. Data were generated through semi-structured interviews, non-participatory classroom observations, and questionnaires administered to Grade 4 Natural Sciences and Technology teacher and were analyzed thematically. Ethical considerations, including informed consent, confidentiality, anonymity, and voluntary participation, were strictly observed throughout the study. Trustworthiness was ensured through strategies such as triangulation of data sources, prolonged engagement, and member checking.

The findings revealed that teachers predominantly used teacher-centered strategies such as direct instruction and question-and-answer methods, with limited use of learner-centered and inquiry-based approaches. Although some group work and demonstrations were observed, practical activities were minimal due to challenges including lack of resources, large class sizes, time constraints, and limited subject content knowledge. The study concludes that while teachers attempt to employ a range of teaching strategies, the effective implementation of learner-centered approaches remains limited. The study recommends ongoing professional development, improved resource provision, and enhanced support for teachers to strengthen the teaching and learning of Natural Sciences and Technology in Grade 4 classrooms.

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List of abbreviations

CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
DBE	Department of Basic Education
NST	Natural Sciences and Technology
PK	Pedagogical Knowledge
TCK	Technological Content Knowledge
TK	Technological Knowledge
TPACK	Technological Pedagogical and Content Knowledge
TPK	Technological Pedagogical Knowledge

Key words: Strategies, learner centred, teacher centred, Natural Sciences Technology Grade Four.

CHAPTER 1

INTRODUCTION OF THE STUDY

1.1. Introduction

The main purpose of the study was to explore the teaching strategies used by Grade 4 teachers when teaching Natural Sciences and Technology. Teaching strategies were understood as structured principles and planned approaches used by educators to facilitate learning, broadly categorised into teacher-centred and learner-centred strategies. Teacher-centred strategies emphasised the transmission of knowledge from the teacher to learners, where learners were viewed as passive recipients of information, and included methods such as direct instruction, lecture-based teaching, and quizzes, which limited opportunities for critical thinking (Masekela, & Ramorola (2023).

In contrast, learner-centred strategies required active learner participation, promoted cognitive and metacognitive development, and encouraged creativity, motivation, and social interaction while recognizing individual differences among learners (Chisango & Muzata, 2022). Learner-centred approaches, such as inquiry-based learning, cooperative learning, and problem-solving activities, are more effective in enhancing conceptual understanding and engagement in science education (Moyo, 2024).The study focused specifically on Grade Four Natural Sciences and Technology, a subject that integrated various scientific fields and explored how science worked and influenced technology. At this level, the curriculum addressed key themes including Life and Living, Energy and Change, Planet Earth and Beyond, and Matter and Materials, which aimed to develop learners' understanding of life processes, energy systems, the Earth and the universe, and the properties and uses of materials.

1.2. The Rationale of the study

Based on four years of teaching experience in Natural Sciences and Technology, it was observed that learners were more motivated and engaged when they actively participated in lessons. The initial use of teacher-centered strategies made it difficult to achieve educational objectives, as learners struggled to understand and interpret the content, despite effective classroom management and full curriculum coverage. In contrast, learner-centred strategies promoted

active involvement, interaction, and deeper understanding. The main difference between the two approaches was that learner-centered strategies positioned learners as active contributors to the learning process, while teacher-centred strategies viewed learners as passive recipients of information. Although education had shifted from teacher-centred approaches to more interactive, learner-centred methods (Lu, 2019), the effectiveness of teaching was found to depend on the quality of instruction rather than the strategy alone. Learner-centred approaches, particularly those encouraging metacognitive thinking, were seen to improve learners' competencies and skills. Erikson et al. (2018) emphasised that effective teaching positively influenced learners' academic achievement. This study was motivated by a strong passion for Natural Sciences and Technology and its role in developing learners' scientific understanding. The findings were expected to benefit public schools by contributing to improved teaching practices and supporting Grade Four teachers in exploring diverse instructional strategies. The study also aimed to assist teachers in addressing learner diversity while ensuring comprehensive curriculum coverage and promoting meaningful learning in science.

1.3. Background of the study

Natural Sciences and Technology is regarded as a field that encompasses the systematic study of the natural and physical world through observation and experimentation (Davies & Sawyer, 2017). For teachers to effectively deliver science as both an analytical and functional practice, they need to incorporate strategies that promote inquiry, investigation, and hands-on learning. Internationally, different teaching strategies are used at the primary school level to enhance learners' understanding of scientific concepts (Howie et al., 2017). However, according to the Programme for International Student Assessment (PISA, 2016), science is often perceived as a difficult subject to teach and learn, partly because it involves specialised language that may differ from learners' home languages. Furthermore, international comparisons indicate that Grade 4 science teaching strategies in countries such as the United States and the Philippines still face challenges in effectively supporting learner achievement.

The educational system in South African before 1994 was based on racial segregation. The educational departments were racially divided, where black South Africans were educationally

discriminated against. This resulted in them getting poor learning resources and teaching (Parker 1994). Parker (1994) observes that South African Bantu Education lacked productive stimulation. A teacher-centred strategy prevailed, as communication between teacher and learner participation was prohibited. Science was narrowed in public schools. During the post-1994 era, the democratic government in South African applied measures of new policies that amended the educational system. The country's policies were then applied to fulfill the basic rights that were set by the new Constitution to apply equal education for all and ensure the discriminatory practices were abolished (Klug, 2010).

Within the South African education system, Natural Sciences and Technology education is seen as essential for developing scientifically and technologically skilled individuals who can contribute to economic growth (Naidoo et al., 2008; James et al., 2008). The national curriculum emphasises learner-centred and meaningful teaching approaches, encouraging active participation and engagement in the learning process. According to the Department of Education (2003), effective teaching strategies should prioritise the development of science process skills, with investigation forming a central part of classroom activities. Teachers are expected to create opportunities for all learners to actively participate in inquiry-based learning, thereby promoting deeper understanding and critical thinking in Natural Sciences and Technology.

1.4. Theoretical framework

A theory, according to Creswell and Poth (2017), is a set of concepts, ideas, or beliefs that explain the interactions between variables. The interaction between human actors and the environment they lived in can be explained by its theories. According to Cohen et al. (2011), educational theory functions as a "double hermeneutic," which means that in order to comprehended and interpreted experiences of the outside world, one must have a solid understanding of the theory and methodology of interpretation (both verbal and nonverbal communication) of the workplace. Harasim (2012) says a "theory" is an explanation for how or why something happened. The study will therefore examine how and why teachers employ different teaching strategies in the process of teaching of Technology and the Natural Sciences.

1.4.1. Constructivism theory

Constructivism theory defines learning as a process in which learners developed understanding by reflecting on their experiences within their social and physical environments. The theory held that learners constructed new meanings by linking prior knowledge with current experiences, rather than passively receiving information. Knowledge was therefore viewed as personally and socially constructed, and learners' interpretations of reality were considered valid based on their unique backgrounds, values, and experiences. In an educational context, constructivism emphasised that learning occurred when learners actively interpreted and explained new ideas using their existing understanding, particularly in science classrooms where meaning-making was essential.

Within constructivist learning environments, learners were expected to play an active role in knowledge construction by bringing their own experiences, concepts, and perspectives into the classroom. Learning was understood as an ongoing and developmental process in which new knowledge continuously built on existing understanding. One of the key principles of constructivism was that learners actively constructed knowledge by extending what they already knew, resulting in learning outcomes that were unique to each individual. Learners' prior experiences, cultural backgrounds, and worldviews were regarded as fundamental in shaping how they understood and applied new information. Another principle highlighted discovery learning, where learners developed new ideas through exploration and problem-solving, allowing newly acquired knowledge to strengthen future conceptual understanding. Additionally, constructivism stressed that learning was an active process in which learners formed meaning through participation, interaction, and engagement with their environment.

Constructivism also underpinned learner-centred teaching approaches, as it promoted active and critical learning rather than teacher-centred instruction. Learners were encouraged to collaborate with peers and teachers in the shared construction of meaning, which enhanced deeper understanding and critical thinking. In this study, constructivism served as the theoretical framework used to examine teachers' understanding of teaching and to assess the extent to which their practices aligned with constructivist principles. The theory supported the evaluation of teaching strategies that promoted active and critical learning as required by the

CAPS curriculum. Rather than prescribing fixed teaching methods, constructivism provided a flexible framework that guided teachers in facilitating meaningful learning experiences. Consequently, learning was viewed as a collaborative and dynamic process by which learners were actively involved in constructing knowledge within supportive classroom environments.

1.5. Key concepts

1.5.1. Teaching strategies

Teaching strategies are an essential component of effective teaching, which constitutes a crucial and ubiquitous tool for delivering instruction in accordance with educational aims or objectives (Beck, 1998). Recitation, discussion, explanation, role-playing, games, simulation, autonomous work, questioning, cooperative task groups, discovery, drills, debate, and more are some of the various teaching techniques.

1.5.2. Learner-centred strategy

The term "learner-centred teaching" refers to a teaching approach that is becoming ever more popular in education (Weimer, 2002). This approach do not use a teaching strategy that is ; rather than that, it emphasises a variety of different methods that focus on what the students learnt, changing the teachers role from one being information provider to one of learner learning and facilitating

1.5.3. Teacher-centred

Zohrabi et al. (2012) describe the phrase "teacher-centered approach" to refer to a method where teachers are central to the process of learning. Although learners are identified as learners who are passive in receiving information from their teachers, teachers serve as information providers and evaluators, who keep an eye on them to ensure they meet learning objectives.

1.5.4. Natural sciences and technology

According to CAPS, Natural Sciences and Technology is compulsory subject for learners in Grades 4 to 6, integrating science and technology to develop critical thinking and investigative skills. In Grade 4, learners study the properties of materials, including hardness, softness, toughness, and fragility. They also explore materials used in traditional dwellings such as Xhosa rondavels and Zulu houses. The curriculum covers energy and energy transfer, focusing on sound, movement, and the interaction between energy and the environment. Learners gain

knowledge about the Earth, its orbit, the Sun, other planets, and life. The Moon is studied in terms of its characteristics, phases, and cultural legends. Learners further introduces to rocketry systems, including basic rocket models and the way in which rockets functions, which support the development of investigative, research, and practical life skills.

1.6. Preliminary literature review

1.6.1. Introduction

A literature review, according to Creswell (2012), is a written synopsis of books, journals, articles, and other materials that outline the state of knowledge regarding the subject of your research project both now and in the past, involving two types of literature, namely: primary, written by people who do research and come up with the ideas; and secondary, written by people who summarise primary materials of primary source. The teaching strategies for Grade Four Technology and Natural Sciences will be reviewed in this literature.

1.6.2. Curriculum

The concept of curriculum was historically rooted in the Latin verb *currere*, meaning to run a course or race, which conveyed the idea of an educational journey with a strong developmental orientation (Slattery, 1995). In this sense, curriculum was understood both as a course of learning and as a vehicle through which learning took place. Slattery (1995) explains that this interpretation emphasised progression, growth, and movement within education. Similarly, Taba (1962) defines curriculum concisely as a "plan for learning," a definition that reflects how curriculum guides teaching and learning processes. Comparable meanings are evident in international terminology, such as *läroplan* in Swedish, *Lehrplan* in German, and *leerplan* in Dutch, all of which refer to structured intentions for teaching and learning. Van den Akker (2003) describes the curriculum as a systematic plan that outlined sequenced learning experiences through which learners could acquire knowledge, skills, and competencies. This perspective emphasises that curriculum functions as a guiding framework for teachers, enabling them to organise teaching activities that supported meaningful academic experiences for learners. Walker (1990) further expanded this understanding by describing curriculum as encompassing the content selected for study, the shared agreement among stakeholders on what was valuable to learn, and the organisation of subjects in relation to time, space, and the broader educational context.

Leyendecker (2012) categorises curriculum development into five levels, viz.: the supra, macro, meso, micro, and nano. The supra level refers to international agreements and shared goals concerning educational quality. The macro level focuses on national policy formulation and curriculum frameworks. At the meso level, curriculum development supports schools and educational institutions, while the micro level involved curriculum implementation outside the classroom context. Boeren (2016) highlights that at the macro level, parents, children, youth, and adult learners play a significant role, as central participants in educational systems and policy discussions, particularly within a global economic context, that emphasises high-level skills. Van den Akker (2003) described the nano level as the classroom-based interactions between teachers and learners, emphasising moment-to-moment instructional decisions shaped by official curriculum demands, learner backgrounds, and classroom realities. Clandinin and Connelly (1992) support this view by demonstrating how teachers constructed curriculum through lived classroom experiences.

1.6.3. Teaching strategies

Bhalli et al. (2016) define teaching strategies are the approaches, procedures, and tactics a teacher employs in order to accomplish the intended learning goals, where the most effective teaching methods involve students actively participating in the process of learning. This implies that educators must ensure that their methods engage learners, as active engagement with the material they are being taught improves learning outcomes. To put it another way, knowing how students learn is crucial, since it aids in choosing the strategy of teaching that will work best for them. As a result, Killen (2010) states that, while teachers can assist learners in acquiring new information or abilities, no single strategy of teaching is always successful for every learner. In order to employ them in their teaching profession, it requires that teachers possess a variety of teaching techniques and be adaptable during their training. This implies that teachers ought to ensure their teaching strategies to engage with learners, as active participation enhances learners' understanding of the material. Consequently, it is essential to comprehend how learners absorb information, as this knowledge aids in choosing the best working teaching strategies for them.

1.6.4. Learner-Centered strategy

Bokhove and Campbell (2020) found that teaching strategies played a significant role in effective classroom practice, particularly learner-centered strategies such as the quasi-mono model and peer instruction. These strategies were applied in the intermediate phase, where teachers were able to address and manage teaching challenges successfully. Roche et al. (2016) reported that learner-centered strategies offered numerous benefits to individual learning by promoting active learning, critical thinking, and deeper understanding. Their purpose was to enhance both vertical and horizontal integration between subjects, particularly Natural Sciences and Technology. Similarly, Hence et al. (2014) describe learner-centered teaching as a strategy that encouraged critical thinking, mental stimulation, and engagement within meaningful contexts, noting that experienced teachers actively facilitated learning both verbally and physically.

Jeffery (2010) explains that the learner-centred approach emphasises active learning by shifting responsibility from the teacher to the learner and promoting collaboration among students. This approach altered the traditional role of the teacher into that of a facilitator. Jeffery (2010) further highlights that this strategy allowed learners to develop content through research, participate in presentations delivered face-to-face or online, and engage in healthy competition to enhance motivation and teamwork, while also developing skills relevant to future workplaces O'Driscoll (2015) explains that cognitivist theory supported learner-centered teaching by emphasising active knowledge construction based on prior experiences. In line with CAPS (2011), which emphasises problem-solving skills, Schunk (2004) confirms that cognitivist incorporated attention, perception, memory, problem-solving, and metacognition as essential process in acquiring knowledge and skills.

1.6.5. Teacher-centered strategy

The teacher-centered approach was identified as the traditional method of instruction, where the teacher assumed the central role as the primary source of knowledge (Bokhove & Campbell, 2020). In this approach, learners were expected to absorb information passively, while the teacher guided the learning process through lectures and demonstrations (Guàrdia et al., 2013). Student performance was typically assessed using formal tests and objective scoring

methods, often based on keys or formulas to ensure consistency across evaluators. Subjective evaluation, by contrast, relied on the teacher's judgment of responses (Guàrdia et al., 2013). Direct Instruction was considered a core strategy, emphasising structured content delivery, formal authority, and teacher expertise. The teacher acted as an expert, directing and guiding students throughout the lessons. Pezaro (2016) highlights that in this strategy; learners were largely passive, participating primarily in writing tasks, while the teacher controlled all classroom activities. Collaboration between teacher and students was limited, as the teacher maintained full responsibility for content coverage. A notable advantage was that important material could not be omitted, ensuring comprehensive delivery of the curriculum. Overall, this approach reinforced the teacher's authority and maintained structured learning environments (Pezaro, 2016).

1.6.6. Teachers' views on strategies of teaching

Teacher-centred and learner-centred strategies were identified as the two primary teaching methods, differing mainly in teacher roles, learner involvement, and lesson planning (Killen, 2000). The choice of strategy determined how teaching was conducted to promote effective learning. Bokhove and Campbell (2020) found that learner-centred strategies allowed learners to work independently, solve problems, discover new information, and collaborate in groups to share ideas. In contrast, teacher-centred strategies focus on knowledge transmission, often using direct instruction with limited opportunities for questions or discussion (Killen, 2000). This approach led to passive learning, restricted creativity, and minimal exploration. Killen (2014) notes that the strategies also varied according to content, classroom arrangements, and discipline area, with teacher-centered methods often fostering stricter classroom discipline. Learner-centred strategies, by comparison, encourage active engagement and deeper understanding. Batwini (2010) concludes that learner-centered approaches are generally more effective than teacher-centred methods. They enhanced positive attitudes, self-confidence, critical thinking, and problem-solving skills. Overall, the effectiveness of teaching was influenced by how well the strategy aligned with learning objectives.

1.7. Problem statement

Batwini (2010) highlights that curriculum reforms causes uncertainty and a lack of confidence among teachers, as they are left unsure which teaching strategies to apply. The transition from NCS to CAPS in 2013 introduced new content by separating Natural Sciences and Technology, each with unique goals, methods, and developmental processes (CAPS, 2013). Many Natural Sciences teachers relied on traditional skills and teacher-centered strategies, while Technology required more observation and experimentation. The reform offered teachers opportunities to design and implement their own teaching strategies, rather than relying solely on conventional methods. However, most educators were not fully applying strategies beneficial to the content (CAPS, 2012). Learner-centered approaches, which encouraged participation, discussion, problem-solving, and collaboration, were shown to enhance engagement and understanding. These strategies also allowed learners to practice debating, resolving conflicts, and logically addressing problems, while improving comprehension and retention of key content.

Despite this, teacher-centred strategies remained common due to their ability to maintain classroom control, efficiently deliver content, and minimise time wastage through lectures, guided discussions, demonstrations, and structured “cookbook” labs (CAPS, 2012). In such settings, learning often focused on memorisation, rather than applying knowledge to solve problems. As a researcher, it was observed that integrating both learner-centered and teacher-centered strategies simultaneously could strengthen teaching in Natural Sciences and Technology, particularly in Grade Four, combining strategies promoted active learning while ensuring accurate content coverage. This approach created supportive learning environments that considered learners’ interests and fostered skill development (Batwini, 2010). Research into these strategies was therefore essential to guide teachers in balancing content delivery with learner engagement.

1.8. Main question

What are the teaching strategies used by Grade Four natural sciences and technology teachers in public schools?

1.8.1. Sub-questions

1. What support is needed to explore the development of teaching strategies among Grade Four Natural Sciences and Technology teachers?

2. How are teaching strategies used by Grade Four teachers in the teaching of Natural Sciences and Technology?

3. Why do teachers use teaching strategies the way they do when teaching Natural Sciences and Technology?

1.9. The aim and objectives of the study

1.9.1. Aim:

The aim of the study is to explore the teaching strategies used by Grade Four Natural Sciences and Technology teachers at schools.

1.9.2. Objectives:

1. To examine the support that Grade Four teachers need to promote their teaching strategies.

2. To analyse the ways in which teaching strategies are used in the teaching of Natural Sciences and Technology.

3. To explore the reasons that informs Grade Four teachers' choice and application of teaching strategies.

1.10. Research design and research methodology

1.10.1. Research methodology

Research methodology is defined as the procedures specifically or techniques used in identifying, selecting, processing, and analysing information about a specific topic. In a paper research, the section of methodology allows one who read to evaluate critically an overall of the study's validity and reliability (Creswell and Poth 2017). This latter study describes methodology as the assumption of analysing, principles analysing, procedure as well as inquiring approaches. Henning et al. (2004) state the fact that methodology is described as the methods grouped together that one complementary to each other where the collection of data is enhanced together with the data findings in order to fit the purpose of the research and also answer the research questions. Furthermore, Holloway (2005) states that framework of

theories is provided by the methodology, along with the guiding principles on which the methods and procedure are dependent, whereas Kothari (2004) explains methodological research as a step-by-step way to help the research problem-solving.

1.10.2. Research paradigm: interpretive

The term "paradigm" was understood as a framework that shaped how individuals perceived and interpreted the world. The interpretive paradigm, in particular, focused on understanding subjective experiences, meanings, and actions in everyday life (Cohen et al., 2011; Poni, 2014). This paradigm emphasised real-world events and individuals' interpretations of their environment (Punch & Oancea, 2014). This paradigm emphasised real-world events and individuals' interpretations of their environment (Punch & Oancea, 2014). It included philosophical assumptions such as ontology, epistemology, methodology, and axiology, which guided how knowledge was constructed, how research was designed, and how values were considered in a study (Cohen et al., 2013). Ontology was described as the beliefs individuals held to make sense of their world, while epistemology referred to how knowledge about teaching strategies could be understood and interpreted. Methodology involved the selection of research design, approaches, and procedures, and axiology considered ethical and value-driven aspects of research planning. An interpretive paradigm was adopted to explore teaching strategies employed by Grade Four educators in public schools, allowing the researcher to interpret participants' subjective experiences while acknowledging multiple realities (Cohen et al., 2013). This approach enabled an understanding of teachers' perceptions, attitudes, and the strategies they applied in classrooms, particularly in Natural Sciences and Technology. By focusing on the experiences of educators, the paradigm highlighted how teachers made sense of their environment and adjusted their teaching methods accordingly. It facilitated insight into how teaching strategies supported learning and how teachers evaluated their practices. Overall, this paradigm provided a framework to comprehend the dynamic and context-specific nature of teaching and learning in Grade Four classrooms (Cohen et al., 2013).

1.10.3. Research approach: Qualitative

Three main research methods—qualitative, quantitative, and mixed—are commonly used in studies, each serving different purposes along a continuum rather than being strict opposites

(Newman & Benz, 1998). Quantitative research employs numerical data to measure phenomena, test hypotheses, and analyse cause-and-effect relationships (Burns & Grove, 1987). In contrast, qualitative research focused on non-numerical data to understand individuals' experiences, meanings, and social interactions within their environment (Hesse-Biber & Leavy, 2010; Creswell &Poth, 2017). Newman and Benz (1998) explain that qualitative methods did not require hypotheses, whereas quantitative methods test theoretical assumptions. Mixed methods combined both qualitative and quantitative data to provide a comprehensive understanding (Creswell & Plano, 2007). This study adopted a qualitative approach to explore Grade Four teachers' strategies, emphasising understanding participants' perspectives (Marshall & Rossman 2014). Semi-structured interviews and focus groups were used to collect in-depth data. Qualitative research allowed flexibility in questioning and encouraged participants to express themselves fully (Marshall & Rossman, 2014). The study aimed to identify common themes in teaching tactics without generalising results. This approach enabled a rich and contextual understanding of both teacher-centred and learner-centered strategies.

1.10.4. Research style: Case study

A case study was defined as an in-depth investigation of a single unit, such as an individual, group, programme, or organisation, using multiple data sources to gain a comprehensive understanding of the case in its context (Ary et al., 2018; McMillan & Schumacher, 2010; Rule & John, 2011). It allowed researchers to explore the significance and meaning attributed to the phenomenon through interactions with participants. Case studies were categorised as exploratory, descriptive, or explanatory, depending on whether the focus was on exploring phenomena, describing natural occurrences, or explaining findings at multiple levels (Tafai, 2017). For this study, an embedded single-case design was employed to examine how Grade Four teachers implemented Natural Sciences and Technology strategies in public schools. The qualitative approach provided detailed insights into teaching practices, learner engagement, and contextual challenges. While the researcher acted as both observer and participant, which could introduce bias, the approach offered a nuanced understanding of classroom dynamics (Salmons, 2014). Overall, the case study method facilitated a focused investigation, highlighting

key teaching strategies while acknowledging its limitations in representing the broader educational context.

1.11. Population and sample

Population was defined as the entire group from which a researcher drew conclusions, while a sample included a specific subset where data collection took place (Neuman, 2011). Participants were selected based on their relevance to the study and their ability to provide appropriate information (Schumacher, 2010). Sampling assisted in determining the number of participants needed for meaningful results. In this study, purposive sampling was employed to select participants with the specific qualities required, particularly Grade Four teachers of Natural Sciences and Technology (Bertram & Christiansen, 2014).This method allowed the researcher to obtain in-depth and relevant data on teaching strategies. Convenience sampling was also applied to select accessible participants within the study timeframe (Robinson, 2014). A survey link was used to gather responses efficiently from participants. The combination of purposive and convenience sampling provided both depth and accessibility in the data. Overall, these sampling strategies ensured that the study captured meaningful insights into classroom practices.

1.12. Data generation method

Data collection refers to the process of gathering information to address a research problem, with participants, organisations, and electronic media serving as potential sources (Wahyuni, 2012). In qualitative research, the researcher spent time exploring the study setting to collect the necessary data. Semi-structured interviews, non-participatory observations, and questionnaires were used to obtain information from participants. An interview guide was employed, and interviews were audiotaped to ensure accurate data capture. Permission to conduct the study was obtained from the Department of Education and the school administrators. The semi-structured interviews allowed Grade 4 Natural Sciences and Technology teachers to respond freely and share their perspectives based on their experiences and insights during teaching.

1.13. One-on-one Semi-structured

Semi-structured interviews were used to provide flexibility, allowing participants to elaborate on their responses while enabling the researcher to ask follow-up questions (Rubin & Rubin, 1995; McMillan & Schumacher, 2010). This method allowed unexpected answers and encouraged participants to freely discuss the topic under study (Ryan et al., 2009).Checklists were often used to guide probing and ensure a deeper understanding of the phenomenon (Berg, 2007). In this study, semi-structured interviews were employed to collect data from sampled Grade Four Natural Sciences and Technology teachers in public schools. The approach facilitated the gathering of first-hand information on how learners responded to teaching strategies. Open-ended questions encouraged educators to share experiences in detail. The researcher was able to observe classroom interactions and note insights directly from the participants' perspectives.

1.14. Non-participatory observation

During the non-participatory observation, the behaviours of participants appeared naturally within the school setting, and understanding was obtained through careful study of these occurrences. The researcher employed a checklist to capture data related to activities and interactions observed around the school premises. According to McMillan and Schumacher (2010), in naturalistic observation, behaviours emerge spontaneously in their natural context, allowing the researcher to gain insights into the phenomenon under investigation. The aspects to be observed were guided by the purpose of the study, ensuring alignment with the research questions and objectives. Although participants were aware of the researcher's presence, no interaction occurred between the researcher and the participants during the observation.

1.15. Questionnaires

Participants in this study were given an informed consent letter that expressed their acceptance and readiness to participate in the study while guaranteeing their anonymity, despite the fact that questionnaires are an inherently intrusive tool that probes into their lives (Cohen et al., 2007). Each teacher had the chance to understand the true goals of the current study by receiving the identical questionnaire in a written report (Wilcox and Keselman, 2012). The first technique of collecting data was through questionnaires, which included questions about the methods teachers used to teach technology and natural sciences to fourth-grade

students. Prior to the in-depth interviews, all teachers were free to fill the questionnaire without feeling compelled to do so (Romm and Zohrabi, 2013). The participants were able to comprehend both closed-ended and open-ended questions on the questionnaire, and they were free to express their opinions and give straightforward answers (Friborg and Rosenvinge, 2013). It will be simpler for the researcher to become familiar with the information gathered from the questionnaires and interviews, as well as to analyze and group the information into emerging themes, thanks to the questionnaires and interviews conducted with each participant.

1.16. Data analysis

In qualitative research, data analysis involved breaking data into parts and reorganising them to form a coherent whole (Potter, 2013). An inductive approach was used to identify connections between key ideas and to interpret data from participants' perspectives (McMillan & Schumacher, 2010). The study focused on teaching strategies employed in Grade Four Natural Sciences and Technology, comparing findings with that of existing literature. Grounded analysis was applied, and data were classified and grouped into meaningful categories to describe occurrences (Walliman, 2017). Teachers' experiences were examined thematically to generate rich, in-depth insights. Both inductive and deductive approaches guided the analysis: inductive methods organised observations into broader patterns, while deductive methods tested theoretical implications (Bertram & Christiansen, 2014). This combination allowed the researcher to derive meaningful conclusions from the collected data.

1.17. Trustworthiness

Trustworthiness in qualitative research referred to the researcher's effort to ensure that study findings were perceived as credible and legitimate by practitioners, researchers, the public, and policymakers (Nowell et al., 2017). Researchers established methodological procedures to maintain the reliability and relevance of the data collected. Truthfulness was obtained through consistent findings, and participants provided valid information when they trusted the researcher. Ensuring trust promoted transparency and confidence in the study's conclusions.

Guba (1981) explained that trustworthiness was determined through credibility, conformability, and dependability. Credibility, similar to internal validity, was ensured via prolonged

engagement, persistent observation, triangulation, and member checks. Conformability involved re-examining data to maintain transparency and allow readers to trace results. Dependability assessed whether the study could be repeated independently with consistent outcomes. These criteria ensured that the research methods and findings were robust and reproducible.

Reliability referred to the ability to design and apply procedures that consistently produced the same results (King et al., 2021). In this study, reliability was achieved through structured semi-structured interviews and observation guided by predefined themes. Data collection tools were applied consistently across participants, and classroom interactions were observed systematically. This ensured that findings accurately reflected teachers' strategies and behaviours. Overall, reliability enhanced the trustworthiness and reliability of the study.

1.18. Ethical considerations

Creswell (2014) explained that research ethics involve moral principles and guidelines that ensure participants are treated sensitively and respectfully. The qualitative researcher was responsible for upholding an ethical framework throughout the study. Participants were informed about the purpose of the study and provided written consent before participation (Men, 2012). Ethical approval was obtained from the university Research Committee, and a gatekeeper's letter was secured prior to data collection (Bertram & Christiansen, 2014). Autonomy was ensured by allowing participants to voluntarily engage and withdraw at any time. The study aimed to contribute to curriculum development and teaching practices. Ethical interviewing maintained moral integrity and professionalism. Overall, adherence to these principles ensured the study was conducted responsibly and respectfully.

1.19. Informed consent

Creswell (2014) explains that informed consent involved providing participants with complete information about the study's purpose, expected duration, procedures, potential benefits and risks, and the researcher's credibility. Participants were informed of any possible risks and the intended use of the data. Henning et al. (2004) emphasise that researchers needed to be honest and transparent, clearly explaining the study's goals and how the collected information

would be utilised. Written consent forms containing accurate and comprehensive details about the study were provided to all participants to ensure voluntary and informed participation.

1.20. Voluntary Participation

As a researcher, I advised that participation in the study was entirely voluntary and not mandatory. McMillan and Schumacher (2010) emphasise that individuals should not be compelled to participate in research, and this principle guided the study. Those who agreed to take part were fully informed that they could decline participation at any point without any negative consequences. Participants willingly provided information, ensuring that their involvement was not influenced or coerced by the researcher. Guillemin and Gillam (2004) also asserted that participation in research should always be based on free choice. Participants were informed in advance about the voluntary nature of their involvement and the potential implications of the study. They were given the opportunity to make an informed decision regarding their participation. It was communicated that no costs would be incurred as a result of participating, and while direct personal benefits were unlikely, the findings of the study could positively impact schools, communities, and society at large.

1.21. Possible limitations

Study limitations by Allen and Wright (2014) are defined as the limitations when problems that may arise throughout the research studies course time, time as such, constraints and the need to accommodate schedules of informants.

1.22. Chapter division

Chapter One

The overview of the study is presented in this chapter. Additionally, it draws the specific introduction, research questions, preliminary literature, research problem and research's goals of the study. It embodies the background data that promote context, pertinent theoretical notions for understanding in the challenges of the research, and the study concepts important. Their study followed methodology of the study.

Chapter Two

This chapter explains the theoretical frameworks and their importance to the research. Variables, correlations, and presumptions that support the study's research are all clearly and thoroughly understood thanks to the theoretical frameworks. They also help define the research question and issue that the study is trying to answer.

Chapter Three

Chapter three presents the problem statement, the study's relevance, the questions of the research, its sub-questions, and its goals and objectives. The study's importance and its key subjects are emphasised in the current chapter. The specific goals that aimed to accomplish are also covered, along with the research paradigm methods and its trustworthiness.

Chapter Four

Chapter four presents the participants background, the study's relevance, the research question, its sub-questions, and its goals and objectives. Importance of the study and its key subjects will be considered to analyses data. The specific goals aimed by the study to accomplish are as well covered.

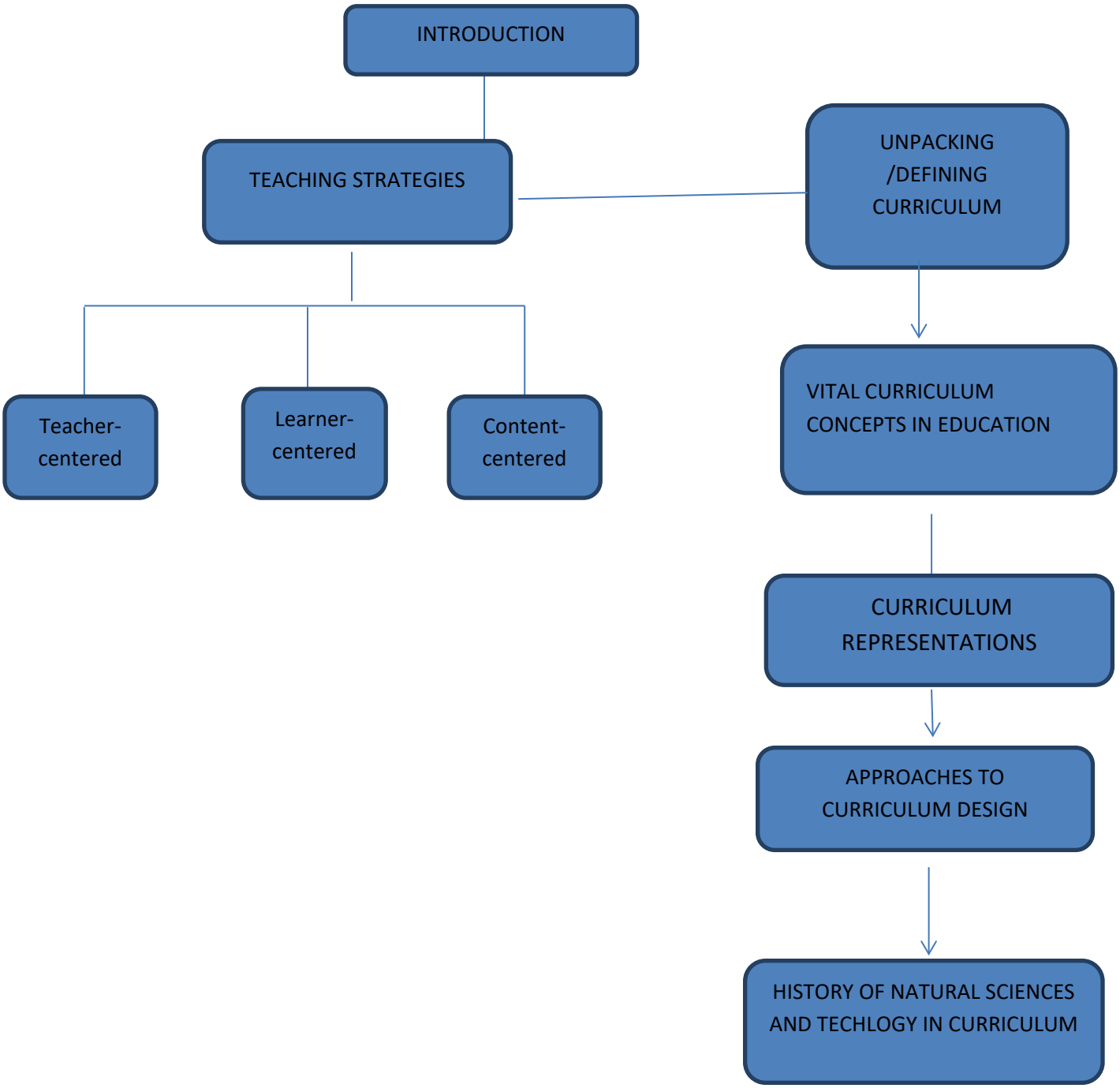
Chapter Five

This chapter explains the paradigm of the study, its methodology, and sampling all form part of the research design. Procedures and tools for gathering and analysing data for the first, the second and the third research questions are included in research techniques. There I include the summary of the study and conclusions.

CHAPTER 2

LITERATURE REVIEW: TEACHING STRATEGIES AND CURRICULLUM

Figure 1: Chapter 2 (flow chart)



2.1. Introduction

In the first chapter, the study's background, rationale of the study, aims, objectives, and questions are presented. The theoretical framework and the research methodology were also included. Chapter Two introduces the discussion about teaching strategies used by teachers in Grade Four. The review first unpacked the phenomenon of the study, which is the teaching strategies, explaining the different levels of teaching strategies: learner-centred, teacher-centred and content-centred from other scholars' literature. The review unpacks the curriculum, the main approaches of curriculum, issues, concepts and history of the curriculum. Then chapter reveals the history of the focus Natural Sciences and Technology used by Grade 4 teachers. At the end of chapter two the conclusion is drawn leading to the next chapter.

2.2. Teaching strategies

Smith (1960) described teaching as a system of the actions intended to provide learning. Green (1971) referred teaching strategy as the task of a teacher which is performed for the development of a child. Moreover, Morrison (1934) refers to teaching as an intimate form of contact between a most mature individual and a less mature individual, which is designed for furthering the education of the latter. Teaching strategies are originated from various researchers such as Jean Piaget, who (1970) describes teaching strategies as the development were learners learn best and actively through exploration, hands-on experiences and through discovery. Bhalli et al. (2016) defines teaching strategies as the procedures, techniques, and methods used by teachers when instructing to achieve the learning objectives that are desired. In other words teaching strategies are crucial to education, as they can significantly impact teaching outcomes, and this needs the active involvement of both teachers and learners. Bua and Martin (2020) describe teaching strategies as the generalised plans for a specific lesson that includes objectives that are instructional and outline of tactics that are planned necessary for implementing the strategies. For instance, a teacher will use a strategy that suit the topic that is being studied, the learner level of expertise and the teaching journey stage.

Furthermore, Sokhulu (2021) defines the decision of making a role of teacher when defining a teaching strategy as an action that teacher of aiming learners understand what is taught during

lessons. As such, Campell and Bokhove (2020), finds teaching strategies as goal setting, the setting being determined to be achieved by making use of available of resources to reach the goal. Furthermore, Bua and Martin (2020) argue that teaching strategies are the best techniques that normally make it easier to achieve the lesson objectives, and they accommodate most learners in a classroom. In other words they help learners to put effort in participation to improve in their academics.

Kaur (2022) further emphasizes that, to effectively meet the teaching needs of natural sciences, learners should actively participate in clarifying concepts during teaching and learning. This implies that appropriate instructional strategies can create opportunities for teachers to explore learners' existing knowledge, attitudes, and values related to science. When working either collaboratively or independently, learners can use graphic organisers to share and record information. Additionally, teachers can use evidence gathered from learners' responses to inform and plan instructional programmes that address the diverse needs of all learners (Klein, 2023).Furthermore, incorporating learner-centred strategies not only enhances conceptual understanding but also promotes critical thinking and problem-solving skills, which are essential in science education. By engaging learners in active knowledge construction, teachers foster deeper learning and improve learners' ability to apply scientific concepts in real-life contexts. This approach ultimately supports the development of scientifically literate individuals who can make informed decisions and engage meaningfully with scientific issues.

Larsson and Jacobsson (2020) indicate that strategies assist teachers in identifying gaps in their own teaching knowledge existing and understanding of concepts of science and collaboratively work to gather information through investigation self-directed. Therefore, this means that learners can make use of the information collected to communicate and generate ideas as well as recording responses on the subject matter for their benefits. Furthermore, Chaudhary (2022) states that strategies encourages on how to sort, to analyse, to organise, to review, to compare and also contrast information for furthering and consolidating their knowledge, their understandings, the skills, attitudes, and also values in teaching. This is evident in the exploratory case study overseen by Maleka (2020) on strategies used by Grade Four educators

to decode science terms. Through observation, findings indicate that teachers use unplanned strategies, which results in teachers taking different roles (facilitator or structure) throughout the lesson. This suggests that strategy can help teachers to plan different roles in teaching during lesson.

Larsson and Jacobsson (2020) further maintains that teaching strategies allows different objectives of teaching questioning for the implementation of strategies that are different to work as means of which transfer or delivery of structured educational content is provided to the receiver's at the end. Klein (2020) elaborates that the positive part of using teaching strategies is that they are hands-on, in teaching the subject natural sciences and technology as teachers are encouraged in undertaking practicals, experiments, and investigations. As such they develop the skill of coming with solutions when encountering problems and practically they end up having evidence that is represented scientifically.

The use of teaching strategies results in insufficient scientific equipment's such as lack of safe teaching environment, where this results in safety risks as teaching becomes narrow and less managed (Burger et al, 2022). In other words, teaching strategies are essential to providing the desirable changes in the learner's behaviour at a well-planned and systematic way according to the pre-determined objectives of learning. Teaching strategies may lead to learners' disengagement depending on the strategy that is currently applied. This suggests that it may lead to memorising the content instead of deep understanding of the content. Sherrington (2021) argues that teaching strategies can consume a lot of time and cannot be easy to manage. As such it ends up leading to most learners relying on other learners in completing tasks. Teaching strategies can be categorised into learner-centred, teacher-centred and context-centred.

2.2.1. Learner-centred strategies

Crosby (2000) defines learner-centredness as a favoured teaching strategy, although it is not without some criticisms. In general, it has to be a positive experience. For example, it emphasises the value of learner-centredness. According to Hmelo-Silver and Barrow (2020) a learner-centred strategy focuses on the needs of the learners rather than teacher involved

more in the teaching processes. In other words learner-centredness allows actively participating in order to discover the process of teaching each other and also being able to construct their own understanding to teaching without being passive.

Furthermore, Boulus et al. (2023) argue that a learner full understands and level of participation can be observed through their responses and the attitudes reflected in their creative engagement. For instance, teachers need to understand the thinking styles of their learners in order to accommodate diverse abilities during instruction. Weimer (2019) supports the use of learner-centred strategies in teaching Natural Sciences and Technology, including the use of engaging, task-based science lessons to enhance interest. This demonstrates that the increased use of learner-centred strategies enables learners to work at their own pace, develop independence, and take responsibility for solving problems. Moreover, such approaches encourage active engagement and intrinsic motivation, as learners feel more involved in their own learning process. This not only improves retention of scientific concepts but also builds confidence and autonomy. As a result, learners become more capable of transferring knowledge to new situations, which is essential for teaching.

Furthermore, a learner-centred strategy's role in teaching is to promote the independence of learners taking charge of their learning process's ownership (Hmelo-Silver and Barrows, 2020). This benefits most learners to think critically so that they can analyse and create information. For example, in classrooms active participation is discovered in learning process when learners are taking a big role than teachers. According to Koh and Lee (2020), motivation amongst the learners enhances the interest of learning amongst individual, where no learning interest is developed, and they also start to develop their own learning as well as setting goals. Cheng et al. (2022) found that learner-centredness promotes teaching through an experience with direct observation, which aligns the role of learners. This allows learners to take control in teaching therefore, it end up making teachers giving learners taking full responsibility in teaching. For instance, teachers allowing group work amongst increases team work and content broad understanding without teacher intervention. In support of this, Burger et al. (2022) agree with Weimer (2019) that the most important benefit in learner-centredness is that learners end up

developing lifelong learning skill of becoming self-directed and able to adjust to new conditions. This suggests that teaching becomes good preparation for change in every-world and teaching lead to success.

According Nurbiyeva et al. (2023) shifting decision-making to learners, becomes a concern that learners will track the curriculum, or look for the way out that is easiest. As such, it results in lessons diminished and academic outcomes. Moreover, Weimer (2023) supports the statement by saying that implementing a learner-centred strategy often requires more time for preparation, teaching, and giving individualised feedback. This suggests that it is challenging for teachers, especially in classrooms with large class sizes, or limited resources. Applying learner-centered strategy requires necessitate access to a variety of resources during practical especially in teaching of Natural Sciences and Technology, teaching materials, and support services (McTighe and Silver 2023). For instance, not all educational institutions may have the resources to properly apply these strategies. Furthermore, Mahmood et al. (2022) support the statement that a learner-centered strategy frequently emphasis learners autonomy and discovery, which can result in less structured learning environments. In contrast, Khan et al. (2023) found that the lack of resources is difficult for some learners who prefer more structured environments or classrooms, where a learner-centred strategy unintentionally aggravates existing inequities between learners. As such, learners from underprivileged backgrounds or with diverse learning styles may struggle to succeed in settings that value self-directed learning and independent enquiry.

2.2.2. teacher-centered strategy

A teacher-centred strategy, also known as the traditional strategy, sees the teacher considered as the main source of all information (Bruce, 2004). Borich and Tombari (1997) define teaching strategy as the strategy that is defined as the direct instruction, expository teaching, or deductive teaching. For instance, teaching at this strategy of the teacher has to direct control over what is taught and giving all the information the learners. Moreover, according to Khan (2022), teaching strategy is described as the teaching methods were a teacher plays the main authority figure and a main information source. Almutairi and Alzahrani (2023) agree with the statement that teacher-centred strategy is that which the teacher actively instructs, while the

learners remain passive or receptive. For example, under teacher-centredness, learners are seen as blank slates, or empty vessels, passively absorbing information from their teachers.

A teacher-centred strategy provides a clear roadmap for teaching and this ensures that the content is all covered (Weimer, 2023). For instance, in a short period of time, a teacher with subject knowledge delivers a large amount of efficient information to learners. Lathan (2021) states that a teacher manages to give clear indications and instructions that easily demonstrate to learners, helping through understanding and completion of content on time. For instance, teachers have enough time to even share their experiences by providing the insights as well as the perspectives. Cheng et al. (2022) outline that, during assessment, by the use of teaching-centered strategy; enough time is given per individual as teachers come prepared, well-organised and well-resourced. As such, more time is spent on aspects of substance, while teaching and assessing time is manageable. Lee and Kim (2020) examined the effectiveness of teacher-centered strategies on student learning outcomes. This study used the mixed research design, applying the survey research and standardised test scores under quantitative data collection and interviews and observation for qualitative data collection. The findings concurs that teachers are aware of teacher-centered strategy as effective for transferring complex information and promoting learners understanding as learners who used teacher-centered got higher grades during tests. This suggests that teachers are able to deliver accurate information. However, teachers should also consider applying other strategies to promote deeper teaching and engagement.

However, McKeachie (2021) elaborates that a teacher-centred strategy can limit an engagement during teaching as teachers will be delivering information without any intervention for elaborating further in terms of misunderstood. This shows that this strategy teamwork is discouraged, lack of commutations, no discussion, or any hands-on activities. (Marzano, 2021) agrees that teachers give information to learners for memorising over understanding and limiting their chances of applying theories practically; also limiting th chances of solving problems and hindering long-term teaching as well as application of knowledge. Christensen (2022) states that, if learners struggle to focus on new content due to

lack of engagement or distractions, this leads to overload. This overload causes frustration and difficulties in teaching.

Furthermore, teacher-centredness ignores real world applications, such as scenarios making it hard to see the value of what is being taught. As such, comparing life experiences with teaching experiences is hindered. According to Kilpatrick (2023), the teacher-centred strategy promotes testing rather than deeper understandings, which may results in anxiety, encourage cheating and fear of failure for both teachers and learners. In other words it undermines the curiosity and the development of creativity. In short, teacher-centered teaching strategies can impair motivation, engagement, understanding, and capacity for critical thought (Hattie, 2023). For instance, teachers may fail to adequately teach learners for success in a world that is becoming more complicated and dynamic, and they may lead to disparities in educational attainment.

2.2.3. Content-centered strategy

According to Bloom (1976), a content-centred strategy is an instructional method that prioritises the delivery of knowledge from the instructor to the learner, concentrating on meeting designated content standards. Furthermore, Hattie (2023) agrees with Mager (2023) in describing the content-centred strategy as an educational strategy that places emphasis on the subject matter or material to be taught, aiming to enhance learner's comprehension and proficiency in that material. This shows that this method places importance on imparting particular knowledge and abilities, frequently through direct teaching, discussions, and demonstrations. As such, Wiggins (2023) explains the content-centered strategy as an instructional strategy that focuses on the matter's subject or content to be taught, with goal of promoting learners understanding and mastery of that content. Moreover, a content-centred strategy as stated by Gagné (1985) is a structured and systematic approach to teaching that involves breaking down complex content into smaller chunks that are manageable, for instructional delivery in a sequential and logical manner.

According to Rosenshine (2022), a content-centred strategy enhances learner's performance in such a way that, strategies centred on content can enhance learner's performance by offering clear and focused instruction on particular knowledge areas. Moreover, Mager (2023) states

that this increases efficiency by concentrating on distinct content, teachers can provide instruction more effectively, enabling learners to cover a greater amount of material in a shorter time frame. This is supported by a qualitative study conducted by Johnson (2020), a case study research design including the observations, interviews and document analyses methodology. The study found that a content-centered strategy can promote learner motivation and engagement. Thus, Kohn (2022) agrees with Clark (2020), namely that the improvement of retention through a content-centred strategy can aid learners in retaining information more effectively, as they offer repeated exposure to essential concepts and skills. This confirms that by repeating content deepens the understanding, and by prioritising the teaching of specific content, it fosters a more profound comprehension and mastery of the subject matter. Hattie (2023) points out that a content-centered strategy facilitate easier assessment of learners learning, allowing teachers to concentrate on specific teaching goals and outcomes.

Furthermore, Kohn (2022) outlines the excessive focus on content can result in minimal learner involvement, as teachers might not perceive the significance or relevance of the material. This will cause a lack and emphasising no delivering of appropriate information, content-focused methods may fail to foster critical thinking or problem-solving abilities. A content-centred strategy can lack flexibility, making it challenging for teachers to adjust to varying teaching styles or skill levels (Marzano, 2023).This results in prioritising memorisation, at the expense of encouraging a deeper understanding or practical application of knowledge. As such, the content limit opportunities for learners' autonomy, content-driven strategies can restrict student autonomy, as learners often have limited choices regarding what and how they study.

2.3. Unpacking curriculum

The word curriculum is derived from the Latin *currere*, meaning is to run, according to Pinar (2004). Racecourses where chariots competed were referred to as currere. Over time, it evolved to refer to a course of study and the learners' educational journey. According to Muller and Hoadley (2019), curriculum is a detailed plan of action that describes the educational experiences, content, instructional strategies, and assessment. The purpose of these components is to accomplish particular learning objectives and outcomes. According to Khoza

and Mpungose (2018), a curriculum represents a plan for learning. Tyler (2013) states that curriculum encompasses all instruction that is organised and guided by the school in order to fulfill its educational objectives.

2.4. Vital curriculum concepts in education

The curriculum refers to the variety of goals (aims, objectives or learning outcomes) assessments, resources, activities or assessment, environment or location and others which give direction to learning and teaching processes (Salo, 1994). This suggests that knowledge, skill or attitudes or the ways of behaviour that learners expected to learn draws from the curricular concepts. It includes the subjects, courses, and activities crafted to meet specific educational goals and results. Govender et al. (2022) concur with Pinar (2012) that curriculum generally consists of learning goals, content, educational experiences, and methods for assessment and evaluation. It can be categorised as formal, informal, or hidden, and its creation involves assessing needs, designing, implementing, and evaluating. However, Govender et al. (2022) describe the five key concepts of curriculum as objectives (what students should learn), content (the knowledge taught), materials and resources (with what are they learning?), assessment (how is their learning assessed?) and location (where are they learning?). This suggests that the teaching of NS seek teacher to be versed of the latter curriculum concepts.

2.4.1. Objectives

An objective is a more specific teaching intention statement, usually one of the specific content areas that the teacher will address in a given block of teaching (Ryan, 2023). However, Priestley and Nieveen (2020) describe the objectives as these outcomes are specific, measurable, achievable and time-bound, as when teachers provide information that enables pupils to be able to do or knows after instructions. As Locke and Latham (2002) argue, objectives are simply a strong of how content shall be achieved.

Objectives are specific, measurable statements their broader general claims of what learners will accomplish (Marzano, 2021). This demonstrates objectives work hand in hand to provide a clearer direction as to what should be taught, helping teachers to plan and implement their teaching. CAPS (2012) shows that natural sciences and technology Grade Four, the lesson

objectives includes the understanding of the concepts such as photosynthesis, description of life processes, explaining how each life process works in things. As such, a teacher-centred strategy is used when developing the way of teaching objectives by articulating what learners ought to be able to do after the lesson. This also suggests that at the end of content teachers should allow learners to provide understanding clearly by applying their knowledge and skill by applying the learner-centered strategy. It also involves learners in giving the feedback of the objectives ensures the ownership sense and agency. However, Ryan (2023) also agrees that objectives serve as benchmarks to assess learners learning and development, guaranteeing accountability and effectiveness in educational and teaching efforts. This suggests that setting clear objectives, teachers can develop a focused and coherent curriculum that fosters teachers teaching achievement.

2.4.2. Content

The content refers to the subject matter, skills and topics that will be taught and learned. Dweck (2006) supports the statement that content within a curriculum pertains to the subjects, topics, and skills that are imparted and acquired. However, O'Donnell et al. (2022) explain that selection and organisation of curriculum content in Natural Sciences and Technology typically involve plants and animals (structure, functions and habitats), ecosystems (interactions between living things and their environment), and adaptations (how plants and animals adapts their environment). This suggests that content includes the knowledge, concepts, and principles that teachers require learners to master, typically arranged into units, lessons, and activities.

In delivering the content teacher-centred strategy is applied, particularly when teachers ensure the consistency of transmitting information. This include also the application of content-centered when only the specific set of information is suitable for delivering, and as such, the only need is to accumulate information. However, Ryan (2023) argues that other teachers allow the learner engagement during delivering of the content ensuring and requiring learner opportunity of thinking independently, especially when performing experiment or practical. Furthermore, Berglund (2022) argues that a careful selection and structuring of content are essential for ensuring that teaching give students an opportunity to gain the knowledge, skills, and attitudes required to realise their full potential. This suggests that content is grounded on

what the learners' experience, in addition to what they know, where teaching is made significant.

2.4.3. Resources

Resources within a curriculum encompass the various materials, the tools, and support that aid in learning and teaching (Bishop & Verleger, 2013). This resource can include textbooks, digital content, educational software, online tools, and multimedia content. Additionally, resources can refer to human elements, such as educators, guest speakers, and mentors, as well as physical assets like classrooms, laboratories, and technology. Selwyn (2023) asserts that a well-designed curriculum takes into account the accessibility and availability of resources, ensuring they are aligned with learning goals and contributes to teaching achievement. According to the ATP (2023/2024), Grade Four Natural Sciences and Technology resources commonly include textbook, workbooks, substances, materials pictures, models and video clips. This shows that the use of textbooks in classroom allows teachers to use the teacher-centered strategy, textbook work as a guide structured for good information presentation and use for leading discussions. Digital resources involved include the educational websites, online simulations and games, science educational apps, as well as hands-on materials science kits, which are used for conducting experiments and investigations. These resources can help teachers create engaging and interactive lessons for Grade Four learners. As such, learners will be taking up a role in a strategy that is learner-centred.

However, a well-designed curriculum considers the resources' availability and accessibility to make sure they support student achievement and are in line with learning objectives (Meldia & Melani, 2022). This shows that textbooks and workbooks are frequently used resources in Grade Four Natural Sciences and Technology classes. For instance, the digital resources used are science education apps, online simulations and games, and educational websites. Additionally, there are science kits with hands-on materials that are used to conduct experiments, experiments as well as investigations and with the aid of these resources, educators can design dynamic and captivating lessons for fourth-graders.

2.4.4. Assessment

Poehnar (2007) concurs with Meldia and Melani (2022) that assessment within a curriculum pertains to the process of gauging student learning and advancement toward specific educational objectives and outcomes. It encompasses the use of various evaluation tools and methods, such as quizzes, tests, projects, and performances, to assess students' knowledge, skills, and attitudes. According to Maulida (2022), assessment can be categorised as either formative, occurring during the educational process, or summative, taking place at the conclusion of a unit or course. This suggests that incorporating assessment into the curriculum, educators can ensure that students are achieving learning objectives and that the curriculum fulfills its intended goals.

Assessment in Natural Sciences and Technology for Grade Four can comprise the following: formative assessments, class discussions, and the observation of students' participation and engagement. Quizzes and classwork serve as regular evaluations to gauge understanding (CAPS, 2012). For instance, projects and presentations allow students to demonstrate their knowledge and abilities and this strategy involves the learner-centered strategy. Summative assessments include unit tests, which offer comprehensive evaluations of specific subjects. Written tests assess the comprehension of scientific concepts include practical assessments that involve science experiments, where learners design and execute their own experiments. Lawler et al. (2023) indicate that such assessments are informed by personal reflection. However, Abraha (2023) note that assessment as the learning focus on to empowering teachers and learners to take an active role to monitor their own teaching journeys, signifying that it is centred on the learner.

2.4.5. Environment or location

Tsui (2002) defines the learning environment within a curriculum encompasses the physical, social, and emotional backdrop for education. This encompasses the classroom atmosphere, the culture of the school, along with the community factors that influence students' experiences and interactions. Group projects and discussions in classroom increases engagement and allow teachers limit taking control, this strategy applied is referred to as learner-centred. Meanwhile, teacher focuses on content and ensures a relevant engagement with relevant resources that when content-centered is applied. Furthermore, nurturing learning

environment can enhance learner engagement, motivation, and academic success, whereas a detrimental environment may impede learning and overall well-being (O'Donnell et al., 2022).

Borji and Farsani (2023) mention classroom setting, interactive learning areas, allocated spaces for experiments, inquiries, and projects, Science hubs, established stations for investigating particular subjects, such as magnetism, electrical circuits, or botany, presentation boards, highlighting student achievements, projects, and findings, outdoor education, school horticulture, making use of gardens or green areas for lessons related to plants. Classromms are the most natural environment to precede learning without intervention and disturbances. Madondo (2021) further elaborates that, depending on the learning experience's focus, classrooms can be categorised as learner-centered, teacher-centred, or content-centred. Whereas teacher-centered classrooms place more emphasis on the teacher's role in imparting knowledge, a learner-centred classroom places more emphasis on the learner's involvement in their own education. Usually in a more conventional arrangement, content-centred classes concentrate on the actual subject matter.

2.5. Curriculum representations

2.5.1. Intended curriculum

According to Van den Akker (2010) intended and planned learning experiences together with results, as described in curriculum materials, standards, and rules, are referred to as the intended curriculum. Moreover, Herzog and Ashton (2022) describe the intended curriculum as the formal and planned educational objectives, content, and learning experiences teachers hope to provide to learners. This demonstrates a result that guides what learners should learn and accomplish, where intended curriculum consists of formal, educational objectives planned, the content, and learning experiences that teachers hope to impart to learners. As such, it acts as a road map for what students ought to learn and accomplish in a classroom, including standards established by teachers, schools, and educational authorities (Makumane & Khoza, 2020). The intended curriculum is the blueprint or plan for what learners should learn, encompassing aims, learning objectives, and substantive and disciplinary knowledge students should be acquired (Govender et al., 2022). This means that it provides a framework for

teachers to follow when designing and implementing their curriculum, focusing on both what students should be learning and how to determine if they are meeting that expectation.

The intended curriculum offers several benefits that include clear learning objectives providing outcomes guide instruction and promote accountability (Priestley and Nieveen, 2020). This shows that it brings the focused instruction on specific learning an objective enhances teaching effectiveness and student learning. Improved student outcomes and achievement result from targeted instruction and assessment. Moreover, Govender et al. (2022) state that the main role of intended curriculums is to provide accountability and evaluation mechanisms promoting transparency, quality assurance, and curriculum revision. However, based on Mpungose (2020a), the structure of the curriculum as a planned curriculum presupposes that teaching occurs in a conventional face-to-face classroom setting, which allows for live scheduled interactions with teacher acting as an instructor and offers prompt feedback to students.. Additionally, Bertram et al. (2021) discovered that, due to differences in learning capabilities, some learners in the classroom are not accommodated when teachers are solely guided by experiences structured to prioritise curriculum coverage by rigidly adhering to the intended curriculum's pacing.

Furthermore, the setback with intended curriculum is rigidity, where intended curriculum can be inflexible, making it difficult to adapt to changing learners needs or unexpected learning opportunities (Govender et al., 2022). According to Herzog and Ashton (2022), this overemphasis on standardisation leads to a lack of creativity and innovation in teaching and learning. Therefore this may lead to limited flexibility for teachers and have limited freedom to design their own curriculum or teaching methods, which can lead to burnout and decreased motivation. The intended curriculum may not provide learners with enough autonomy to make choices about their own learning, which can lead to decreased motivation and engagement, Kilpatrick (2023). In addition, intended curriculum may reflect the cultural biases of the dominant culture as such the process, which can lead to a lack of representation and inclusion for diverse student populations.

2.5.2. Implemented curriculum

Van den Akker (2010) describes the implemented curriculum, also referred to as the perceived curriculum as enacted by teachers through their instruction and classroom activities. In contrast, Biggs (2003) refers to it as the "curriculum in action," highlighting that both teachers and learners actively participate in the learning and teaching process. According to Ornstein and Hunkins (2009), this stage of the curriculum centres on putting national intentions and educational goals into practice. The implemented curriculum therefore encompasses aspects such as classroom management, institutional structures, teaching strategies, the use of resources, and teachers' attitudes.

Makumane and Khoza (2020) further support this view by noting that the implemented curriculum is reflected in the actual teaching and learning interactions occurring in schools, both between teachers and learners and among learners themselves. This means that the intended curriculum is transformed into practice and delivered in real classroom settings, as also emphasised by Van den Akker (2010).Consequently, the activities planned for instruction are carried out in order to achieve the intended learning outcomes, implying that learning outcomes form a key component of the implemented curriculum. Priestley and Nieveen (2020) discuss the role of research in improving curriculum reform and describe learning outcomes as the full range of knowledge, skills, values, attitudes, competencies, or behaviours that learners acquire upon completing a curriculum. It is therefore evident that, during curriculum implementation, learners are expected to attain the outlined tutorial learning outcomes.

The implemented curriculum contextualises learning, and is tailored to the specific needs and context of the learners, making learning more relevant and effective (Makumane & Khoza, 2020). In this case, the implemented curriculum allows for flexibility and adaptability, enabling teachers to respond to changing student needs and unexpected learning opportunities. However, Subban et al. (2022) state that the implemented curriculum provides teachers with the autonomy to design their own teaching methods and materials, promoting creativity and innovation.

This means that the student-centered strategy focuses on the needs and interests of the learners, promoting a student-centered strategy to learning. This implemented curriculum can lead to improved learner engagement and motivation, as learners are more likely to be interested in learning that is relevant and meaningful to their lives.

Furthermore, according to Subban et al. (2022), the quality of the implemented curriculum can vary significantly depending on the expertise and resources of the educators and institutions involved. The implemented curriculum may lack consistency across different classrooms, schools, or districts, leading to unequal learning experiences for students, Kohn (2022). This may require significant resources, including funding, technology, and personnel, which may not be available in all settings. Teachers and stakeholders may resist changes to the implemented curriculum, which can hinder its effectiveness and adoption Muller and Hoadley (2019). However, this causes difficulty in assessment, assessing the effectiveness of the implemented curriculum can be challenging, particularly if there, are limited resources or infrastructure for evaluation.

2.5.3. Attained curriculum

Van Den Akker (2003) indicates that learning objectives and accomplishments that students truly gain from their educational experiences is referred to as the attained curriculum. The author notes that it is the outcome of interactions among the learning environment, the executed curriculum, and the intended curriculum. Govender et al. (2022) support the statement by describing the attained curriculum as completed through the accomplishments and learning results that learners truly gaining from their educational experiences. As such, attained curriculum gives teachers and educational institutions a sense of accountability. Furthermore attained curriculum provides input on the efficacy of the planned and executed curriculum, which helps with curriculum adjustment and improvement.

The attained curriculum presents numerous benefits, including the emphasis on student learning, which centres on what students genuinely acquire, rather than what is envisioned or arranged (Khoza 2020). However, attained curriculum establishes a standard of responsibility for educational institutions and instructors. The achieved curriculum is essential for student

success, as it represents the knowledge, skills, and attitudes that learners develop during their educational journey. Kavaric (2023) demonstrates that the achieved curriculum guides the refinement and update of the curriculum, as it offers insights into the effectiveness of the planned and executed curriculum. This achieved curriculum fosters improved teaching and learning, as educators concentrate on aiding students in reaching defined learning goals. As stated by Muller and Hoadley (2019), the competence curriculum model is an educational framework that emphasises evaluating students through their demonstrated skills, competencies, and abilities developed throughout the learning experience. This means that the competence curriculum model seeks to leverage a learner's personal experiences and daily life to build new understanding, thereby promoting learner-centered strategies and indicating that the teachers' partly structured experience is crucial in the process.

However, Herzog and Ashton (2022) note that attained curriculum has several drawbacks, such as a limited Focus on Quantifiable Outcomes, where it may concentrate too much on measurable results and potentially neglect crucial elements of learning that are hard to assess. This results in insufficient emphasis on critical thinking and creativity, as the curriculum might favor rote learning and recall over developing critical thinking skills and creativity. The teachings towards exams lead educators to concentrate mainly on test preparations instead of fostering a deeper understanding of the content (Kavaric, 2023).

2.6. Approaches to curriculum design

Curriculum design methods are commonly grouped into three main categories, namely: vertical, horizontal, and pragmatic curriculum models (Beane, 1997). Each model highlights different aspects of curriculum development and is intended to meet specific learner needs within the teaching and learning context.

2.6.1. Vertical curriculum

Vertical curriculum, also known as performance curriculum, influences enactment of strategies from facts and schooled knowledge (Bernstein, 1999). This type of curriculum, as its name suggests, is hierarchically organised. This denotes that new knowledge is built up from existing knowledge, with the newly acquired knowledge being more complex than the former. Furthermore, O'Donnell et al. (2022) support the statement vertical curriculum signifies a

systematic approach to curriculum development, wherein subject content is arranged in levels of increasing complexity. As such, Maulida (2022) states that vertical curriculum's knowledge is incited by selected content, where all learners acquire the same body of knowledge from the lowest to the highest levels, and educators are provided an opportunity to develop understanding. As such, this is a teacher-centred strategy, as it clearly articulates teaching goals and logical progression. Moreover, for Shoba and Khoza (2022), vertical curriculum considerations the teacher carefully sequences and paces teaching experiences to ensure that learners build prior knowledge. Khoza (2021) explains that this approach builds on learners' existing knowledge and abilities, ensuring that a solid foundation is laid before introducing more advanced concepts. This implies that the curriculum follows a vertical progression, where learning develops in a structured and sequential manner. For example, in a Natural Sciences and Technology classroom, a vertical curriculum would start with basic concepts, such as distinguishing between vertebrates and invertebrates, thereafter advancing to more complex ideas like exoskeletons and endoskeletons, and eventually move on to broader topics such as matter and materials. According to Khoza (2023), this design recognises that learning grows over time and that students need foundational understanding to grasp higher-level content. This illustrates a teacher-centred model, as it is guided by structured, content-driven reflections.

2.6.2. Horizontal curriculum

Makumane et al. (2022) define horizontal curriculum, also known as integrated curriculum, referring to the alignment and integration of teaching experiences and content around different subjects at the same grade level. This denotes that society lies at the heart of the teaching/learning environment). Further to this, Sangeeta (2024) as well as Khoza (2016) are of the view that horizontal curriculum, which is a competence-based curriculum, emphasises the connection of various subject areas and the relationships among them). This strategy aims to foster a comprehensive and integrated learning experience for learners. Consequently, it promotes interdisciplinary learning and aids students in recognising how knowledge from different subjects can be applied in practical scenarios. In this type of curriculum, different subjects and disciplines are fused and interconnected, thus resulting in dissolution of the

subject boundaries approach (Pacala, 2023). This ideology echoes an opinion that integrated curriculum discards compartmentalised subject-based form of instruction and adheres to interconnections among different disciplines posit that the latest trend to emerge relating to pedagogy has shifted from teacher-centred to a learner-centered approach. In the teacher-centered strategies, learners assume a greater responsibility in the acquisition of knowledge (Sangeeta, 2024). The competence-based curriculum promotes this trend as it favours enhanced problem-solving skills, knowledge construction, and creativity as learners are actively engaged in their learning. This would allow learners to examine the interconnectedness of diverse environmental challenges and understand how their actions impact ecosystems, human societies, and sustainability.

2.6.3. Pragmatic curriculum

Makumane and Khoza (2020), along with Khoza (2021), explain that a pragmatic curriculum is designed to empower teachers to operate effectively across different curriculum levels. Put simply, this approach blends elements of performance-based and competence-based models, giving teachers the freedom to direct the teaching and learning process according to their judgment. Essentially, the pragmatic curriculum is teacher-driven, enabling educators to draw on the strengths of both curriculum types to shape a balanced learning experience suited to their context (Shoba & Khoza, 2022). In addition to supporting teachers, this curriculum also assists learners in achieving the intended learning outcomes. It aligns well with blended learning environments, as it relies on teachers' self-developed experiences and motivations to address both their own needs and those of their learners (O'Donnell et al., 2022).

2.7. History of natural sciences and technology in curriculum

The Natural Sciences and Technology (NST) curriculum in South Africa has undergone significant developments, particularly with the introduction of the Curriculum and Assessment Policy Statement (CAPS). While the exact starting date of the Natural Sciences and Technology curriculum is not specified, key milestones include the year. Prior to1994, Science education in South Africa enacted apartheid, emphasising rote learning and substantive aspects of science (Songer and Linn, 1991). In 1994 the democratic government took over, marking a significant shift in education, with a focus on scientific inquiry and nature of science. Later in 1997

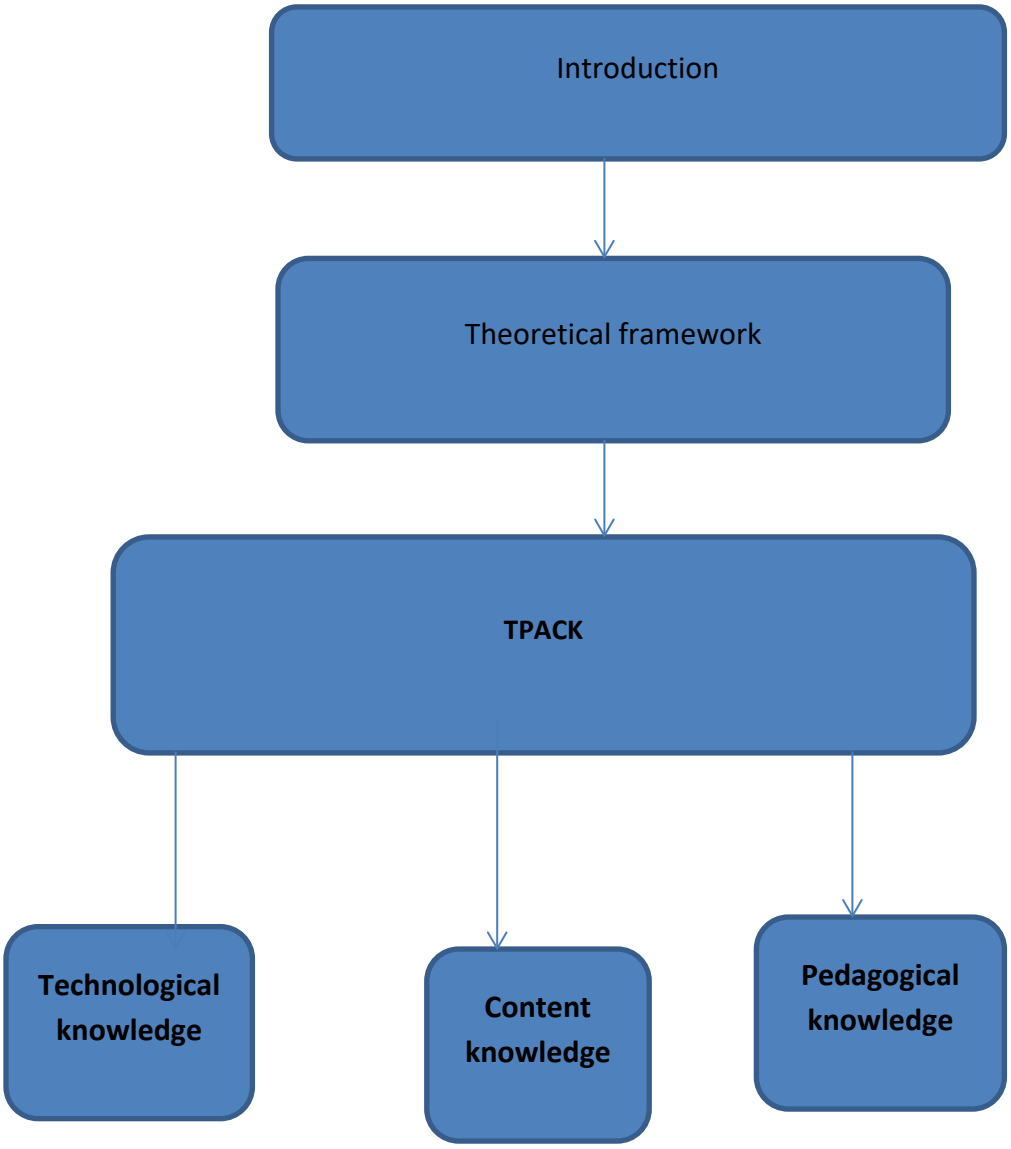
outcomes-based education was introduced, signaling a paradigm shift from the apartheid era's content-based curriculum. Miles and Huberman (1994) explain that the Curriculum and Assessment Policy Statement (CAPS) was introduced to outline the specific content and assessment standards required for each grade, including Natural Sciences and Technology (NST). In Grades 4–6, Natural Sciences and Technology are offered as an integrated subject. The curriculum covers key strands such as Life and Living, Matter and Materials, Energy and Change, and Planet Earth and beyond.

Cheung (2020) notes that the Natural Sciences and Technology (NST) curriculum in Grade Four builds on foundational concepts introduced in earlier grades. Students explore the natural world through subjects like Biology, Physics, and Earth Sciences, while also learning about technology and its applications. They engage in activities that are hands on, the experiments involvements, and the projects fostering critical thinking, problem-solving, and creativity. The curriculum aims to develop curious, informed, and environmentally aware citizens who can apply scientific principles and technological skills to real-world challenges. By integrating NST into the Grade Four curriculum, learners developing a deeper understanding of the world around them and lay the groundwork for future scientific exploration and innovation.

CHAPTER 3

THEORETICAL FRAMEWORK: TPACK

Figure 2: chapter 3 (flow chat)



3.1. Introduction

The previous chapter analysed phenomenon of teaching strategies and their levels: learner-centered, teacher-centred, and content-centred. The curriculum was also unpacked with its concepts (Objectives, content, resources, assessment and environment), the representations (intended, implemented, and attained), and approaches to curriculum (vertical, horizontal, and pragmatic). Chapter 3 discusses the Technological Pedagogical Content Knowledge and constructivism as the theoretical frameworks underpinning this study.

3.2. Theoretical framework

The theoretical framework is a set of concepts interconnected, theories and research guides that provide a view of a structure (Anfara & Mertz, 2014). The key component of the framework includes concepts, theories and models. Meriam and Tisdell (2016) argue that the theoretical framework's purpose is to guide the researcher and assist with the interpretation of the complex phenomena. A theoretical framework referred as a guide for research process, functioning like a roadmap that assists researchers in systematically interpreting their findings. It provides a structured approach for organising data and drawing conclusions. For this study, the primary theoretical frameworks selected are the technological pedagogical content Knowledge (TPACK) model.

3.2.1. TPACK theoretical framework

The TPACK framework serves as a theoretical model that guides teachers in using technology meaningfully in their instructional practice. It focuses on the dynamic relationship among three core forms of knowledge, namely: content knowledge, which involves mastery of the subject; pedagogical knowledge, which refers to the methods and strategies used to teach; and technological knowledge, which concerns understanding digital tools and their educational uses (Zhang & Tang, 2021; Koehler et al., 2013; Schmidt et al., 2009). Mishra and Koehler (2006) further explain that TPACK includes the intersections of these domains—for example, technological content knowledge, which involves selecting suitable technologies for particular subject matter, and technological pedagogical knowledge, which entails choosing tools that support specific learning goals and teaching contexts. This framework therefore suggests that effective technology integration requires more than basic technical ability; it demands instead a

thoughtful alignment of technology with both pedagogy and content to enhance teaching and learning.

Originally developed by Shulman in 1986 as Pedagogical Content Knowledge (PCK), which included only pedagogy and content knowledge, the framework was expanded in 2006 by Mishra and Koehler at Michigan State University to incorporate technology, resulting in the TPACK model. Cherner and Smith (2017) explain that the TPACK theory is the effective teaching that blends teachers' extensive knowledge of content with efficient assessment strategies and pedagogical methods, aiming to deliver meaningful and impactful learning experiences for students. In essence, Potyrała and Tomczyk (2021) necessitate that teachers utilise both their organised and experiential knowledge to effectively address both content and pedagogical understanding. However, Andoh et al. (2022) note that this framework emerged during a period when technological advancements largely targeted industrial applications rather than education. Andoh et al. (2022) concur with Cherner and Smith (2017) that the need for integrating technology into educational practices has grown, prompting revision of theory to incorporate technological knowledge into the curriculum content teaching.

Thompson and Mishra (2007) examine the TPACK framework, initially introduced by Koehler and Mishra (2005), which is composed of seven interrelated components (as illustrated in Figure 1.1) including technological knowledge (TK), 2) content knowledge (CK), 3) pedagogical knowledge (PK), 4) pedagogical content knowledge (PCK), 5) technological content knowledge (TCK), 6) technological pedagogical knowledge (TPK), and 7) technological pedagogical content knowledge (TPCK). According to Mishra and Koehler (2006) and colleagues, the TPACK framework builds upon Shulman's PCK model by integrating technological knowledge into the intersections of content and pedagogy, taking into account contextual elements such as learners' prior knowledge (Mishra & Koehler, 2009; Schmidt et al., 2009).

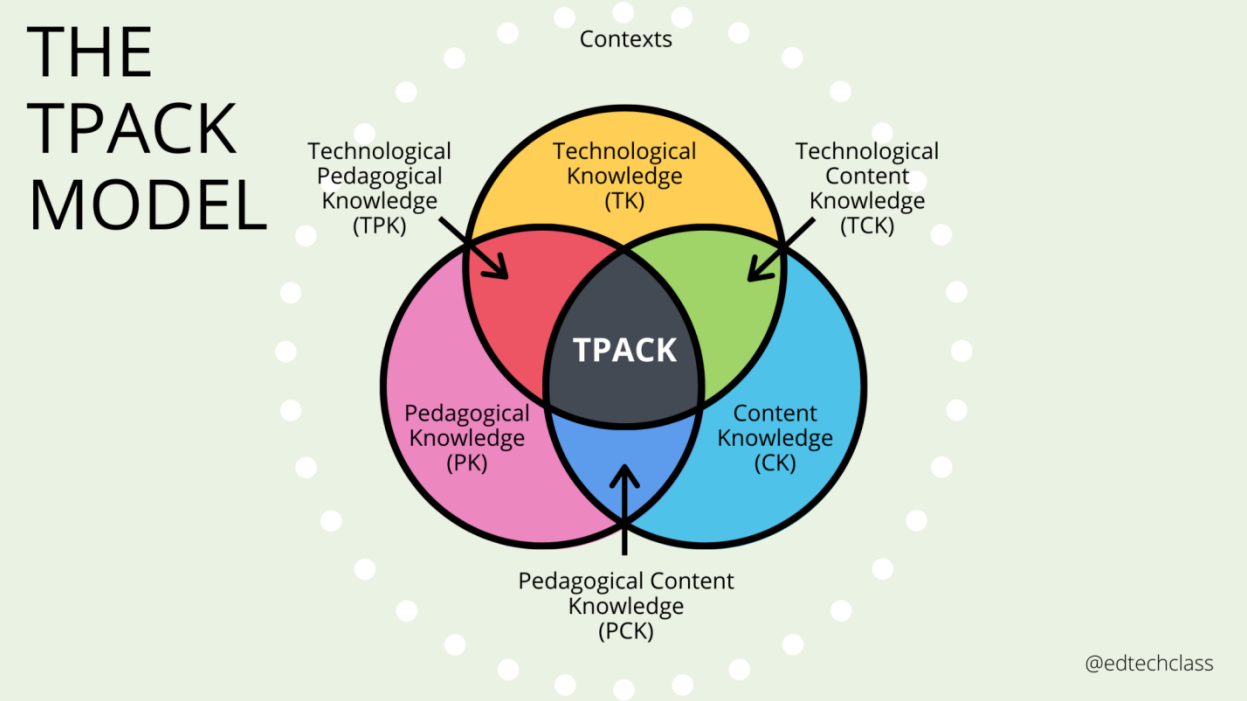


Figure 3: TPACK model diagramme (Mishra & Koehler, 2007)

Three main forms of knowledge

3.2.1.1. Technological knowledge

Technical knowledge (TK) encompasses an organised and quality-controlled understanding of technical systems and processes, developed, expanded, and improved over time. Andoh et al. (2022) further explain that technological knowledge comprises both explicit knowledge that can be taught and learned, as well as implicit knowledge that contributes to technical practice. According to Chirinda et al. (2021), a learner-centred strategy is implemented in the realm of technological knowledge, particularly within educational and training contexts. Therefore, technology is essential in enhancing learner-centered strategies by providing customised learning experiences, enabling collaboration, and granting access to an abundance of resources such as hardware (projectors and computers). This suggests that technology provides an easy teaching skill, but can also presents distractions, by making use of computers instead of working on content which may start playing games. For instance, a simple distraction may cause another learner's loss of focus. Lack of computers or any device used may also limit the teaching and learning participation.

Furthermore, technological knowledge makes use of teacher-centered strategies where teachers actively convey information to learners, typically through lectures or direct teaching, while learners adopt a more passive, receptive (Mpofu 2020). Nonetheless, even within teacher-centred methods, technology can significantly aid teachers and enrich the teaching experience. This suggests that technology can assist teachers in streamlining administrative responsibilities, enhancing lesson delivery, personalising instruction, and promoting learner's collaboration, even within a teacher-centered setting. For example, teaching natural sciences and technology in Grade Four, teachers can also apply an online or software platform for assessment teaching, such as online quizzes and online practicals, in case the equipment is hazardous.

3.2.1.2. Pedagogical knowledge

Pedagogical knowledge (PK) involves the strategies and techniques teachers use to facilitate learning. It includes elements like managing the classroom, designing assessments, planning lessons, and understanding learners' needs and learning processes (Schmidt et al., 2009). Supporting this perspective, Koehler and Mishra (2009) suggest that pedagogical knowledge entails an in-depth of a teacher's understanding of how to apply various curriculum concepts effectively to facilitate students' knowledge acquisition and skill development. Khoza (2020) adds that pedagogical knowledge is closely linked to a teacher's intrinsic motivation to support learners, meaning that personal experiences often shape selection of teaching methods and strategies to achieve learning outcomes that meet students' needs. Another related instance highlighted by Chirinda et al. (2021) and Mpofu (2020) illustrates that, during the new improvement of different facilities, teachers faced six difficulties in transitioning to online teaching, due to their lack of experience with various methods required for effective online instruction.

In Grade Four, the involvement of pedagogical knowledge in natural science includes the understanding of the concepts such as energy, matter, life and living and planet earth. This includes the application of the use of a teacher-centred pedagogical strategy, where teachers serve as the main source of knowledge and direct the teaching process. Mishra and Warr (2021) state that conveying information through lectures, presentations, and direct instruction, while

learners passively receive content; teachers also track learner progress and give feedback, with learners demonstrating comprehension through assessments. This suggests that teacher-centered teaching methods provide a clear framework and facilitate quick information dissemination, but that they may also hinder learner involvement and critical analysis. Furthermore, Bahtiar et al. (2023) note that teacher-centredness works best when applied deliberately to teach essential concepts or scientific concepts. Nonetheless, teacher-centredness can suppress creativity and diminish learners' sense of responsibility for their own learning.

3.2.1.3. Content knowledge

Content knowledge (CK) is defined as the understanding of specific subject matter that has to be taught or learned (Mishra & Koehler, 2006). This implies that teachers need to have a solid grasp of the topics they intend to teach and understand that the characteristics of knowledge differ depending on the subject area. For example, a teacher teaching about photosynthesis would need to understand the chemical equation involves the role of sunlight, and importance of the process for plant growth and the food chain.

According to Von Kotzebue and Beliefs (2022), content knowledge ought to consider the theoretical foundations of teaching that shape the content knowledge constructs of the teachers, enabling them to master their teaching methods and improve the effectiveness of their educational outcomes. Therefore, content-centredness prioritises the subject matter as the primary focus of teaching, establishing it as a fundamental approach to content knowledge. This suggests that the method aims to provide learners with a profound understanding of the subject by engaging with relevant material rather than merely memorising information.

Thyssen et al. (2023) explain that in deep subject matter expertise, a content-centered approach prioritises a thorough understanding of the subject; allowing teachers to build the best and strongest foundation of knowledge. As such, the focus on content can provide a structured and organised learning environment, making it easier for learners to grasp key concepts of natural sciences and technology. In other words, a well-implemented, content-centered strategy can facilitate in-depth teaching, allowing learners to explore complex ideas

and develop a strong understanding of the subject. This may result in Limitation of Focus on Pedagogical Practices, where the emphasis on content can sometimes overshadow the importance of effective teaching strategies, potentially leading to a less engaging learning experience. Content-centered approaches may not prioritise student-driven learning or allow for individual learning preferences and styles, as such, it lacks student agency.

3.2.1.4. Contextualising TPACK Theory

Contextualising TPACK involves comprehending and implementing the Technology, Pedagogy, and Content Knowledge framework tailored the specific learning environment Mishra and Warr (2021). At its essence, TPACK is a flexible framework where technology integration is considered not as a standalone tool but as an instrument that should be utilised alongside pedagogical insights to enhance content delivery relevant to a certain learning context. TPACK is a living model, not a fixed one; it evolves as educators and students engage with technology across various contexts. The learning environment, including the students, the subject matter, and the resources at hand, shapes the application of TPACK. Contextual Knowledge within TPACK, experienced teachers, in contrast to beginners, cultivates contextualised knowledge that empowers them to modify TPACK principles according to particular situations. Mishra and Warr (2021) point out that the current technology in a classroom works in processes and experiences. The latter authors developed the spaces for education designation in order to provide different elements that contribute to teachers' teaching strategies. The "Five Spaces for Design in Education" framework comprises five elements, namely artifacts, processes, experiences, systems, and culture as illustrated in Figure 2. Each of these elements can be described and connected to the three types of knowledge outlined in the TPACK framework.

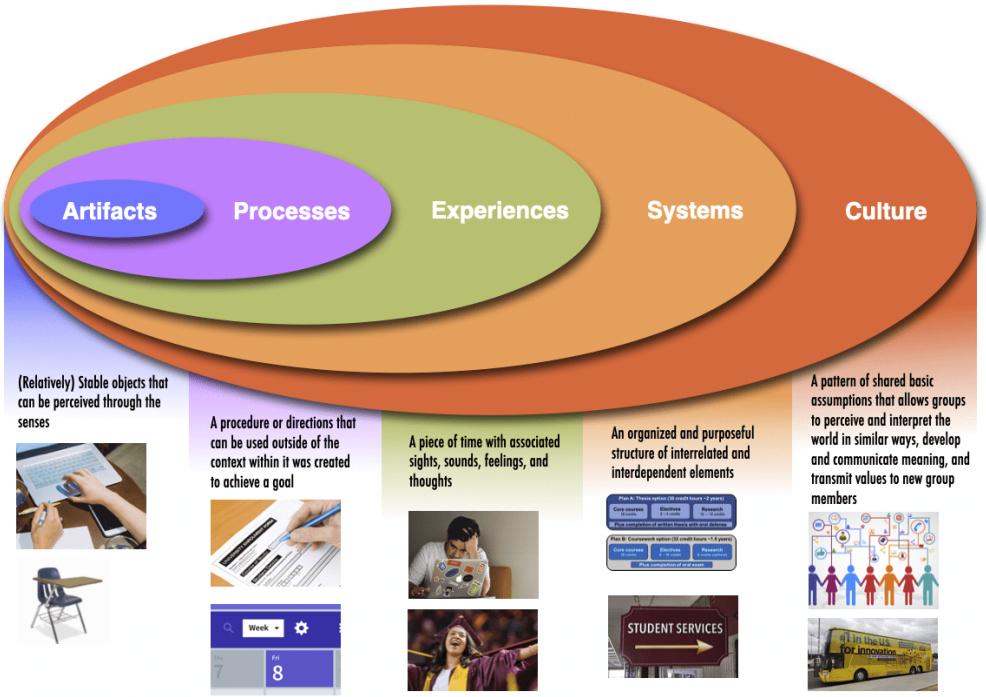


Figure 4: The five spaces for design in education (Punya Misha, 2021)

An artifact is defined as an object created to serve a specific function (Mishra & Warr, 2021; Preston, 2020). In the context of design, artifacts are linked to Technological Knowledge (TK) because they involve using resources such as books, posters, applications, and other tools that teachers employ to deliver content, reflecting teachers' semi-structured experiences. Processes refer to "a sequence of steps or instructions that can be applied to accomplish a goal beyond the original context in which they were developed" (Warr et al., 2020, P.601). As a design space, processes are connected to TK since they often involve using software for task execution, requiring teachers to draw on their semi-structured experiences in order to address social and educational demands. Teaching and learning are thus seen as ongoing activities, emphasising the teacher's role within the design environment (Liu, 2022; Stenhouse, 1975).

Experiences, referred as a design domain, relate to the unfolding of life over time, encompassing interactions with various sights, emotions, sounds and ideas (McCarthy & Wright, 2004; Mishra & Warr, 2021). This space aligns with Pedagogical Knowledge (PK), as it relies on teachers' structured experiences to apply diverse instructional strategies tailored to

learners' individual needs, such as virtual field trips. Systems, viewed as a design space, are described as "an organised and intentional framework of interconnected and interdependent components" (Mishra & Warr, 2021, p. 2).This space connects with Content Knowledge (CK) because it then requires teachers to use their structured experiences to fulfill professional obligations like adhering to scheduled instructional time. The fifth design space, culture, refers to recurring patterns of thought shaped by shared symbols, values and norms which allow groups in order to interpret and understand the world in similar ways (Lebrón, 2013; Warr et al., 2020). Culture is associated with TK, as it draws upon teachers' semi-structured experiences to satisfy societal expectations regarding the perceived role of technology in education. Collectively, these five spaces, namely artifact, experiences, systems, processes and culture—provide a framework for educational design, each linked to specific types of teacher knowledge.

Table 1
Definitions and examples of the five spaces for design in education.

Space	Definition	Examples
Artifacts	Stable objects that can be perceived through the senses	Apps, devices, software, videos
Processes	A procedure or directions that can be used to achieve a goal outside of the context within it was created	Online learning modules, learning material access and submission procedures, learning management system organization, daily work schedule
Experiences	A piece of time with associated sights, sounds, feelings, and thoughts	Online activities (asynchronous and synchronous), synchronous class meetings, virtual field trips
Systems	An organized and purposeful structure of interrelated and interdependent elements	IT systems, school format requirements (required instructional time, standards for in-person and online instruction), student support services, budgets
Culture	A pattern of shared basic assumptions that allows groups to perceive and interpret the world in similar ways, develop and communicate meaning, and transmit values to new group members	Perceptions of technology, schools, and education broadly; parents' beliefs about online learning and how they should support online learning; societal expectations of the role of schools (including whether online instruction meets these goals)

TABLE 1: Five spaces of education design and examples (Mishra & Warr, 2021)

The five spaces framework also enables teachers to gain insight into the processes, systems, and cultural factors that can hinder their efforts, even when their intentions are strong. It highlights that obstacles may exist beyond the classroom, and effectively addressing these challenges often requires an understanding of systems and cultural contexts, which are typically overlooked in teacher training or professional development programmes. By comprehending the wider systems and cultural environment in which classrooms function, teachers can

develop knowledge that supports the meaningful integration of technology for the benefit of learners.

3.2.1.6. Contextualising TPACK

To contextualise TPACK here, Figure 3, provides definitions, level of teaching strategy and examples that is linked to it. The table is adopted from Chai et al. (2013).

TABLE 2 :Theories strategies using TPACK

TPACK Components	**Definition**	**Teaching strategy**	**Example**
Technological knowledge (TK)	Technological knowledge pertains to a teacher's comprehension of and capability to utilise different technological tools and resources, as well as their consequences for teaching and learning Andoh et al. (2022).	Learner-centred and content-centred.	Learner-centred technology can assist learners with various teaching preferences by offering different ways to access information and fulfill tasks. Concerning Content-Centered, technological knowledge is vital for grasping how technology affects the representation and understanding of specific subject areas.
Pedagogical Knowledge (PK)	According to Khoza and Biyela (2020).Pedagogical	teacher-centred	For instance, pedagogical knowledge highlights

	knowledge is described as teacher's comprehension of learning and teaching methods and processes.		the teacher's insight on how learners to learn and the most effective ways to support that learning.
Content knowledge (CK)	Andoh et al. (2022) concur with Cherner and Smith, (2017) Content knowledge involves to a teacher's thorough understanding of the matter of the subject they teach, encompassing facts, theories, and principles.	Content-centred	The strategy level is focused on Content, For example, Content knowledge underlines the crucial knowledge base-facts, theories, principles, concepts, and terminology that educators need to understand and convey effectively.

This study adopts the TPACK theoretical framework to provide guidance and structure. According to Brantley-Dias and Ertmer (2013), aligning with Mishra and Koehler (2006), TPACK is context-dependent, which has led to its adaptation and re-conceptualisation in various ways to suit different teaching environments. For instance, Brantley-Dias and Ertmer (2013) note that framework have been adjusted to highlight specific knowledge teachers need for different contexts, named web-based instruction, which emphasises technological knowledge (TK) of teachers, driven by learner-centered strategy, where teachers need to be skilled in leveraging technology to effectively teach concepts, practice skills, and improve learners understanding

across different disciplines. Specific disciplinary knowledge, which requires teachers' CK, driven by teacher-centered strategy, relates to a teacher's insight into how resources and digital tools can effectively be employed to present and deliver content within a specific subject area. Additionally, Mpungose (2020d) and Mishra and Koehler (2006) agree that knowledge that is sufficient in education system leads to the greater understanding of the content, technologies and pedagogies to be used in process of teaching. This elaborates that the TPACK framework can be applied by teachers for teaching effectively, which makes the study more relevant.

Furthermore, the aim of the study is to explore the teaching strategies in Grade Four natural sciences and technology. Zhang and Tang (2021) argue that Learner-centered TPACK supports learner-centered strategy by highlighting the important for understanding on how technology can enhance teaching. Teachers may use TPACK to create engaging teaching experiences that cater to diverse teaching styles and needs. This suggests that by leveraging technology effectively, teachers can promote learner autonomy, collaboration and active participation in learning process. In teacher-centred, TPACK can also be used to support a teacher-centred strategy, where the teacher takes a more direct role in delivering content and guiding learning Bahtiar et al. (2023). As such, teachers can use technology to create instructional resources, manage the classroom, and provide feedback to students. This shows that TPACK helps teachers make decisions informed about how to best use this technology to support their instructional goals. However, Andoh et al. (2022) state that the Content-Centered, TPACK emphasises the importance of content knowledge and how it informs the use of pedagogy and technology. Further to this, it states that teachers can use TPACK to select appropriate technologies and develop effective instructional strategies that align with the specific content being taught. This suggests that by focusing on content-specific knowledge, teachers can ensure that technology is used to enhance understanding and mastery of the matter of the subject.

Essentially, TPACK offers framework for teachers to consider how pedagogy, content, and technology can work together in develop effective and engaging teaching methods for Grade Four Natural Sciences and Technology, irrespective of whether the emphasis is on learner-centered, teacher-centered, or content-centered strategies. These three teaching methods

(learner-centered, teacher-centered, and content-centered) appear to correspond with the three knowledge types outlined in TPACK (TK, PK, and CK). Consequently, to apply TPACK within scope of this study, th term knowledge will be replaced with strategies (Figure 3) (Mbona 2023).

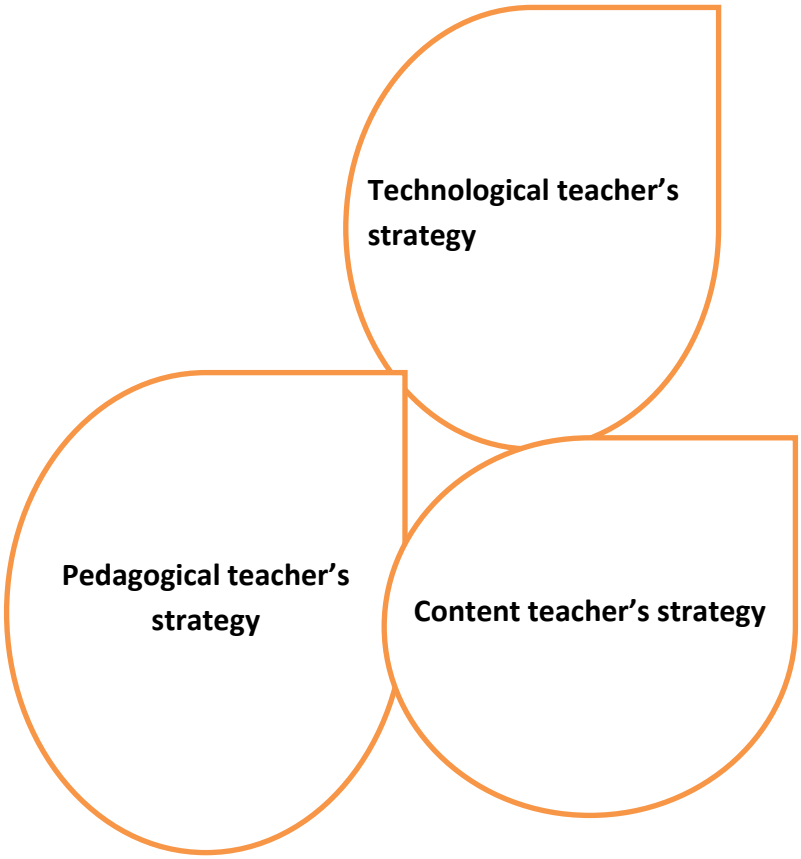
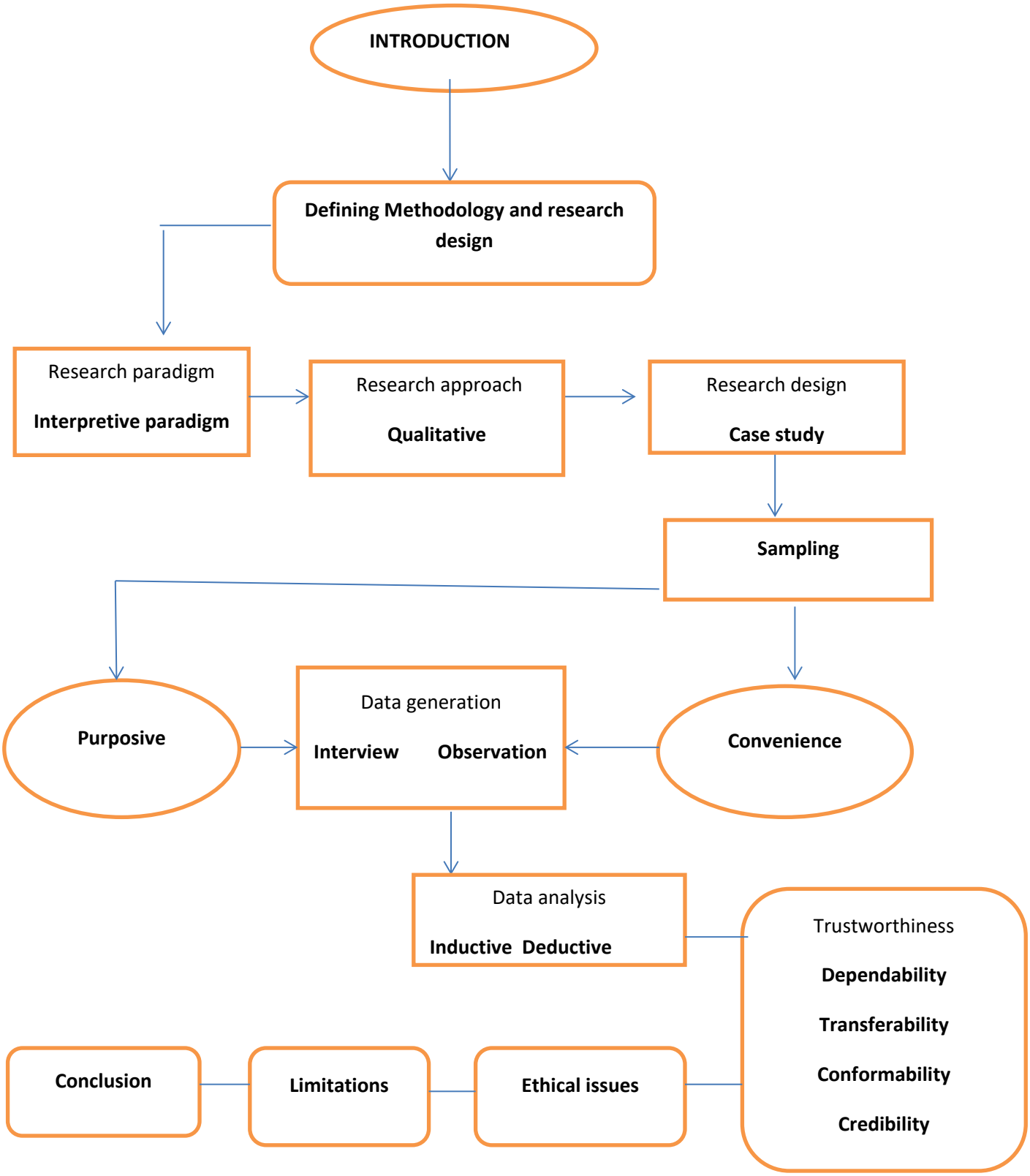


Figure 5: **TPACK as strategies by a teacher**

CHAPTER 4

METHODOLOGY AND RESEARCH DESIGN

Figure 6: Chapter 4 (flow chat)



4.1. Introduction

The former chapter described the theoretical framework and its purpose. The theory applied is the TPACK theory. The chapter also revealed the three main knowledge of the TPACK, which includes the Technological Knowledge, Pedagogical Knowledge and Content Knowledge. Conceptualising of knowledge is also described with the five spaces of knowledge. This chapter guides readers through the various processes involved in achieving the study's objectives. To begin, it examines the paradigm of the research selected for the study, along with the approach of the research and design that align amongst it. Additionally, this current chapter explores the participant process of sampling that leads into a discussion on how the data was collected and subsequently analysed. It draws the measures taken in order to enhance integrity and reliability of the research findings, as well as the consideration of the ethical issues. The chapter then addresses research's limitations followed by a conclusion.

4.2. A Brief Definition of Methodology

Methodology pertain the structured and the theoretical examination of the methods used within particular area of the study Kothari (2004). It involves analysing the collection of methods and principles linked to a specific area of knowledge. Creswell (2014) describes methodology as the method for acquiring knowledge through various processes and techniques. As such, research methodology aims to find strategies to address the issues within the study, encompassing paradigms, research design, research approach, data generation methods from participants, data analysis, sampling, methods, ethical considerations, trustworthiness, and more. Bertram and Christiansen (2014) concurs with Choy (2014) explaining that research in methodology outlines how the researchers collects, analyses, categorises, and organises data to address the research questions. Furthermore, Creswell (2017) states that research methodology section draw the design the research and strategy applied in the study, justifying each part in relation to its appropriateness for the specific research.

4.3 Research Paradigm

Research paradigm is defined as a philosophical framework which influences researcher's perspectives on knowledge, reality, and existence. It directs the complete research process, from recognising the issue to analysing the outcomes. Research paradigm is characterised as perspective which provides researcher with a specific set of lenses for exploring world in pursuit of truth and comprehension (Ramrathan, 2017). In addition, a paradigm functions as structure that directs the creation knowledge regarding the social realm. research paradigm serves as a framework directing the research strategy, methodology, and techniques. It encompasses a collection of understanding, beliefs, or ideas within which theories and practices operate.

The study is grounded in an interpretive research paradigm, which enables researcher to obtain rich, detailed insights into the teaching strategies used in Grade Four Natural Sciences and Technology. This paradigm consists of three components: “ontology, epistemology, and methodology”. Ontology is a branch of philosophy that investigates the essence of existence, particularly what is real and what entities inhabit the world (Gray, 2014). It emphasises the premises that researchers hold in regard of reality and types of entities that exist, which influences their research methodologies. In the context of teaching strategies, ontology pertains to recognising nature of the reality and knowledge within classroom. According to Dudovskiy (2021), teachers typically believe that knowledge is an objective entity that can be imparted to learners. Consequently, teachers also hold the view that knowledge is created by learners through their experiences and social interactions. However, Pérez (2024) concurs with Creswell (2014) that ontology highlights a learner-centred strategy to teaching, wherein learners actively engage in constructing their own knowledge. This suggests that, by grasping how learners build knowledge, teachers can craft more effective educational experiences. As such, awareness of ontology encourages teachers to foster critical thinking, analysis, and evaluation among their learners.

Epistemology is the philosophical field that explores the nature, origins, and boundaries of knowledge (Gray, 2014). Furthermore, Pervin (2022) notes in the context of research that epistemology pertains to the understanding of knowledge and the processes through which it is

acquired, validated, and justified. It relates to the assumptions a researcher has in regard of the nature's reality, knowledge, and means of acquiring it. The teaching strategies employed are shaped by an individual's beliefs about epistemology, specifically concerning how knowledge is gained and what qualifies as knowledge Dudovskiy (2021). For instance, teacher-centred methodologies typically correspond with a view of knowledge as a fixed set of facts that can be conveyed to students.

Kivunja and Kuyini (2017), with the support of Hennink et al. (2020), agree that ontological and epistemological dimensions primarily address an individual's perspective on the world, focusing on the nature of reality. However, Cropley (2022) argues that interpretive teaching paradigms emphasise comprehension and the creation of meaning by involving learners in critical examination and personal interpretation of texts or concepts. These methods motivate learners to go beyond merely obtaining knowledge to actively develop their own understanding, appreciating individual viewpoints, and participating in meaningful discussions. According to Pervin (2022), in an interpretive framework, a learner-centred method highlights the significance of grasping the learner's personal experiences and interpretations of the learning process. This differs from conventional, more objective models that prioritise the delivery of information. However, Cropley, (2022) emphasises that, rather than a teacher-centered strategy in which knowledge is merely accepted, the interpretive framework promotes active meaning-making by learners through their own experiences and engagements. This suggests that interpretivism allows researchers to dig into the meanings learners ascribe to their teaching experiences, providing a clear understanding of their individual teaching strategy, preferences, and challenges.

However, Pervin (2022) further explains that interpretive methods encourage teachers to step into the learners' shoes, fostering empathy and understanding of their perspectives. As such, interpretive research often requires interviews, observations, and analysis, making it time-consuming and resource-intensive. This shows that an interpretive is beneficial in studying teaching strategies because it emphasises understanding meaning and the context of teaching practices, rather than just observing them. It helps researchers explore the lived experiences of

learners and teachers, consider multiple perspectives, and gain the deepest understanding of how teaching strategies are enacted and interpreted in real-world classroom settings.

4.4. Research approach

The interpretivist paradigm supports the engagement qualitative methods in the research endeavor (Creswell, 2013). In addition to this, the study implemented qualitative approach to gain a more profound insight into the strategies utilised by teachers while instructing Natural Sciences and Technology in Grade Four. The concept of qualitative research highlights focus on the nature and processes of entities, as well as meanings that are not assessed or quantified through experimental methods (Creswell, 2018). This indicates that qualitative research underscore the construction socially essence of the reality and involve researchers establishing a connection with the participants involved in the study. Additionally, Alharahsheh and Pius (2020), together with Creswell (2014), maintain the goal of qualitative research to explore an individual's unique insights and interpretations of a teaching strategy as shaped by their skills. Consequently, this propose that qualitative researchers observe subjects within their natural settings with the aim of interpreting and understanding a phenomenon are based on the meanings that individuals attribute to it. In alignment with the aforementioned points, a qualitative research methodology is deemed to be fit for the purpose of this study, as it aims to investigate the strategies that individuals experience and how educators derive meaning from these strategies.

As indicated by Ravitch and Carl (2021), a key advantage of qualitative research lies in their capacity to furnish a detailed textual account of how individuals engage with specific phenomena. This suggests that qualitative researches provide clear insight into teacher strategies to allow for a great understanding of most needed during teaching. Furthermore, it gives an understanding that is deeper of the subject Natural Sciences and Technology concepts and how teachers should interact with learners during teaching. For example, Natural Sciences and Technology Grade Four, such as water cycle plants growth, when taught outside classroom, the detailed information is shown. Moreover, Harvey (2022) notes the qualitative methodology as a fitting choice for this study, since its primary objective is to explore the teaching strategies employed in Grade Four Natural sciences and Technology. This suggests that research effort,

which seeks to comprehend the teaching strategies (phenomenon), underscores the appropriateness of both the interpretive paradigm and the qualitative approach.

Denzin and Lincoln (2018) agree that qualitative research may be time-consuming as the collection and analysing requires a lot of time. These encompass possible biases from researchers in interpreting data, the labor-intensive nature of data collection and analysis, challenges in applying findings to broader populations, and issues with study replication. Qualitative research significantly depends on researcher's interpretation, which may be shaped by their individual biases or preconceived notions. As such, limited sample sizes and particular contexts utilised in qualitative research hinder the ability to generalise results to larger groups. In summary, both interpretive paradigm and qualitative methodology are essential in research focusing on delving into and interpreting the nuanced understanding of human behaviour.

4.5. Research design

Case studies in qualitative research involve an inquiry method that entails a comprehensive examination of a phenomenon within its actual environment (Creswell, 2014). It enables researchers to gain a thorough meaningful explanation of complex proper details that may not be evident or easy to access through alternative research approaches. The specific cases or case selected for study may include an individual, a group, or an organisation, and what is deemed a relevant case for examination is determined by the researcher and their research question. Jwan and Ong'ondo (2011) align with Kozleski's (2017) categorisation of different case study approaches, such as explanatory, exploratory, intrinsic, instrumental, collective, and descriptive designs. For the purposes of this research, an exploratory case study design is adopted to obtain an in-depth insight into the teaching strategies employed in Grade Four Natural Sciences and Technology.

According to Coombs (2022), qualitative case studies utilise a range of evidence sources such as documents, artifacts, interviews, and observations to build a rich, detailed understanding of the phenomenon under investigation, in this case the teaching strategies. The aim is to enhance the reader's comprehension of teaching strategies in natural sciences and technology Grade Four beyond merely abstract statistical or theoretical explanations. By adopting a case study

approach, as researcher can acquire a more profound understanding of teaching strategies in context, which can ultimately inform practices and enhance teacher's outcomes.

Cohen et al. (2007) concur with Mtisi (2022) that a case study seeks to portray what it means to be in a specific context by providing detailed, realistic, and richly textured accounts of participants' lived experiences, perspectives, and emotions. In this study, Grade Four teachers will complete questionnaires to generate data on their experiences and the instructional strategies they employ when teaching Natural Sciences and Technology. Furthermore, teachers were being observed while teaching in order to answer how and what questions. However, Schoch (2020) indicates that case studies can be time-consuming, necessitate substantial preparation from researchers, and may not always have broad applicability to other contexts. This suggests that some teachers could find the open-ended nature of case studies challenging and unfamiliar, which may lead to frustration or disengagement. Additionally, teachers might bring their own biases and perspectives into the analysis, potentially impacting their interpretations and conclusions.

4.6. Sampling

Sampling is defined as a method of selecting subjects, objects or participants from specific objects of category or beings (Ramrathan, 2017). In the context of teachers, sampling involves choosing a portion of teachers to for wider population to be represented of teachers in a research study. According to Scribbr (2022), sampling is necessary because gathering data from every individual teacher is often impractical, or unfeasible. For instance, one might survey a select number of teachers to assess general satisfaction with a new curriculum or conduct interviews with a small group of seasoned teachers to identify best practices.

According to Bertram and Christiansen (2014) and Ramrathan (2017), researchers can choose from a variety of sampling strategies, including random, stratified, purposive, and opportunistic, convenience, and snowball sampling, among others. Bertram and Christiansen (2014) note that random and purposive samplings are the main approaches commonly applied, and they include several subcategories. For instance, convenience sampling is considered a form of purposive sampling. However, Bertram and Christiansen (2014) concurs with

Canonizado (2021) that these two primary sampling methods differ from one another; random sampling ensures that each and every individual in the target population has a chance that is equal to be selected for the sample, whereas purposive sampling involves the researcher making deliberate selections regarding participants to be included in the sample). Consequently, this research utilised purposive sampling along with convenience sampling approach.

4.6.1. Purposive sampling

Purposive sampling is a technique that does not involve random selection, where researchers choose participants based on certain characteristics or criteria that are pertinent to their research question. Patton (2015) and Andrade (2021) agree that this method involves a conscious decision to select individuals or cases that are deemed the most insightful for the study, rather than using a random selection process. It is especially advantageous in qualitative research aimed at acquiring a deep understanding of a specific phenomenon or demographic. According to Aguinis (2024), when conducting research in Natural Sciences and Technology Grade Four, selecting the appropriate sampling methods is essential for effectively and reliably gathering data from a larger group of teachers. This suggests that purposive sampling enables researchers to collect valuable insights without the necessity of evaluating every single teacher, thus making the research process more efficient and manageable.

However, Memon et al. (2023) say that gathering data from a vast group can be resource-heavy and time-consuming. As such, sampling considerably cuts down on the required time and resources, facilitating faster analysis and reporting. Furthermore, purposive sampling can lower the overall costs associated with research by decreasing the number of participants and materials involved. By working with a smaller sample size, it becomes easier to oversee, analyse, and interpret the collected data, resulting in more focused and meaningful findings. Purposive sampling methods can help reduce bias and ensure that the sample reflects the larger group of students being examined (Aguinis et al., 2021). Moreover, a researcher's subjective judgment might introduce bias during the selection process and the results obtained may not be applicable to a population that is wider due to the non-random selection's nature.

This indicates that the effectiveness of purposive sampling is also dependent on the researcher's capability to identify suitable participants.

4.6.2. Convenience sampling

Convenience sampling is a non-probability sampling approach in which participants are selected because they are easy to reach, readily available, and willing to participate (Etikan et al., 2016). This method is commonly used in exploratory or preliminary studies, particularly when researchers face time or resource limitations. Gill (2020) note that convenience sampling is the great widely used form of non-probability sampling, as it focuses on gathering data from accessible individuals that are easily and generally willing to take part. Unlike probability-based methods, convenience sampling does not require randomly selecting participants (such as teachers) according to defined criteria. Instead, researchers use their judgment to recruit individuals who are open to participating. Consequently, samples may be drawn from diverse settings including shopping centres, public spaces, workplaces, or online platforms whenever participants are available.

However, Saunders et al. (2019) indicate that these various settings present opportunities for conducting research, and that the data collection is simplified, where virtually anyone can conduct the research; there's no prerequisite for training or extensive experience to gather data through convenience sampling. For example, by constructing a survey that facilitates the collection of information quantitatively, researchers can swiftly analyse trends. Additionally, utilising a smaller sample size reduces the time spent sifting through large amounts of raw data. Nonetheless, since this sample relies on individuals who are available at the time and location of the researcher's presence, it may not encompass a diverse range of participants in each round of data collection. Moreover, the subjective selection of participants by the researcher can also affect the final sample (Gill 2020). Furthermore, the voluntary nature of participation implies that individuals who are more knowledgeable about the subject or supportive of the topic might be overrepresented in the data.

As such, as the sample will accurately not reflect the population entirely, it can be challenging to generalise the findings about the wider population. This suggest that if research is solely

based on convenience sampling without validating results or supplementing with an additional probability-based sampling method, credibility the research results may be questioned within the broader research community.

4.7. Data generation

4.7.1. One-on-one semi-structured Interview

One-on-one semi-structured interviews involve a conversational exchange between the researcher and a single participant, with the purpose of gathering information that aligns with the study's aims (Cohen et al., 2007; Khoza & Biyela, 2020). This approach allows the researcher to use flexible, guiding questions to elicit rich insights and gain a more comprehensive understanding of the phenomenon being explored.

I selected this method because it encourages participants to share their experiences openly, in the mean while allowing me to probe further and obtain clarification where necessary (Doody & Noonan, 2013; Ramrathan, 2017). Using these strategies will therefore contribute to producing rich insights into teachers' strategies for teaching Natural Sciences and Technology in Grade Four. Patton (2002) emphasises that interviewing enables a researcher to access another person's viewpoint, suggesting that one-on-one semi-structured interviews are well suited to addressing the research questions: What support do Grade Four Natural Sciences and Technology teachers require to develop their teaching strategies? How do these teachers use teaching strategies in their classrooms? And why do they employ these strategies in the ways that they do?

During the interview process, I ensured that participants were both willing and available to take part (Cropley, 2022). Prior to generating data, participants were selected through purposive and convenience sampling. However, this method is not without limitations; interactions between interviewer and interviewee may be shaped by power relations, which can result in socially desirable responses (Cropley, 2022). The approach also depends on participants' memory, making it vulnerable to recall bias, and it requires interviewers who can skillfully probe and explore emerging ideas. To mitigate these challenges, I fostered an open, supportive, and non-threatening environment to reduce potential power imbalances.

4.7.2. Non-participatory Observation

Non-participatory observation in educational settings involves watching a lesson or classroom activity without taking an active role as either a teacher or a learner (Kawulich, 2005). This approach enables an unbiased evaluation of teaching methods and student involvement, which can yield important insights for enhancing teaching practices and improving student results. Liu and Maitlis (2010) explain that Structured Observation utilises a specific checklist or observation guide to concentrate on particular elements of teaching, such as interactions between teachers and students, classroom management, or the application of teaching materials. This suggests that non-participatory observation may serve as a component of an official assessment process, offering teachers feedback regarding their strengths and areas needing development.

However, Saunders et al. (2019) say observers might overlook subtle details of classroom dynamics that could become apparent through direct participation. Even with a structured observation approach, the observer's personal viewpoints and interpretations can affect the findings. Therefore, conducting covert observations can be challenging and may pose ethical certain dilemmas.

4.8. Data analysis

Data analysis includes systematically using statistical or logical techniques in order to interpret, condense, and evaluate the collected information (Creswell, 2014). This process entails reviewing data sets to draw conclusions about the information they hold, frequently to aid in decision-making or to respond to particular inquiries. Cohen et al. (2013) concur with Miles et al. (2014) and describe data analysis as a technique for identifying essential elements within generated data and structuring it for interpretative purposes. In qualitative research context, Henning (2004) characterises data analysis as a non-linear practice due to its adaptable and ongoing nature, which does not adhere to a strictly linear or sequential format.

However, the data analysis process incorporated of both inductive and deductive reasoning strategies. Bertram and Christiansen (2014) agree with Bingham and Witkowsky (2022) that deductive reasoning is a method in data analysis that enables a researcher to start with predetermined categories (themes) to classify and organise the data. Themes were developed

based on TK, PK, and CK. In essence, these three elements of the TPACK theoretical framework provided a structured set of categories or themes used to focus, organise, and categorise data.

Deductive analysis involves using existing theories to interpret data with the aim of examining or verifying those theories (Bingham, 2023). This approach is typically described as "top-down," particularly in qualitative research where predefined codes guide the analysis. In contrast, inductive analysis is a bottom-up process in which the researcher engages closely with the data, categories, allowing patterns and codes to emerge naturally. As noted by Bingham and Witkowsky (2022), this study also employed inductive reasoning, enabling themes to arise directly from the data. Inductive reasoning stands in opposition to deductive reasoning; it is due to themes generated from the data itself rather than imposed beforehand (Bertram & Christiansen, 2014). Consequently, this approach contributed to identifying additional themes beyond the three knowledge areas initially outlined. Inductive reasoning was further applied in analysing information collected through one-on-one semi-structured interviews and reflective activities, supporting the development of conclusions for this study.

4.9 Trustworthiness

Cloutier and Ravasi (2021) note that trustworthiness in qualitative research relates to how accurate, relevant, and impartial the study's findings are, ensuring that the results represent participants' actual experiences rather than the researcher's own views. According to Rose and Johnson (2020), within the interpretive paradigm, trustworthiness depends on the rigour of the research process, the appropriateness of the chosen methods, the honesty of the researcher, and the extent to which the findings can be verified. According to this paradigm, detailed and transparent descriptions of the data strengthen trustworthiness (Bertram & Christiansen, 2014). Drawing on Guba and Lincoln's (1994) framework, Bertram and Christiansen (2014) also emphasise that trustworthiness is achieved by addressing four aspects, namely: dependability, credibility, transferability, and conformability.

4.9.1 Dependability

In qualitative studies, the notion of reliability is often replaced with dependability, which refers to whether the research process produces stable and consistent findings. This is supported by systematic documentation, reflective practice, and external review procedures (Cohen et al.,

2017; Moon et al., 2016). Nowell et al. (2017) emphasise that dependability is promoted when the research process is coherent, transparent, and well recorded. In this study, dependability was strengthened by a clear definition of the research questions and providing a detailed account of the methodological approach, data presentation, and analytical procedures. The literature review also contributed to dependability by comparing previous studies with the present one. Additionally, an audit trail will be maintained to record how data was collected, how categories were developed, and the reasoning behind methodological decisions (Cohen et al., 2017).

4.9.2 Transferability

Transferability concerns the extent to which the findings which may be applicable in other settings, which is supported by providing wealthy, detailed descriptions of research context and participants (Bertram & Christiansen, 2014). According to Bertram and Christiansen (2014) and Moon et al. (2016), transferability is strengthened when the researcher offers sufficient contextual detail to others in order determine whether the findings might be relevant elsewhere. In this study, the conclusion drawn from the findings was comprehensive enough to assist readers evaluating the applicability of the results to similar environments. Audio recordings were used to preserve participants' narratives, enabling thick descriptions that enhance trustworthiness (Hadi & José Closs, 2016). Scott (1996) notes that thick descriptions allow readers to judge whether the findings may be relevant to other settings. This indicates that while I agree that the results of this study cannot even be generalised to every secondary school in South Africa, they may be relevant in other comparable contexts.

4.9.3 Credibility

According to Cohen et al. (2017), credibility is described as the trust in the accuracy of the results, attained through methods such as prolonged engagement, member checking, and triangulation so as to effectively represent participants' experiences. Bertram and Christiansen (2014) emphasise that the credibility in interpretive research ought to agree with the lived realities of participants, functioning as an alternative to the quantitative concept of validity (Chetty & Ramrathan, 2017). In this study, the credibility was enhanced by ensuring accuracy during both data collection and analysis. Participants were encouraged to articulate their

experiences freely, ensuring that their own perspectives not the researcher's expectations—informed the data. Guba and Lincoln (1994) as well as Bertram and Christiansen (2014) consider this alignment between participant realities and research findings as a key indicator of credibility. Furthermore, triangulation was employed by using multiple data generation methods—specifically reflective activities and individual semi-structured interviews. Cohen et al. (2017) argue for triangulation is a strong means of concurrent validity demonstrations.

4.9.4 Confirmability

Conformability is defined as the objectivity and neutrality of the results found, to ensure the accurate reflect participants' experiences and perspective rather than researcher's biases (Lincoln & Guba, 1985). Qualitative research's confIrmability is crucial for establishing trustworthiness and credibility (Shenton, 2004). This suggests that confirmability is essential in teaching strategies as it ensures credibility and reliability of research findings, allowing teachers to make informed decisions and develop effective instructional practices. However, Cloutier and Ravasi (2021) explain that confirmability guarantees that research findings are shaped by experiences of participants and perspectives, rather than the researcher's biases. As such, confirmability supports evidence-based practices, since it prioritises conformability, and teachers can develop teaching strategies grounded in trustworthy research, leading to improved student outcomes.

Furthermore, conformability is an essential element of qualitative research that guarantees the findings are influenced by the responses and data rather than the biases of the researcher (Noble, & Smith, 2018). Nonetheless, it has certain limitations, such as the challenge of attaining complete objectivity. Conformability recognises that qualitative research is inevitably shaped by the researcher's viewpoint and context, which makes achieving total objectivity difficult. It can also be time-consuming and resource-heavy. Furthermore, Korstjens and Moser (2020) explain that even with strategies for conformability, the interpretation of data can remain subjective, and researchers might unintentionally infuse their biases into the analysis. Additionally, conformability is focused on the specific context and participants, who can make it difficult to apply the findings to larger populations.

4.10. Ethical issues

Ethics describes the principles and guidelines that govern acceptable conduct toward research participants, which researchers must follow throughout a study (Beauchamp & Childress, 2013). This highlights the importance of addressing ethical issues, especially when the research involves human participants (Ramrathan et al., 2017). In accordance with the University of South Africa's ethical research policy, all required measures were implemented before the study commenced in order to protect the participants' autonomy and ensure their anonymity. I first applied for and received ethical clearance from the University of South Africa, which authorised the study and provided direction for ethical practice. Thereafter, I sought permission from the Department of Basic Education to carry out the research. The permission letter and consent forms were then shared with the school principal and the teachers who agreed to participate.

To add more to the previously mentioned points, Bertram and Christiansen (2014) highlight three key principles to consider when dealing with ethical concerns: non-maleficence, autonomy, and beneficence. Regarding non-maleficence, the research was conducted in a way that ensured no harm would come to individuals, particularly the participants. Participants were provided with the questions beforehand to allow them to understand what to expect and to make an informed decision about their involvement. To uphold the principle of autonomy, I ensured to secure consent from every individual taking part in the research. Furthermore, to ensure anonymity, I protected participants' privacy by using pseudonyms such as participants 1, 2, and 3 instead of their actual names. Additionally, participants were given a clear explanation of what was required of them in this study, ensuring they understood their involvement were voluntary. Participants were informed that they could exit the study at any time without any consequences. All participants signed a consent form that indicated their willingness to take part in the study and allowed for the audiotaping of the interviews for research and dissemination of the findings. The details of the study were thoroughly explained, and once the participants consented to the interviews, appointments were arranged.

4.11. Limitations

Allen and Wright (2014) describe limitations as the obstacles that may be faced during a research study, including constraints related to time and the necessity to align with the schedules of informants. The primary limitation of this research stems from its interpretive and qualitative case study approach. This implies that the ability to generalise the data is restricted, as teachers were intentionally and conveniently selected from high schools in the Mopani West District. Consequently, the data generated reflected the broader population of natural sciences and technology Grade Four teachers. To address this limitation, the study drew conclusions based on its findings, which aid in understanding similar contexts.

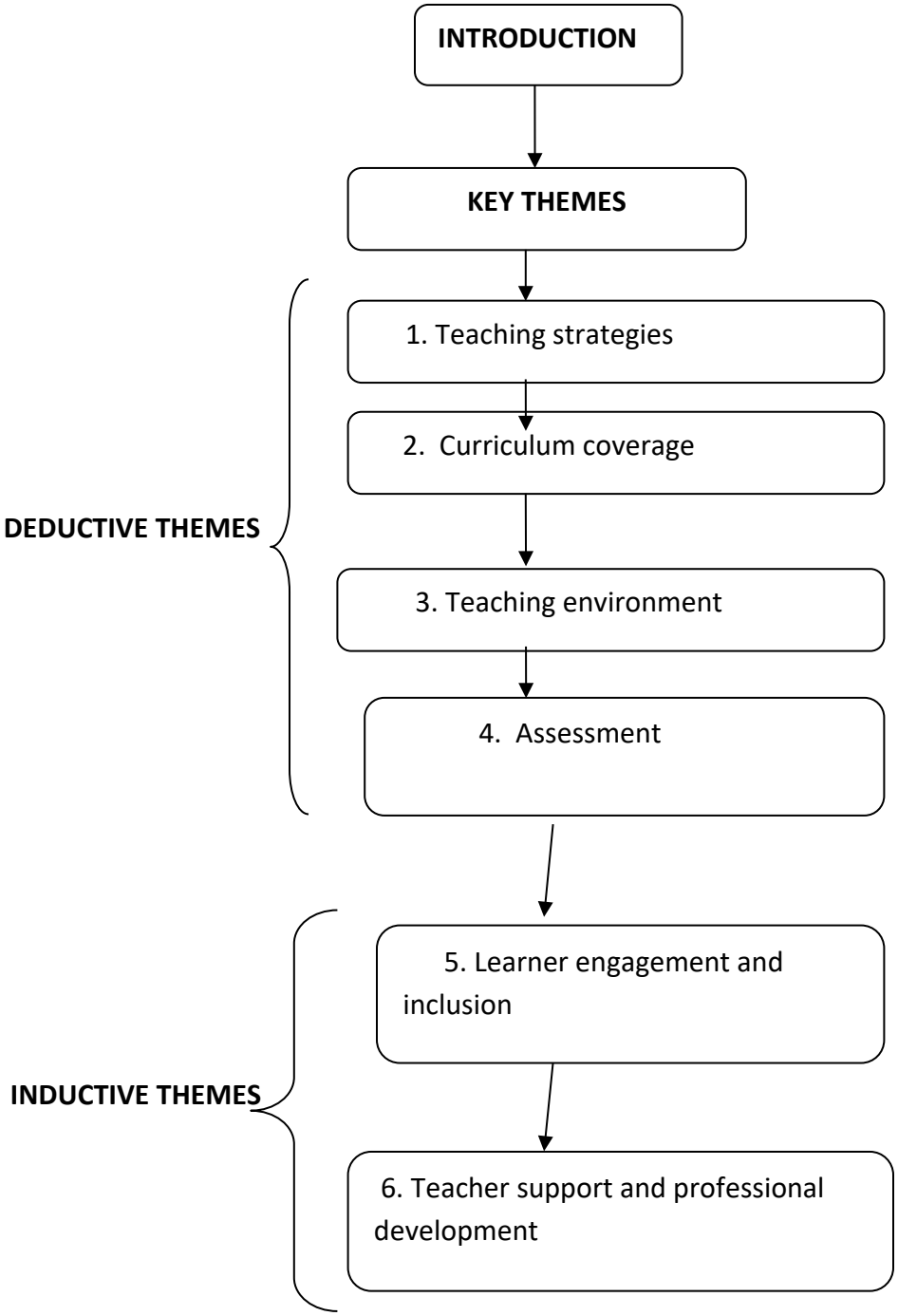
4.12. Conclusion

This chapter has guided the reader through initial introduction as previously detailed. The selected research paradigm for this study has been explained, along with the chosen research approach and design. Additionally, the chapter addressed sampling, which led to a discussion on the data generation and analysis process. It also highlighted the study's trustworthiness and the approach taken toward ethical considerations. The chapter further touched on the research limitations and the methods employed to address them. The next chapter will present the data and explore the findings derived from interviews and reflective activities.

CHAPTER 5

DATA PRESENTATION AND DISCUSSIONS

Figure 7: Chapter 5(flow chat)



5.1. INTRODUCTION

The previous chapter guided the reader through the various steps taken to achieve the aims of this research, covering research paradigm, the approach and design, sampling methods, data collection and analysis, integrity as well as trustworthiness, ethical considerations, and also limitations. In this chapter, the data is presented, and findings derived from interviews and reflective activities are discussed. The analysis employs thematic analysis, utilising both deductive and inductive themes. Deductive themes enabled identification of five organised themes, which connect to the TPACK framework that underpins this research. Additionally, this chapter outlines concepts that emerged from the findings and develops these into themes based on deductive and inductive theme reasoning. As a result, the research identified seven themes: the deductive theme; Teaching Strategies, Content Knowledge, Teaching Environment, Resources (Technological, Content, and Pedagogical Knowledge - TPACK), Assessment and the inductive theme; Learner Engagement and Inclusion as well Teacher Support and Professional Development. Additionally, this chapter provides responses to the research questions posed in the study. 1. What are the teaching strategies used by Grade Four Natural Sciences and Technology teachers in Mopani West under Makhutswe Circuit? 2. What support do Grade Four Natural Sciences and Technology teachers need to develop their teaching strategies? 3. How are teaching strategies used by Grade Four teachers in teaching of Natural sciences and Technology? 4. Why do teachers use teaching strategies the way they do when teaching Natural Sciences and Technology?

5.2. FINDINGS AND DISCUSSIONS

I identified essential themes using three knowledge areas: technology, pedagogy, and content. Inductively, I analysed the generated data to identify probable themes. I coded data for additional emergent themes beyond the seven previously identified ones. The study identified seven themes.

5.2.1. Theme 1: The teaching strategies

Question: What teaching strategies do you use to engage learners in teaching Natural Sciences and Technology?

Participants gave answers with reasons as to why they use each strategy. These are cited verbatim below.

Participant 1 *said "I normally use learner-centred and teacher-centered strategies depending on the topic that am going to teach. Some topics need me to explain to learners before I can give them chance to participate."*

Participant 2 *maintained "I use learner-centered strategy because I believe that it is more effective and learners get to participate in the lesson in that a way they easily master things and it is not easy for them to forget."*

Participant 3 quoted "*I normally use learner-centred to support learners' skills and allow them to show their skill since we don't have enough materials to show so allowing them to talk helps spot their level of understanding."*

Participant 4 asserted" *I use teacher-centred strategy when explaining the content and apply learner-centered strategy to allow learners participate so I can be able to identify their level of understanding****."***

Participant 5 stated "*learner-centred strategy is dominating when I teach I only apply teacher-centered when I have to explain certain content without disruptions. Learner-centred assist in checking their skill and I like it when learners engage in classroom."*

Participant 6 said "*when introducing the lesson I use teacher-centred strategy then when going deep with the content I apply learner-centered to accommodate learners and make them participate to check what they understand."*

DISCUSSIONS

Results reveal that teachers adopt a learner-centred strategy in an attempt to considerably enhance learners' engagement, motivation, and long-term retention by considering individual needs, strengths, and interests. This promotes vital competences such as critical thinking, the solving problem, and making decisions; increases learner confidence and gives them a sense of ownership of their learning, thereby preparing them for lifelong success in an ever-changing, highly integrated world. In other words, an analysis of the participants 'responses reveals their consideration of both the application of learner-centered and teacher-centered teaching strategies in instruction of Natural Sciences and Technology. The participants affirm the importance of adapting their teaching strategy to the specific needs of the learners, as well as the content, reflecting flexible and pragmatic strategy to pedagogy.

During the classroom observation, learners actively engaged with the teacher, frequently interacting to demonstrate their understanding of the lesson content. This interaction reflected a learner-centred strategy, where knowledge is co-constructed through dialogue between teacher and learners. Such engagement aligns with Lev Vygotsky's social constructivist theory, which emphasises the importance of social interaction in cognitive development. The learners' willingness to communicate their understanding suggests that the teacher created a supportive environment that encouraged participation and verbal expression. For instance, research by Le and Nguyen (2024) found that constructivist teaching strategies significantly improve learners' engagement and comprehension by encouraging active participation. Therefore, the observed interaction in Participants classroom aligns with contemporary pedagogical practices that emphasise social learning and active knowledge construction.

The responses of the participant are the strategic use of learner-centered teaching, which is viewed as instrumental in promoting learner engagement and participation that is active. Participant 2 assert *"this learner-centered enhances learners' understanding and retention as it*

encourages them to be active contributors to the lesson rather than passive recipients." Similarly, Participant 3 highlighted, *"in contexts where teaching materials are limited, allowing learners to express themselves verbally helps to identify their prior knowledge and level of understanding."* These perspectives align with constructivist learning theories, which advocate for learners to be actively involved in the construction of their own knowledge (Bremner, 2022; Do, 2023).

Previous studies corroborate the teachers' inclination toward learner-centred approaches observed in this research. Such pedagogical methods are consistently associated with higher levels of learner engagement, motivation, and the sustained retention of knowledge (Bremner, 2022; Do, 2023). According to Vygotsky (1978) and Bruner (1996), learners build understanding through active involvement and meaningful interaction. Participant 2's observation that learner-centered methods make learning "easier to remember" aligns with Bremner's (2022) view that active engagement promotes critical thinking and deeper comprehension. Similarly, Participant 3's reliance on discussion-based learning in resource-limited classrooms resonates with Do's (2023) claim that a discussion effectively addresses learning disparities in contexts with limited resources.

Although learner-centered methods were generally preferred, participants also recognised the necessity of teacher-led strategies for supporting learners' conceptual development. According to Sun (2023), explicit instruction is vital for establishing foundational understanding before learners participate in inquiry-based learning. This perspective is reflected in the practices of Participants 1, 4, and 6, who indicated that teacher explanations are particularly valuable when introducing challenging content, followed by more involving the learner-centered. The findings therefore endorse a hybrid model in which teacher direction and learner independence work together to enhance teaching outcomes, particularly in resource-constrained educational settings (Bremner, 2022 & Sun, 2023).

The combination of teaching methods observed among participants reflects a strong grasp of pedagogical and content knowledge, aligning with the TPACK framework proposed by Mishra and Koehler (2006). This model emphasises that effective teaching arises when teachers

successfully integrate technological (TK), pedagogical (PK), and content knowledge (CK). The study findings indicate that teachers demonstrate effective PK–CK integration by modifying their instructional approaches according to the complexity of the subject matter and learners' needs. For example, Participant 6 explained that lessons often begin with teacher-centered before shifting to learner-centered as an intentional pedagogical adjustment. Nonetheless, the minimal mention of technology suggests that the technological knowledge component remains underdeveloped. This issue reflects common challenges in South African classrooms, where limited access to digital tools constrains technology use. As Koehler and Mishra (2009) note, comprehensive TPACK integration requires an understanding in how technology usage can enhance both teaching methods and content delivery. Although participants exhibit strong pedagogical and content expertise (PCK), future progress could involve incorporating accessible technological tools—such as mobile phones, offline digital media, or educational simulations—to support learning and address resource limitations.

The findings of this study align with the principles outlined in the Curriculum and Assessment Policy Statement (CAPS) for Natural Sciences and Technology, which advocates for teacher-centered and learner-centered strategies aimed at developing critical thinking and problem-solving abilities (Department of Basic Education, 2011). Participants' focus on learner engagement and collaborative exploration mirrors CAPS's emphasis on positioning learners as active constructors of knowledge. At the same time, the deliberate use of teacher-centred strategy to introduce or explain complex concepts aligns with the policy's call for scaffolding—supporting learners through guided instruction before they undertake independent inquiry. Nevertheless, Participants 3 and 5 pointed out those insufficient resources constrain the implementation of practical investigations, revealing a continuing disparity between policy intentions and classroom realities. This challenge echoes Muthivhi's (2015) observation that resource limitations frequently impede the practical application of learner-centered teaching in South African schools. Furthermore, the administrative and assessment requirements embedded within CAPS may compel teachers to priorities content completion, leading them to rely selectively on teacher-led strategies to manage time effectively.

In conclusion, the findings reveal that teachers use a combination of learner-centered and teacher-centered strategies to facilitate effective teaching of Natural Sciences and Technology. This adaptable practice corresponds with international research as well as the principles of the TPACK and CAPS frameworks, highlighting pedagogical flexibility that responds to contextual realities. Nonetheless, challenges such as inadequate access to technology and limited teaching resources hinder the full implementation of inquiry-based, learner-centered instruction. Enhancing teachers' technological skills and providing sustained professional development and innovative resource support are essential for advancing the transformative aims of science and technology education in South Africa.

5.2.2. Theme 2: Content Knowledge (Content Delivery and Understanding)

Question: Are you satisfied with your content progress and time given in teaching using the strategy/strategies?

Participant 1 *said "I am satisfied with the time given however learners' actively participate during talking than writing, it becomes difficult and time consuming since they have to write using both Sepedi and English. The only thing needed to finish on time is careful planning and the integration of both teacher-centered and learner-centered strategies allows me to push and cover content and helps ensure learners understand key concepts."*

Participant 2 *quoted "yes I am satisfied because I always engage with my learners and use examples that are related to their daily lives. I even use instruments such as drums in case I teach sound to play the drum and let them hear the different sound so that it becomes easy for them when answering, interacting with learners gives me good way forward. I even use demonstrations and group discussions to enhance learners' grasp of abstract scientific ideas, enabling steady progress through the content."*

Participant 3 *maintained "The time given during class are too little, since we are still trying to adjust the new teaching and learning of using two languages. Teaching in Sepedi and English is time-consuming remember if I write what is a drum? I have to as well write moropa ke eng? Learners with learning barriers sometimes don't even finish the activities. Honestly we have no equipment's and materials for these translations of languages sometimes we even use the lend*

words (maadingwa) instead of the Sepedi correct word. We are not given enough materials for these language transition even textbooks are only written in English and I have to do translations on my own. Gradually we are busy and I think we will get there in time."

Participant 4 *said "I normally introduce topic with a live example and it assist me to finish content on time. Explaining in Sepedi and ask them to translate in English and then I assist were necessary. I have been applying both languages since then now is official and makes my work more easier. With me I make sure I finish content on time and with the other rest of the time I do revision to make sure learners understand what I taught them. I am happy with the application of two languages because learners understand more of their language than other, then the time given to write is not enough since I have to write questions with English and Sepedi. I think all will be easier if we had enough materials that written in Sepedi and English, but with time are getting there and I am not complaining."*

Participant 5 *state "since I use learner-centered strategy in most cases, these methods is time-consuming and often prevented from finishing all the required topics, leading to frustration and the need to rush through remaining sections. I sacrifice towards the end of the term trying to cover all the content. The most delaying part of all this is translating languages but it works in my favor since it helps learners understand the content. I am happy because at the end they know what to write as an answer."*

Participant 6 *said "Yes, I am satisfied with my content progress and the time given because I am using both learner-centered and teacher-centered strategies. By combining these strategies, I am able to balance active learner participation with teacher-centered, which helps ensure that learners grasp key concepts effectively. Using both Sepedi and English in my teaching has also improved learners' understanding, as it bridges the language gap and supports comprehension. Although it sometimes takes extra time to translate and explain concepts, I find it worthwhile because learners become more confident and perform better. Overall, the strategies enable me to complete most of the required content while ensuring meaningful learning takes place*."

Discussions

All six participants indicated that they employed a combination of learner-centered and teacher-centered pedagogical strategies when delivering Natural Sciences and Technology in bilingual classrooms (Sepedi and English). Four participants (P1, P2, P5, and P6) frequently adopted learner-centred approaches, such as demonstrations, group discussions, practical activities, and contextual examples, to facilitate learners' conceptual understanding and active participation. For instance, Participant 2 explained the use of a drum to teach sound so that "learners could hear the different sounds, making it easier for them to answer questions." Similarly, Participants 1, 4, and 6 emphasised that lesson planning plays a key role in blending direct instruction with interactive activities to ensure adequate content coverage.

A very serious challenge noted by participants concerned the time implications of bilingual instruction. Teachers reported that the process of translating content and written work into both Sepedi and English often extended lesson duration and occasionally prevented full coverage of the prescribed curriculum (P3, P5). Participant 3 highlighted the shortage of bilingual resources and the additional workload associated with translating English textbooks into Sepedi. Despite these challenges, the majority of participants expressed satisfaction with learner progress, asserting that bilingual instruction enhanced understanding and learner confidence, even though lessons required more time to complete.

During classroom observations, learners interacted with the teacher intermittently, and in some cases, the teacher had to interpret or clarify learners' responses to ensure understanding of the content. This suggests the presence of linguistic or conceptual challenges requiring instructional support. Recent research highlights that scaffolding remains essential in addressing such barriers, particularly in multilingual classrooms. A study by Salani et al. (2025) emphasises that teachers play a crucial role in mediating understanding through guided support, especially when learners struggle to express themselves clearly. Thus, Participants teaching strategy demonstrates responsiveness to learners' needs, although it also reveals the importance of strengthening communication strategies in diverse classroom contexts.

The findings reveal that teachers implemented adaptive hybrid pedagogy, intentionally combining learner-centered and teacher-centered strategies to meet curriculum expectations while addressing the linguistic realities of bilingual classrooms. This practice aligns with constructivist perspectives, which promote active, contextualised, and socially mediated learning for deeper conceptual development (Vygotsky, 1978; Bruner, 1996). The reported use of discussions, demonstrations, and culturally relevant examples corresponds with strategies recognised in the literature as effective in promoting engagement and conceptual change in science education. Nonetheless, teacher concerns regarding time constraints support existing literature that identifies learner-centered methodologies as more time-intensive and demanding of structured planning (Bremner, 2022). Effective implementation, therefore, requires careful management and institutional support to ensure that learner-centered teaching remains sustainable.

In relation to the Technological Pedagogical and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006), participants demonstrated strong integration of content knowledge (CK) and pedagogical knowledge (PK). They adjusted instructional strategies according to both the nature of the content and the bilingual needs of learners through scaffolding, translation, and practical demonstrations. However, the technological component (technological knowledge – TK) appeared limited, as participants made little reference to digital tools, likely due to restricted access to technological resources. Despite this, teachers' creative use of tangible materials, such as musical instruments and real-life examples, exemplifies the TPACK principle of selecting contextually appropriate methods to enhance learning.

The findings also resonate with the Curriculum and Assessment Policy Statement (CAPS) for Natural Sciences and Technology (Department of Basic Education, 2011), which promotes inquiry-driven, learner-centered teaching to foster problem-solving and critical thinking skills. Teachers emphasise demonstrations, collaborative activities, and real-world connections reflects these curriculum principles. However, ongoing challenges—particularly the shortage of translated materials and bilingual textbooks—limit the consistent implementation of CAPS across classrooms and contribute to time pressures during instruction

Analysis of participants' responses indicates that learner-centered approaches dominate in practice, while teacher-centered methods are employed strategically to manage pacing and ensure curriculum completion. Bilingual instruction emerges as a critical contextual factor influencing both strategy selection and lesson timing. Where adequate planning and resources exist (as reported by P4 and P6), teachers are able to complete content and review work effectively. Conversely, where translation demands is high and resources limited (P3, P5), teachers experience delays and increased workload towards the end of each term.

5.2.3. Theme 3: Teaching Environment (Classroom Climate and Culture)

Question: Do you feel encouraged by the participation you get in the teaching environment?

Participant 1 said "*I am not fully natural sciences and technology requires a lot of practical's problem is equipment's, some topics I manage to gather all materials to use were some we do practical's theoretically just that learners are exposed to some of them and it becomes easier. When they know what we are talking about the atmosphere in class becomes interesting when they don't know it forces me to find pictures so I can do a visual learning instead of practices. So that why am saying I don't have full courage."*

Participant 2 answered, "*I feel encouraged because most learners are actively involved during lessons. They respond well to questions and enjoy participating in discussions, especially when I use practical examples or demonstrations. Learning and teaching becomes more interesting and motivates me to continue using learner-centered strategy in most cases."*

Participant 3 respond *"I do feel encouraged because the learners are showing progress and confidence when expressing their ideas in both Sepedi and English. Their willingness to engage makes the lessons more interactive and helps me see that they understand the content better."*

Participant 3 state "*Not always. Sometimes learner participation is very low, especially when lessons are conducted and questions being asked in English only few will understand but the moment I translate the question they actively answer. Some learners hesitate to respond because they are not confident in the language, which makes me feel discouraged. I have to keep motivating them and try starting with Sepedi explanations to increase participation then English will always follow."*

Participant 4 state "*Yes, I am encouraged by the participation I receive, particularly during group work and experiments. Learners enjoy working together and asking questions. Even those who are usually quiet tend to participate more when they work in smaller groups, which show that learner-centered strategy is very useful in my classroom."*

Participant 5 maintained "the *classroom environment is manageable because the learners are not overcrowded. It is easy to point a learner and normally my learner's respect they always ask permission before talking by raising hands."*

Participant 6 *said "the teaching environment is very good though learners exceed 50 in my class but I try by all means to manage them. To keep environment educational at all times I have to always keep them busy with work or questions. The learners are still young they need full attention and care so I give all that so that my teaching and learning environment remains educational and productive on daily bases."*

Discussions

The findings reveal that teachers' feelings of encouragement are closely linked to the interaction between classroom context and learner participation. P2 expressed strong motivation derived from active learner involvement, stating, *"I feel encouraged because most learners are actively involved during lessons. They respond well to questions and enjoy participating in discussions, especially when I use practical examples or demonstrations."* This shows those learner-centred strategies, particularly demonstrations and discussions, foster enthusiasm and engagement, making teaching more fulfilling for educators. According to Mavhunga (2021) and Nkambule and Mukeredzi (2017), teacher morale and participation levels are influenced by class size, resources, and language barriers. Studies confirm that large class sizes reduce opportunities for individual participation and make practical work difficult, while smaller, interactive groups encourage learner engagement and critical thinking.

Similarly, Participant 3 confirmed that bilingual engagement enhances participation, noting, *"I do feel encouraged because the learners are showing progress and confidence when expressing*

their ideas in both Sepedi and English." The use of both languages not only increases learner confidence but also aligns with Probyn (2019), who emphasises the importance of language choice in multilingual classrooms top promote comprehension and interaction. In contrast, other participants highlighted challenges that diminish their sense of encouragement. P1 admitted that, *"I am not fully encouraged... natural sciences and technology require a lot of practical's, the problem is the equipment… some topics we do practically, others theoretically. When they don't know, it forces me to find pictures so I can do visual learning instead of practicals."* Mashiyi (2020) supports this adaptive approach, arguing that visuals and locally available materials can effectively substitute for experiments when resources are limited. Language barriers also emerged as a discouraging factor. Another P 3 reported that*, "Not always. Sometimes learner participation is very low, especially when lessons are conducted and questions being asked in English… the moment I translate the question they actively answer."* This shows that learner confidence and participation are deeply affected by language proficiency, reinforcing Probyn's (2019) finding that bilingual instruction enhances engagement and inclusivity. Despite challenges, some participants maintained positive perceptions of their classroom environments.

P 4 stated that, *"Yes, I am encouraged by the participation I receive, particularly during group work and experiments. Learners enjoy working together and asking questions."* Likewise, P5 noted that, *"the classroom environment is manageable because the learners are not overcrowded. It is easy to point a learner, and normally, my learners respect and raise their hands before talking."* These responses highlight that smaller class sizes, structured routines, and collaborative learning contribute to positive classroom climates, as supported by Nkambule and Mukeredzi (2017), who found that manageable class sizes and mutual respect enhance teacher morale and participation. On the other hand, P6 described the difficulties of managing a large class of over 50 learners yet still maintained an optimistic outlook. This reflects teacher's resilience and commitment to maintaining an effective learning environment despite overcrowding; a challenge also noted by Mavhunga (2021) as a factor that reduces individual participation opportunities. This situation often results in a more teacher-centered approach, where management and control are necessary to sustain engagement.

Observation revealed that learners participated actively in classroom activities; however, some of their written responses were incorrect. This suggests that although learners were engaged, there were gaps in conceptual understanding. Recent studies indicate that active participation must be supported by effective feedback to ensure accurate teaching. Ngcobo and Mulaudzi (2025) argue that constructivist classrooms should address learner misconceptions through continuous assessment and corrective feedback. Therefore, while Participants fostered a participatory environment, the findings suggest a need for improved formative assessment practices to enhance learners' accuracy and conceptual clarity together with a productive teaching environment.

The Technological Pedagogical Content Knowledge (TPACK) framework, proposed by Mishra and Koehler (2006) provides an analytical lens for understanding these adaptive teaching strategies. Teachers like P1 demonstrated Technological Pedagogical Knowledge (TPK) by using "pictures" and "visual learning" as compensatory tools when laboratory materials were unavailable. This integration of technology and pedagogy reflects contextual awareness, where teachers modify instruction to sustain engagement despite limited resources. Similarly, the use of bilingual explanations by P3 and 4 aligns with TPACK contextual dimension, as they tailor their teaching to meet learner's linguistic needs. The Curriculum and Assessment Policy Statement (CAPS) for Natural Sciences and Technology (Department of Basic Education, 2011) emphasises learner-centered approaches, practical investigation, and discussion-based learning. However, as P1's experience illustrates, the implementation of these expectations is often hindered by equipment shortages. Even so, teachers continue to adhere to the spirit of CAPS by adapting through visual demonstrations, bilingual instruction, and group activities actions that reflect both learner-centred and teacher-centred strategies, depending on the context and resource availability. This adaptation partially fulfills CAPS objectives of inclusivity, experimentation, and learner engagement. Moreover, the CAPS document underscores inclusivity and linguistic accessibility in learning. Teacher use of bilingual explanations (Sepedi and English) aligns with this requirement, ensuring that all learners, regardless of language proficiency, can participate meaningfully in learning activities.

5.2.4. Theme 4: Assessment

Question: What aspects or assessments of natural sciences and technology do you find most enjoyable and how do you assess them?

Participant 1 state ***"****I enjoy conducting practical investigations and experiments as forms of assessments. I also give classwork's and homework's in order to assess their individual knowledge because some may participate in groups and some may not. My learners participate more actively when they are required to elaborate their understanding through hands-on activities. I usually assess them using rubrics that measure their observation, data recording, and interpretation skills. I believe that learners show more interest and creativity when the assessment involves real-life examples of scientific concepts. Through these practical assessments, I can clearly see how well learners understand and apply what they have learned."*

Participant 2 Express *"I enjoy teamwork when it comes to assessing; learners sometimes understand each other's explanation than mine. I normally give different assessment such as class and homework, project-based assessments which they form groups and discuss with me interfering and assisting was necessary because they promote collaboration and problem-solving among learners. During projects, learners work together to research and find answers as such, it which helps them develop teamwork and communication skills. There are class test that I normally prepare them for final term test which is common from the district."*

Participant 3 Express *"I find written tests and formal assessments challenging, especially because many of my learners struggle with writing and language barriers. Most of them understand the content during practical lessons, but they find it difficult to express themselves in writing, especially when they must use both English and Sepedi. Because of this, I often feel that written assessments do not accurately reflect my learners' true understanding or abilities. I prefer more practical and interactive assessments that give learners a chance to demonstrate their knowledge through doing rather than writing and they do excel. In this way it helps a lot and improves during formal assessments."*

Participant 4 State *"I enjoy using continuous assessments such as quizzes, worksheets, and class discussions. These activities keep learners engaged and help me track their progress over time. I also use peer assessment and self-assessment, which allow learners to reflect on their learning and take responsibility for their progress. I believe that these assessment methods make learning more interactive and enjoyable for both me and my learners, while also helping them to identify their strengths and areas for improvement."*

Participant 5 Maintain *"I often feel frustrated with the formal assessments set by the department because they are too rigid and do not cater to the diverse abilities of my learners. These assessments tend to focus more on memorization than true understanding, which I find discouraging. I prefer using informal assessments such as group experiments, class observations, and oral questioning. These methods allow me to see what my learners actually understand and can do, rather than just what they can remember for a test. Furthermore at the end of each term formal assessments must be administered so that most learners are fully prepared. "*

Participant 6 Express *"I enjoy integrated assessments that combine concepts from both Natural Sciences and Technology. For instance, I once asked my learners to design simple instruments after studying sounds. I assessed those using rubrics, observation notes, and peer evaluations. I find this approach engaging because it allows learners to apply their knowledge creatively and see how science and technology connect to everyday life. Formal and informal assessments make learning more meaningful and encourage learners to think critically and innovative; that's why I often give them classwork, homework's, group discussions, worksheet etc. and at the end of the term formal practical and test will be administered."*

Discussions

The findings under Theme 4 reveal that participants employ different assessment strategies in Natural Sciences and Technology classrooms, reflecting both positive and negative perceptions toward current assessment practices. Most participants (P1, P2, P4, and P6) expressed enjoyment in using practical, practical, and continuous assessments, while others (P3 and P5) voiced concern over the rigidity and linguistic challenges of formal assessments. These

experiences align with recent educational literature, which emphasises that assessment in science education should be authentic, learner-centered, and reflective of learners' conceptual understanding rather than rote memorisation (Black & Wiliam, 2023; Ngwenya, 2022). P1 highlighted the use of practical investigations and experiments as effective assessment tools, noting that they engage learners and provide tangible evidence of scientific understanding. This view is supported by Mabaso and Mthethwa (2023), who argue that practical assessments promote inquiry-based learning and enhance learners' problem-solving abilities. Similarly, P 2's emphasis on teamwork and project-based assessment aligns with Vygotskian social constructivist principles, (Vygotsky, 1978; Chikasha & Dube, 2021), again reinforcing the learner-centered strategy.

P6's preference for integrated assessments combining Natural Sciences and Technology is closely aligned with the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). As such, it also demonstrates a learner-centered level of phenomenon, as learners create artifacts and apply knowledge to real-life contexts. Conversely, P3 and P5's frustration with rigid, summative assessments illustrates a teacher-centred phenomenon, where standardised procedures and curriculum demands dominate instructional control. According to Jansen and Taylor (2020), such conditions limit teacher'x flexibility to assess understanding meaningfully.

During observation, learners in classrooms were highly active and demonstrated strong knowledge of the subject matter, confidently responding to the teacher's questions during feedback. In addition to participation, the teacher incorporated assessment practices by continuously questioning learners to gauge their understanding. This form of informal formative assessment enabled the teacher to monitor progress and provide immediate feedback. Recent research highlights that ongoing assessment is critical in enhancing learner achievement, as it informs instructional decisions and supports teaching and learning progression. Ramírez-Montoya et al. (2025) emphasise that integrating assessment into daily teaching promotes deeper cognitive engagement and knowledge retention.

TPACK emphasises the integration of technology, pedagogy, and content knowledge to design meaningful learning experiences. The participants' example of learners designing simple instruments after studying sound reflects the intersection of content knowledge (scientific concepts of sound), technological knowledge (design and construction of instruments), and pedagogical knowledge (learner-centered project-based instruction). According to Koehler et al. (2021), such integrative assessments promote critical thinking and creativity by connecting theoretical learning with practical applications, a key principle also underscored in the CAPS document, which encourages the integration of Science and Technology to develop learners' problem-solving and innovation skills. However, challenges such as limited resources, linguistic barriers, and rigid departmental testing systems continue to hinder the full implementation of flexible and contextualised assessment strategies. Recent studies (Nkosi & Maphalala, 2023; Reddy, 2022) recommend ongoing teacher development in assessment literacy and TPACK integration to help educators design assessments that are not only curriculum-aligned but also inclusive and technologically adaptive.

These practices also reflect the CAPS (Curriculum and Assessment Policy Statement) mandate, which requires educators to assess learners through a range of formal and informal activities, including practical investigations, projects, and written tasks CAPS (2011). P3 raised concerns regarding the challenges posed by written and language-based assessments, particularly in bilingual classrooms. This challenge is supported by Mahlangu (2022), who notes that multilingual learners in South African classrooms often struggle to express scientific concepts in English despite demonstrating strong conceptual understanding during practical work. In this context, practical and oral assessments, as preferred by P3, become essential in ensuring equitable evaluation and authentic measurement of understanding. P4's use of continuous, peer, and self-assessment reflects a formative assessment approach that fosters learner autonomy and metacognitive awareness. According to Heritage (2021), formative assessment enhances learning when learners are actively involved in reflecting on their progress.

Similarly, CAPS supports the use of continuous assessment to monitor learners' development and provide timely feedback throughout the learning process. Participant 5's criticism of

departmental formal assessments highlights a disconnection between policy-driven summative assessments and classroom realities, a challenge also discussed by Jansen and Taylor (2020), who argue that standardised assessments often fail to accommodate learners' diverse learning needs and contextual factors.

5.2.5. Theme 5: Learner engagement and inclusion

Question: Do you think that the teaching strategies cater to different ways of learning and teaching?

Participant 1 said *"Yes, my teaching strategies accommodate different learning styles. I use a variety of methods such as group discussions, visual demonstrations, and experiments to help both visual and kinesthetic learners understand the content better. Learners differ a lot sometimes I do peer learning to accommodate those who are scared to ask in class or those who don't interact with me at all."*

Participant 2 expressed *"I believe they do to some extent. I combine teacher-centred and learner-centred strategies so that all learners can benefit, but due to limited resources, I cannot always meet every learner's needs fully. Pairing them in groups cater different learning styles because others will be learning from their mates."*

Participant 3 state *"Not really. My lessons often end up being teacher-centred because of time pressure and large class sizes. It becomes difficult to adapt to every learner's learning style, especially those who need extra attention."*

Participant 4 maintained *"Yes, I make sure my teaching caters for different ways of learning. For example, I use storytelling, pictures, and experiments to make lessons more inclusive. This approach helps learners with different strengths to participate and understand better."*

Participant 5 said *"Partially. I try to integrate diverse strategies like peer learning and questioning techniques, but sometimes it's hard to cater for slow learners while keeping up with the syllabus pace. I cover all the content and prepare them with group discussions and class discussions using real examples. "*

Participant 6 maintain "*No, I don't think my strategies fully cater to different learning styles. The curriculum demands and lack of teaching materials make it challenging to differentiate instruction effectively, especially for learners who need more support. I try by all means to cater all learners and ensure they understand the content as needed."*

Discussion

The findings from participants indicate varied experiences in catering to diverse learning styles and teaching approaches. Four participants (1, 2, 4, and 5) reported using a range of styles such as group discussions, storytelling, visual demonstrations, and experiments, to accommodate visual, auditory, and kinesthetic learners. These participants also incorporated peer learning to assist learners who are less confident or prefer collaborative interaction. These reflect a learner-centered level of phenomenon because the focus is on adapting instruction to learners' needs and promoting active participation. In contrast, two participants (3 and 6) expressed that time constraints and limited resources often force them to adopt teacher-centered approaches, limiting their ability to differentiate instruction effectively. This reveals a teacher-centred level of phenomenon, where instructional control remains with the teacher.

Sepadi (2025) found that in South African mainstream classrooms, teachers conceptually support inclusive education but remain constrained by curriculum demands and insufficient resources. This reflects the experiences of Participants 3 and 6, who struggle to accommodate learners' diverse needs despite good intentions. Ramaila (2025) and Ituma (2025) argue that differentiated instruction enhances participation by addressing learner diversity, a hallmark of learner-centred pedagogy. The importance of differentiated instruction (DI) for learner engagement and inclusion is well established. Ramaila (2025) emphasises that DI enhances learner participation and performance by addressing varied readiness levels, interests, and learning profiles. Similarly, Ituma (2025) links differentiated instruction to culturally responsive teaching, arguing that it allows teachers to value learners' backgrounds and learning differences while promoting equity. Participants 1, 2, 4, and 5 demonstrate this alignment by applying varied instructional methods that encourage participation and accommodate diverse learning preferences. However, as these authors highlight, consistent implementation of differentiated

instruction depends on adequate professional development and institutional support, which are still lacking in many South African schools.

During observations, learners were active and played a supportive role in assisting the teacher during lesson transitions, particularly with language-related challenges. This reflects a high level of learner engagement and an inclusive classroom environment where learners contribute meaningfully to the teaching process. The teacher's openness to learner support suggests an inclusive approach that values linguistic diversity and encourages participation from all learners. Recent studies indicate that inclusive practices enhance learner engagement by recognising and utilising learners' diverse backgrounds and abilities. Kerimbayev et al. (2025) stated that an interactive environment promotes collaboration and active involvement.

The Technological Pedagogical and Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) offers valuable insight into these findings. The framework posits that effective teaching results from the dynamic interaction of CK, PK, and TK. In this study, teachers' challenges and practices reflect gaps particularly in TPK and TCK, where technology is not sufficiently used to support pedagogy or enhance understanding of natural sciences and technology concepts. Chai et al. (2024) similarly found that, while teachers acknowledge the importance of integrating technology into teaching, many lack the readiness or resources to apply it meaningfully. This mirrors the participants' experiences, where meaningful technology integration remains limited due to resource scarcity and inadequate training. Strengthening teachers' TPACK would enable them to design more inclusive and differentiated lessons—for instance, using visual simulations to support visual learners or interactive digital tools to engage kinesthetic learners.

The Curriculum and Assessment Policy Statement (CAPS) and (Department of Basic Education, 2011) emphasises learner-centered education, inclusivity, and active participation. This learner-centered emphasis indicates that CAPS positions learners at the core of the teaching and learning process by prioritizing their needs, abilities, and levels of engagement. The reference to inclusivity reinforces this focus, as the policy requires teachers to accommodate diverse learning needs, including learners with barriers, to ensure equitable participation. Furthermore, the emphasis on active participation highlights CAPS' expectation that learners should construct

knowledge through involvement in meaningful learning activities rather than relying solely on teacher-directed instruction. CAPS encourage teachers to use varied teaching methods, such as experiments, group discussions, and problem-solving tasks to accommodate different learning styles and support learners with barriers. The participant responses partially align with these principles. Teachers who use visual aids, storytelling, and group work demonstrate efforts to implement CAPS' inclusive vision. However, those constrained by time, curriculum pressure, and inadequate resources reflect the gap between policy intention and classroom reality (Sepadi 2025).

The findings show that, while teachers are aware of the need to accommodate diverse learning styles and adopt inclusive strategies; their ability to do so is heavily influenced by contextual factors such as class size, resource availability, and time pressure. Recent literature reinforces the benefits of differentiated and culturally responsive instruction for learner engagement and inclusion (Ramaila, 2025; Ituma, 2025). The TPACK framework underscores the need for balanced integration of content, pedagogy, and technology to enhance inclusivity, while CAPS provides a clear mandate for differentiated, learner-centred teaching. Bridging the gap between policy and practice requires ongoing professional development for teachers, improved access to technology, and institutional support to empower educators to fully implement inclusive, multimodal teaching strategies.

5.2.6. Theme 6: Teacher Support and Professional Development

Question: Do you feel comfortable and supported in the classroom with the applied teaching strategy/strategies and resources?

Participant 1 states *"I feel comfortable using the applied teaching strategies because they help me reach learners with different abilities. The school provides sufficient support and encourages collaboration among teachers. I often receive guidance from senior educators, which boosts my confidence. The only problem is the resources provided make lesson delivery hard since they only written in English. I believe professional development workshops have improved my teaching though I still need to put more effort. Overall, I feel well-supported in my teaching environment except materials still lacks."*

Participant 2 express *"Yes, I feel well-supported in implementing the teaching strategies in my classroom using two languages helps with understanding though translating require more effort and time. The training sessions we attend have enhanced my confidence and knowledge of effective teaching methods. The school management also ensures that we have the necessary resources though they are not enough. My colleagues are always willing to share ideas on how to translate some words in Sepedi. This collaboration makes teaching more enjoyable and productive. I feel empowered to handle different learning situations effectively."*

Participant 3 says *"I sometimes feel uncomfortable with the applied teaching strategies because I do not always receive enough supporting materials. The resources are limited, making it difficult to implement practical activities in natural sciences and technology. Although I try to adapt, the lack of materials and follow-up training affects my confidence. I feel that more guidance is needed from the subject leadership. It becomes challenging to maintain learner engagement with inadequate support. Overall, I feel that teacher development programs should be improved."*

Participant 4 express *"I feel confident and supported when using the teaching strategies in my classroom. The workshops and training sessions we attend provide clear guidance on how to apply learner-centered the new model of teaching. My colleagues also assist me when I face challenges and I also seek help with colleagues from other schools, which creates a strong sense of teamwork. There is no enough availability of teaching aids makes lesson delivery more challenging. I can see positive changes in learners' participation and understanding in applying bilingual. This motivates me to continue improving my practice."*

Participant 5 state *"Yes, I feel comfortable using the teaching strategies because of the continuous support from the school management. The professional development programmes help me stay updated with new methods and technologies. I don't have access to various teaching resources with both languages that can make lessons more interactive. I make collaboration with colleagues to also enhance my lesson planning skills. The support I receive encourages me to try innovative approaches."*

Participant 6 express *"I feel supported and encouraged to apply different teaching strategies in my classroom. I normally provide worksheets that make learning more practical and engaging. Professional development workshops have helped me strengthen my teaching techniques. Whenever I face challenges, I can seek assistance from colleagues. This support system makes me feel confident and motivated to teach effectively. I believe that if subject leaders can provide continuous training it will contribute to better learning and teaching outcomes."*

DISCUSSIONS

Teachers generally expressed that they feel supported in implementing the applied teaching strategies, though challenges remain regarding insufficient resources and language barriers. Most participants (1, 2, 4, 5, and 6) reported positive experiences with professional development workshops, collaboration among colleagues, and guidance from senior educators. These reflections represent a learner-centered approach because teachers demonstrate continuous learning, adaptability, and a commitment to learner engagement. However, Participant 3 expressed discomfort due to limited support materials and a lack of continuous guidance from subject leaders. Several teachers indicated that teaching materials written only in English limit effective lesson delivery in multilingual classrooms. Nonetheless, bilingual approaches, particularly translating into Sepedi, were mentioned as beneficial for improving learner understanding. The teachers highlighted the value of collaboration, school-based support, and workshops, but stressed the need for ongoing professional development and contextualised resources to align with curriculum demands. Teacher emphasis on collaboration and sharing of ideas indicates that professional learning communities' plays a crucial role in the strengthening of teacher capacity. Shambare (2024) found that continuous, collaborative professional development enhances teachers' self-efficacy and classroom innovation. The participants' appreciation of teamwork reflects this, as most rely on colleague support to overcome resource and translation challenges. Participant 4 highlighted cross-school collaboration, showing how collective engagement reinforces pedagogical knowledge and confidence. Language emerged as a central issue. The reliance on English-only materials limits accessibility for learners who use African languages as their home language. Olawale (2024) and Hendricks (2024) both emphasise that bilingual and translanguaging pedagogies enhance

content comprehension and learner participation in South African classrooms. Participants' reports of translating lessons into Sepedi correspond with these findings.

The observation of Participants indicated that learners were active and consistently engaged in answering the teacher's questions, reflecting a dynamic classroom environment. However, sustaining such engagement requires ongoing teacher support and professional development to enhance instructional strategies. Recent research highlights that continuous professional development enables teachers to adopt effective teaching methods that improve learner participation and outcomes. Khalid et al. (2023) emphasise that teacher training in constructivist approaches strengthens classroom interaction and learner engagement. Furthermore, institutional support for teachers is essential in maintaining high-quality instruction. Therefore, while classroom demonstrates effective engagement, ongoing teacher support and professional development remain critical for sustaining and improving teaching practices.

The finding suggests that, while teachers are comfortable with applied teaching strategies, adequate support and contextualised resources remain key determinants of success. These results align with the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasises the intersection of technological, pedagogical, and content knowledge as essential for effective classroom practice (Mishra & Koehler, 2006). According to Petko (2025), teachers' ability for knowledge integration domains within local contexts directly affects classroom confidence and learner engagement. In this study, participants demonstrated strong pedagogical and content knowledge; however, the limited availability of teaching materials and technological tools constrained their full integration of TPACK components.

Nevertheless, the lack of practical materials and follow-up training as identified by Participant 3 demonstrates gap between policy intentions and classroom realities. CAPS require teachers to conduct hands-on practical activities in Natural Sciences and Technology to develop scientific inquiry and problem-solving skills. Without adequate resources, teachers resort to theoretical demonstrations, reducing the experiential quality of learning. Hendricks (2024) argues that resource constraints undermine curriculum alignment, as teachers cannot fully meet

assessment standards specified in CAPS. Similarly, Petko (2025) asserts that TPACK-based training must include strategies for adapting low-resource contexts, using locally available materials and digital simulations to sustain active learning.

This practice aligns with CAPS policy, which recognises the importance of learners accessing content knowledge in a language they understand. CAPS advocates for differentiated instruction and equitable access to learning opportunities across diverse linguistic contexts (Department of Basic Education [DBE], 2011). Participants acknowledged that workshops increased their confidence, yet many desired continuous, context-based PD rather than occasional sessions. Research supports this concern: Shambare (2024) and Petko (2025) found that sustained, practice, and feedback are more effective than one-time workshops. Furthermore, Hendricks (2024) highlights that ongoing mentoring and follow-up visits are critical for ensuring that new teaching strategies are successfully integrated into practice. This aligns with TPACK's recommendation that subject management ought to focus not only on isolated technology or pedagogy, but on the integration of all knowledge domains through classroom application.

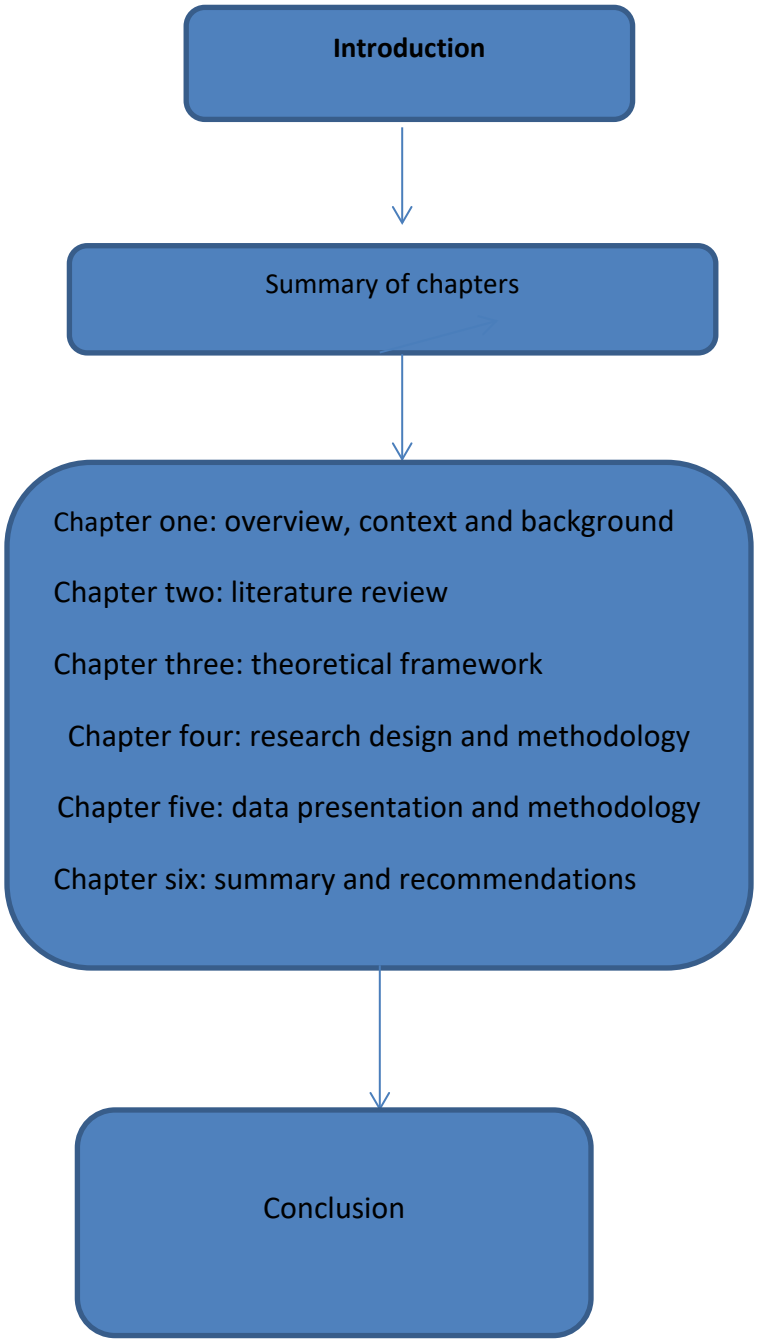
Conclusion

This chapter presented and discussed the findings of the study, organised into six major themes aligned with the research questions and supported by participant responses, CAPS principles, and relevant literature. The findings collectively demonstrate how teaching strategies, teacher knowledge, and contextual factors influence the implementation of Natural Sciences and Technology in the Intermediate Phase Grade Four.

CHAPTER 6

SUMMARY, RECOMMENDATIONS AND CONCLUSION

Figure 8: Chapter 6 (flow chat)



6.1. Introduction

The previous chapter provided the reader with the presentation of data and discussion of the research findings generated using interviews and reflective activity. This chapter provides an overall synthesis of the study by summarising the key insights from Chapters 1 to 5. It revisits the research purpose, methods, and major findings, and demonstrates how each chapter contributed to answering the research questions. The chapter also presents recommendations based on the empirical findings, focusing on learner-centred, teacher-centred, and content-centred teaching strategies. The chapter concludes by highlighting the implications of the study and areas for future research.

6.2. Summary of the Study

6.2.1. Chapter 1: Overview, Context and Background

Chapter 1 introduced the study by outlining the background and motivation for exploring teaching strategies in Natural Sciences and Technology classrooms within the South African context. It highlighted challenges such as limited resources, curriculum demands (CAPS), and diverse learner needs. The research problem, purpose, objectives, and key questions were presented. The chapter also explained the significance of the study in promoting effective instructional strategies that enhance learner participation and content understanding. In addition, the chapter presented a summary of methodology adopted for this study, which includes, paradigm, research approach, design and sampling and also the data-generation methods, data analysis, trustworthiness, ethics issues and limitations of the study. Lastly, Chapter 1 provided the reader with the summary of chapters found in this research study.

6.2.2. Chapter 2: Literature Review

Chapter 2 reviewed national and international literature on learner-centred, teacher-centred, and content-centred teaching strategies. It emphasised how effective teaching requires flexibility, PCK, and the ability to integrate strategies for inclusive learning. The chapter showed that learner participation, resource availability, classroom climate, and teacher competencies influence teaching outcomes. The literature further demonstrated the value of mixed instructional approaches in improving comprehension, motivation, and academic performance.

6.2.3. Chapter 3: Curriculum Issues and Theoretical Framework

The chapter introduces and explains the theoretical frameworks selected for the study, namely the Technological Pedagogical and Content Knowledge (TPACK) framework. The study demonstrated pedagogical and content knowledge supports more effective teaching strategies. The chapter argued that teaching strategies must align with both curriculum demands and contextual realities.

6.2.4. Chapter 4: Research Design and Methodology

Chapter 4 described the qualitative research design adopted for the study. It explained the sampling approach, data collection methods (mainly interviews), and thematic analysis used to interpret findings. The chapter addressed issues of trustworthiness, ethical considerations, and limitations such as dependence on self-reported data and limited time. The methodology ensured that the lived experiences of teachers formed the foundation for the study's findings.

6.2.5. Chapter 5: Data Presentation and Analysis

Chapter 5 presented and discussed findings that emerged from the participants' responses. Six major themes were identified: Teaching strategies, Curriculum coverage, Teaching environment, Assessment, Learner engagement and inclusion, and Teacher support and professional development. The analysis showed that, while teachers value learner-centred approaches, challenges such as limited resources, language barriers, and curriculum pressure often lead them to combine learner-centered and teacher-centered. Participants emphasised the need for better support, training, and materials to improve lesson delivery.

6.3. Summary and Recommendations

6.3.1. Teaching strategies

The findings revealed that Grade Four Natural Sciences and Technology teachers relied on a combination of learner-centred and teacher-centred strategies depending on lesson complexity, time availability, and available resources. Teachers frequently described using group work, demonstrations, questioning techniques, and limited practical activities to support learners' understanding of basic scientific concepts. These findings are consistent with Darling-Hammond et al. (2020), who argue that effective teaching requires flexible instructional approaches that respond to contextual classroom conditions. The findings further highlight that most teachers recognised the value of active participation and hands-on exploration,

particularly for learners who grasp concepts more effectively through experiential learning rather than passive listening. However, challenges emerged when teachers attempted to implement these strategies consistently. Teachers identified large class sizes, insufficient resources, time constraints, and overcrowded classrooms as key barriers to effective strategy implementation. Similarly, Schweisfurth (2019) found that while learner-centred approaches are widely promoted, their implementation is often constrained by contextual realities in developing education systems. As a result, teachers frequently reverted to teacher-centred strategies such as whole-class explanations, which limited opportunities for learner exploration and collaborative learning.

The study recommends that teachers should receive targeted training on practical, low-cost learner-centred methods suitable for large classes, such as rotational group stations, peer-assisted learning, and structured cooperative tasks. Schools can support this by creating resource banks with simple, reusable materials for demonstrations and experiments. Furthermore, time management workshops may assist teachers in balancing team teaching with curriculum demands. Collaborative planning among teachers can also help generate shared lesson ideas and reduce workload. The Department of Basic Education (DBE) should increase provision of essential science materials and encourage project-based learning models aligned with CAPS. Lastly, mentorship programmes led by experienced science educators can help teachers refine methods and build confidence.

6.3.2. Curriculum coverage

The findings showed that curriculum coverage remained a major concern in Grade Four classrooms. Teachers reported pressure to progress through the CAPS curriculum within tight time frames, leading them to prioritise syllabus completion over depth of understanding. Teachers further explained that they often rushed through topics, especially those requiring practical demonstrations or extended inquiry, to ensure they finish the work schedule prescribed by the district. Challenges affecting curriculum coverage included absenteeism, slow learners, and lack of teaching resources, and administrative duties that consumed teaching time. Teachers struggled to balance pacing with learner comprehension, and many felt that the curriculum was done for Grade Four learners and language translation. Consequently,

curriculum coverage was sometimes achieved superficially, compromising conceptual mastery (UNESCO, 2023).

To improve curriculum coverage, the study therefore recommends that teachers can adopt pacing guides that break CAPS content into manageable weekly goals while still allowing space for reinforcement activities. Differentiated instruction strategies, such as simplified worksheets and scaffold tasks, can support slow learners without delaying the entire class. Schools should minimise unnecessary administrative duties during teaching time to protect lesson hours. Strengthening attendance monitoring and intervention strategies can reduce absentee-related delays. Regular curriculum review meetings among teachers may help identify difficult topics and jointly plan faster, more effective delivery methods. The Department of Basic Education should consider adjusting content load for Grade Four to ease the translation of languages during teaching. Finally, providing additional learning support classes or remedial sessions can help learners catch up without compromising overall coverage (DBE, 2022).

6.3.3. Teaching Environment

6.3.4. Assessment

The findings showed that teachers used a combination of formal and informal assessments to evaluate learner progress. These included classwork, homework, practical tasks, oral questioning, and projects. Many teachers expressed that assessment helped them monitor understanding and identify learners needing additional support. Teachers also acknowledged the importance of aligning assessment with CAPS requirements, while ensuring that activities were age-appropriate for Grade Four learners. Despite this, challenges related to assessment were evident. Teachers struggled with marking loads, particularly in large classes, which limited their ability to provide timely and detailed feedback. Practical assessments were also difficult to implement due to lack of resources and time constraints. Some teachers felt that learners did not fully grasp assessment instructions, especially when tasks involved higher-order skills (Black & Wiliam, 2023).

To improve assessment challenges, the study therefore recommend that it be reduced by using a variety of quick, formative techniques such as exit tickets, peer assessment, and observation checklists to monitor learning without adding heavy marking loads. Teachers can develop

rubrics that simplify marking while ensuring CAPS alignment. Schools should schedule dedicated assessment moderation meetings to help teachers streamline tasks and share best practices. Digital tools, where available, can support faster marking and record keeping. Training in designing clear, learner friendly tasks can address misunderstandings of instructions. Where practical assessments are difficult, teachers can use demonstration-based tasks or simplified experiments that still assess core competencies. Time allocation for assessment-related duties should be improved to reduce teacher overload (Andrade & Brookhart, 2023).

6.3.5. Learner engagement and inclusion

The findings demonstrated that learner engagement varied significantly across classrooms. Teachers observed that learners were generally more engaged during practical, hands-on, or group-based activities. Many learners showed enthusiasm for experiments, demonstrations, and interactive discussions. Teachers also attempted to adapt activities for learners with different learning styles to promote inclusion. However, maintaining consistent engagement proved challenging. Learners often became disengaged during teacher-centered lessons or when resources were lacking. Inclusion was also affected by class size; teachers found it difficult to give individual attention to struggling learners. Some learners faced language barriers, making it difficult to understand scientific terminology.

To improve engagement and inclusion, the study states that teachers can incorporate more hands-on activities, even using improvised or low-cost materials, as these consistently stimulate interest (Darling-Hammond et al., 2021). Strategies such as group rotations and interactive questioning help ensure participation from all learners. Differentiated instruction—using visual aids, simplified texts, or multi-level tasks—can accommodate diverse learning needs. Language support tools, including vocabulary lists and bilingual explanations, can assist learners struggling with terminology. Peer support strategies, such as assigning buddies, can further promote inclusion. Clear routines and engaging lesson starters help maintain learner focus, while reducing extended teacher talk and increasing active learning time improves concentration. Creating a classroom environment where all contributions are valued also supports sustained engagement (UNESCO, 2023).

6.3.6. Teacher Support and Professional Development

The findings indicated that teachers valued professional development and expressed a strong desire for continuous support in teaching Natural Sciences and Technology. Many participants benefited from workshops, subject meetings, and collaborative planning opportunities that enhanced their skills and confidence. Teachers emphasised that effective support improved their understanding of content, teaching approaches, and assessment practices. Nevertheless, challenges emerged regarding the availability and relevance of professional development. Several teachers reported irregular training sessions, limited follow-up support, and workshops that focused more on policy than practical classroom application. Others felt isolated due to insufficient mentorship or lack of subject advisors' visits.

Strengthening teacher support and professional development, the study indicates that it requires more frequent, subject-specific workshops that focus on practical classroom application rather than policy recitation (Darling-Hammond et al., 2021).Mentorship programmes led by experienced Natural Sciences and Technology teachers can provide hands-on guidance. Schools should promote professional learning communities I which teachers collaboratively plan lessons, analyse challenges, and share resources. Regular school visits and follow-up sessions by subject advisors can ensure sustained support. Providing digital platforms or WhatsApp groups for resource sharing enables continuous communication. The Department of Basic Education and districts should prioritise equipping schools with necessary science materials and offering training on their use. Teachers can also benefit from short online courses to build content knowledge. Encouraging reflective practice through journals or peer observations helps teachers continually improve. Overall, sustained, targeted support improves confidence and instructional quality.

6.4. Addressing the main research question

The study was guided by the main research question: What are the teaching strategies used by grade four natural sciences and technology teachers in public schools? Followed by the following Sub-questions: What support is needed to explore the development of teaching strategies among Grade Four Natural Sciences and Technology teachers? How are teaching strategies applied by Grade Four teachers when teaching Natural Sciences and Technology?

Why do teachers use particular strategies in the ways that they do during Natural Sciences and Technology lessons? These questions were aligned with the study's objectives, which were to explore teaching strategies used by Grade Four teachers, to understand the types of support Grade Four teachers require to strengthen their teaching strategies, to identify how various strategies are implemented in the teaching of Natural Sciences and Technology, and to explore the reasons behind teachers' choices and use of specific strategies.

6.4.1. Teaching strategies used by Grade Four Natural Sciences and Technology teachers

The findings revealed that teachers employed a variety of teaching strategies in their classrooms, the teacher-centered and learner-centered strategies. Many teachers explained that they relied on direct instruction methods such as explanation, chalk-and-talk, and textbook use, and structured questioning. These strategies were mainly used to introduce new concepts and to ensure that learners grasped foundational knowledge. Teachers indicated that teacher-centered assisted them in maintaining classroom control and managing time effectively. Although teacher-centred practices were predominant, teachers also reported using learner-centred strategies. These included group discussions, simple demonstrations, and the integration of learners' everyday experiences into lessons. However, the interviews showed that learner-centered activities were often limited in scope and tightly guided by the teacher. Learners were given opportunities to participate, but decision-making and lesson direction largely remained with the teacher. These findings demonstrate that teachers adopted a blended approach to teaching, although teacher-centered strategies dominated classroom practice. This outcome confirms that the first research objective, which sought to identify the teaching strategies used by Grade Four Natural Sciences and Technology teachers, was successfully met. The continued reliance on teacher-centered approaches is supported by research suggesting that structured, explicit instruction remains effective for building foundational knowledge, particularly in resource-constrained classrooms (Kirschner & Hendrick, 2023). At the same time, scholars argue that learner-centered approaches are essential for promoting critical thinking and active engagement, but their success depends on careful scaffolding.

6.4.2. Support required developing and strengthening teaching strategies

The findings indicate that from the interviews was the need for continuous is professional support. Teachers expressed the need for regular training opportunities that focus on Natural Sciences and Technology content as well as practical classroom strategies. Participants reported that such training would improve their confidence in implementing learner-centred strategies, particularly practical and investigative activities. Similar concerns have been highlighted in research showing that ongoing, content-focused professional development is essential for strengthening pedagogical competence and classroom innovation (Opfer & Pedder, 2022).Another key issue raised by teachers was the shortage of teaching and learning resources. Many participants indicated that limited access to scientific equipment, teaching aids, and technological resources constrained their ability to conduct hands-on activities. Consequently, teachers reported relying more heavily on teacher-centered strategies that require minimal resources (Desimone & Garet, 2021). Support from school management and subject advisors also emerged as an important requirement. Teachers indicated that guidance, monitoring, and mentoring would help them improve their instructional practices. These findings confirm that the objective of identifying the support needs of teachers was achieved.

6.4.3. Application of teaching strategies in the classroom

The findings showed that teaching strategies were applied in structured ways throughout lessons. Teachers reported that teacher-centred were commonly used during lesson introductions and when explaining new content. These phases were dominated by verbal explanations and guided questioning. Learner-centred strategies were mainly applied during follow-up activities aimed at reinforcing learning. Teachers described organising learners into groups, facilitating discussions, and assigning worksheets. However, interview data revealed that these activities were closely supervised, with limited opportunities for independent exploration. Practical activities were often demonstrated by teachers rather than carried out by learners. Assessment practices further influenced the application of teaching strategies. Teachers indicated that written tasks and oral questioning were the primary forms of assessment, which aligned more closely with teacher-centered instruction (Shulman, 2022).These findings address the objective of examining how teaching strategies are applied in Grade Four Natural Sciences and Technology classrooms.

6.4.4. Reasons for the use of particular teaching strategies

Several factors influenced teachers' choice of teaching strategies. One of the most prominent factors was curriculum pressure. Teachers reported that time constraints and the need to complete the syllabus encouraged the use of teacher-centered strategies that allowed for quicker content coverage. Teacher confidence and experience also played a significant role. Many participants indicated that they preferred strategies with which they were familiar. Limited content knowledge and uncertainty about managing learner-centered activities led teachers to favor direct instruction. According to Schweisfurth, (2021) Contextual factors such as large class sizes, limited classroom space, and diverse learner abilities further shaped teachers' instructional decisions. Teachers reported that structured, teacher-led approaches helped them manage classrooms effectively. Despite these challenges, teachers acknowledged the value of learner-centered teaching in promoting learner engagement and understanding.

6.5. Conclusion

This chapter consolidated the central findings of the study and presented actionable recommendations for improving teaching strategies in Natural Sciences and Technology classrooms in Grade Four. The study concluded that effective instruction requires a balanced integration of learner-centred and teacher-centred strategies. While teachers demonstrate commitment to quality teaching, challenges such as limited resources, language barriers, and curriculum demands remain obstacles. The findings highlight the need for ongoing professional development, improved support structures, and resource provision to ensure that teaching strategies meet both curriculum expectations and learner needs. The study contributes valuable insights into practical classroom realities and offers a foundation for further research on instructional improvement in South African schools.

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Annexures

Annexure A: Consent letter

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT THE CIRCUIT

Ms Maanaso M.T

P O BOX 231

TRICHARDTSDAL

0890

04 AUGUST 2025

MAKHUTSWE CIRCUIT

PRIVATE BAG X4032

TRICHARDTSDAL

0890

DEAR SIR/MADAM

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT SCHOOLS MAKHUTSWE CIRCUIT

Research title: Exploring teaching strategies used by grade 4 educators teaching natural sciences and technology in Mopani West at Makhutswe Circuits.

I Maanaso Maite Trace, student number 64515656, enrolled as a Master student, College of Education, at the University of South Africa under supervision of Prof Mpungose CB. I am doing research of the title mentioned above. I hereby request permission to conduct research at the above mentioned circuit. The aim of the study is to explore the teaching strategies used by grade 4 natural sciences and technology teachers at Mopani West District under Makhutswe Circuit.

The benefit of this study is to assist teachers who are teaching grade 4 to apply and explore new strategies. The study is a great opportunity for natural sciences and technology teachers to test some ideas to cater to teaching diversity at schools. The need for teachers is to ensure that all the aspects are covered during teachings.

There are no potential risks that are involved in participating in this study.There will be no reimbursement or any incentives for participation in the research Feedback procedure will entail viewing of the research findings by the participants before it is written in the dissertation.

Yours sincerely

Med Student (Maanaso M.T).

REQUEST FOR PARTICIPATION IN A RESEARCH STUDY

PARTICIPANT INFORMATION SHEET
Date:

DEAR PROSPECTIVE PARTICIPANT
My name is Maanaso Maite Trace, and I am doing research under supervision of Prof. Mpungose CB, a Professor in the Department of curriculum and instructional studies towards a MEd at the University of South Africa. We are inviting you to participate in a study titled: : Exploring teaching strategies used by grade 4 educators teaching natural sciences and technology in Mopani West at Makhutswe Circuits.

WHAT IS THE PURPOSE OF THE STUDY?
The main purpose of the study is to explore the teaching strategies used by grade 4 teachers when teaching natural sciences and technology in the Makhutswe circuit.

WHY AM I BEING INVITED TO PARTICIPATE?
You are invited because you are currently teaching natural sciences and technology in grade 4 a member at Primary School in 2025.
I obtained your contact details from the principal of Primary School. You are one of the four people that are invited to participate in this study.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?
(Describe the participant's actual role in the study).
The study involves semi-structured interviews. The questions will be based on teaching strategies that you apply in classroom during teaching and learning. The research study will be conducted over a period of five days, but I will need only thirty minutes of your time to answer the interview questions. There might be one or two follow-up interviews which shall not exceed thirty minutes each.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?
Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?
The benefits of this study are to get to find the best teaching strategies. May assist teachers who are teaching grade 4 to apply and explore new strategies. The study is the great opportunity for natural sciences and technology teachers to test some ideas to cater teaching

diversity at schools. The need of teachers is to ensure that all the aspects are covered during teachings. This enfold that the approaches as well as the techniques used in teaching the subject must promoted in terms of searching the understanding of the world of science and strategies that need to be promoted.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

There are no potential risks that are involved in participating in this study.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and the supervisor, will know about your involvement in this research. Your name will not be recorded anywhere, and no one will be able to connect you to the answers you give. Your answers will be given a code number, or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

A report of the study may be submitted for publication in an article, but individual participants will not be identifiable in such a report.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard in my office for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded, and electronic copies will be permanently deleted from the hard drive of the computer using the Bleach Bit when the information is not needed anymore.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

There will be no reimbursement or any incentives for participation in the research.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Research Ethics Review Committee of the CEDU, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Maanaso Maite on 076 505 0143 or email at 64515656@mylife.unisa.ac.za. The findings are accessible for a month before an article is submitted for publication.

Should you have concerns about the way in which the research has been conducted, you may contact Prof. C.B Mpungose on 079 385 0351.Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

CONSENT TO PARTICIPATE IN THIS STUDY (Return slip)

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the semi structured interview

I have received a signed copy of the informed consent agreement.

_____ (Participant Name & Surname)

_____ _____

Participant Signature Date

(Researcher)

_____

Researcher's signature Date

Annexure B: One-on-one interview guide questions

Researcher: Maanaso M T

Title: EXPLORING TEACHING STRATEGIES USED BY GRADE 4 NATURAL SCIENCES AND TECHNOLOGY TEACHERS IN MOPANI WESST UNDER MAKHUTSWE CIRCUIT.

Theme 1: The teaching strategies

Question: What teaching strategies do you use to engage learners in teaching natural sciences and technology?

Theme 2: Content Knowledge (Content Delivery and Understanding)

Question: Are you satisfied with your content progress and time given in teaching using the strategy/strategies?

THEME 3: Teaching Environment (Classroom Climate and Culture)

Question: Do you feel encouraged by the participation you get in the teaching environment?

Theme 4: Assessment

Question: What aspects or assessments of natural sciences and technology do you find most enjoyable and how do you assess them?

Theme 5: Learner engagement and inclusion

Question: Do you think that the teaching strategies cater to different ways of learning and teach

THEME 6: Teacher Support and Professional Development

Question: Do you feel comfortable and supported in the classroom with the applied teaching strategy/strategies and resources?

NON- PARTICIPATORY OBSERVATION

QUESTIONS	YES/NO	COMMENTS
1. Does learners respond to different teaching strategies? Are they engaged and interested?		
2. Do the teaching strategies seem to support learners understanding and achievement of learning goals?		
3. Do teaching strategies impact classroom management, learner interactions, and teacher-learner relationships?		
4. Does the teacher utilize resources (like technology, textbooks, or manipulative) to support teaching strategies?		
5. Do strategies promote good teaching environment or individualized learning?		
6. Does the teacher check understanding through assessments and provide feedback?		
7. Do strategies impact classroom dynamics and behavior?		
8. Does the teacher adjust strategies for diverse learners?		
9. Is the lesson pace effective for student learning and time given?		

Annexure C: Ethical Clearance

UNISA university of south africa

College of Education _ERC

NHREC Registration # : (If applicable)
Ref #: 8045
Name: Miss Maite Trace Maanaso
Student #: 64525656
Staff #:

Date: 17/09/2025

Dear: Miss Maite Trace Maanaso

Decision: Ethics Approval from 17/09/2025 to 16/09/2028

Researcher: Miss Maite Trace Maanaso

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Tzaneen

maanasomt@gmail.com 083 865 4017

Supervisor: Prof Cedric Bheki Mpungose mpungcb@unisa.ac.za

Co-Supervisor:

Co-Researcher(s):

Email address:

EXPLORING TEACHING STRATEGIES USED BY GRADE 4 NATURAL SCIENCES AND TECHNOLOGY TEACHERS IN MOPANI WEST DISTRICT UNDER MAKHUTSWE CIRCUIT.

Qualification: Med

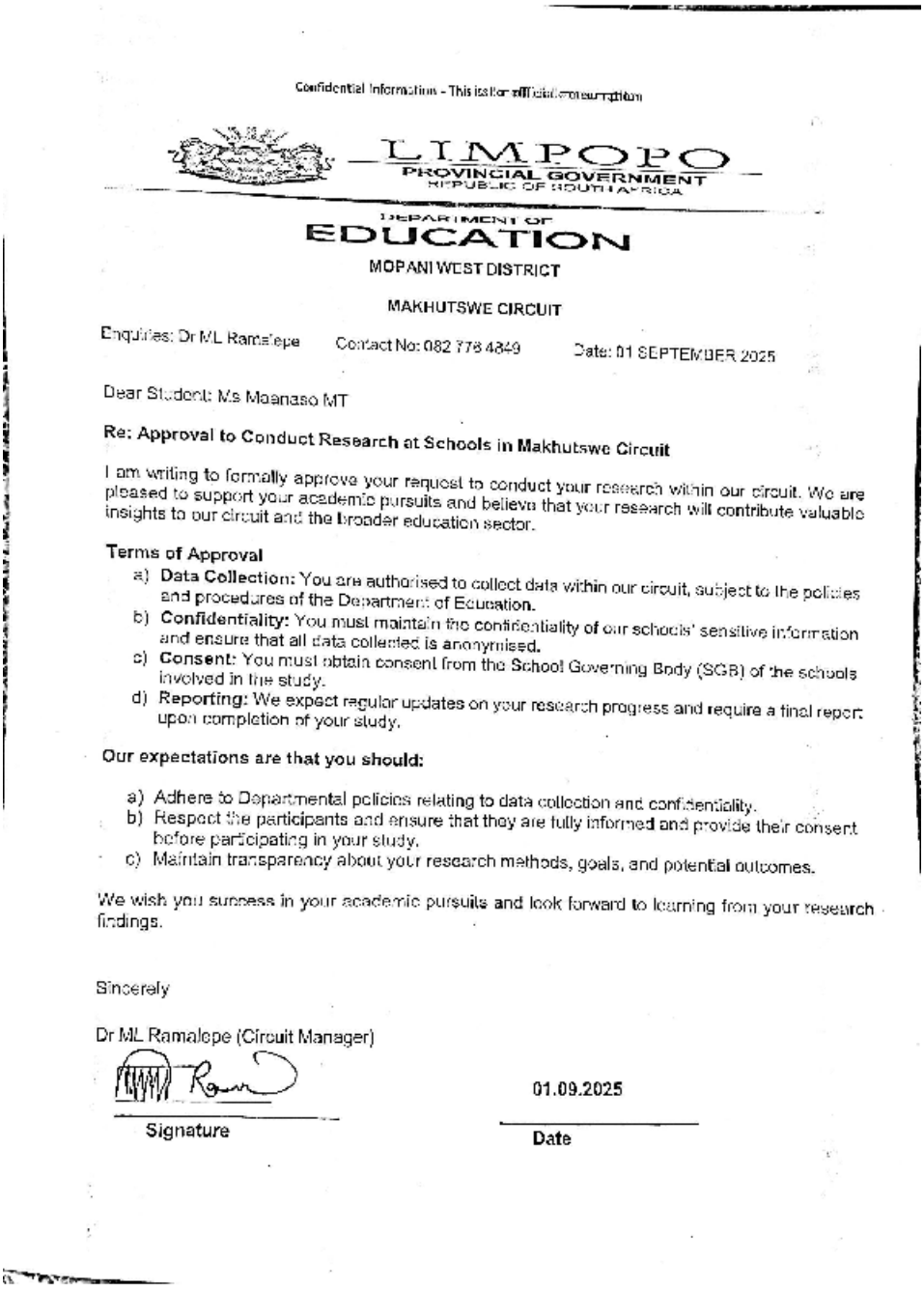
Thank you for the application for research ethics approval by the College of Education _ERC for the above-mentioned research study. Ethics approval is granted for three years .

The **low risk application** was **reviewed** by the College of Education _ERC in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising during the undertaking of the research study that may affect the ethical integrity of the study, including those involving research participants, third parties, or juristic persons, must be reported in writing to the College of Education _ERC without delay.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that may affect study-related risks to research participants, juristic or third persons, must be reported in writing to the College of Education _ERC, accompanied by a progress report.

Annexure D: Gatekeepers letter



Confidential Information - This is for official consumption

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

MOPANI WEST DISTRICT

MAKHUTSWE CIRCUIT

Enquiries: Dr ML Ramalepe Contact No: 082 778 4849 Date: 01 SEPTEMBER 2025

Dear Student: Ms Moanaso MT

Re: Approval to Conduct Research at Schools in Makhutswe Circuit

I am writing to formally approve your request to conduct your research within our circuit. We are pleased to support your academic pursuits and believe that your research will contribute valuable insights to our circuit and the broader education sector.

Terms of Approval

a) **Data Collection:** You are authorised to collect data within our circuit, subject to the policies and procedures of the Department of Education.
b) **Confidentiality:** You must maintain the confidentiality of our schools' sensitive information and ensure that all data collected is anonymised.
c) **Consent:** You must obtain consent from the School Governing Body (SGB) of the schools involved in the study.
d) **Reporting:** We expect regular updates on your research progress and require a final report upon completion of your study.

Our expectations are that you should:

a) Adhere to Departmental policies relating to data collection and confidentiality.
b) Respect the participants and ensure that they are fully informed and provide their consent before participating in your study.
c) Maintain transparency about your research methods, goals, and potential outcomes.

We wish you success in your academic pursuits and look forward to learning from your research findings.

Sincerely

Dr ML Ramalepe (Circuit Manager)

Signature

01.09.2025
Date

Annexure F: Turnitin (plagiarism) report

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Summary

Annexure E: Letter of Edit

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EDITING CERTIFICATE

Date: 2026/1/30

This serves to confirm that the document entitled:

EXPLORING TEACHING STRATEGIES USED BY GRADE 4 NATURAL SCIENCES AND TECHNOLOGY TEACHERS IN MOPANI WEST DISTRICT UNDER MAKHUTSWE CIRCUIT.

BY: MAITE TRACE MAANASO
64515656
PROPOSAL SUBMITTED FOR THE DEGREE
MASTERS OF EDUCATION
CURRICULUM STUDIES

has been language edited on behalf of its author.

Genevieve Wood
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