INTERMEDIATE PHASE TEACHERS' VIEWS AND PEDAGOGICAL PRACTICES ON INTEGRATING NATURAL SCIENCES AND TECHNOLOGY

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Submitted in fulfilment of the academic requirements for the degree of

Master of Technology Education

Science, Mathematics and Technology Education Cluster

Faculty of Education

University of KwaZulu-Natal

South Africa

November 2024

DECLARATION

I, the undersigned, Karina Basitheva, hereby declare that this thesis entitled “Intermediate Phase Teachers’ Views and Pedagogical Practices on Integrating Natural Sciences and Technology” is my own original work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

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DEDICATION

This thesis is dedicated to my loving fiancé and greatest supporter, **Thashvir**. Thank you for all the love and encouragement that you give me. Your faith in me and my goals and aspirations mean the world. You have been incredible in this journey, constantly cheering me on and helping in every way that you can.

I also dedicate this thesis to my **mom and dad**, **Dhanwanthie and Jairajh Basitheva.** Thank you both for providing me with every opportunity to achieve my goals. I appreciate your love, kindness and guidance. You both have always taught me to believe in myself and my abilities. Thank you for always helping me to flourish in my aspirations.

I love you all dearly.

ACKNOWLEDGEMENTS

The accomplishment of this thesis was made possible by the tremendous support, encouragement and guidance from the following individuals.

My supervisor and mentor, Prof Asheena Singh-Pillay, thank you for your academic support, unwavering guidance, intellectual conversations, incredible knowledge and advice. You have made this journey an inspiring experience. Your words of encouragement were highly valuable and appreciated throughout this journey.

Mrs M. Van Wyk, my co-supervisor, thank you for your support and guidance. I appreciate everything you have done for me throughout this journey.

My parents, mom and dad, thank you both for your constant motivation and encouragement. You have always encouraged me to aim high and supported me in achieving my goals.

My fiancé, Thashvir, thank you for being my greatest supporter. Your unconditional love, faith and encouragement mean the world to me. You have motivated me daily and made this journey an exciting one.

My brother, Ashveer, thank you for your words of encouragement and always believing in my goals. Your constant support and guidance are appreciated.

My friend and sister, Sujatha, you have been a constant source of motivation to me. Thank you for your kind words every day and for always believing in me. I appreciate you more than you know.

The University of Kwa-Zulu Natal, thank you for allowing me the opportunity to pursue my Masters.

Teachers and principals that participated in this research study, thank you for your participation and sharing your experiences and wisdom with me.

Finally, I thank **God**, through whom all things are made possible.

ABSTRACT

The South African educational system has undergone significant transformation in its curriculum over the years. An important change occurred in 2011 when the Department of Basic Education introduced the Curriculum and Assessment Policy Statement (CAPS) which integrated related subjects, notably combining Natural Sciences and Technology into a single subject (NS-TECH) in the intermediate phase. Although this integration was grounded in the subjects' natural interconnections, recent evidence indicates potential challenges in its implementation.

Drawing from personal experience as an intermediate phase NS-TECH teacher and supported by research highlighting the crucial role of teachers' experiences in shaping instructional approaches, this study examines the effectiveness of this curricular integration. Specifically, this research addresses three fundamental questions:

1. What are intermediate phase teachers' views on integrating Natural Sciences and Technology?
2. How do intermediate phase teachers integrate Natural Sciences and Technology?
3. Why do intermediate phase teachers integrate Natural Sciences and Technology in the way they do?

The study employed a qualitative approach and a case study design to comprehensively address these questions. Data were gathered through interviews, classroom observations, documentation analysis, and post-observation interviews. The research focused on the Berea area in Durban, where 12 intermediate phase NS-TECH teachers were selected from four different schools. The theoretical framework guiding this research, Bernstein's Theory of Classification and Framing (1971), provides valuable insights into the current state of NS-TECH integration. The findings demonstrate strong classification in NS-TECH implementation, unlike the weak classification ideal for integrated subjects. Furthermore, in terms of framing, 11 of the 12 teachers exhibited unintegrated teaching approaches, indicating considerable difficulties in achieving genuine subject integration.

Several key challenges emerged from the research:

- Teachers felt inadequately prepared to teach integrated NS-TECH, particularly citing insufficient knowledge of Technology;
- Resource limitations hampered both teaching and learning; and
- The densely packed curriculum left minimal time for practical, hands-on activities.

Based on these findings, the following actions are recommended:

- Develop and implement clear policy guidelines for NS-TECH integration;
- Provide comprehensive professional development and training support;
- Include teacher input in policy-making processes;
- Design a more realistic, time-conscious curriculum; and
- Supply learning materials and textbooks that effectively support integrated instruction.

These recommendations aim to address the challenges identified while maintaining the intended benefits of subject integration in the South African educational system.

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LIST OF ACRONYMS

CAPS- Curriculum and Assessment Policy Statement

DBE- Department of Basic Education

NAE- National Academy of Engineering

NRC-National Research Council

NS-TECH- Natural Sciences and Technology

OBE- Outcomes Based Education

STEM- Science, Technology, Mathematics and Engineering

CHAPTER 1

BACKGROUND AND INTRODUCTION OF THE STUDY

1.1 Introduction

The aim of this research is to explore intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology. Prior to the implementation of the Curriculum and Assessment Policy Statement (CAPS) in 2011, Natural Sciences and Technology were taught as separate subjects. CAPS introduced a framework designed to interconnect subjects and foster a more holistic approach to learning. However, the integration of NS-TECH poses challenges for teachers, including managing an expanded curriculum due to the amalgamation of two subjects, which constrains effective instructional time. Additionally, insufficient resources, instructions and facilities hinder comprehensive student understanding during NS-TECH lessons.

This study was motivated by the researcher's experiences as an intermediate phase NS-TECH teacher and aims to provide insights into the practicalities of implementing an integrated curriculum. Research underscores the pivotal role of teachers' experiences in shaping their instructional approaches, professional growth, and future career aspirations (Pirtheepal, 2019).

The effectiveness of integrating NS-TECH, as mandated by CAPS, was closely examined. Policy directives like CAPS often overlook the practical challenges faced at the school level, where the ideals of curriculum integration can clash with the realities of implementation. Data were collected through semi-structured interviews, observations and document analysis to explore the views and pedagogical practices of intermediate phase teachers' on integrating Natural Sciences and Technology.

The study highlights the diverse approaches teachers use to integrate NS-TECH into their daily teaching practices, reflecting a flexible approach required to meet evolving curriculum demands. It posits that teachers' experiences not only shape the curriculum but are shaped by it, emphasizing the significance of understanding these experiences in navigating curriculum changes.

Given the limited research on intermediate phase teachers' views and pedagogical practices for integrating Natural Sciences and Technology in the South African context, this study addresses

a critical gap, as previous studies focused primarily on learners' perspectives (Guzey & Roehrig, 2009; Izci, 2017; Khanyile, 2016; Nampota, 2008; Pirtheepal, 2019; Weber, 2008). Understanding teachers' views on curriculum change could facilitate more effective adaptation to new educational paradigms, potentially enhancing teaching and learning quality in South African classrooms.

This chapter provides the background and context for the research study, underscoring the relevance and necessity of examining intermediate phase teachers' views and pedagogical practices regarding the integration of NS-TECH. It further explains the significance, rationale and purpose of this study. The location and overview of the research design and methodology are also included. This chapter concludes by presenting the organisation of the dissertation.

1.2. Background

In the context of the South African curriculum, Natural Sciences (N.S.) and Technology (Tech) are construed as complementary subjects; thus, in the grades 4 to 6 intermediate phase Curriculum Assessment Policy Statement (CAPS) documents, these two learning areas are integrated. The rationale for this integration is the subjects' symbiotic relationship, which mutually supports their progress. Due to the cross-cutting nature of N.S. and Tech, integrating these subjects was seen as a conduit to promote or enhance holistic teaching and learning. Table 1.1. below reflects how N.S. and Tech complement one another.

Table1.1. Complementarity between N.S. and Tech

	NATURAL SCIENCES	TECHNOLOGY
Goal	Pursuit of new knowledge and understanding of the world around us and of natural phenomena	The creation of structures, systems and processes to meet peoples' needs and improving the quality of life
Focus	Focus is on understanding the natural world	Focus is on understanding the need for human–made objects and environments to solve problems
Developmental methods	Discovery through carrying out investigations	Making products though design, invention and production
Major processes	Investigative and logical processes • planning investigations • conducting investigations and collecting data • evaluating data and communicating findings	Practical solution-orientated processes • identifying a need • planning and designing • making (constructing) • evaluating and improving products • communicating
Evaluation methods	Analysis, generalisation and creation of theories	Analysis and application of design ideas

Source: CAPS- IP NS-Tech document, p 9 (D.B.E., 2011)

Table 1.1. reflects the interconnectedness and convergence between the N.S. and Tech regarding their goals and focus, while the divergence in developmental methods and processes is clear. N.S. depends on inquiry-based learning, practical work, and investigations, while the design process undergirds tech. Despite the CAPS grade 4-6 NS-TECH policy espousing the idea of NS-TECH being taught as an integrated subject, the policy is not explicit on how the integration should occur in each knowledge strand. Table 1.2. highlights the knowledge strands for N.S. and Tech.

Table 1.2. Knowledge Strands for NS-TECH

NATURAL SCIENCES STRANDS	TECHNOLOGY STRANDS
Life and Living	Structures
Matter and Materials	Processing
Energy and Change	Systems and Control
Planet Earth and Beyond	

Source: CAPS- IP Ns-Tech document, p 10 (D.B.E., 2011)

As shown in Table 1.2, N.S. has four knowledge strands, and Tech has three knowledge strands; these are maintained as separate entities. Moreover, teachers are not provided with example

resource materials to help integrate content and activities across these knowledge strands. There is a clear lack of information on how or when the integration should occur. In this regard, it is important to note that authors such as Singh-Pillay and Sotsaka (2020) and Singh-Pillay (2010) assert that the successful implementation of the curriculum hinges on teachers. Teachers are responsible for curriculum reform and implementation and need adequate training to drive the process. Within South Africa, a cascade model is used to train practising teachers for the implementation of the curriculum.

Singh-Pillay and Alant (2015, p. 13) critique the theoretical nature of the "once-off just in time" professional development training teachers receive for curriculum implementation via the cascade model. They contend that this approach to training teachers presents a considerable challenge impacting the South African education system. Teachers are expected to embrace the goals and intentions of the curriculum without having practical training on pedagogies or how to integrate N.S. and Tech in their teaching and assessments. Many have explored the integration of technologies in N.S. and the teaching of Tech (Ramaila, 2021; Juggernath & Govender, 2021; Syfer, 2010); there is a study on teachers understanding of the integration of NS-TECH (Khanyile, 2016) and the implementation of practical activities in NS-TECH (Makhubele, 2016), but there is a paucity of studies on Intermediate Phase Teachers' Views and Pedagogical Practices on the Integration of Natural Sciences and Technology.

1.3. Purpose and Rationale

Although the initiative to integrate N.S. and Tech was based on their interrelatedness, the logistical and operational aspects of the curriculum do not reflect this connectedness in content or assessment. The CAPS NS-TECH policy consistently prioritises N.S. over Tech. Rather than providing information on integrating NS-TECH, the policy separates the topics and specifies the timeframe for teachers to address each concept or topic in the subjects. Again, N.S. topics are allocated more time than Technology. This demonstrates that even the policy document contradicts the goal of integrating N.S. and Tech.

For example, the introduction focuses exclusively on science, despite the subject being N.S. and Tech. Furthermore, as already mentioned, the notional hours for the N.S. and Tech strands are unequal with more time and attention given to N.S. This disparity implies that Tech is

viewed as inferior to N.S., a notion that serves as the foundation for this study. The CAPS document lacks an explanation of how to integrate N.S. and Tech.

While scholarly discussions advocate for an integrated curriculum, previous studies focused primarily on its structure and the benefits offered to learners, rather than the actual experiences of teachers implementing it (Pirtheepal, 2019). According to Kelly (2010), effective implementation of an integrated curriculum can yield substantial advantages. Therefore, this research aims to investigate intermediate phase teachers' firsthand views and pedagogical practices in implementing an integrated Natural Sciences and Technology (NS-TECH) curriculum.

The insights and views shared by participants in this study offer valuable data on how teachers perceive and execute integrated curricula (CAPS, 2011). Discussions from the Academy of Science of South Africa Forum emphasise that poor learner performance can demoralise both students and teachers, significantly affecting educational outcomes (Grayson, 2010; Pirtheepal, 2019). Additionally, existing pedagogical barriers in educational systems, such as inadequate infrastructure, resource scarcity, frequent policy changes, and policies that lack instruction as to the integration of new content, pose substantial challenges to the successful integration of subjects (Izci, 2017). Literature underscores the pivotal role of teachers' experiences in the successfully implementing integrated curricula (Oloruntegbe, 2013).

The motivation for this study arises from my involvement with the NS-TECH curriculum. I teach NS-TECH in the intermediate phase at a primary school in the greater Durban area. I am passionate about teaching NS-TECH and strive to integrate both the content of the knowledge strands and the assessment. However, many of my colleagues teaching NS-TECH in the intermediate phase focus on the familiar content of N.S., as they are trained in this subject. As a result, they tend to overlook the Tech content or cover it briefly to fulfil a requirement. Often, teachers who have not specialised in both N.S. and Tech or lack experience in teaching both subjects rely on textbooks for guidance. The challenge is that textbooks offer content without providing guidance on integrating subjects. In addition to these key challenges, teachers face other typical issues arising in the South African schooling system. These include extensive content knowledge requirements, resource deficiencies, and time constraints.

These challenges are often overlooked in curriculum workshops, which typically prioritise delivery methods and administrative oversight. This research aims to provide NS-TECH

teachers with a platform to articulate their views, challenges and pedagogical practices on integrating NS-TECH into the classroom.

1.4. Significance of the Study

This study endeavours to highlight the experiences of NS-TECH teachers and uncover the reasons underlying their challenges, with the goal of improving curriculum implementation and enhancing pedagogical practices. By addressing these issues, the study aims to help create a more supportive learning environment for students and reinforce the role of NS-TECH teachers. This study also aims to encourage the provision of training for teachers on the integration of NS-TECH, and it suggests that the CAPS (2011) document serves as a guideline for teachers on how to integrate the content and strands of N.S. and Tech effectively. Outcomes from this research may inform policymakers and educational authorities to revise the NS-TECH curriculum to better align with teachers' practical experiences and needs.

1.5. Location of Study

The study was conducted at four primary schools in the Berea area, each staffed with three NS-TECH teachers in the intermediate phase, with a total of 12 NS-TECH teachers invited to participate in the research. The primary schools in the Berea area are classified as ex-Model C schools. Despite this classification, the student body comprises learners from diverse socio-economic backgrounds.

Historically, the Berea area was affluent; however, recent years have seen a shift in economic status. Learners commute from various regions such as Sydenham, Newlands West, Musgrave, Glenwood, Westville, South Beach, Morningside, Clare Estate, Durban North, Kwa Mashu, and Umlazi to attend these prestigious schools in Berea. Consequently, the student population at these primary schools reflects a range of socio-economic statuses, from affluent to disadvantaged. The schools in the area continue to uphold their strong reputation owing to the dedication of their teachers, who strive to deliver quality education.

School leadership, including principals, deputy principals, and School Management Teams (SMTs), are recognised as visionary figures committed to upholding the schools' strong reputation and ensuring educational excellence.

1.6. Research Questions

This research study is entitled ‘Intermediate Phase Teachers’ Views and Pedagogical Practices on the Integration of Natural Sciences and Technology’. The objectives of this study are to:

1. Ascertain teachers' views on implementing an integrated N.S. and Tech curriculum in the intermediate phase;
2. Establish how integrating N.S. and Tech impacts intermediate-phase teachers' pedagogical practice; and
3. Explore why intermediate phase teachers integrate N.S. and Tech in the way that they do.

The following three key research questions were guided by the above objectives:

1. What are intermediate phase teachers’ views on integrating N.S. and Tech?
2. How do intermediate phase teachers integrate N.S. and Tech?
3. Why do intermediate phase teachers integrate N.S. and Tech in the way they do?

1.7. Overview of the Research Design and Methodology

This study employs a research design and methodology that facilitated the acquisition of precise responses to the research questions. The research design and methodology selection were driven by the research objectives, ensuring coherence and practicality in the study. Rooted in the interpretivist paradigm, the study prioritises the everyday experiences of individuals, seeking in-depth and subjective understandings of their encounters (Babbie, 2016). Specifically, it aims to explore the firsthand views and pedagogical practices of intermediate phase teachers.

This study utilises a qualitative research approach, which provides flexibility in sampling procedures and data generation methods due to the expansive and dynamic nature of the field (Draper & Swift, 2011). Employing an exploratory case study design enabled an in-depth and subjective exploration of teachers' views and pedagogical practices, aiming to interpret the

uniqueness of their encounters (Pirtheepal, 2019). The research analyses their perspectives and experiences to elucidate the "complexities and situatedness" of their engagement with the NS-TECH curriculum, in order to ensure that the curriculum is delivered as an integrated whole. Purposive sampling was used to select participants who taught NS-TECH within the intermediate phase.

Data collection involved semi-structured interviews, observations and document analysis to ensure methodological complementarity (Creswell, 2014). Ethical approval was obtained from the Department of Education for research conducted at all study sites involving all participants. Additionally, clearance was obtained from the university's research office before commencing the study.

A detailed discussion of the research design, methodology, and considerations of validity, trustworthiness, and ethical principles appears in Chapter 3 below.

1.8. Organisation of Dissertation

This research comprises five chapters, each addressing distinct aspects of the study:

Chapter 1 introduces the research by providing a contextual background, the purpose or rationale for this study, and its significance and location. It further outlines the study's objectives and research questions and presents an overview of the research methodology and structure.

Chapter 2 reviews relevant literature, focusing on scholarly discussions around implementing an integrated curriculum like NS-TECH. Literature pertaining to the following aspects is discussed in detail:

- What is integration?
- The rationale for integration in the curriculum.
- The rationale for the integration of NS-TECH in the curriculum.
- The benefits of integrating STEM subjects.
- The implementation of an integrated NS-TECH curriculum in a local and international context.
- The similarities and differences between the technological design process and the scientific method.

- Teachers' experiences and challenges when implementing an integrated curriculum.

This chapter further explores the theoretical framework that guides this study. Bernstein's Theory of Classification and Framing was selected to underpin the research study due to its suitability, which is explained in detail in Chapter 2.

Chapter 3 meticulously outlines the qualitative research design and methodology employed in this study. It provides a comprehensive justification for the chosen research approach and paradigm, describes the selection of research location, and elaborates on sampling procedures and data collection methods (including semi-structured interviews, observations and document analysis). Additionally, it covers the procedures for data analysis. The chapter emphasises the establishment of rigour through considerations of validity, trustworthiness, and reliability. It concludes by discussing the ethical considerations and limitations inherent in the study's design and execution.

Chapter 4 serves as the focal point of this study, presenting the primary qualitative data findings obtained from interviews and questionnaires. It analyses and interprets these findings in relation to the research questions that directed the study, offering a comprehensive discussion that connects the findings with the reviewed literature and the theoretical framework employed.

Chapter 5 consolidates the study with concluding discussions, summarising the key findings. It concludes with recommendations for future research and areas that require further investigation.

1.9. Conclusion

Chapter 1 presented an introductory overview of the study, detailing its background, purpose and significance. It outlined the geographical setting and main objectives of the research, specific research questions, and gave an overview of the study's design and methodology. The chapter concluded with an outline of the dissertation's organisational structure.

The subsequent chapter critically reviews literature pertinent to the intermediate phase teachers' views and pedagogical practices on integrating NS-TECH, as well as the theoretical framework that underpins this study.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

Brown (2024) describes a literature review as published information that can support another's argument. The first part of this chapter reviews previous studies and scholarly articles thematically organised around the integration of NS-TECH. The second part explores Bernstein's (1971) Theory of Classification and Framing. This theoretical framework is discussed in detail in support of integration in NS-TECH.

A review of the literature focused on the following aspects, which are discussed below:

1. What is integration?
2. The rationale behind integrating subjects in the curriculum.
3. The rationale for integrating Natural Sciences and Technology,
4. The benefits of integrating STEM subjects.
5. The implementation of an integrated NS-TECH curriculum at both local and international levels.
6. The similarities and differences between the design process (TECH) and the scientific method (N.S).
7. Teachers' experiences and the challenges they encounter when implementing an integrated curriculum**.**

The latter part of this chapter expounds on the Theoretical Framework applied to this study. The theoretical framework provides a more transparent structure for organising and interpreting data collected during the research study (Hecker, 2024). Berstein's Theory of Classification and Framing is utilised in this study as it offers a particular lens and relativity through its explanation of classification and framing. Firstly, the theory itself is discussed and divided into two parts: classification and framing. Then, it is examined as a cohesive whole and applied to the teaching and learning of NS-TECH.

2.2. What is Integration?

Multiple definitions of integration can be traced as far back as 1940. Klein (2006) asserts that the term curriculum integration indicates the collaboration of different disciplines within the school curriculum and includes the transference of content knowledge, skills, and values across and between disciplines. The National Council for Curriculum and Assessment (2017) defines integration as the relationship between all things. An integrated curriculum implies that learning is synthesised across traditional subject areas. Varthana (2023) adds that integration is beneficial in the educational field as it provides learners with opportunities to be more creative and find connections between subjects, develop a greater understanding of the subjects, develop transferrable skills, such as critical thinking, teamwork and problem-solving, and manage their time well.

Lederman (1997) describes integration using terms like interdisciplinary, multidisciplinary, transdisciplinary, integrated, thematic, connected, sequenced, nested, shared, webbed, threaded, immersed, networked, blended, unified, coordinated, and fused. These terms indicate that integration is the joining and coming together of two separate entities to form a whole new entity.

Beanne (1995) suggests that the differing ways integration is conceptualised across content areas may contribute to the multitude of definitions associated with it. Over the past two decades, literature has reflected these variations in defining integration, with numerous descriptions offered to explain the concept.

The following definitions of Indistinct Subject Integration, Topic/Theme Integration, and Recognizable Subject Integration illustrate this point:

Indistinct Subject Integration: One-way integration has been defined as teaching subjects so that it is unclear where each subject begins and ends when they are combined. Berlin and White (1992) describe how 60 Math and Science educational professionals assembled at a conference funded by the National Science Foundation and, after three days of discussion, could not agree on the definition of integration of Science and Mathematics. One group proposed the working definition: "Integration infuses mathematical methods in Science and scientific methods into Mathematics such that it becomes indistinguishable as to whether it is Mathematics or Science" (Berlin & White, 1992, p. 341). A study by Lederman and Niess (1997) broadened this description to encompass the use of real-world problems for instructional purposes. They also

define integration as two subjects taught together to form a seamless whole, combining them so that each discipline is not clearly defined. The integrated subjects are taught through real-world problems. The authors justify their definition, stating that since daily experiences are not confined within a range of defined subjects, neither should the school curriculum.

Topic/Theme Integration: Another way integration can be defined is as a curriculum planned around topics or themes. This definition of integration differs from indistinct integration because the combined subjects are organised according to the topics and themes taught. Beane (1996) defines integration as having four characteristics:

(a) Curriculum that is organised around topics of personal and social importance in the real world;

(b) Use of applicable information in the context of the topic without consideration for subject lines;

(c) Subjects are used to study current issues rather than for testing; and

(d) Importance is placed on assignments and activities with real-world application of knowledge and analysis.

He explains that other descriptions of integrated curricula focus too heavily on separate subject areas and are not integrated. Integration, defined as subjects organized by topics, may also include theme teaching. Hurless and Gittings (2008) identify an integrated curriculum as a method of teaching that combines multiple subject areas, such as math, literacy, or the arts, to a central theme. They explain that teachers apply this method of instruction through comprehensive planning, enabling them to educate students using authentic, relevant learning experiences.

Recognisable Subject Integration: Additionally, integration has been defined as using several subjects in recognisable combinations to teach a central idea, solve a problem, or plan an event. This definition is unique from indistinct integration because the multiple subject areas remain clear while exploring the new idea. This definition differs from Topic/Theme Integration in that it focuses on central ideas, problems, or events. Parker (2005) defines integration as an approach that purposefully draws together knowledge, viewpoints, and methods of examination from several disciplines to develop a more robust understanding of a central idea, problem, individual, or event. Parker additionally identifies two approaches of integration that teachers use most often based on this definition: fusion and infusion.

The fusion design of curriculum integration can be applied when multiple subjects are merged to form a new unified idea. The infusion design works when subjects are combined to create a relevant curriculum. Parts of one subject area are inserted into another subject to help the learner better understand the second. This broad method is the most regularly used practice of curriculum integration at the elementary level (Hinde, 2005).

The definition of integration as using individual subjects in combination to teach a significant idea was expanded to include how the particular subjects reinforce each other in the lesson. Farris (2004) describes integration as combining multiple subjects in a lesson. He emphasises the importance of highlighting each subject's related concepts, skills, and values, reinforcing them through interdisciplinary instruction. Farris underlines that learning should be relevant and meaningful to students.

Hall-Kenyon and Smith (2013, p. 90) furthermore describe integration as "instruction based on two or more objectives from two or more subject areas in one lesson". They also identify two essential components that lessons should integrate. The first is to have a valid connection(s) made between skills and/or content knowledge of each content area. The second is that each objective is directly taught and measured.

From the above, it is apparent that time and energy have been spent clarifying the meaning of integration rather than focusing on actual classroom practice.

2.3. Rationale for Integrating Subjects in the Curriculum.

It is imperative to understand what curriculum integration means in the context of this study. Curriculum integration has been widely researched internationally and locally (Izci, 2017; Wei, 2009; Zhou & Kim, 2010). However, most research has focused on the need for curriculum integration and theoretical curriculum models. The rationale behind implementing an integrated curriculum is to take advantage of the interconnectedness of knowledge across different disciplines in the real world. In contrast, separate subjects can narrow learners' perspectives, failing to provide a comprehensive learning process (Harell, 2010). Scholars such as Harell (2010) argue for an integrated curriculum, noting that the student can grow and develop as an individual through interaction with multifaceted knowledge.

Harell (2010) further explains that the rationale behind an integrated curriculum is to allow the learner to integrate knowledge, thereby enhancing learning. The focus in literature appears to

lean more toward learners and their learning through an integrated curriculum, while it overlooks teachers' experiences (Park, 2008).

Arguably, integrating subjects is the ability to combine knowledge from two or more disciplines to enhance cognitive abilities in ways that a single subject cannot (Spelt et al., 2009). The aim here is to set forth the complexities teachers face when there is marked transformation in the school curriculum. An integrated curriculum, such as the one offered by CAPS, is one way in which curriculum developers seek to expand and modify the curriculum to better suit South African classrooms. CAPS seeks to draw attention to the fact that the content learned in N.S. or Tech should not exist in isolation (DBE).

2.4. Rationale for Integrating Natural Science and Technology

Many studies have investigated the need for curriculum integration (Izci, 2017). However, there are few studies that focus specifically on the integration of NS-TECH. Additionally, there has been limited research on how South African teachers implement an integrated curriculum. This study focuses on the experiences of South African teachers in grades 4 to 6, who implement an integrated NS-TECH curriculum on a daily basis (Izci, 2017).

The rationale supporting the implementation of integrated curriculum is to benefit from the interconnected nature of knowledge across various subject disciplines in the real world. This approach contrasts with teaching isolated subjects, which may constrain learners' perspectives and do not adequately support the learning process (Motsienyane, 2016). The South African CAPS curriculum is one strategy developed to better align the curriculum with the needs of South African classroom. CAPS emphasises that N.S. and Tech content should not be treated as separate subjects (Department of Basic Education, 2011). The introduction of NS-TECH broken down barriers between these two subjects in the intermediate phase; N.S. aims to understand the world, while Tech is concerned with addressing and solving problems (Department of Basic Education, 2011). The notion of curriculum has progressed over the years, adopting a more integrated approach, which is evident in the present CAPS curriculum.

Button (2021) suggests that adopting a 21st-century curriculum allows for a blend of knowledge, critical thinking, and innovative skills, which underpin NS-TECH. Teachers acquire substantial knowledge through classroom practices that facilitate the integration of subjects like Maths, Science, and Tech (Sen & Ay, 2017). Even schools with limited resources

can incorporate Science and Tech through practical, problem or project-based teaching methods (Johnston et al., 2014; Sheikh Abdullah, 2016). There is concern that integrating Science and Tech, particularly in higher grade levels, may reduce the coverage of content knowledge, resulting in potential challenges for learners and teachers. However, incorporating these subjects in lower grades is effective because it introduces content knowledge in a manageable way, helping to prevent confusion and overwhelm among learners (Pirtheepal, 2019).

2.5. The Benefits of Integrating STEM Subjects

Margot (2019) explains that in order to have more STEM (Science, Technology, Engineering and Mathematics) literate individuals in the workplace, teachers should practice teaching STEM subjects conjunctively and interdependently in the classroom. Kettler (2019) affirms that all STEM subjects share similarities and differences, making it highly likely that teachers will overlap with other subjects within the field when teaching STEM subjects.

STEM is considered a field; one entity rather than four different subjects. Prior to CAPS (2011), it was not developed to the extent that it now is; workplaces and certain fields of study, such as engineering, software and the sciences, expect individuals to have knowledge in the entire STEM field.

The NAE (National Academy of Engineering) and NRC (National Research Council) indicate that having knowledge in STEM means

1. Understanding the roles that Science, Tech, Engineering and Mathematics play in modern society;
2. Being familiar with fundamental concepts in each of these subject areas; and
3. Possessing basic knowledge of application fluency, such as the ability to evaluate Science or Engineering content, troubleshoot technologies, and perform basic daily operations.

Teachers serve as catalysts in achieving the three objectives above, along with contributing to the learning and development of individuals. They can help learners to develop a holistic understanding of STEM and its related subjects, or the complete opposite.

2.6. Implementation of an Integrated NS-TECH Curriculum in the South African Context

The pedagogy of teachers is vital in the integration of a curriculum as the way the curriculum is delivered is the responsibility of the teacher. According to Chakma (2022), education is a triangular process comprising three components: the teacher, the learner, and the content of the subject. For teachers to effectively teach content, they must have a deep understanding of the subject. With the above three-point process considered, the integration of subjects becomes more delicate and complex. The teacher, who may have a vast deal of knowledge in one subject, may lack knowledge in another. The lack of subject knowledge can worsen the challenges teachers face, such as time constraints and insufficient support and resources. Furthermore, the curriculum may not be aligned with classroom practices, making the implementation of an integrated curriculum challenging (Izci, 2017).

The quality of a curriculum and its implementation are often scrutinised. Teachers in South Africa and globally struggle with how best to educate learners through an integrated curriculum while striving to meet global education standards. This is particularly difficult given the diverse contexts we experience as a country (Umalusi, 2014). Most countries still promote an education system that addresses the needs of the past and neglects those of the present, which may be detrimental to subjects such as NS-TECH, which focuses on developing skills relevant to modern Science and Technology.

2.7. Implementation of an Integrated NS-TECH Curriculum in an International Context

As countries such as the Netherlands and France implement Science and Technology as an integrated subject, literature alludes to the growing need for an integrated curriculum in the 21st century. Such a curriculum supports the holistic development of learner's life skills rather than cultivating isolated skills when subjects are taught separately (Costley, 2015). Despite the global call for integration and acknowledging the benefits of integration, studies conducted in the U.S.A. and England have found that Science, Technology, and all other subjects within the curriculum are persistently taught as separate subjects (Gresnigt et al., 2014).

The effective implementation of an integrated curriculum becomes evident when the focus is on motivating teachers rather than prescribing an unfamiliar curriculum for teachers to

implement themselves (Ferguson-Patrick et al., 2018). However, most studies note that emphasis is placed on N.S. when teaching NS-TECH as an integrated subject. Teachers in Turkey had mixed experiences with the implementation of an integrated Science and Technology curriculum. Some teachers acknowledged positive elements, for example the ability of such an integrated curriculum to support the scientific and technological understanding of learners and relate the knowledge acquired to learners' daily lives (Yidiz Dubun, 2014). More importantly, teachers highlighted the challenges of the difficult level of content, insufficient in-service and pre-service training, overcrowded classrooms, and inadequate facilities, rendering the implementation of NS-TECH problematic. Teachers facing these challenges cannot successfully implement an integrated NS-TECH curriculum, (Lowe, 2017).

2.8. Similarities and Differences between the Design Process (Technology) and Scientific Method (N.S)

2.8.1. The Design Process (Technology)

Maslyk (2021) explains the design process as a process that is applied when teaching Tech. She affirms that this process guides every aspect or content area of teaching Tech. The design process was established to offer a solution to the main objective of Tech, which is finding the best solution to a current problem. The design process implies that coming up with a solution or an idea is not enough. Hence, curriculum makers have developed a cyclical eight-step process, the design process, to allow learners to meet the subject's primary objective.

The steps of the design process are set out below. It is important to note that the process is flexible; it serves as a guide, meaning the steps may not always follow the same order.

Steps of the Design Process:

Step 1: Identify the problem.

Step 2: Research the problem.

Step 3: Generate possible solutions.

Step 4: Select the best solution.

Step 5: Create a model or prototype of the best solution.

Step 6: Test the model.

Step 7: Retest and refine the model.

Step 8: Communicate the final solution.

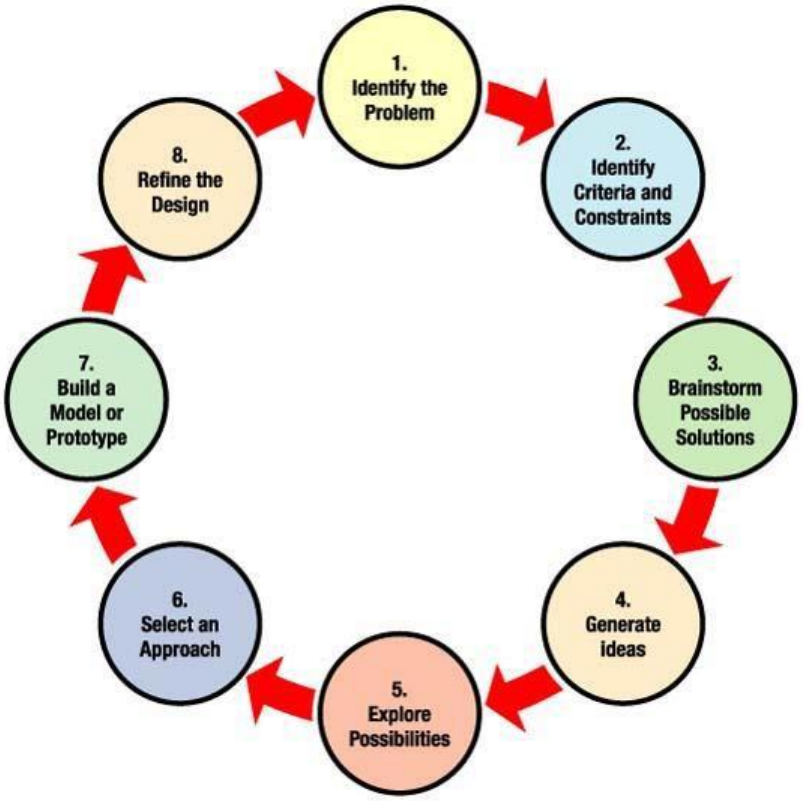


Figure 2.1: Diagram of the Design Process in Technology

Source: Senior Phase Technology CAPS document

2.8.2. The Scientific Method

The Scientific Method is a process that is utilized in the teaching of N.S.. Maslyk (2021) defines the scientific method as a process that is used to explore observations and answer questions in the field of science. Unlike Tech, which relies on new ideas and solutions, Science is based solely on observable facts.

The steps of the Scientific Method are as follows:

Step 1: Ask a question.

Step 2: Do background research.

Step 3: Come up with a hypothesis.

Step 4: Test the hypothesis by carrying out an experiment.

Step 5: Analyze your data and draw a conclusion.

Step 6: Communicate your results.

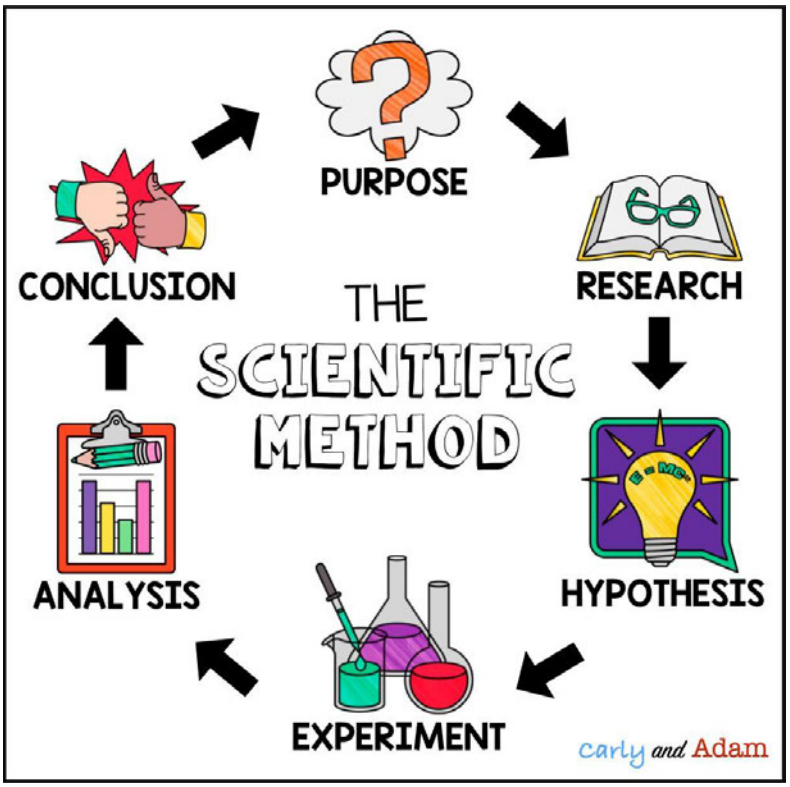


Figure 2.2: Diagram showing the Scientific Method

Source: Natural Sciences Grade 5 Platinum textbook

2.8.3. Similarities between the Design Process and Scientific Method

Both the design process and the scientific method allow for learners to be actively engaged and involved throughout the entire process. Both N.S. and Tech are subjects that relate to application and practical work. Both subjects utilise processes to engage learners as active, critical thinkers. Thus, the integration of these subjects is warranted when one considers the framework that guides them, the design process and the scientific method.

2.8.4. Differences between the Design Process and the Scientific Method

Although there are similarities between the design process and the scientific method, there are also differences. The differences between these subjects' stem from the nature of these subjects; as mentioned in the first chapter of this research paper, N.S. and the Sciences in general are fact and observation- based, aiming to explore the natural, existing world. Technology is more idea and solution-based, endeavouring to improve the world.

The design process enables learners to tap into their creative abilities and create new solutions. It allows individuals to express their own ideas and creativity, and values diversity of thought and ideas. The scientific method, on the other hand, observes and questions what exists and how it exists. It allows for no grey areas; it follows a more black-and-white method. This simple difference can either separate subjects if integration is not properly practised, or it can serve as a way to join these subjects through their differences.

2.9. Teachers' Experiences and Challenges Encountered when Implementing an Integrated Curriculum

The motivation for analysing teachers' experiences and challenges with an integrated curriculum is that teachers play a pivotal role in how the planned curriculum is delivered to learners. Pirtheepal (2019) notes that teachers are active decision-makers who make instructional decisions when teaching based on personal, practical, contextual, and professional experiences.

Scholars such as Pirtheepal (2019), Khanyile and Phosisi (2016) have explored the area of curriculum integration in various contexts. The challenges, experiences, and perspectives of teachers in curriculum integration are markedly similar in all these studies. The main challenge is the lack of professional development and training in one subject. While curriculum integration is intended to support learners and holds numerous benefits, teachers often view the call for integration of NS-TECH as a shortfall. Teachers participating in these studies indicated that they were not trained to teach one of the integrated subjects in their university years, nor were they exposed to professional development in the subject after the introduction of CAPS (2011). Therefore, they rely on resources such as textbooks to teach the subject content, and often teach NS-TECH separately.

Furthermore, most teachers were taught these subjects separately during their schooling years, and experienced the Outcomes Based Education curriculum (1997). As a result, they are unable draw upon their own educational experiences. In a study investigating the implementation of Outcomes Based Education, Selepe (2016) noted similar shortcomings that led to its lack of success, primarily the inadequate training provided to teachers when transitioning from one curriculum to another. For curriculum change to be successful, it is essential to consider that teachers may not have experienced the same curriculum that they are required to teach. Therefore, they should be extensively guided and mentored.

Additionally, teachers feel ill-prepared, leading to a lack of organisational skills and understanding when attempting to implement an integrated curriculum (Dowden, 2014). Many lack the practical and personal knowledge needed to implement a newly integrated curriculum. It is crucial that teachers be well-informed about curriculum integration designs. Teachers also encounter difficulties in improving their teaching strategies, citing inadequate training to enhance their content knowledge and skills within an integrated curriculum. Another factor influencing the successful implementation of an integrated curriculum is that teachers in South African primary schools are expected to teach all subjects in the intermediate phase. This requires teachers to venture beyond their subject specializations, resulting in lessons dominated by information-rich content lacking practical examples. Also, greater emphasis is often placed on one subject at the expense of another, as teachers tend to focus on their areas of specialization, which they are passionate about.

Nevenglosky (2018) notes several challenges in addition to the main challenge mentioned above. Lack of resources and teaching time also impacts the implementation and delivery of the curriculum to learners. In the South African context there are variations among schools. Some schools have resources that support teaching and learning, such as textbooks, charts, and infrastructure like laboratories. However, the majority of schools in South Africa are woefully under-resourced and lacking in basic resources. This adds to the many challenges that hinders teaching and learning in South Africa, with teachers consistently expressing their frustration with the lack of resource support received from the Department of Education. Learners from under-resourced schools struggle with the practical aspects of NS-TECH. When they reach university, they find that they have not been equipped with the skills outlined in the CAPS (D.O.E., 2011), which they're expected to be master.

The final challenge relates to the lack of teachers' knowledge and expertise in the creating, designing and developing the curriculum. Gupta (2023) emphasises that teachers should be involved in policy-making. He argues that teachers should be responsible for assessment, content setting, and goal and objective setting. Gupta (2023) makes a valid point; if teachers were the ones designing and developing the curriculum, they would then be fully accountable for its implementation and overall success.

2.10. Theoretical framework

2.10.1. Bernstein's Theory of Classification and Framing

This study is guided by Bernstein's (1971) Theory of Classification and Framing within the curriculum. It serves as a lens through which to analyse the relationship between different subject areas and the connection between school knowledge and everyday knowledge. According to Pluim, Nazir and Wallace (2021), Bernstein's Theory is particularly applicable to STEM fields because there are actual links between all STEM subjects (Science, Technology, Engineering and Mathematics).

Bernstein's Theory of Classification and Framing relates the two terminologies to the ideas of control and power. Framing refers to the degree of control that the teacher and learner possess over the selection, sequencing, pacing and evaluation of knowledge transmitted and received in the pedagogical relationship (Bernstein 1975, p.88). Thus, Framing relates to the relationship between the teacher and learner, together with the subject knowledge. Classification refers to the power of the teacher to pass knowledge on to the learner. In the context of integration, this means that the teacher is responsible for how the integration occurs and how the teaching and learning of NS-TECH is conducted.

Furthermore, this framework helps understand teachers' experiences while implementing an integrated curriculum, as well as their past experiences with N.S. and Technology as distinct subjects. Bernstein's views on symbolic boundaries and knowledge control are explored within the context of curriculum integration in the intermediate phase of education across four South African schools, as indicated by Spelt et al. (2009). The use of Bernstein's Theory to analyse teacher discourse in an integrated curriculum is supported by many researchers, including Short, Singh, Yarrow, and Millwater (2019), who highlight its utility, especially in examining teacher discourse.

2.10.2. Classification and Framing of an Integrated NS-TECH Curriculum.

When interpreting Bernstein's Classification and Framing Theory, weak and strong categorisations are possible. Weak categorisation implies indistinct subject boundaries (NS-TECH), whereas strong categorisation indicates clear separation between subjects (Natural Science and Technology). Integration requires weak categorisation between subjects, in this instance, N.S. and Tech. These subjects should be interlinked and taught concurrently. Teachers frame (control) this based on how they classify knowledge. Their knowledge and power stem from their experience and relationship with the subject. Within NS-TECH, Framing is robust as teachers deliver the curriculum in a way that aligns with their comfort levels, potentially leaning towards either N.S. or Tech based on their expertise

Bernstein's Theory underscores the significance of social structure in implementing an integrated curriculum, asserting that curriculum change depends on societal changes. In South Africa, CAPS was established to bring about social and political change by integrating knowledge from different learning areas. This implies a weaker implementation of Framing and Classification of Knowledge between subjects, resulting in an integrated NS-TECH curriculum where the boundaries between different subjects are less distinct.

To understand teachers' experiences with an integrated NS-TECH curriculum in the intermediate phase, this study examines adherence to these criteria in South African schools, focusing on CAPS, teachers' experiences, and their pedagogical practices within an integrated curriculum.

Bernstein's Theory serves as a guiding framework for this study’s data production and analysis. The research highlights that to achieve effective curriculum integration, teachers must possess a nuanced understanding of the components involved in an integrated curriculum. This shift requires teachers to go beyond merely imparting information and instead to focus on analysing and integrating new knowledge with previously acquired knowledge. Such a transformation demands thorough teacher preparation, which has significant implications for teacher development and training. Teachers must be well-informed about these discourses in order to guide learners toward multiple discourses of schooling (Bernstein, 1996).

Bernstein's Theory of Classification and Framing provides a valuable framework for descriptive analysis of relevant policy documents and teachers' educational practices. It highlights key issues that warrant a comprehensive qualitative analysis. In accordance with the study’s aim to explore teachers' experiences in implementing an integrated NS-TECH

curriculum within the intermediate phase, this interpretive research study examines whether the principles of Bernstein's Theory are adhered to in the South African curriculum design and implementation context. By analysing teachers' experiences, Bernstein's Theory enables researchers to assess the strengths and weaknesses of implementing an integrated NS-TECH curriculum. Furthermore, it proves helpful in understanding the professional identities of NS-TECH teachers and the implications of an integrated approach for these educators.

2.11. Conclusion

This literature review examined scholarly articles related to this research study *on Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*. The following attributes were reviewed and discussed in detail: the concept of integration; the rationale for integration in the curriculum; the rationale for the integration of N.S. and Tech; the advantages of integrating STEM subjects; the implementation of an integrated NS-TECH curriculum both locally and internationally; the similarities and differences between the design process (TECH) and the scientific method (N.S); and finally, the experiences and challenges teachers face when implementing an integrated curriculum.

In conclusion, the literature suggests that NS-TECH was integrated based on similarities and inter-connectedness, and the introduction of CAPS (2011). There are many benefits to integration; however, research reveals a lack of knowledge about how the integration should occur. South Africa aims to improve its education system by integrating subjects and reflecting on its contributions to global education. However, the specific factors applicable to the South African schooling context were not fully considered. To facilitate a successful and operational NS-TECH curriculum that heads in the direction of STEM, where subjects are presented and taught holistically, educators must be taught precisely how to integrate NS-TECH. Curriculum makers must consider teachers' views and the significant challenges they face. The next chapter focuses on the methodology of this study.

CHAPTER 3

METHODOLOGY

3.1. Introduction

As mentioned in Chapter 1, this study responds to the following research questions.

1. What are intermediate-phase teachers' views on integrating N.S. and Tech?
2. How do intermediate-phase teachers integrate N.S. and Tech?
3. Why do intermediate-phase teachers integrate N.S. and Tech in the way they do?

A brief synopsis of the methodology was presented in Chapter 1. The methodology refers to the researcher's approach to the research study. In this chapter, the interpretative paradigm's philosophical assumption underpinning this study is discussed, and the layout of the research method used and reasons for using a case study design are explained. According to Maxwell (2016) and Merriam and Tisdell (2016), research design entails a well-considered system of plans, processes, and procedures employed in carrying out a research study to achieve the research objectives. Furthermore, it explores the location of the study, sampling, the data generation plan, the data collection methods, and the ethical considerations of the research study.

The link between the paradigm, research question, approach, design and instruments used is illustrated in Figure 3.1. below:

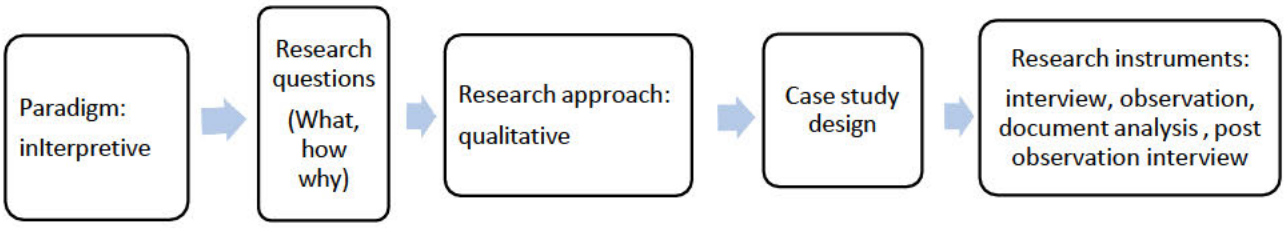


Figure 3.1. The Research Design Map

This chapter also describes the location or site of the study, the approach taken to gain access to different gatekeepers at each stage of the research, and the challenges the researcher encountered in the process of data generation. It also addresses considerations of ethical clearance from the respective and relevant authorities.

The core of this chapter outlines the data generation instruments and sampling procedure. This is followed by a detailed description of data generation and the method of data analysis. The chapter concludes by justifying the validity of the instruments and analysis procedures. This relates to the strategy used to ensure the credibility of the research outcomes and to meet the study's objectives.

3.2. Paradigm: Interpretivist

The key to having a clear direction for the method of inquiry is choosing a particular paradigm, which flags and directs thought patterns and actions in the study. A paradigm is regarded as one of the frames of reference we use to organise our observations and reasoning (Maxwell, 2016). It serves as a lens through which to view phenomena and make decisions regarding the theoretical framing, literature, methods, or research design (Cohen et al., 2018).

Paradigms help frame the approach to a research problem and guide decisions about how to address it based on certain beliefs about the world. It is a guide that helps researchers to anchor their research. The research adopts an interpretive paradigm.

Within the interpretive paradigm, researchers focus on understanding and describing how people make sense of their context and actions (Bertram, 2014, p.3). This paradigm aims to understand the subjective world of human experience and derives meaning from those shared experiences (Cohen et al., 2017). Essentially, researchers using this paradigm seek to explain social phenomena, such as people's opinions and experiences, from the perspective of the participants. Any paradigm has four philosophical assumptions: ontology, epistemology, axiology, and methodology (Creswell, 2013; Mertens, 2010). Cohen et al. (2018) note that interpretivist paradigm has the following characteristics: It focuses on the individual; involves small-scale research; acknowledges subjectivity; is qualitative; has multiple directions of causality; and seeks to understand actions or reasons rather than cause and effect. Researchers using this paradigm focus on the specific context in which people live and work (Creswell, 2013).

This study is concerned with understanding how NS-TECH teachers view NS-TECH integration and the pedagogical strategies they use to integrate NS-TECH. The ontological assumptions of the interpretative paradigm required me to consider the existence of multiple realities. I understood that the reality of NS-TECH teachers integrating NS and Tech is

multifaceted, which could only be understood from their perspective. In this regard, Cohen et al. (2018) state that the role of the researcher in the interpretive paradigm is to understand, explain, and demystify social reality through the eyes of the participants (p.16). For that reason, I used the participants' descriptions of their views and pedagogical practices on integrating N.S. and Tech as the data for this study.

Interpretivism, from an epistemological perspective, values the subjective meaning of a social phenomenon (Cohen et al., 2018). According to Cohen et al. (2018), epistemology involves research and enquiry into the nature of reality. This study generated credible knowledge from interviews, observations and document analysis.

Axiology is concerned with the values adhered to during data generation. I ensured that participants were aware that their involvement was voluntary and that they had the right to withdraw from the study at any stage without repercussions. I engaged in straightforward, honest data generation, member checking, providing clear details on data analysis, and sharing my findings with my supervisor.

The interpretative paradigm is best suited for this study, which embraces a qualitative approach.

3.3. Research Approach: Qualitative

This study employed a qualitative research approach because it aims to explore how NS-TECH teachers view NS-TECH integration and what pedagogical strategies they use to integrate NS-TECH. In opting for this approach, I was guided by the ontological position of the interpretative paradigm. The notion of constructing multiple social realities is fundamental to a qualitative approach, and it is recommended by Flick (2018) for furnishing comprehensive descriptions of human experiences of a phenomenon. Qualitative research offers an effective approach to gaining an in-depth understanding of a real-life phenomenon, such as human subjective experiences, contexts or conditions of living, social behaviours, understanding or conceptions, and perspectives on social issues (Yin, 2017). Yom (2015) and Cohen et al. (2018) agree that qualitative research is concerned with understanding participants' views, experiences, beliefs, ideals, thoughts, and actions related to social or human problems.

Qualitative research is advantageous when investigating a completely unknown or unpredictable situation (Creswell, 2018). It allows participants to express their opinions without bias, providing the researcher with uncut data. Furthermore, qualitative research that

involves human subjects uses audio, visual or textual data, enabling the researcher to derive meaning from an active social context (Flick, 2018). Accordingly, qualitative data analysis entails the researcher identifying patterns or themes that best describe the phenomenon observed (Creswell, 2012). For these reasons, qualitative research was deemed most suitable for this project as it explores intermediate-phase teachers' views and pedagogical practices on integrating N.S. and Tech.

3.4. Research Design: Case Study

A case study design was used to explore intermediate phase teachers' views and pedagogical practices on integrating N.S. and Tech. According to Yin (2017), a case study is a design that facilitates exploring a phenomenon within its context using various data sources. Resonating with Yin's (2017) idea of a case study, Creswell (2018) defines a case study as "an in-depth exploration of a bound system which could be an activity, event, process or individuals" (p. 462). In describing the philosophies underlying case study research, Njie and Asimiran (2014) suggest that this research is often grounded by time (in which data is generated or intended to be generated), phenomenon and context. A case cannot be evaluated without considering its context, as the context is essential to understanding the case itself. The case in this study is NS-TECH teachers teaching at the intermediate phase level. The phenomenon is their views and pedagogical practice regarding the integration of NS-TECH. The context is related to the intermediated N.S. and Tech phase at 4 primary schools in the Berea area.

The hallmark of the case study approach, according to Lapan et al. (2011, p. 245) and Cohen et al. (2013), is that the methodology provides comprehensive descriptions of participants' lived experiences of, or thoughts about and feelings for, a situation, using multiple data sources. These authors further contend that the strength of the case study approach lies firstly in its focus on obtaining detailed and explicit descriptions of events which helps to develop a deep understanding of the views of individual actors or groups. Additionally, they emphasise that the researcher is often personally or professionally connected to the case, which further enriches the study.

Case studies may be categorised based on their outcomes. There are three main types of research case studies: descriptive, explanatory, and exploratory. In a descriptive case study, the purpose is to describe a phenomenon in a real-world context. An explanatory case study aims

to find casual factors to explain a particular phenomenon and the primary focus is to explain why a specific phenomenon came into being in the first place. Lastly, the primary purpose of an exploratory case study is to elicit information to seek new insights and clarify one's understanding of a process or problem (Priya, 2020). This approach provides new and detailed information or insight about a phenomenon through the research findings, which could inform policy or serve as the background for further research.

This study employs an exploratory case study to examine intermediate-phase teachers' views, pedagogies, challenges, and experiences regarding the integration of NS-TECH. The case study design sets the sampling parameters and suggests the methods of generating data. Sampling is discussed in the section that follows.

3.5. Sampling

Sampling involves deciding which people, settings, events or behaviours to include in the study (Bertram & Christiansen, 2014). In agreement with Bertram and Christiansen, Gentles et al. (2015) define sampling in qualitative research as gathering information from a selected group of participants to gauge answers in response to the research questions posed. Flick (2018) asserts that sampling is vital for data collection, interpretation and presentation of findings. It is essential because it enables researchers to choose participants and data collection methods rationally. In this study, the selection of participants was guided by my research design. The specified criteria of the case and the context required that participants be intermediate-phase N.S. and Tech teachers within the Berea area.

There are several different sampling techniques available. This study employed purposive sampling to select the participants and generate relevant data to respond to the research questions.

According to Maniram, Maistry (2018), and Etikan et al. (2016), purposive sampling is a deliberate act of choosing a participant based on the attributes he or she possesses. It is not done randomly; the researcher finds people who can provide the relevant information needed for the study based on their experiences or knowledge. In this study, the criteria for selecting participants was grade 4 to 6 NS-TECH teachers in the Berea area.

The rationale behind selecting schools in the Berea area was convenience. I currently teach in that area, making the schools and teachers easily accessible to me. Next, the location of the study is discussed.

3.6. Location of the Study

The study was conducted at primary schools in the Berea area. The area has four primary schools, each with three NS-TECH teachers. Therefore, 12 NS-TECH teachers were invited to participate. As previously mentioned, the schools in the Berea area are all ex-Model C schools. The learners, however, come from different socio-economic backgrounds. Additionally, the area was once affluent but is no longer so. Learners travel from various areas to attend these schools in Berea. Having conversed with about 50 learners from these schools, I found that many learners travel to school from their homes in Sydenham, Newlands West, Musgrave, Glenwood, Westville, South Beach, Morningside, Clare Estate, Durban North, Kwa Mashu and Umlazi. The areas mentioned suggest that learners attending these schools have diverse socio-economic backgrounds, varying from being very wealthy to being very poor.

A map of the Berea area and those surrounding it appears below.



Figure 3.2: Map of the Berea and Surrounding Areas

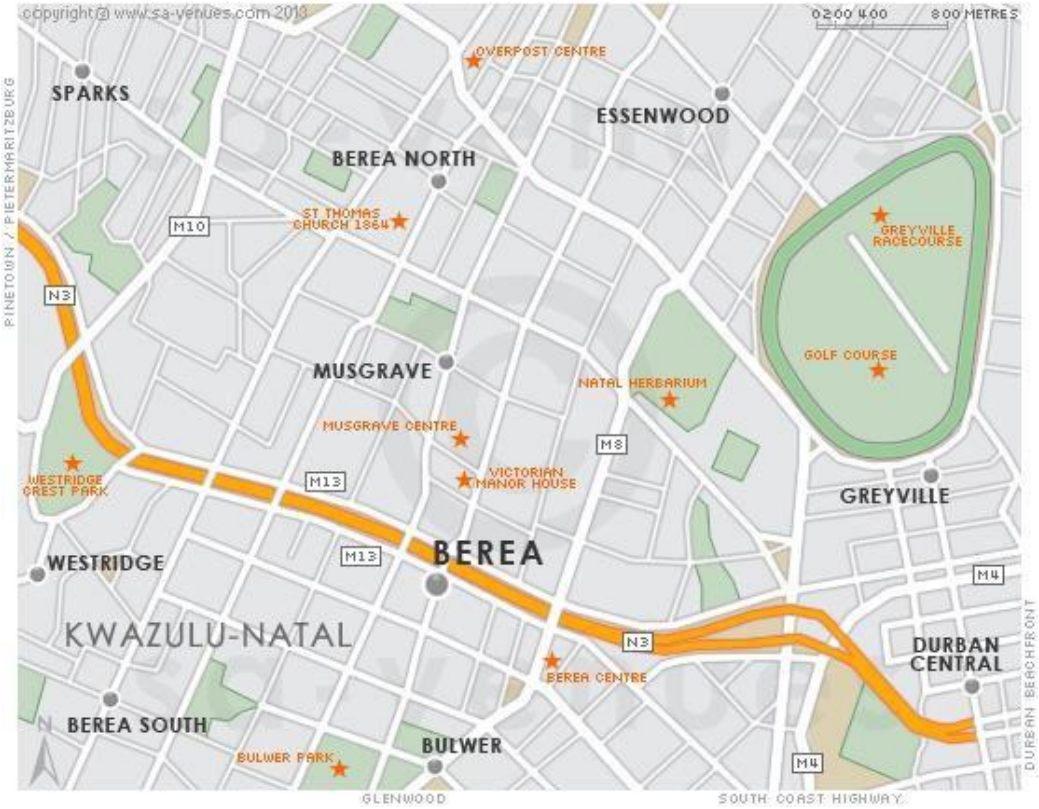


Figure 3.3: Map of the Berea Area

3.7. Data Generation Plan

Lewis (2015) defines data generation as the exercise of gathering a set of interrelated information to answer the research questions posed. The importance of data generation must be acknowledged, as it aims to contribute to a better comprehension of a theoretical framework (Bernard, 2017). It is, therefore, essential that decisions regarding how and from whom data will be obtained are carefully taken, as no amount of analysis can compensate for inaccurate data collection (Etikan et al., 2016). In this study, data was generated in two phases, as reflected in Table 3.1 below, to answer the research questions posed.

Table 3.1. Data Generation Plan

Research question	Data source	Instrument
1. What are teachers' views on implementing an integrated N.S. and Tech	NS-TECH Teachers	Interviews

curriculum in the intermediate phase?		
2. How do intermediate phase teachers integrate N.S. and Tech?	NS-TECH Teachers	Observation, Document analysis (teachers' portfolio) Post observation interview
3. Why do intermediate phase teachers integrate N.S. and Tech in the way they do?	NS-TECH Teachers	Observation, Document analysis (teachers' portfolio) Post observation interview

The above table shows the research questions, the corresponding data sources and the data generation instruments used. Each of the data generation techniques utilised will be discussed next.

3.8. Data Collection Methods

Any good study relies on the acquisition of rich and dense data. According to Deakin and Wakefield (2014), using appropriate data collection methods is the cornerstone of a successful study.

For this study, the following data collection methods were used:

- Interviews;
- Observations and
- Document analysis.

3.8.1. Interviews

Cohen et al. (2017, p.349) define an interview as an "interchange of views between people on topics of mutual interest that may assist in answering the research questions". The most commonly selected method of data collection for qualitative research is to interview participants (Adhabi & Anozie, 2017). According to Flick (2018), a well-planned interview creates an accommodating environment that puts participants at ease, allowing them to thoughtfully answer questions in their own words and add meaning to their answers. This study adopted a qualitative approach, and individual face-to-face interviews were conducted with 12 NS-TECH grade 4 to 6 teachers. Face-to-face interviews are useful because they offer the researcher an opportunity to probe participants' responses and to observe non-verbal cues which accompany verbal responses (Sullivan, 2012). There interview process has many advantages, the most significant being that it allows for a more personal experience between the researcher and the participant, facilitating interactive conversations and yielding high-quality, in-depth data.

Creswell and Creswell (2017) note that there are three types of interviews: structured, semi-structured, and unstructured. The authors elaborate further on these three types:

- Structured interview: This type of interview is controlled by the interviewer and contains predetermined questions with fixed wording in a specific order;
- Semi-structured interview: The interviewer utilises an interview schedule that guides the interview. The addition of unplanned follow-up questions (probes) is allowed. This type of interview is less controlled by the interviewer; and
- Unstructured interview: This type of interview is flexible and informal in nature, with the interviewer having a general area of interest but allowing the conversation to develop.

Semi-structured interviews are advantageous in collecting data from individuals with personal experiences, attitudes, viewpoints, and opinions pertinent to the subject of study (DeJonckheere & Vaughn, 2019). In this study, I used semi-structured face-to-face interviews. 12 teachers were interviewed (See Appendix 1 on page 96 for Interview Protocol) and the interviews were audio-recorded. The interviews were 30 minutes in duration and the questions asked during the interview included the following:

1. What are your thoughts on the integration of N.S. and TECH? Please explain.

2. Do you feel confident in teaching the content of both N.S. and TECH? Please explain.

3. What topic/s in the curriculum do you prefer to teach and why?

4. Do you think that all content areas taught in NS and TECH can be integrated?

5. How do you integrate the strands Energy and Change (N.S.) and Systems and Control (Tech)?

6. From your experience of teaching NS-TECH, do you feel that the integration of N.S. and TECH is done equitably, or do you feel that one subject is given preference over another?

The coordination of interviews was a significant challenge, with two to four weeks required to complete all the interviews. This extended timeframe was necessary because teachers had committed to helping learners prepare for their June tests. To safeguard the integrity of individual testimonies and minimise the duplication of thoughts and ideas, interviews were done individually and in secluded environments.

3.8.2 Observations

Observations entail being present and recording impressions of what occurs, and then interpreting the meaning of the observed behaviour (Cohen et al.2017). With fieldwork observations, researchers are in direct contact with the setting and the people they observe. This direct observation gives researchers first-hand experience, enabling them to generate detailed descriptions of the setting, the activities, interactions, and participants' experiences. Observation also allows the researcher to compare what is set out in the curriculum to what takes place. First-hand experience on-site is essential to providing insights that might be missed if the researcher relies solely on other people's descriptions of the setting (Creswell & Creswell, 2017). Reasonable inquiry through observation documents what is happening. Through direct observation, a researcher sets out to document, accept, and understand the complexities of a changing situation, including what may be unanticipated but emerges as vital in understanding the participants' experiences.

Cohen et al. (2017) point out that observation potentially produces more valid or authentic data than that obtained by reading a second-hand account. Likewise, the advantage of observations is that they give direct access to social interaction.

In light of this, an observation schedule was designed with the assistance of university

researchers to focus on how NS-TECH teachers plan and teach their lessons. Each teacher was observed twice, totaling 24 observations of 12 teachers. Teachers permitted the lesson observations to be audio-recorded to make the data concrete.

The observation sheet used is included below:

Appendix 7: Observation schedule

Theme	Guiding questions	comment
Structural	How is the lesson introduced?	
	What is the pace of the lesson?	
	What were the specific aims for learners to learn in this lesson?	
	What motivation was given for learners to learn /follow the intended outcomes?	
	How is the lesson concluded?	
	What type/kind of activity did learners engage in?	
Methods	What approaches are used to organize and stimulate learner learning or cater for learner misconceptions?	
	Teaching procedure and reasons for using these procedures to engage with teaching of design	
	What teaching and learning resources are used in the lesson?	
	How do learners respond to the methods?	
	Were Difficulties /limitations connected with teaching this idea noted/justified/explained	
	Was there a link between knowledge about learners thinking that influences the teaching of the design process	
	What other factors influenced the teaching of this idea/design process?	
Overall	What is the atmosphere in the lesson like?	
impression	How did the teacher relate to the learners?	
	How are learners with special needs catered for?	

3.8.3. Document Analysis

Bowen (2009) mentions that document analysis involves carefully studying documents to deeply understand the meaning of the content. In addition, Yin (2014) asserts that documents can provide information which supports details obtained from other sources.

According to Cohen et al. (2017), documentary studies use primary and secondary documents. Primary documents refer to eyewitness accounts produced by people who experience the particular event or behaviour under study. Secondary documents are those compiled by authors who are not eyewitnesses but who obtain information from interviewing eyewitnesses or reading primary documents.

This study analysed grade 4 to 6 NS-TECH teachers' teaching portfolios, in particular the lesson plans and assessment activities. The lesson plans were examined in conjunction with the integration of the Energy and Change and Systems and Control Knowledge Strands (see Appendix 3 on page 99). Lesson plans were also analysed to determine the way in which testing occurs.

3.9. Data Analysis

Qualitative data analysis involves organising, accounting for and explaining the data; in short, making sense of data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities (Cohen et al., 2018). Scholars such as Creswell (2013), Mouton (2001) and Merriam (2015) note that data analysis entails the following tasks:

- Preparing and organising the data,
- Reducing the data into themes; and
- Representing the data in figures, tables or discussions.

While undertaking these three tasks in the study, I was mindful that data analysis is not a linear process. Instead, as Creswell (2013, p.228) states, it is "inductive", "iterative", "eclectic", and "interpretive". Data analysis involves working from specific data sets to develop general codes and patterns. The unit of analysis in this study is intermediate phase NS-TECH views and pedagogical practice on integration.

In preparation for data analysis, all audio recordings of interviews and observations of lessons were transcribed verbatim and numbered from one to 12, corresponding to the pseudonym (e.g., P1) of each participant. The interview transcripts were read through several times and coded in response to the constructs of the study's conceptual framework. Coding refers to relating standardised remarks in transcripts and grouping them into sections (Adler & Clark, 2008). I

adopted an “open-coding” approach, where “concepts” are used to convey the information derived from the data collection methods (Flick, 2018, p. 297). Open coding was accomplished using the “line-by-line and phrase-by-phrase” technique (Cohen et al., 2011, p. 561).

The following diagram illustrates the process of data analysis:

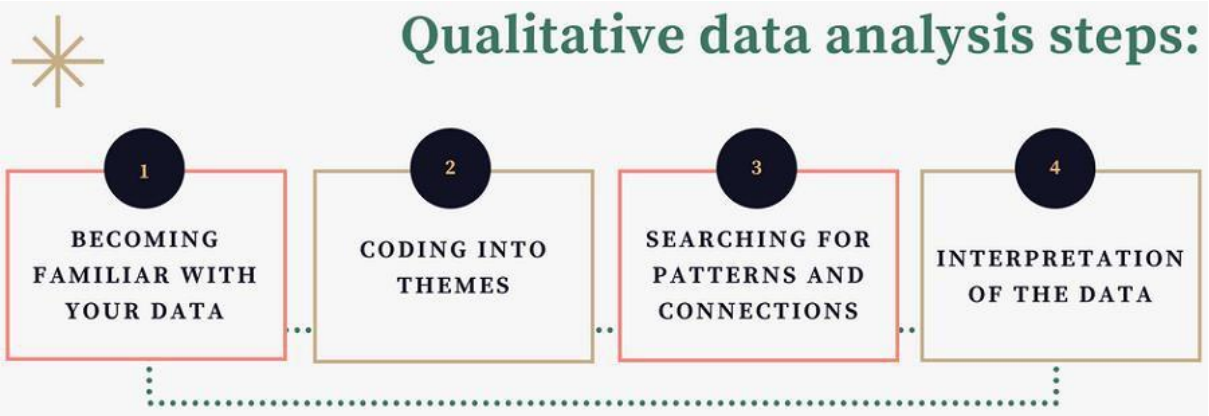


Figure 3.4: Qualitative Data Analysis Steps

Source: Research Gate (Google)

Codes were regrouped into themes. Roulston (2010, p. 150) describes thematic analysis in qualitative research as “sorting and classifying codes into groupings or clusters”. Braun and Clarke (2006, p.19) also mention that “thematic analysis reports experiences, meaning and the reality of participants”.

3.10. Ethical Considerations

Ethics refers to moral principles by which individuals can judge their actions as right or wrong, good or bad. Social researchers are expected to conduct their research ethically because research of any kind takes place within a social context (Creswell & Creswell, 2017). The ethical considerations in this study were as follows:

Gatekeeper Permission

Ethical clearance was obtained from the University of KwaZulu-Natal and from the principals of schools participating in the study. It was also necessary to obtain permission to participate in respect of participating teachers.

Informed Consent

Informed consent was obtained from NS-TECH teachers, who were made aware that participation was voluntary and that they could withdraw from the research without repercussions.

Confidentiality and Anonymity

Cohen et al. (2018) mention that participants should be assured that they will be protected from physical or psychological harm by using pseudonyms. Pseudonyms are also used to ensure the anonymity and confidentiality of participants in this study for both the schools involved and the individuals participating.

Data use, Storage and Disposal

The data will be stored for at least five years in a secure location agreed to by my research supervisors. All transcripts will be shredded after five years using a shredding machine. Audio recordings would be incinerated after five years.

3.11. Research Rigour

In qualitative research, the researcher is the primary instrument for data collection. Researcher biases that are not appropriately addressed and errors in judgment can compromise the quality of data and research results. Rigour in research and quality criteria extends beyond the researcher. Therefore, effective review processes are required. Rigour in qualitative research aims to ensure that the research design, method, and exclusions are free of bias. Rigour is achieved when each element of the study is systematic and transparent. In qualitative research, validity and reliability are replaced by credibility and trustworthiness.

Trustworthiness or rigour of a study refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Closa, 2021, p. 275). In each study, researchers should establish the protocols and procedures necessary for a study to be considered worthy of consideration by readers (Amankwaa, 2016, p. 32). Although most experts agree that trustworthiness is necessary, there are ongoing debates in the literature regarding what constitutes trustworthiness (Shufutinsk, 2020, p. 52). Trustworthiness includes credibility, dependability, confirmability, and transferability.

Credibility is a quality measure that involves establishing that research findings are in accordance with participants' contributions and articulation of the data collected (Kumar,

2019). According to Creswell (2017, p. 206), “validation" in qualitative research is an attempt to assess the "accuracy" of the findings, as best described by the researcher and the participants. To enhance the study’s credibility, I validated data by re-engaging with all participants through member checking. This process reaffirmed their responses, obtained clarification and elaboration where necessary, and verified their agreement with the information gathered.

3.12. Limitations of the Study

This study involved a case study; hence the data cannot be generalised. To overcome this limitation, rich, thick descriptions are provided in terms of the data generated.

3.13. Conclusion

This chapter discussed the suitability of the selected research methodology in relation to the research study. The characteristics of an interpretive, qualitative, exploratory case were explored. Interviews, observations, and document analysis, which were utilised as data collection methods, were explained in detail. Furthermore, the sampling method, location, ethical considerations and limitations were outlined. The next chapter focusses on presentation of data and discussion of findings.

CHAPTER 4

PRESENTATION AND DISCUSSION OF FINDINGS

4.1. Introduction

The integration of N.S. and Tech as a combined subject (NS-TECH) represents a significant curriculum reform in education. However, the effectiveness and implementation of this integration have raised concerns among educators (Department of Basic Education [DBE], 2011). Chapter 3 above provided the methodological approach, research design, and population and sample procedures used in the study. Additionally, the chapter gave a detailed description of data collection methods and instruments, data analysis methods to ensure reliability and credibility of the study, validity and research rigour measures implemented in light of the instruments used, and ethical procedures followed. This chapter presents empirical findings from the data analysis, along with their interpretation.

The chapter begins by outlining the biographical data of teachers who participated in the study as a means of understanding teachers' personal attributes based on their professional experiences, skills, qualifications, experience of teaching NS-TECH, exposure to professional development workshops, and how these factors influence their practice of integrating NS-TECH. This is followed by a presentation and discussion on the first research question: ***What are intermediate-phase teachers' views on integrating N.S. and Tech***? This question was addressed through data derived from semi-structured, face-to-face interviews, observations and document analysis (lesson plans). Three themes emerged relating to intermediate phase teachers' views on integrating Natural Sciences and Technology (NS-TECH), namely, teachers' rationale for integrating NS-TECH, inequitable integration of NS-TECH, and advocacy for separation of NS-TECH. Each of these themes is discussed in detail in section 4.3 below. Section 4.4 addresses the second research question: ***How do intermediate phase teachers integrate N.S. and Tech?*** Section 4.5 discusses the findings in response to the third research question: ***Why do intermediate phase teachers integrate N.S. and Tech in the way they do?*** The chapter ends with a conclusion on the findings.

4.2. Biographical Data of Teachers

The section below presents the biographical data of NS-TECH teachers in the Berea area. The data provides insights into the teachers' characteristics in terms of their gender, professional qualifications, general teaching experience, the experience of teaching NS-TECH as a subject, subjects taught prior to teaching the NS-TECH curriculum, and attendance at professional development workshops organised by the provincial DoE. 12 teachers participated in the study and pseudonyms were used to protect the confidentiality of the participants.

Table 4.1. Biographical Data of Teachers

Teachers	Gender	Qualification & Majors	Years of Teaching Experience	Years of Teaching Experience in NS-TECH	Other Subjects Taught	Attendance of Workshops for NS-TECH
1	Female	Intermediate phase: Natural Sciences and Social Sciences	13	5	English, Social Sciences, Mathematics	1
2	Female	Foundation Phase: English, Mathematics and Life Skills	9	2	English, Mathematics, Life Skills, Social Sciences, Afrikaans	0
3	Female	Intermediate Phase Teacher: Natural Sciences and Art	8	8	Social Sciences, Mathematics	2
4	Female	Intermediate Phase: English and Natural Sciences	17	10	Social Sciences, English, Mathematics	2
5	Male	Intermediate Phase: Natural	2	1	Social Sciences	0

		Sciences and Mathematics				
6	Female	Senior and FET: Geography and Mathematics	7	3	Social Sciences and Mathematics	0
7	Female	Foundation Phase: Mathematics, English and Life Skills	10	4	Mathematics, Life Skills	0
8	Male	Intermediate Phase: Mathematics and Natural Sciences	5	5	Mathematics, English, Life Skills	0
9	Female	Intermediate Phase: English and Natural Sciences	3	1	English	1
10	Female	FET phase: Mathematics and Life Sciences	16	1	English, Mathematics, Life Skills, Social Sciences	0
11	Female	Intermediate Phase: Natural Sciences and Technology	4	4	English, Mathematics, Life Skills, Social Sciences	1
12	Male	Intermediate Phase: Social Sciences and Natural Sciences	7	7	Social Sciences	2

From the above, it appears that more females are currently teaching NS-TECH. Six of the nine female participants had attended professional development workshops.

4.3. Presentation of Findings and Discussion: RQ1: What are Intermediate-Phase Teachers' Views on Integrating N.S. and Tech?

As mentioned in the introduction of this chapter, three themes emerged. These were teachers' rationale for the integration of NS-TECH, inequitable integration of NS-TECH, and advocacy for separation of NS-TECH.

4. 3.1. Teachers' Rationale for the Integration of NS-TECH

Five of the 12 teachers supported the integration, commenting as follows:

"I do feel like the intention to integrate N.S. and Tech was to cater for all learners' needs and abilities. The technological content and practical work allow learners who aren't always book smart and academically inclined to develop critical thinking, problem-solving skills, and creativity, and apply them to their context." P2, interview.

P2 believes that the integration of the two subjects enhanced learners' understanding of the interconnectedness of subject content, processes, and the design process. The integrated curriculum promotes the development of essential 21st century skills, such as critical thinking and problem-solving, which can be applied to solve everyday problems.

Similarly, P9 noted that, "If learners are good with Technology and not with N.S., they can still do well, and vice versa. However, I feel like the practical aspects need to be included more and skills focus should be included." P9, interview.

P9 asserts that the integration of NS and Tech effectively caters to learners' diverse abilities due to the enhanced practical nature of the subject and the application of content and skills to solve contextual problems.

The participants of the study believe that integrating NS-TECH fosters an understanding among learners of the interconnectedness of subjects and their collective relevance to real-life situations and future opportunities. Additionally, they believe that the combination of the two subjects' benefits learners with varying academic strengths, as learners who may not excel in one subject but are proficient in the other are able to achieve a good grade for NS-TECH (which is represented as a single subject on academic reports).

This finding resonates with a study by Williams and Dixon (2019), which highlights the importance of real-world application opportunities in the integration of subjects. The teachers' perspectives suggest that integrating NS-TECH provides learners with the opportunity to apply

their knowledge and skills to solve contextual problems, enhancing their understanding of and engagement with the subject matter.

4.3.2. Inequitable Integration of NS-TECH

The research findings show a profound imbalance regarding how N.S. and Tech are integrated within the CAPS NS-TECH curriculum. This imbalance represents a significant concern for educational equity and effectiveness in South African schools. The interviews reveal a clear pattern of systematic prioritisation of N.S. content over Tech in both curriculum design and classroom implementation.

Participants' comments provide compelling evidence of this disparity:

"I feel that there is not a good balance, there is more emphasis on Scientific theory and very little coverage of the technological aspect." (P1, interview)

This observation reflects a broader structural issue within the curriculum framework. P5's historical perspective reinforced this sentiment. This teacher noted the significant changes that occurred when the subjects were combined:

"I've taught N.S. for many years. When I started teaching, it was N.S. and Tech separately. The combination of these subjects was introduced to compress the curriculum. We, as teachers, also had to then compress the content. It is blatantly shown that N.S. is favoured."(P5, interview)

The disparity manifests most notably in the allocation of teaching time and resources. Within a typical 10-week term, N.S. is allocated approximately six to seven weeks of instructional time, leaving Tech with one to two weeks for content delivery. This compressed timeframe for Tech education raises serious concerns about the depth and quality of the technological literacy being developed in learners. This stark contrast in time allocation reflects a deeper systemic bias in favour of N.S. in the curriculum structure.

Interestingly, the study revealed an unexpected dimension to this imbalance, when considered through the lens of teacher preparation and expertise. Many teachers acknowledged their limited background in Tech education, with several admitting to learning Tech content alongside their students. Some teachers found the compressed Tech schedule personally beneficial due to their own knowledge gap. However, this situation could perpetuate a cycle of inadequate Tech education and could further marginalise the subject within the curriculum.

The research also highlights broader implications for educational policy and practice. The current curriculum structure appears to be a product of historical circumstances and administrative convenience rather than pedagogical best practices or student learning needs. This situation mirrors findings in international research on integrated curricula, where similar challenges have been documented in attempts to combine previously separate subjects.

The implications of this imbalance extend beyond immediate classroom instruction. Students may graduate with underdeveloped technological competencies, limiting their readiness for an increasingly technology-driven world. Furthermore, the marginalization of Tech within the curriculum could discourage student interest in technological fields, impacting future career options.

These findings suggest a need for comprehensive curriculum reform to establish a more equitable balance between N.S. and Technology. Such reform should consider content distribution, time allocation, teacher preparation, and professional development needs. The current situation, while pragmatic from an administrative perspective, fails to serve the changing educational needs of students in a dynamic technological society.

This analysis aligns with broader research in the field of integrated curriculum studies, particularly echoing the findings of Venville et al. (2012) regarding the challenges of maintaining subject equity in integrated STEM education. The consistent marginalisation of Tech within the NS-TECH curriculum raises important questions about the effectiveness of current integration approaches and indicates the need for a fundamental rethinking of how these subjects are combined and taught in South African schools.

4.3.3. Advocacy for Separation of NS-TECH

A comprehensive analysis of teacher interviews reveals significant challenges to the implementation of the integrated Natural Sciences and Technology (NS-TECH) curriculum. The research findings point to a complex interplay of professional identity, pedagogical competence, and curriculum design issues that impact teaching and learning effectiveness. Teachers' comments offer clear evidence of these challenges, as highlighted by P6:

"When it comes to the older teachers, Technology was not a part of the syllabus... Even my lecturer wasn't very aware of Technology. Hence, it's not as familiar to me." (P6, interview)

This statement underscores a generational gap in Technology education that continues to influence current teaching practices. The historical absence of Tech in older teacher training programmes has created a marked knowledge deficit that affects teachers' ability to deliver integrated content effectively. The situation is further complicated by teachers' professional identity formation, which is deeply rooted in their subject expertise, primarily N.S.

The effect of having a limited Tech background on teacher confidence has emerged as a critical theme:

"I have never studied Technology, so when it comes to the content of Technology, I am not looking forward to teaching these content areas" (P7, interview)

P7's forthright admission reflects a widespread sense of professional vulnerability and insecurity when teaching outside one's area of expertise. This lack of confidence directly impacts instructional quality and learner experiences of Tech education.

Teachers' ethical concerns regarding educational equity add another significant dimension to the findings:

"From a fairness point of view, I definitely think they need to be given equal hours or separated"(P11, interview)

P11's observation speaks to a deeper understanding of curricular justice. The current integrated structure appears to disadvantage both teachers and students, particularly in the Tech component of the curriculum. This aligns with research by Bennett and Hogarth (2019), who found that teacher expertise significantly influences the quality of integrated STEM education delivery and student outcomes.

The preference for subject separation, expressed by half of the interviewed teachers, stems from genuine concern for student learning rather than mere convenience:

P2's interview statement, "*I don't like integrating NS and Tech, I feel both subjects are interesting and exciting and deserve to be taught on their own*", reflects a professional judgment about the optimal conditions for student learning. Teachers consistently emphasise that their limited knowledge and reduced enthusiasm for Tech content compromises their ability to provide effective instruction.

These findings suggest that successful curriculum integration requires more than structural changes to timetabling and content organization. The integration challenges identified in this

study align closely with international research findings. For example, Williams and Lockley (2012) noted similar patterns in their study of integrated Science and Tech teaching in New Zealand, where teacher background was shown to have a major influence on the quality and depth of Tech instruction. Their research showed that teachers with limited Tech training tended to emphasise familiar Science content while neglecting or superficially covering Tech components. The research indicates a need for comprehensive reform in teacher preparation and professional development programs to address the historical gaps in Tech education. Teachers' experiences highlight the importance of subject-specific expertise in delivering quality education, particularly in technical fields that require specialized knowledge and skills.

The implications of these findings extend beyond immediate classroom practice to broader questions of educational policy and curriculum design. While theoretically sound, the current integrated curriculum structure, faces important practical challenges in implementation. Teachers' widespread advocacy for subject separation reflects their professional judgment about the best ways to ensure quality education in both N.S. and Tech.

The research also underscores the need for a more nuanced approach to curriculum integration that acknowledges the complex relationships between teacher expertise, subject knowledge, and effective pedagogy. This might involve reconsidering the current integrated model in favour of approaches that better align with teacher capabilities and student learning needs. Such reform needs to address both the structural aspects of curriculum design and the fundamental issue of teacher preparation in Tech education.

Additionally, the findings suggest that successful curriculum integration requires careful consideration of teacher preparation and ongoing professional development, taking into account the practical realities of classroom instruction. The current challenges identified by teachers indicate a need for systemic change to achieve effective implementation of integrated N.S. and Tech education. This may include enhanced teacher preparation programmes, structural curriculum changes, and alternative delivery models that better serve both educators and students.

4.4 RQ 2: How do Intermediate Phase Teachers Integrate N.S. and Tech?

This study investigated the complexities of integrating N.S. and Tech (NS-TECH) in intermediate phase teaching practices. The research addresses a critical gap in understanding

how teachers navigate the challenges of implementing an integrated NS-TECH curriculum in these traditionally separate disciplines (Drake & Burns, 2021).

The analysis identified three distinct themes relating to the integration of N.S. and Tech. These were the absence of integration, successful integration and, finally, a third theme characterised by teachers who, despite trying to connect N.S. and Tech in their lesson plans, struggled to effectively implement this integration during the actual delivery of their lessons. These themes provided valuable insights into the varying levels of integration and highlighted discrepancies between planned and implemented practices in certain cases.

4.4.1. Theme 1: Absence of Integration

Teachers in this category were observed to consistently approach the teaching of NS-TECH as two distinct subjects with no links or reference to them as complementary subjects drawing on the same foundational principles. Of the 24 lessons observed, *twenty-three lacked any sense of integration* between N.S. and Tech. Additionally, 14 displayed no integration at the planning stage, as evidenced by lesson aims, which were subject-specific and lacked interdisciplinary connections.

Examples of lesson aims included:

- "Learners should be able to understand what fuels are and how they are used" (P1, lesson 1, document analysis).
- "For learners to understand how wheels and axles work, the difference between a fixed and turning axle, and its importance in a system" (P4, lesson 2, document analysis).
- "Learners should be able to explain how electricity travels to get to our homes" (P10, lesson 1, document analysis).

These aims demonstrate a clear delineation between the two subjects. Each aim focused narrowly on either a N.S. or a Tech concept, without any attempt to establish meaningful connections or integration:

Aim 1: The objective to understand fuels and their uses focused solely on the scientific aspects, such as the properties and applications of fuels in energy production, without exploring how fuels are utilised in technological systems such as engines or machinery.

Aim 2: The aim to understand wheels and axles centred on the mechanical function and variations of these components but failed to link these concepts to the scientific principles underpinning movement, such as force and friction.

Aim 3: The aim regarding electricity transmission emphasised scientific processes but overlooked technological aspects, such as the design of power systems and devices facilitating energy delivery.

This lack of integration was further evident in the implementation of the lessons, observed as follows:

P2's lesson 2 was on Systems for Moving Things. The teacher introduced the lesson by telling learners that they will be moving on to the more tech aspect of NST, dealing with systems, control, wheels, and axles. The teacher then proceeded with the textbook content. (P2, lesson 2, observation)

P7's lesson was on Safety with Electricity. The teacher started the lesson by asking learners to look at their textbook., which showed two pictures; one of someone using electricity dangerously and another using it safely. (P7, lesson 2, observation)

Lesson on Systems for Moving Things: This Technology-focused lesson involved introducing systems and control (wheels and axles). The lesson missed opportunities to engage learners through hands-on activities, such as constructing a wheel-and-axle model, which could have enriched understanding by linking the technological concept to the scientific principles of motion and force.

Lesson on Safety with Electricity: This N.S.-focused lesson began with a discussion of textbook images illustrating unsafe and safe uses of electricity. The teacher relied solely on the textbook, without encouraging exploration or critical thinking through practical demonstrations or discussions on technological innovations for electrical safety. The absence of a technological perspective limited the scope of the lesson, preventing learners from considering the broader applications of electricity in safe system designs.

The teaching approaches observed reflect a compartmentalised or silo understanding ofN.S. and Tech, involving limited effort to interweave the two disciplines. The absence of integration of NS-TECH can be linked to teachers' content knowledge of NS-TECH or lack thereof. This separation limits learners' ability to appreciate the interconnectedness of scientific concepts and

technological applications and undermines their ability to apply their learning to real-world contexts. For example:

Fuels could have been linked to Tech by exploring how they power vehicles or machinery, and how advancements in technology are driving the development of alternative energy systems.

Wheels and axles could have been connected to N.S. by investigating how forces, motion, and energy transfer contribute to their function within a system.

Electricity could have bridged into Tech by examining devices and infrastructure that enable safe and efficient energy transmission.

The teaching approaches used were textbook-centred instruction involving limited hands-on activity and no application or connection to the real-world context. This finding resonates with that of Johnson et al (2021), who studied the challenges of STEM integration and its application to people's everyday lives. The lesson structure took a traditional lecture format with limited learner engagement. There was a notable lack of connections between related concepts in science and technology during instruction. The assessment tasks also focused on either science or Tech. This separation of N.S. and Tech reflects what Venville et al. (2020) refer to as the "disciplinary silo effect" in STEM education. This phenomenon occurs when subjects are taught in isolation, contrary to the integrated nature of real-world applications.

4.4.2. Successful Integration of NS-TECH

Teachers who are confident in the content knowledge of N.S. and Tech possess a deep understanding of the scientific principles that undergirding these subjects. They are able to appreciate the link between the content knowledge and to develop innovative pedagogy to teach NS-TECH in an integrated manner. They are mindful of the connection between science inquiry and the design process, as well as scientific principles and technological applications:

"*There can be integration in Natural Sciences and Technology, for example, if we look at the technology used in the medical field, everything has advanced to the use of technological equipment, if the curriculum was integrated in this way learners would be able make links*." (P6, interview).

"*For learners to understand what systems are and how they function. Learners will need to use prior knowledge on fuels, to understand that systems need a to use a fuel as an input energy*." (P3, lesson 2, document analysis).

P3's lesson began with a video of different vehicles. She asked the learners how these vehicles moved, which integrated the concepts of wheels and axles (Tech) and fuel (N.S.). (P3, lesson 2, observation)

As is apparent above, these teachers were able to make complex abstract concepts accessible to learners by linking them to the learners' daily lives. Furthermore, this teaching approach is learner-centred, with the teacher adapting the curriculum materials to meet student needs. the biographical data indicates that these teachers have attended training on how to integrate NS-TECH and are qualified to teach NS- TECH. They are familiar with pedagogical approaches, such as inquiry-based learning and project-based learning, for the integration of NS-TECH. These findings align with those of Kelley, et al (2016) who emphasise the need for strong content knowledge and pedagogy for integrating STEM subjects, as well as ongoing commitment to professional development and pedagogical innovation.

4.4.3. Planning-Implementation Disjuncture

A few teachers indicated that they intended to integrate NS-Tech in the design of their lesson plan, but this intention did not translate into practice. The specific aims outlined in certain teachers' lesson plans illustrate this:

For learners to be able to identify different types of fuels and understand input and output energy. Learners will have to first understand what input and output means. This will be explained through the integration of Technology, using the following diagram. (P1, lesson 1, document analysis)



Figure 4.1: Input, Process, Output Diagram

Source: Technology CAPS Document Senior Phase

Although P1 had a well-planned lesson that supported integration, she did not refer to the lesson plan in the actual teaching. The planned lesson would have been a NS-TECH lesson, had she done so. However, the lesson went as follows:

The teacher introduced the lesson on fuels by speaking about food providing energy, which acts as a fuel for the body. She used examples of food and how, when we feel tired and have a meal, we feel energised. In teaching, she followed the textbook, which did not allow for integration. She explained the process of food growing and how it reaches us. (P1, Lesson 1, Observation).

The above observation of P1's lesson showed that the planned lesson and actual lesson did not match one another. The planned lesson was well structured and would have been a completely wholesome and integrated NS-TECH lesson, had it been taught in accordance with the plan. This was discussed with P1 in her post-observation interview. She was straightforward and honest in her response, explaining that her lesson plan was downloaded from a learning website, and done for the purpose of filing only. She further expressed that when she teaches, she does not refer to her lesson plans; rather, she teaches from the textbook, CAPS Document, Annual Teaching Plan (ATP), and her experience and knowledge.

This was a common perspective of the participants who included integration in their lesson planning stage, but not in their implementation. Another view shared was that the DofE provides lesson plans for NS-TECH, which teachers found logically and practically difficult to implement owing to disparate resources and time constraints. All participants indicated that they do not follow a lesson plan; rather, they rely on the textbook. Considering that there is no integration within the textbook, it may be that the issue lies here.

4.5. RQ3: Why do Intermediate Phase Teachers Integrate N.S. and Tech in the Way they do?

The third research question critically explores the reasons underlying teachers' decisions to integrate or not integrate N.S. into their teaching practices. While the first research question focused on teachers' views and the second on their pedagogical practices, this final research question synthesises these two aspects. It offers a platform for teachers to elucidate the rationale underpinning their perspectives and pedagogical practices. Moreover, spending time in

classrooms with these educators provided valuable insights into their practices, as reflected in their actions during lessons.

This question was addressed through a combination of classroom interviews, observations, document analysis, and post-observation interviews. Teachers were also afforded the opportunity to articulate their views in relation to their pedagogical practices.

Two prominent themes emerged in relation to the question. The first was the educators' confidence or lack of confidence in teaching NS-TECH. The second was the extent to which teachers' years of experiences impacted their practices. These findings highlight the interplay between experience and confidence in shaping teachers' pedagogical approaches to integrating N.S. and Tech.

4.5.1. Confidence of NS-TECH Teachers and the Impact this has on how the Curriculum is Integrated and Implemented

One of the questions that were asked during the interview process was: Do you feel confident teaching NS-TECH, as a whole and integrated subject? Some of the responses are provided below:

"*Yes, I feel confident in teaching NS-TECH as a whole. However, I had majored in N.S. and not Technology at university. Regardless of this, I have made a concerted effort and taken the initiative to learn, as well as be able to teach the content of Technology*." (P2, interview)

"*I feel more confident in Natural Sciences, as I am more knowledgeable about it. However, since it is integrated, I am forced to teach Technology as well*." (P4, interview)

Upon analysing the two excerpts, it is apparent that the participants demonstrate differing levels of confidence in teaching NS-TECH. Notably, three of the participants expressed views that were similar to P2. While acknowledging their lack of formal Tech training or background, these teachers conveyed confidence in their ability to teach the subject effectively. This self-assuredness was rooted in their dedication to preparation, which included watching instructional videos, engaging with supplementary materials, and thoroughly familiarising themselves with the content prior to their lessons. Such proactive measures seem to have compensated, to some extent, for their lack of Tech expertise.

One important factor linking these teachers was their years of experience in the teaching profession, which contributed to their overall sense of competence. The role of experience in teacher confidence will be explored in greater detail in the next theme. It is worth noting that experience often equips teachers with the ability to adapt to new challenges and navigate unfamiliar content areas, which may explain why these participants felt relatively secure in teaching NS-TECH despite their lack of a specialised background.

That being said, a more detailed examination of their teaching practices revealed a discrepancy between their self-reported confidence levels and their actual implementation of integrated teaching strategies in the classroom. During the interview process, these teachers emphasised their confidence and asserted that they incorporated integration into their lesson planning. They described efforts to bridge the two subjects in ways that enrich students' understanding. Classroom observations presented a different situation. There was no apparent integration of N.S. in the teaching practices observed. Instead, the lessons primarily focused on the distinct content areas, while integration was either absent or not explicitly demonstrated.

Despite this inconsistency, it is important to acknowledge the confidence these teachers displayed in delivering NS-TECH as individual subjects. Their effectiveness in teaching the material indicates that their preparation and experience provide a solid foundation for content delivery. However, the gap between their stated intentions and observed practices raises critical questions about the challenges of implementing integrated pedagogical approaches.

P7 was the other participant who expressed confidence in teaching NS-TECH. However, observation of his lesson revealed a complete lack of integration:

The lesson dealt with burning fuels and the fire triangle. The teacher stated the topic for the lesson and began teaching the content using the NS-TECH textbook. The textbook focused solely on the three things that are required for a fire to burn so the entire lesson was based N.S. (P7, observation)

P7 was confident and demonstrated a strong background knowledge in concepts taught. He was knowledgeable in N.S. and provided an in-depth lesson when teaching this to learners. Furthermore, he displayed confidence and initiative when teaching his Tech lesson, which focused on wheels and axles and how they work together. He utilised videos to explain the way wheels and axles work.

In the post-interview process, P2, 4 and 7, responded to the question regarding why they taught their lessons in the way that you did, as follows:

P2: "I *am confident and have knowledge of both subject areas, but I do not know how to link them together, hence I teach them both separately but to the best of my ability*."

P4: "*I am more confident in Natural Sciences, and I feel like that is evident, however, I do try and relate Technology to our daily lives for me to be able to find links and similarities, however, I am not always able to*."

P7: "*Although I planned to use some integration when I am teaching, I find it easier to teach Science and Technology content separately, however I use a lot of videos for Technology because I feel that can help learners understand better, since I am not an expert in Technology*."

The excerpts above reveal that although these teachers are confident in teaching N.S. and Tech, they perceive these as two distinct subjects rather than a unified discipline. For them, N.S. and Tech are separate entities each requiring dedicated focus and a comprehensive approach to teaching. This perspective highlights their belief that the subjects would benefit from being taught individually to provide greater depth and clarity to learners.

Furthermore, the teachers' adaptability is evident. Despite their personal preferences or lack of enjoyment in certain aspects of the curriculum, they demonstrate a willingness to step outside their comfort zones to facilitate effective learning. This reflects a strong sense of professional commitment and resilience, as they prioritise the learners' educational needs over personal preferences. Their adaptability also underscores the broader dedication of teachers to overcoming classroom, even when the demands of the curriculum do not align with their expertise or interests.

Additionally, the words and actions of teachers, both direct and indirect, indicate that their experiences and years of teaching these subjects have shaped their attitudes. Repeated exposure to the dual requirements of N.S. and Tech has encouraged them to adapt, embrace, and even find enjoyment in teaching both subjects over time. This progression demonstrates the impact of experience in fostering professional growth and confidence. It also highlights the dynamic nature of teaching, requiring that educators continually evolve and refine their practices to meet the expectations of the curriculum while supporting the holistic development of their students.

Overall, these teachers' reflections illustrate the connection between professional competence, adaptability, and the transformative power of experience on their teaching practices and attitudes towards N.S. and Tech.

In contrast to this, there were many teachers who expressed a lack of confidence in teaching NS-TECH. When asked whether they felt confident in teaching NS-TECH, as a whole and integrated subject, they responded as follows:

"*No, I do not, I am more knowledgeable in Natural Sciences, and I prefer teaching Natural Sciences*." (P1, interview)

"*This year, according to the needs of the school, I needed to move to the intermediate phase. However, I am more confident with NS as I have specialised in the foundation phase, and NS is something that is taken through from Grade R*." (P11, interview)

The two teachers mentioned above represent a category of educators who have expressed a lack of confidence in teaching N.S. While these teachers explicitly identified their challenges, nine additional educators shared a similar perspective, albeit indirectly. These teachers did not openly articulate a lack of confidence in N.S. but instead highlighted their struggles with teaching Tech. This apprehension towards Tech translated into difficulties in integrating it effectively with N.S., as required by the curriculum. Despite their efforts to deliver the subject as an integrated whole, their lack of confidence in Techn often resulted in an incomplete approach to teaching NS-TECH as a unified discipline.

The interviews with these teachers revealed a recurring theme: many lack the necessary skills or understanding to implement an interdisciplinary approach successfully. This limitation was evident in both their verbal responses and during classroom observations. The teachers acknowledged their uncertainty about how to integrate the two subjects, often attributing this to gaps in their professional training or insufficient exposure to integrative teaching methods. Their lack of confidence in navigating the complex intersection of N.S. and Tech further reinforced their preference to approach these as separate disciplines, which hindered their ability to fully adopt the integrative framework envisaged by the curriculum.

This affiliation between the teachers' reflections during interviews and their observed classroom practices highlights the relationship between teacher confidence, pedagogical skill, and curriculum delivery. It underscores the necessity for targeted professional development and support to address the specific challenges of teaching NS-TECH. Improving educators'

confidence and competence in both subject areas can enhance the quality of integration and ensure more effective curriculum implementation.

Years of Experience in Teaching N.S. and Tech, and Teaching as a Whole

P3's comments regarding the impact of experience on confidence in teaching is instructive:

"*I am definitely more knowledgeable in Natural Sciences as compared to Technology, but after years of teaching the content of both subjects, I have gotten better at it*." (P3, Interview)

This sentiment, echoed by many participants, affirms that years of experience in a field fosters confidence and expertise. The sample used for this research study consisted of teachers that varied in age. The five participants, each of whom had at least 15 years of teaching experience, expressed that their years of experience in the teaching field have played a significant role in their confidence levels.

"*As teachers, we are expected to adapt and change with the curriculum policies and procedures, and we have become accustomed to that*." (P8, post observation interview)

This opinion was shared amongst the five experienced participants. The theme of experience in a field helping to develop confidence can be applied to any situation: when an individual is expected to do the same thing every day or every year as in this case, it becomes a part of that individual's make-up. Having been a part of the teaching/school system for over 15 years, these teachers would have been exposed to a range of curriculum policies in addition to CAPS (Curriculum Assessment Policy Statement, 2011), in which they have gained significant experience. They shared their experiences of growth over the years and how long it took them to become more knowledgeable about Tech content and the newly introduced N.S. content through CAPS (DBE, 2011).

By contrast, younger teachers lacked confidence. Four of the remaining participants had between one to five years of experience and were either fairly new to the field of teaching or new to teaching NS-TECH. The last three participants formed the middle range of experience, with between six and 14 years of experience teaching N.S. and Tech.

"*It is my first-year teaching NS-TECH, and I feel like Natural Sciences forms a bigger part of the subject. However, I am okay with that as I know about the content covered in Natural Sciences, I can teach using nature and the environment. Maybe with time I will be more comfortable with the technological content.*" (P6, interview)

P6 had only a few months experience of teaching NS-TECH and she expressed that she did not feel confident. She stated that she lacks experience, which was evident in the lesson observation as well:

The lesson focused on energy and electricity. The teacher began by switching the lights on and then asking learners to share how they thought electricity got to the classroom. Learners shared their thoughts, but thereafter, the teacher did not spend time discussing learners' contributions. She went on to follow the textbook and learners appeared to lose interest as the terminology became confusing. She used words like 'generator' and 'turbines' but struggled to explain them to learners. (P6, observation).

Although this lesson was primarily based on N.S., P6 still lacked the confidence and seemed about how to make the lesson more relatable and relevant. She mentioned feeling more confident in N.S., but still lacked the confidence of teachers with more experience in this subject. This highlights the theme that years of experience teaching N.S. and Tech are related to the effective implementation of its curriculum.

4.6. Conclusion

This chapter explored the data that answered the following three research questions:

1. What are intermediate phase teachers' views on integrating N.S. and Tech?
2. How do intermediate phase teachers integrate N.S. and Tech?
3. Why do intermediate phase teachers integrate N.S. and Tech in the way they do?

In summary, the findings were as follows:

RQ1:

Intermediate phase teachers expressed views that were grouped into three categories. The first included teachers who believe that integrating NS-TECH is beneficial to learners. Their views in this regard are that integrating two subjects creates balance in summative and formative assessment. They emphasise that learners often prefer one subject over another and integrating subjects favours them. Another point made is that teaching an integrated curriculum enhances understanding of its overall purpose and how different subject areas interconnect, as well as their relevance to our daily lives. The second category included teachers who feel that the

integration of NS-TECH is not done equitably. Teachers expressed views on the lack of integration and their lack of technological knowledge. Although the participants all prefer teaching N.S., they shared the ethical view that integration should be done fairly or not at all. This aligns with the final category, which included those teachers who believe that since NS-TECH is being taught as two separate entities, they should remain distinct. The main point raised here is that learners do not experience the curriculum as an integrated whole; N.S. is prioritised, resulting in an inadequate and inequitable experience of Tech.

RQ2:

Three themes emerged here. The first was teachers who did not integrate NS-TECH at all when teaching; this included the majority of participants. It was found that most educators teach NS-TECH, as separate subjects focusing either entirely on N.S. or on Technology. The second theme was teachers who integrate NS-TECH; only one teacher employed N.S. content in her Tech lesson. The final theme was teachers who aim to integrate these subjects but do not. This theme highlighted that although teachers planned to integrate N.S. and Tech in their lessons, they did not the implement it in practice.

RQ3:

This research question combined elements of the previous two questions and critically explored the reason behind teachers' views, actions, and plans. The findings show that that teachers integrate NS-TECH in specific ways based on two main factors: their confidence in the subject and their years of experience teaching it. A connection was identified between these two factors, revealing that teachers generally become more confident over time.

This comprehensive analysis reveals the complex nature of NS-TECH integration in intermediate phase teaching. While successful integration is possible, as demonstrated by isolated cases, systematic challenges persist. The findings indicate the need for a multi-faceted approach to educational reform, incorporating professional development, resource development, and institutional support systems.

The study contributes to the growing body of research on STEM integration while highlighting specific challenges in the South African context. Future research should focus on:

1. Long-term impact of professional development initiatives;
2. Effectiveness of integrated assessment approaches;
3. Student outcomes in integrated versus traditional programmes; and

4. Resource development and implementation strategies for teaching NS-TECH, which can be modified as years of teaching experience in the subject increase.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

Understanding the integration of NS-TECH in intermediate phase teaching requires systematic analysis of teacher views, implementation practices, and underlying factors influencing pedagogical choices (Ramnarain & Chanetsa, 2021). This study aimed to explore intermediate phase teachers' views and pedagogical practices on integrating N.S. and Tech. The study provided intermediate phase NS-TECH teachers with the opportunity to air their perspectives on teaching the subject as integrated and combined discipline. The rationale for the research study stemmed from my experiences as an NS-TECH teacher and how the NS-TECH curriculum is structured and delivered. I observed that N.S. content dominates the curriculum, which Tech only occupying a minimal proportion of the curriculum.

To determine whether this occurs on a greater scale and in other schools, this research study was conducted in four schools in the Berea area of Durban, in addition to the one where I teach. Three NS-TECH teachers were purposively selected from each of the four schools, with a total of 12 teachers participating in the research study. The teachers were interviewed through face-to-face semi-structured interviews. Their lesson plans were analysed (document analysis), and their lessons were observed (observation) to understand their pedagogical practices. Additionally, the 12 teachers participated in a post-observation process to assess whether their planned lessons (lesson plans) aligned with their actual pedagogical practices (observations).

The next section provides a summary of the key findings of this study. Recommendations based on the study's outcomes follow.

5.2. Summary of Key Findings

The table below summarises the themes identified from the three research questions that guided this study.

Research Questions	Themes
1. What are intermediate phase teachers' views on integrating N.S. and Tech?	• Teachers' rationale for the integration of NS-TECH. • Inequitable integration of NS-TECH. • Advocacy for separation of NS-TECH.
2. How do intermediate phase teachers integrate N.S. and Tech?	• Absence of integration. • Successful integration of NS-TECH. • Planning-implementation disjuncture.
3. Why do intermediate phase teachers integrate N.S. and Tech in the way they do?	• Confidence of NS-TECH teachers and its impact on how the curriculum is integrated and implemented. • Years of experience in teaching Natural Sciences and Technology and teaching as a whole.

Table 5.1: Summary of Findings

Analysis of the data generated from the study, in response to the three research questions, led to the following main findings.

1. What are intermediate phase teachers' views on integrating N.S. and Tech?

The data collected from the 12 participants were coded and organised into three main themes: the teachers' rationale for integrating NS-TECH, inequitable integration of NS-TECH, and advocacy for the separation of NS-TECH.

Analysis revealed three distinct but interconnected themes regarding teachers' views on NS-TECH integration. Teachers supporting NS-TECH integration highlight its potential to accommodate diverse learning preferences and abilities. They observed that academically oriented students often excel in N.S. but struggle with Tech's creative demands, while practically inclined learners showed the opposite tendency (McKinley & Miller, 2023). In their view, this complementarity allows students to develop balanced competencies across both domains.

The second theme emphasised a significant implementation gap. Despite the intentions behind curriculum design, N.S. dominates classroom time and resources, accounting for 75-80% of instructional focus. This imbalance, identified through an analysis of CAPS documents and teaching plans, reflects broader systemic challenges in curriculum integration (Msimanga & Ramnarain, 2022).

The third theme highlighted strong advocacy for separating N.S. and Tech. Teachers consistently feel more confident teaching N.S., as opposed to Tech, due to their limited formal training in the latter. Many experienced educators noted that they did not receive formal Tech training during their studies, which has led them to rely on self-directed learning (Roberts & de Beer, 2024). Classroom observations reveal how this knowledge gap affects teaching enthusiasm and effectiveness.

2. How do intermediate phase teachers integrate N.S. and Tech?

Data analysis revealed three key themes: absence of integration, successful integration, and planning-implementation disjuncture (Mavuru & Ramnarain, 2023). Notably, 11 of the 12 participants taught the subjects separately, despite the curriculum's integrated design. Only one teacher demonstrated effective integration, emphasising the common challenge of implementing the intended curriculum model.

A key finding revealed a disconnect between lesson planning and classroom execution. While some teachers' documentation reflected integrated approaches, their actual teaching remained compartmentalised, indicating systemic barriers to effective integration (Webb & Motlhabane, 2023).

3. Why do intermediate phase teachers integrate N.S. and Tech. in the way they do?

The analysis of the data uncovered two interconnected themes: the influence of NS-TECH teachers' confidence in integrating and implementing the curriculum; and teachers' years of experience teaching N.S and Tech specifically, and in teaching generally.

A critical interpretive approach was used to analyse the data. As explained in Chapter 4, this research question essentially combined the first two research questions, aiming to interpret teachers' views and pedagogical practices. The themes were interconnected; teachers integrated N.S. and Tech into their teaching based on their confidence in the subject matter. Those teachers who exhibited greater confidence taught the subject in a more engaging manner. Teachers who lacked confidence voiced their concerns during interviews, and this lack was also evident in

the observation process. The next theme was the relationship between years of experience in teaching NS-TECH and teacher confidence. It became clear that those teachers with more years of experience tended to be the ones who exhibited confidence.

The data generated in this study highlighted various challenges. When asked about difficulties they've encountered, NS-TECH teachers identified a lack of technological knowledge, inadequate resources for teaching and learning, and time constraints. Lack of technological knowledge is discussed above in detail. In summary, teachers feel that they are sufficiently trained or equipped to teach Tech, a subject in which they did not specialise. They have also not received the necessary training to support them in this area; this will be discussed further in the recommendations section. The second challenge that teachers articulated was a lack of resources. This sentiment was prevalent among educators, regardless of whether their school was fairly well-resourced or under-resourced. Teachers at well-resourced schools expressed concerns about not having a science lab or Tech workspace. They noted that this limitation restricted the number of practical tasks learners could engage in, further constraining the tech curriculum. Schools that are under-resourced face other major concerns. For them, having access to a science lab or Tech workspace would be a luxury. Instead, they report a lack of textbooks for all their learners. Additionally, they struggle with overcrowded classrooms, and insufficient desks and chairs to accommodate every learner. Teachers at these under-resourced schools have shared that they do their best, but the obstacles they face are substantial. Finally, a common challenge expressed by teachers is the lack of time allowed for completing the curriculum. They indicated that the curriculum is so tightly packed that it leaves little room for practical and engaging tasks that incorporate Tech. As a result, teachers focus on theoretical instruction, eliminating the activities that could enhance learner creativity. But take additional time.

The theoretical framework underpinning this study is Bernsteins Theory of Classification and Framing (1971), as discussed in Chapter Two. This theory consists of weak and strong categorisations. Weak categorisation allows for minor differences between subjects and seeks connections to relate them to one another. In the context of integrating NS-TECH, weak categorisation would be ideal. Conversely, strong categorisation involves distinct boundaries between subjects, which is how NS-TECH was actually taught. Framing refers to the power that teachers have in delivering the curriculum and the power that learners have in receiving it. 11 of the 12 participating teachers indicated that they taught the subjects separately, delivering the NS-TECH curriculum in an unintegrated manner. Only one teacher made a deliberate effort

to teach the subject as an integrated whole. Consequently, learners experienced the curriculum differently: those whose teachers established a connection between N.S. and Tech perceived the curriculum as integrated, while those whose teachers failed to make such links, viewed it as two separate entities subjects.

5.3. Recommendations

The key challenges expressed by the participants were as follows: teachers feel unequipped to teach NS-TECH as an integrated subject due to insufficient knowledge of Tech; there is a distinct lack of resources to support the teaching and learning as a whole and the tightly packed curriculum allows little to no room for practical, hands-on tasks.

The following recommendations are suggested:

Firstly, teachers should be provided with professional development by subject advisors and the DoE. Cluster meetings and workshops commonly occur for subjects like English and Mathematics; the same should take place for NS-TECH and all other subjects. Among the teachers, there are likely to be a few with Tech background who could teach and share their expertise with their colleagues.

Secondly, a comprehensive guideline for integration should be included as a policy document. The guideline should clearly indicate and identify areas to be integrated into N.S. and Tech. Examples of ways to explain the connections between subjects should be given; this will assist teachers who struggle to identify these links themselves. Also, given that the subject is called NS-TECH, time allocated and content included should be more fairly distributed between disciplines. While it is true that N.S. encompasses a significant amount of content, a proper policy guideline for integration can facilitate the incorporation of Tech into all NS-TECH lessons and vice versa.

The third recommendation involves restructuring of textbooks and learning materials. The textbooks that are currently utilised for NS-TECH separate the content of these subjects. If textbooks are aligned with integration, then the integration of NS-TECH is bound to happen.

The challenge of limited resources is a common concern among teachers across subjects. Resources such as textbooks are essential for effective learning, schools must provide these basic materials for learners to thrive. Many children are visual and kinaesthetic learners,

meaning they need to see what they are being taught or engage in hands-on activities to grasp concepts fully. Teachers are often instructed to cater for all types of learners; however, they need assistance from the DoE to support every learner.

Finally, the challenge of time can be effectively addressed if curriculum developers and policy makers are primarily composed of teachers, or if they possess a more realistic understanding the classroom context. The content taught should be relevant and engaging for learners, as well as applicable to their daily lives. Additionally, more formative assessment should be incorporated to accommodate the diverse range of learners in the classroom. Learning should be more qualitative and less quantitative.

5.4. Conclusion

This chapter explored the key findings and recommendations for this study, *intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology (NS-TECH).* Analysis of the data demonstrated that NS-TECH is not being taught as an integrated subject due to various reasons and challenges. These challenges, identified by teachers, include educators' lack of technological knowledge, inadequate resources and time constraints. In response to these challenges, recommendations were made. These include professional developmental workshops designed to support and equip teachers in teaching the subject; formulation of a policy document that outlines a clear plan for integrating content areas; textbooks and learning materials that facilitate integration should be provided, along with more hands-on resources that enable practical work. Finally, the curriculum design should be designed to be less densely packed, allowing space for formative learning.

REFERENCES

Amankwaa, L. (2016). Creating Protocols for Trustworthiness in Qualitative Research. Journal of Cultural Diversity, 23, 121-127. http://www.tuckerpub.com/jcd.htm

Babbie, E. R. (2020). *The practice of social research*. Cengage Au.

Beane, J. (1996). On the Shoulders of Giants! The Case for Curriculum Integration. *Middle School Journal*, *28*(1), 6–11. https://doi.org/10.1080/00940771.1996.11496182

Bennett, J., & Hogarth, S. (2019). Teacher knowledge and confidence in integrated STEM education: A systematic review. *International Journal of Science Education*, 41(7), 919-944.

Bernard, H. R. (2017). Research Methods in Anthropology: Qualitative and Quantitative Approaches. Lanham, MD: Rowman & Littlefield.

Bernstein, B. (1971). On the classification and framing of educational knowledge. In MFD Young (ed). Knowledge and Control: New directions for the sociology of education. London: Collier MacMillan, 47-69.

Bernstein, B. (1996). Pedagogy, symbolic control and identity: theory, research, critique. London: Taylor and Francis.

Bertram, C., & Christiansen, I. (2014). Understanding research: An introduction to reading research (1st ed.). Pretoria: Van Schaik Publishers.

Brown, F. (2024). The learning professional. The learning forward journal.

https://learningforward.org/journal/curriculum-based-professional-learning/learning-forwards-standards-and-curriculum-go-hand-in-hand/

Button, L. (2021). 21st century teachers and learners: meeting the needs of all learners and the curriculum. https://oer.pressbooks.pub/curriculumessentials/chapter/chapter-21st-century-teachers-and-learners-meeting-the-needs-of-all/

Chakma, Urmee. (2022). Chakma and Education. 10.4324/9781003326953-3.

Cohen, L., Manion, L., & Morrison, K. (2017). Action research. In *Research methods in education* (pp. 440-456). Routledge.

Coldwell, M. (2017). Exploring the influence of professional development on teacher careers:

A path model approach. Teaching and Teacher Education. 61. 10.1016/j.tate.2016.10.015.

Costley, K. C. (2015). Research supporting integrated curriculum: Evidence for using this

method of instruction in public school classrooms. Retrieved from https://eric.ed.gov/?id=ED552916.

Creswell. J.W. and Creswell, J.D. (2017) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th Edition, Sage, Newbury Park.

DeJonckheere M, Vaughn LM. Semistructured interviewing in primary care research: a balance of relationship and rigour. Fam Med Community Health. 2019 Mar 8;7(2):e000057. doi: 10.1136/fmch-2018-000057. PMID: 32148704; PMCID: PMC6910737.

Department of Education. (2011). Curriculum and Assessment Policy Statement: Natural Science and Technology (Intermediate Phase). Pretoria.

Dowden, T. (2007). Relevant, challenging, integrative and exploratory curriculum design: Perspectives from theory and practice for middle level schooling in Australia. *The Australian Educational Researcher*, 34(2), 51-71.

Dowden, T. (2014). Challenging, integrated, negotiated and exploratory curriculum in the middle years of schooling: *Designing and implementing high quality curriculum integration. Australian Journal of Middle Schooling*, 14(1), 16-27.
Draper A, Swift JA. Qualitative research in nutrition and dietetics: data collection issues. J Hum Nutr Diet. 2011 Feb;24(1):3-12. doi: 10.1111/j.1365-277X.2010.01117.x. Epub 2010 Nov 23. PMID: 21091918.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5, 1-4. https://doi.org/10.11648/j.ajtas.20160501.11

Farris, J. (2004). Philosophy regarding technology. *Essays in Philosophy*, *6*(1), 76-84.

Ferguson-Patrick., Reynolds, R., & Macqueen, S. (2018). Integrating curriculum: a case study of teaching Global Education. European Journal of Teacher Education, 41(2), 187 201.

Flick, U. (2018). Triangulation in data collection.

Gentles, S. J., Charles, C., Ploeg, J., & McKibbon, K. (2015). Sampling in Qualitative Research: Insights from an Overview of the Methods Literature. *The Qualitative Report*, *20*(11), 1772-1789. https://doi.org/10.46743/2160-3715/2015.2373

Gresnigt, R., Taconis, R., van Keulen, H., Gravemeijer, K., & Baartman, L. (2014). Promoting science and technology in primary education: *A review of integrated curricula. Studies in Science Education*, 50(1), 47-84. doi:10.1080/03057267.2013.877694

Gupta, A. (2023). Revisiting educational advantage and social class: a Bourdieusian analysis of middle-class parents' investment in private schooling and shadow education. *British Journal*

of Sociology of Education, *44*(1), 26–42. https://doi.org/10.1080/01425692.2022.2126824

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: case studies of science teachers' development of technological pedagogical content knowledge (TPCK). *Contemporary Issues in Technology and Teacher Education*, *9*(1), 25-45.

Hall-Kenyon, K. M., & Smith, L. K. (2013). Negotiating a shared definition of curriculum integration: A self-study of two teacher educators from different disciplines. *Teacher Education Quarterly*, *40*(2), 89-108.

Harrell-Levy, M. K., & Kerpelman, J. L. (2010). Identity process and transformative pedagogy: Teachers as agents of identity formation. *Identity: An international journal of theory and research*, *10*(2), 76-91.

Hecker, A & Scholze, A. (2024). The job demands-resources model as a theoretical lens for the bright and dark side of digitization. *Computers in Human Behavior*, *155*, 108177.

Hinde, E. T. (2005). Revisiting Curriculum Integration: A Fresh Look at an Old Idea. *The Social Studies*, *96*(3), 105–111. https://doi.org/10.3200/TSSS.96.3.105-111

Hurless, B., & Gittings, S. B. (2008). A First Grade Teacher Integrates Teaching and Learning. *YC: Young Children*, *63*(2).

Izci, K. & Caliskan, G. (2017). Development of prospective teachers" conceptions of assessment and choices of assessment tasks. *International Journal of Research in Education and Science (IJRES)*, 3(2), 464-474. DOI: 10.21890/ijres.327906

Johnson, R., Smith, M., & Wilson, K. (2021). "Challenges in STEM Integration: A Systematic Review." *Teaching and Teacher Education*, 95,

Johnston, J., Riodain, M. A., & Walshe, G. (2014). An integrated approach to the teaching and learning of science and mathematics utilising Technology - *The teachers' perspective. manager's Journal on School Educational Technology*, 9(4), 14-26.

Juggernath, A., & Govender, N. (2020). Natural Sciences Teachers' Beliefs as Barriers for Integrating ICTs in a Technology-rich Context. *African Journal of Research in Mathematics, Science and Technology Education*, *24*(1), 105–115. https://doi.org/10.1080/18117295.2020.1736854

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. International Journal of STEM Education, 3(1), 1-11.

Kelly, H. (2010). How Games and Simulations Can help Meet America's Challenges in Science Mathematics and Technology Education. In *Serious game design and development: Technologies for training and learning* (pp. 117-133). IGI Global.

Kettler, R. J. (2019). *Research methodologies of school psychology: Critical skills*. Routledge.

Khanyile, P. D. (2016). Exploring grade six educators' understanding of the integration of the natural sciences and technology in the Mafukuzela – Ghandi circuit, Ethekwini region. https://researchspace.ukzn.ac.za/server/api/core/bitstreams/c455c8d5-69a9-4f5a-be03-8c1eca594523/content

Kitchin, R. (2014). Big Data, new epistemologies and paradigm shifts. *Big Data & Society, 1(1).* https://doi.org/10.1177/2053951714528481

Klein, H. J., Noe, R. A., & Wang, C. (2006). *Motivation to learn and course outcomes: The impact of delivery mode, learning goal orientation, and perceived barriers and enablers. Personnel psychology*, *59*(3), 665-702.

Lapan, S. D., Quartaroli, M. T., & Riemer, F. J. (Eds.). (2011). *Qualitative research: An introduction to methods and designs*. John Wiley & Sons.

Ledermen G, Bell R; et al. (2013). Views of nature of science questionnaire: Toward valid and meaningful assessment of learners' conceptions of nature of science. Journal of research in Science Teaching.

Lederman, Norman & Abd-El-Khalick, Fouad & Smith, Mike. (2019). Teaching Nature of Scientific Knowledge to Kindergarten Through University Students. Science & Education. 28. 10.1007/s11191-019-00057-x.

Lewis, S. (2015). Qualitative Inquiry and Research Design: Choosing among Five Approaches. Health Promotion Practice, 16, 473-475. https://doi.org/10.1177/1524839915580941

Lowe., R (2017). Pre-Service Teachers' Experiences with Curriculum Integration*: A Qualitative Study (Master's Thesis)*, Faculty of Education, Brock University St. Catharines, Ontario.

Lumivero. (2023). The basics of document analysis. https://lumivero.com/resources/blog/the-basics-of-document-analysis/#:~:text=Published%3A%20Dec.-,12%2C%202023,and%20come%20to%20a%20conclusion.

Makhubela, M.S. (2016). "From psychology in Africa to African psychology": Going nowhere slowly. *Psychology in Society 52(52):1-18* DOI:10.17159/2309-8708/2016/n52a1.

Maniram, R., and S.M. Maistry. 2018. "Enabling Well-Being and Epistemological Access through an Authentic Assessment Intervention: A Case Study of a Higher Education Programme". *South African Journal of Higher Education* 32 (6), 305-25. https://doi.org/10.20853/32-6-2982.

Margot, K.C., Kettler, T. Teachers' perception of STEM integration and education: a systematic

literature review. *IJ STEM Ed* **6**, 2 (2019). https://doi.org/10.1186/s40594-018-0151-2

Maslyk, J. (2021). *Connect to Lead: Power Up Your Learning Network to Move Your School Forward*. International Society for Technology in Education.

Mavuru, L., & Ramnarain, U. (2023). "Teacher Professional Development in Integrated Science and Technology Education." South African Journal of Education, 43(1), 1-15.

Maxwell, J. A. (2016). Expanding the history and range of mixed methods research. *Journal of mixed methods research*, *10*(1), 12-27.

McKinley, E., & Miller, B. (2023). "Bridging Theory and Practice in Science and Technology Integration." Studies in Science Education, 59(1), 45-67.

Milian, E. (2019).Fintechs: A literature review and research agenda, *Electronic Commerce Research and Applications. Volume 34*,100833, ISSN 1567-4223. https://doi.org/10.1016/j.elerap.2019.100833.

Merriam, S. B., & Tisdell, E. J. (2015). Qualitative Research: A Guide to Design and Implementation. San Francisco, CA: Wiley.

Millwater, J & Hudson, P. (2014). Chinese TEFL teachers' perceptions about research and influences on their research endeavours. Teacher Development. 18. 10.1080/13664530.2014.919344.

Motsienyane, L.S. (2016). Re-examining curriculum knowledge and pedagogy of grade 12 Physical Science teachers.

Msimanga, A., & Ramnarain, U. (2022). "Curriculum Integration in Science and Technology: A South African Perspective." African Journal of Research in Mathematics, Science and Technology Education, 26(2), 178-190.

Munna, A. S., & Kalam, A. (2021). Teaching and learning process to enhance teaching effectiveness: a literature review: *International Journal of Humanities and Innovation* (IJHI) Vol. 4 No. 1, 2021 pp. 1-4

Nampota, D. C., & Thompson, J. J. (2008). Curriculum continuity and school to university transition: science and technology programmes in Malawi. *Compare*, *38*(2), 233-246.

National Council for Assessment. (2017). Integrated policy by Primary program. https://www.google.com/search?q=what+is+integration+in+education&sca_esv=462730c3beb4cb6f&sxsrf=

Nevenglosky, E. (2018). Barriers to Effective Curriculum Implementation. *Walden Dissertations and Doctoral Studies*. 5235. https://scholarworks.waldenu.edu/dissertations/5235

Oloruntegbe, K. O. (2013). Effective science learning through restructuring and reconstruction from the knowledge soup. American Journal of Humanities and Social Sciences, 1(2), 63-66.

Parker, I. (2005) Qualitative Psychology: Introducing Radical Research. Open University Press, Maidenhead

Pirtheepal, T. (2019). Exploring teachers' experiences of implementing an integrated Natural Science and Technology curriculum in the Intermediate phase.

Pluim, G., Nazir, J., & Wallace, J. (2020). Curriculum integration and the semicentennial of Basil Bernstein's classification and framing of educational knowledge. *Canadian Journal of Science, Mathematics and Technology Education*, *20*, 715-735.

Priya, K., & Ruby, T. R. Utilization and Challenges of Higher Education Teachers Towards the open Educational Resources in teaching.

Ramaila, S & Molwele, A. (2022). The Role of Technology Integration in the Development of 21st Century Skills and Competencies in Life Sciences Teaching and Learning, *International Journal of Higher Education, Sciedu Press*, vol. 11(5), pages 1-9, October.

Ramnarain, U., & Chanetsa, T. (2021). "Analyzing Teacher Perspectives on Integrated Science and Technology Teaching." Research in Science Education, 51(2), 789-805

Roberts, N., & de Beer, J. (2024). "Technology Education in South African Schools: Contemporary Challenges and Solutions." International Journal of Technology and Design Education, 34(1), 123-142.

Sen, C., & Ay, Z, S. (2017). The Views of Middle School Mathematics Teachers on The Integration of Science and Technology in Mathematics Instruction. *International Journal of Research in Education and Science* (IJRES), 3(1), 151-170

Selepe, C.M. (2016). Curriculum reform in Lesotho: teachers' conceptions and challenges.

Sheikh-Abdullah, S. H. (2016). Transforming Science Teaching Environment for the 21st Century Primary School Pupils. *Malaysian Online Journal of Educational Technology*, 4(4), 68-76.

Short, K., Goetz, J., Cude, B., Sperling, L., Welch-Devine, M., & Chatterjee, S. (2019). A case for graduate student financial education. College Student Journal, 53(1), 47-55.

Shufutinsky, A & Deporres, D & Long, B & Sibel, J. (2020). Shock leadership development for the modern era of pandemic management and preparedness. 13. 20-42.

Singh, P. (2002). Pedagogising Knowledge: Bernstein's theory of the pedagogic device. *British Journal of Sociology of Education*, *23*(4), 571–582. https://doi.org/10.1080/0142569022000038422

Singh-Pillay, A. (2010). An exploration of the interface between schools and industry in respect of the development of skills, knowledge, attitudes and values (SKAV) in the context of biotechnology (Doctoral dissertation).

Singh-Pillay, A., & Alant, B. (2015). Tracing the policy mediation process in the implementation of a change in the Life Sciences curriculum. *African journal of research in mathematics, science and technology education*, *19*(1), 12-22.

Singh-Pillay, A & Sotsaka, D.S. (2020). An Exploration of First Year Pre-service Engineering Graphics and Design Teachers' Spatial Visualisation Ability at a University of Technology. *Journal for the education of the gifted 8(2):*681-690DOI:10.17478/jegys.639351

Spelt, E. J. H., Biemans, H. J. A., Tobi, H., Luning, P. A., & Mulder, M. (2009). Teaching and learning in interdisciplinary higher education: *A systematic review*. *Educational Psychology Review*, 21(4), 365-378.

Sullivan, P. (2012). *Qualitative data analysis using a dialogical approach*. SAGE Publications Ltd, https://doi.org/10.4135/9781446268391

Syfers, B. J. (2010). *The pedagogical use of ICT in grade eight natural science classes in South African schools* (Doctoral dissertation, North-West University, Potchefstroom Campus).

Umalusi. (2014). What's in the CAPS package? A comparative study of the National Curriculum Statement (NCS) and the Curriculum and Assessment Policy Statement (CAPS) Further Education and Training (FETF.E.T.) Phase. Umalusi Council of Quality Assurance in General and Further Education and Training, Pretoria: Sharon Grussendorff, Celia Booyse and Elizabeth Burroughs.

Varthana. (2023). What is integrated learning and how it benefits students? https://varthana.com/school/what-is-integrated-learning-and-how-it-benefits-students/

Venville, G., Rennie, L., & Wallace, J. (2012). Curriculum Integration: Challenging the assumption of school science as powerful knowledge. In Second International Handbook of Science Education (pp. 737-749). Springer, Dordrecht.

Venville, G., Wallace, J., Rennie, L., & Malone, J. (2020). "Curriculum Integration: Challenging the Assumption of School Science as Powerful Knowledge." *Research in Science Education*, 50(2), 685-698.

Webb, P., & Motlhabane, A. (2023). "Professional Development Needs of Science and Technology Teachers in South Africa." Professional Development in Education, 49(1), 78-94.

Weber, E. (2008). Educational Change in South Africa: Reflections on Local Realities, Practices, and Reforms. Sense Publishers. https://doi.org/10.1163/9789087906603

Wei, X., Yu, J. W., Shattuck, P., McCracken, M., & Blackorby, J. (2009). Science, technology, engineering, and mathematics (STEM) participation among college students with an autism spectrum disorder. *Journal of autism and developmental disorders*, *43*, 1539-1546.

Yarrow, N. B. (2019). Project Information Document-Realizing Education's Promise: Support to Indonesia's Ministry of Religious Affairs for Improved Quality of Education-P168076.

Yildiz-Duban, N. (2013). Science and technology teachers' views of primary school science and technology curriculum. *International Journal of Education in Mathematics, Science and Technology*, 1(1), 64-74.

Yin, R. K. (2017). Case Study Research and Applications: Design and Methods. Washington DC: Sage Publications.

Yom, S. (2015). From methodology to practice: Inductive iteration in comparative research. *Comparative Political Studies*, *48*(5), 616-644.

Zhou, G., & Kim, J. (2010). Impact of an integrated methods course on preservice teachers' perspectives of curriculum integration and faculty instructors' professional growth. *Canadian Journal of Science, Mathematics and Technology Education*, *10*, 123-138.

APPENDICES

A1: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

16 September 2024

Karina Basitheva (215022294)
School of Education
Edgewood Campus

Dear K Basitheva,

Protocol reference number: HSSREC/00007447/2024
Project title: Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 06 August 2024 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

Incidents of adverse events and serious adverse events (AEs and SAEs) should be reported in writing to HSSREC, the study sponsors, and any regulatory authority (where appropriate), within 7 working days of the occurrence for local sites and 14 days for all other South African sites.

This approval is valid until 16 September 2025.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

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

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)
/nng

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

A2: LETTER SEEKING PERMISSION

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

UKZN Edgewood Campus
121 Marianhill Road
Pinetown
3601

7 August 2024

Dear Parent

Re: Permission for your child's participation in research.

I am Karina Basitheva, a master's student in Technology Education at the University of Kwa-Zulu Natal. This letter intends to request your permission to conduct research in your child's school. My research topic is*: Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*. As I am a teacher in the Berea area, my research study will occur at schools in the area. I have received permission from the school principal to carry out research in this school, however I require your permission as I will need to observe Natural Sciences and Technology lessons in grades 4 to 6, which your child will be a part of.

The objectives of my study are:

1. To ascertain teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase.
2. To establish how integrating Natural Sciences and Technology impacts on intermediate phase teachers' pedagogical practices.
3. Finally, to explore why intermediate phase teachers integrate Natural Sciences and Technology teachers integrate the subject in the way that they do.

Therefor:

- I request your permission to observe the teacher while you are being taught Natural sciences, and to audio record these observations.

This study is purely for academic purposes, and it aims to holistically support teachers and learners in the subject Natural Sciences and Technology. The purpose of this study is to determine if Natural Sciences and Technology are integrated when teaching occurs, thus providing learners will a wholesome curriculum and equal knowledge in both areas of the subject.

Observation will be used as one of my data generation methods, however anonymity of learners, and any participants for that matter is promised. Teaching and learning will not be disturbed at all, as I will simply observe the lesson.

If there are any enquiries, please contact me on:

[redacted]

[redacted]

You may also contact the Research Office through:

[redacted]

I hope the above explanation is sufficient for permission for my research study to be granted.

Yours Faithfully

Karina Basitheva

CONSENT:

I _____ have been informed about the study entitled: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology.*

that is carried out by _Karina Basitheva.

I understand the contents of this document and the nature of the research study. I **consent to / do not consent to my child's participation in this study. I consent to/ do not consent to :**

- The lessons on NS-Tech in my child's class to be observed by the researcher.
- The lessons being audio recorded

I understand the purpose and procedures of the study (observation of Natural Sciences and Technology lesson) and have been given an opportunity to ask questions and contact the researcher regarding the study.
I declare that my child's participation in this study is entirely voluntary.

[redacted]

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

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

[redacted]

_____ _____

Signature of Participant **Date**

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

UKZN Edgewood Campus
121 Mariannhill Road
Pinetown, Durban
3605

07 August 2024

Dear Principal

Re: Permission to conduct a research study in the school.

I am Karina Basitheva, a master's student in Technology Education at the University of Kwa-Zulu Natal. This letter intends to request your permission to conduct research in your school. My research topic is: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*. As I am a teacher in the Berea area, my research study will occur at four schools in the area.

The objectives of my study are:

1. To ascertain teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase.
2. To establish how integrating Natural Sciences and Technology impacts on intermediate phase teachers' pedagogical practices.
3. Finally, to explore why intermediate phase teachers integrate Natural Sciences and Technology teachers integrate the subject in the way that they do.

Therefore, consent is sought for:

- Your school's participation in this study.
- Observation and audio recording of grade 4-6 NS-Tech lessons
- The analysis of lesson plans

Holistically, this study aims to benefit teachers, learners, and the school as it intends to allow teachers to share their views, experiences and challenges of teaching Natural Sciences and Technology as an integrated subject. It hopes to provide teachers with the necessary support they require. Furthermore, it aims to benefit learners by ensuring that they receive the curriculum as an integrated one, whereas both Natural Sciences and Technology are encouraged.

The planned duration for data generation is a term, starting from the day ethical clearance is granted. Data collection methods include interviews, observation of two Natural Sciences and Technology lessons and document analysis. You, as the principal, is required to give permission for the research study to occur in your school. Additionally, I will request (in a separate letter) permission from three Natural Sciences and Technology teachers in grades 4, 5 and 6 (intermediate phase) to allow me the opportunity to interview them on their experiences, views and pedagogical practices regarding Natural Sciences and Technology, as well as permission to observe two of their lessons. Moreover, I will also ask parents of learners in the class being

observed for permission prior to the observation process. Lastly, lesson plans of Natural Sciences and Technology teachers will be analysed to determine how the lesson was integrated and to establish if the planned lesson matched the implemented lesson. Teaching and learning will not be disturbed at all, as I will simply observe the lesson. There are no financial benefits from this study, it is entirely free and for academic purpose only.

All participants' identities will be anonymous, and pseudonyms will be used for participants, as well as the schools. Therefore, it should not bring any discomfort to participants, however, participants will be allowed to withdraw from this study if they feel any sort of discomfort.

In summary:

- The information that you provide will be used for scholarly research only.
- Participation is entirely voluntary. You have a choice to participate, not to participate, or stop participating in the research. You will not be penalised for taking such an action.
- Participants' views in this interview will be presented anonymously. Neither your name nor identity will be disclosed in any form in the study.
- There will be audio recorded interviews, document analysis, and lesson observations, however these will be held in a password-protected file accessible only to myself and my supervisors. All data will be stored in secure storage and destroyed after 5 years.
- Anonymity as a research participant will be guaranteed through using pseudonyms.
- There are no financial benefits from participating in this research. Your participation is entirely free and for academic purposes only.
- If you agree to participate, please sign the declaration attached to this statement (a separate sheet will be provided for signatures).

If there are any enquiries, please contact me on:

[redacted]

I hope the above explanation is sufficient for my request to be granted to have you as a participant in the study.

Yours Faithfully,
Karina Basitheva

CONSENT:

I _____ have been informed about the study entitled: : *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*
that is carried out by _Karina Basitheva.

I understand the contents of this document and the nature of the research study. I **consent to/ do not consent you**

- My school's participation in this study.
- Observation and audio recording of grade 8 Natural Sciences lessons on ecosystems
- Interviews with teachers which will be audio recorded
- The analysis of lesson plans

It is understood that participation is voluntary and that participants will be assured confidentiality and anonymity.

I understand the purpose and procedures of the study (Interviews which will be audio recorded, document analysis, and observation of lessons) and have been allowed to ask questions and contact the researcher regarding the study.

[redacted]

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

[redacted]

_____ _____
Signature of Participant Date

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

UKZN Edgewood Campus
121 Mariannhill Road
Pinetown, Durban
3605

08 August 2024

Dear Natural Sciences and Technology Teacher

Re: Permission to conduct research during your Natural Sciences and Technology lessons.

I am Karina Basitheva, a master's student in Technology Education at the University of Kwa-Zulu Natal. This letter intends to request your permission to conduct research in your Natural Sciences and Technology lessons, as well as an opportunity to interview you on your views and pedagogical practices regarding the integration of Natural Sciences and Technology.

My research topic is*: Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*. As I am a teacher in the Berea area, my research study will occur at schools in the area. I have received permission from your school principal to carry out research in your school, however I require your permission as well.

The objectives of my study are:

1. To ascertain teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase.
2. To establish how integrating Natural Sciences and Technology impacts on intermediate phase teachers' pedagogical practices.
3. Finally, to explore why intermediate phase teachers integrate Natural Sciences and Technology teachers integrate the subject in the way that they do.

Therefore consent is sought:

- For Your participate in this study,
- To be interviewed , interview will be audio recorded
- have my teaching on NS-Tech observed and audio recorded
- your lesson plans to be analysed

Holistically, this study aims to benefit teachers and learners as it intends to allow teachers to share their views, experiences and challenges of teaching Natural Sciences and Technology as an integrated subject. It hopes to provide teachers with the necessary support they require. Furthermore, it aims to benefit learners by ensuring that they receive the curriculum as an integrated one, whereas both Natural Sciences and Technology are encouraged.

The planned duration for data generation is a term, starting from the day ethical clearance is granted. Data collection methods include interviews, observation of two Natural Sciences and Technology lessons and document analysis. You will be required to give permission to be interviewed and will further need to permit to the interview being audio recorded. Two Natural Sciences and Technology lessons will also need to be observed. Lastly, lesson plans will be

analysed to determine how the lesson was integrated and to establish if the planned lesson matched the implemented lesson. Teaching and learning will not be disturbed at all, as I will simply observe the lesson. There are no financial benefits from this study, it is entirely free and for academic purpose only.

All participants' identities will be anonymous, and pseudonyms will be used for participants, as well as the schools. Therefore, it should not bring any discomfort to participants, however, participants will be allowed to withdraw from this study if they feel any sort of discomfort.

In summary:

- The information that you provide will be used for scholarly research only.
- Your participation is entirely voluntary. You have a choice to participate, not to participate, or stop participating in the research. You will not be penalised for taking such an action.
- Your views in this interview will be presented anonymously. Neither your name nor identity will be disclosed in any form in the study.
- There will be audio recorded interviews, document analysis, and lesson observations, however these will be held in a password-protected file accessible only to myself and my supervisors. All data will be stored in secure storage and destroyed after 5 years.
- Your anonymity as a research participant will be guaranteed through using pseudonyms.
- There are no financial benefits from participating in this research. Your participation is entirely free and for academic purposes only.
- If you agree to participate, please sign the declaration attached to this statement (a separate sheet will be provided for signatures).

If there are any enquiries, please contact me on:





I hope the above explanation is sufficient for my request to be granted to have you as a participant in the study.

Yours Faithfully,
Karina Basitheva

CONSENT:

I _____ have been informed about the study entitled: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology.*
that is carried out by Karina Basitheva.

I understand the contents of this document and the nature of the research study. I **consent to/ do not consent to**

- participate in this study,
- be interviewed , interview will be audio recorded
- have my teaching on NS-Tech observed and audio recorded
- have my NS-TECH lesson plans to be analysed

It is understood that participation is voluntary and that participants will be assured confidentiality and anonymity.

I understand the purpose and procedures of the study (Interviews which will be audio recorded, document analysis, and observation of lessons) and have been allowed to ask questions and contact the researcher regarding the study.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher on [redacted] or via email at [redacted]

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

[redacted]

_____ _____
Signature of Participant Date

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

INFORMED CONSENT RESOURCE TEMPLATE

06 August 2024

Dear Mrs. Ntuli

I am Karina Basitheva (215022294). I am a master's student in Technology Education at the University of KwaZulu-Natal. This letter intends to request permission from the Department of Education to carry out a research study at four schools in the Berea area, Durban, KwaZulu-Natal. This research study is titled "Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology".

This study will occur in the Berea area, as I am a teacher in this area. The following four schools will be used as research sites, as I have received permission from the principals. These schools include
Hartley Road,

- Springfield Model,
- Collegevale and
- Berea Primary.

Three teachers from each school, teaching in the intermediate phase (grade 4-6), will be selected and approached to participate in this research study. A total of 12 teachers will be selected.

The aims and objectives of this research study are as follows:

1. To ascertain teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase.
2. To establish how integrating Natural Sciences and Technology impacts on intermediate phase teachers' pedagogical practices.
3. Finally, to explore why intermediate phase teachers integrate Natural Sciences and Technology teachers integrate the subject in the way that they do.

Holistically, this study aims to benefit teachers and learners as it intends to allow teachers to share their views, experiences and challenges of teaching Natural Sciences and Technology as an integrated subject. It hopes to provide teachers with the necessary support they require. Furthermore, it aims to benefit learners by ensuring that they receive the curriculum as an integrated one, whereas both Natural Sciences and Technology are both encouraged.

The planned duration for data generation is a term, starting from the day ethical clearance is granted. Data methods include interviews, observation of lessons and document analysis. Teachers will be required to give permission to be interviewed and will further need to permit to these being audio recorded. Natural Sciences and Technology lessons will also need to be observed, and with regard to this, I will also request permission from parents of learners in that particular class. Lastly, teachers' lesson plans will be analysed to determine how the lesson was integrated and to establish if the planned lesson matched the implemented lesson. There are no financial benefits from this study, it is entirely free and for academic purpose only.

All participants' identities will be anonymous, and pseudonyms will be used for participants, as well as the schools. Therefore, it should not bring any discomfort to participants, however, participants will be allowed to withdraw from this study if they feel any sort of discomfort.

If there are any enquiries, please contact me on:

[redacted]

You may also contact the Research Office through:

[redacted]

I hope the above explanation is sufficient for permission for my research study to be granted.

Yours Faithfully

Karina Basitheva

CONSENT:

I _____ have been informed about the study entitled: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*.
that is carried out by Karina Basitheva.

I understand the contents of this document and the nature of the research study. I **consent to/ do not consent** to this study being conducted at the following schools :

Hartley Road,

- Springfield Model,
- Collegevale and
- Berea Primary.

It is understood that participation is voluntary and that participants will be assured confidentiality and anonymity.

I understand the purpose and procedures of the study (Interviews which will be audio recorded, document analysis, and observation of lessons) and have been allowed to ask questions and contact the researcher regarding the study.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher on [redacted] or via email at [redacted]

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

[redacted]

_____ _____
Signature of Participant Date

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

INFORMED CONSENT RESOURCE TEMPLATE

UKZN Edgewood Campus
121 Mariannhill Road
Pinetown, Durban
3605

07 August 2024

Dear Learner

Re: Permission to observe Natural Sciences lessons in your classroom.

I am Karina Basitheva, a master's student in Technology Education at the University of KwaZulu-Natal. This letter intends to request your permission to conduct research in your Natural Sciences and Technology Classroom. My research topic is: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology*. I have received permission from the school principal to carry out research in this school, however, ethical research require that you are aware of the study and consent to participate.

Thus, I seek your permission to:

1. observe the teacher while you are being taught Natural sciences.
2. Audio record the observations

The objectives of my study are:

1. To ascertain teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase.
2. To establish how integrating Natural Sciences and Technology impacts on intermediate phase teachers' pedagogical practices.
3. Finally, to explore why intermediate phase teachers integrate Natural Sciences and Technology teachers integrate the subject in the way that they do.

This study is purely for academic purposes, and it aims to holistically support teachers and learners in the subject Natural Sciences and Technology. The purpose of this study is to determine if Natural Sciences and Technology are integrated when teaching occurs, thus providing learners will a wholesome curriculum and equal knowledge in both areas of the subject.

Observation will be used as one of my data generation, however anonymity of learners, and any participants for that matter is promised. Teaching and learning will not be disturbed at all, as I will simply observe the lesson.

If there are any enquiries, please contact me on:

[redacted]

[redacted]

You may also contact the Research Office through:

[redacted]

I hope the above explanation is sufficient for permission for my research study to be granted.

Yours Faithfully

Karina Basitheva

CONSENT:

I _____ have been informed about the study entitled: *Intermediate phase teachers' views and pedagogical practices on integrating Natural Sciences and Technology* that is carried out by Karina Basitheva.

I understand the contents of this document and the nature of the research study. I consent to:

- The lessons on in my NS-TECH class to be observed by the researcher.
- The lesson being audio recorded

I understand the purpose and procedures of the study (observation of Natural Sciences and Technology lesson) and have been given an opportunity to ask questions and contact the researcher regarding the study.
I declare that my participation in this study is entirely voluntary.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher on [redacted] or via email at [redacted].

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

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

[redacted]

_____ _____

Signature of Participant **Date**

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Ballito

Date: 6 December 2024

To Whom It May Concern

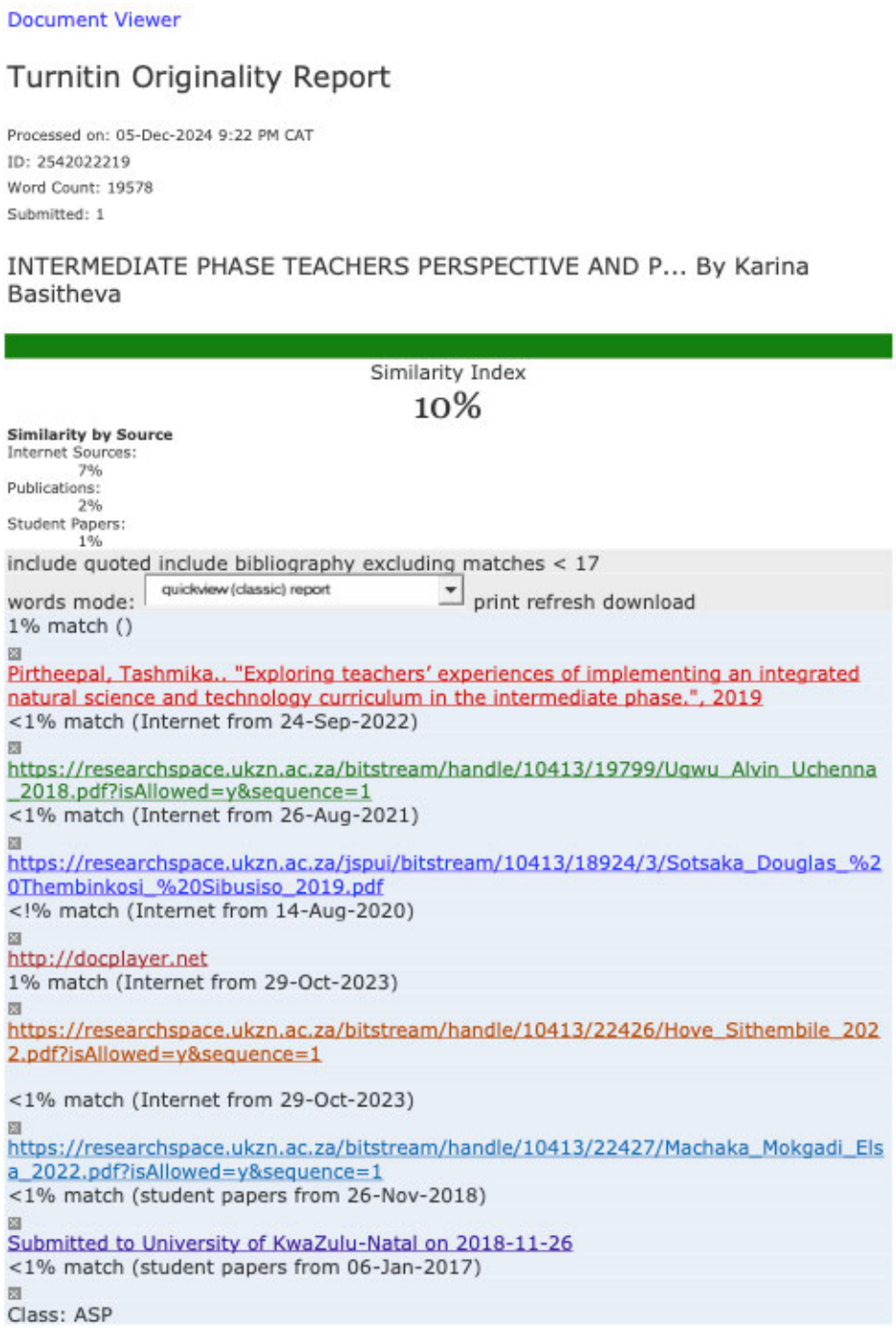
This is to certify that the dissertation entitled 'Intermediate Phase Teachers' Views and Pedagogical Practices on Integrating Natural Science and Technology' authored by Karina Basitheva has been edited by me for language.

Please contact me should you require further information.

Kind regards

[redacted]

A4: TURN IT IN CERTIFICATE



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A5: LETTER GRANTING PERMISSION



KWAZULU-NATAL PROVINCE
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OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X 9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201 **Ref**: 2/4/8/296
Enquiries: Ms Phindile Duma **Email:** phindile.duma@kzndoe.gov.za **Tel:** 033 392 1063

[redacted]

Dear Miss Basitheva

PERMISSION TO CONDUCT RESEARCH IN THE KZN DOE INSTITUTIONS

Your application to conduct research entitled: **"INTERMEDIATE PHASE TEACHERS' VIEWS AND PEDAGOGICAL PRACTICES ON INTEGRATING NATURAL SCIENCES AND TECHNOLOGY"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 04 September 2024 to 31 March 2027.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UMLAZI DISTRICT

[redacted]

Mr GN Ngcobo
Head of Department: Education
Date: 09 September 2024

GROWING KWAZULU-NATAL TOGETHER

Appendix 1: Interview Questions

Interviews will be conducted in response to research question 1.

Research question 1:

What are teachers' views on implementing an integrated Natural Sciences and Technology curriculum in the intermediate phase?

Interview Questions:

1. What are your thoughts on the integration of N.S. and TECH, please explain?
2. Do you feel confident in teaching the content of both N.S. and Technology, please explain?
3. What topic/s in the curriculum do you prefer to teach and why?
4. Do you think that all content areas taught in NS and TECH can be integrated?
5. How do you integrate the strands Energy and Change (N.S.) and Systems and Control (Tech)?
6. From your experience of teaching NS-TECH, do you feel that the integration of N.S. and TECH is done equitably, or do you feel that one subject is given preference over another?
7. In your opinion, what do you think can be done to assist teachers of NS-TECH to teach the content NS-TECH as an integrated subject?
8. What challenges do you encounter when teaching NS-TECH lessons?
9. Would you say that there are enough resources to support the integration of NS-TECH?
10. Do you believe that the integration of NS-TECH caters for the diversity of learners and their abilities?

Appendix 2

Observation:

Observation will be conducted in response to research questions 2 & 3.

Research Question 2 & 3:

How do intermediate phase teachers integrate Natural Sciences and Technology?

Why do intermediate phase teachers integrate Natural Sciences and Technology in the way they do?

- I will ask NS-TECH teachers' permission to observe their lessons and analyze the methods, resources and pedagogical practices they utilize when teaching the subject.
- I will use the CAPS document as a framework to guide me in the observation process.

Appendix 7: Observation schedule

Theme	Guiding questions	comment
Structural	How is the lesson introduced?	
	What is the pace of the lesson?	
	What were the specific aims for learners to learn in this lesson?	
	What motivation was given for learners to learn /follow the intended outcomes?	
	How is the lesson concluded?	
	What type/kind of activity did learners engage in?	
Methods	What approaches are used to organize and stimulate learner learning or cater for learner misconceptions?	
	Teaching procedure and reasons for using these procedures to engage with teaching of design	
	What teaching and learning resources are used in the lesson?	
	How do learners respond to the methods?	
	Were Difficulties /limitations connected with teaching this idea noted/justified/explained	
	Was there a link between knowledge about learners thinking that influences the teaching of the design process	
	What other factors influenced the teaching of this idea/design process?	
Overall	What is the atmosphere in the lesson like?	
impression	How did the teacher relate to the learners?	
	How are learners with special needs catered for?	

Appendix 3

Document analysis (file-lesson plans, tests. Assignments)
Document analysis will be used in response to research questions 2 & 3.

Research Question 2 & 3:

- How do intermediate phase teachers integrate Natural Sciences and Technology?
- Why do intermediate phase teachers integrate Natural Sciences and Technology in the way they do?
- In this study, the teaching portfolio of all teachers will be used to obtain data about their pedagogy used when teaching NS-TECH, the kinds of activities planned to engage learner, assessment used.
- Teaching portfolios will be analysed during the observation of the class lessons. I will look at their lesson plans in conjunction with the NS-TECH CAPS document and look for links and methods of integration.

Document analysis protocol
This study will utilize document analysis to determine the following:

1. Lesson objective: what is integrated in the topics taught.
2. Content: what content is integrated, how it is integrated and what links are made between subjects.
3. Tasks/activities: what activities are given on the content integrated.