

# **Analysis of teaching and learning of the Earth and Beyond Strand in the Intermediate phase in two districts, North West Province**

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# DECLARATION

I, **Nkagisang Nellytia Motaung**, hereby declare that the work contained in this dissertation is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature

A handwritten signature in black ink, appearing to read 'Motaung', is written above a horizontal line.

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*While it may seem small, the ripple effects of small things is extraordinary*

~ Matt Bevin

## **ABSTRACT**

An astute way to begin this study would be to define Natural Science and Technology. According to the Curriculum Assessment Policy Statement (CAPS), Natural Science is a systematic way of looking for explanations and connecting the ideas we have (DBE, 2011). In Science, certain methods of inquiry and investigation are generally used. In Technology, people use the combination of knowledge, skills and available resources to develop solutions that meet their daily needs and wants. This is where Science and Technology cross paths. Economic and environmental factors and a wide range of attitudes and values need to be considered when developing technological solutions. Technology also advances as our knowledge and needs expand (NCS policy document, 2011).

Globally, Science and Technology as a construct has become a projecting aspect in understanding how the world works and in improving the way in which technological knowledge is used in our daily lives (DBE, 2011). Learners in the Natural Sciences and Technology classroom are required to use critical thinking skills and to use technology effectively. Therefore, learners need both the human resource (i.e. the teacher) and the pertinent content knowledge the teacher offers. The rationale behind this research was to analyse the teaching and learning of the Earth and Beyond strand in Natural Science and Technology. The study focused on the intermediate phase and also served to help the researcher gain a deeper understanding of how the said transition evolves in the classroom. The sample comprised two districts in the North West province, namely the Bojanala and Ngaka Modiri Molema districts. A qualitative empirical research approach was employed. The data analysis was informed by the iterative approach in which the data was colour coded was initially undertaken. Later The researcher then applied themes and subthemes to the different responses, which she later used to develop a full analysis of the data and later a descriptive narration of the findings

The findings indicate that teachers have a challenge of teaching the Earth and Beyond strand successfully. Based on its outcomes, the study indicates that teachers battle to demonstrate the grade 5 Earth and Beyond strand effectively due to the lack of resources, poor language acquisition by learners, non-support from subject advisors from the Department of Education (DoE), and lack of motivation of learners.

The researcher discusses with reference to the teacher's responses, how teachers in the intermediate phase battle with the challenges mentioned above. Also, a discussion is provided as to what theories may assist teachers in overcoming some of the challenges experienced in the Earth and Beyond strand.

The Inquiry Based Science Education approach theory is one strategy recommended by the researcher which will eliminate the challenge of lack of pedagogical content knowledge by teachers teaching the subject.

**Key terms:** Natural Science and Technology, Earth and Beyond strand, scientific knowledge (concepts), effective teaching, effective learning

# TABLE OF CONTENTS

DECLARATION .....	i
ACKNOWLEDGEMENTS .....	ii
ABSTRACT .....	iv
LIST OF TABLES .....	xi
LIST OF FIGURES .....	xii
CHAPTER 1 .....	1
INTRODUCTION TO THE STUDY .....	1
1.1 INTRODUCTION .....	1
1.2 PROBLEM STATEMENT .....	4
1.3 SIGNIFICANCE OF THE STUDY .....	5
1.4 RESEARCH QUESTIONS .....	5
1.4.1 Primary research question .....	5
1.4.2 Secondary research questions .....	5
1.5 AIMS AND OBJECTIVES OF THE STUDY .....	6
1.5.1 Research aim .....	6
1.5.2 Research objectives .....	6
1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY .....	7
1.7 CLARIFICATION OF CONCEPTS .....	7
1.8 DIVISION OF CHAPTERS .....	8
CHAPTER 2 .....	10
LITERATURE REVIEW AND THEORETICAL FRAMEWORK .....	10

2.1	INTRODUCTION.....	10
2.2	NATURAL SCIENCE AND TECHNOLOGY IN THE INTERMEDIATE PHASE ....	11
2.3	SOME CHALLENGES IN THE TEACHING AND LEARNING OF SCIENCE EDUCATION.....	14
2.4	SUCCESSFUL TEACHING OF SCIENCE.....	15
2.5	THEORETICAL FRAMEWORK .....	17
2.5.1	Inquiry-Based Science Education (IBSE) Theory.....	17
2.5.2	Learner-centred approach.....	21
2.5.3	Systems-thinking model: seeing the forest through the trees.....	22
2.6	SUMMARY.....	26
CHAPTER 3.....		27
RESEARCH DESIGN AND METHODOLOGY .....		27
3.1	INTRODUCTION.....	27
3.2	RESEARCH DESIGN .....	27
3.3	RESEARCH CONTEXT .....	31
3.4	RESEARCH METHODOLOGY .....	31
3.4.1	Participant recruitment .....	32
3.4.2	Research instruments .....	35
3.4.2.1	Questionnaires .....	35
3.4.2.2	Interviews .....	37
3.4.2.3	Classroom observations.....	37
3.5	DATA GENERATION.....	39
3.6	DATA STORING .....	41
3.7	DATA ANALYSIS .....	42
3.7.1	Questionnaires and interviews .....	44



3.7.2	Classroom observations.....	45
3.8	ROLE OF THE RESEARCHER .....	46
3.9	QUALITY CRITERIA AND TRUSTWORTHINESS .....	46
3.10	ETHICAL CONSIDERATIONS.....	47
3.11	RELIABILITY AND VALIDITY .....	50
3.12	ANONYMITY AND CONFIDENTIALITY .....	50
CHAPTER 4.....		51
FINDINGS AND DISCUSSION.....		51
4.1	INTRODUCTION.....	51
4.2	SETTING: LEARNING OF EARTH AND BEYOND INSIDE AND OUTSIDE OF THE CLASSROOM.....	52
4.3	TEACHERS' PERSPECTIVES REGARDING HOW LEARNERS LEARN THE EARTH AND BEYOND STRAND.....	53
4.4	FACTORS THAT HINDER THE SUCCESSFUL TEACHING AND LEARNING OF THE EARTH AND BEYOND STRAND .....	56
4.4.1	Insufficient content knowledge .....	56
4.4.2	Lack of teaching and learning resources.....	57
4.4.3	Lack of human resources – shortage of teachers .....	59
4.4.4	Curriculum Policy .....	60
4.4.5	Learners' lack of interest and language barrier .....	61
4.4.6	Lack of support from district officials .....	62
4.5	FACTORS THAT FACILITATE THE SUCCESSFUL TEACHING AND LEARNING OF THE EARTH AND BEYOND STRAND.....	63
4.6	TEACHERS' PERCEPTIONS REGARDING TEACHING .....	68
CHAPTER 5.....		70

CONCLUSION AND RECOMMENDATIONS .....	70
5.1 CONCLUSION .....	70
5.1.1 Teachers .....	70
5.1.2 Learners .....	70
5.1.3 Professional development .....	72
5.2 RECOMMENDATIONS .....	72
5.2.1 Recommendations for intervention strategies .....	73
5.2.1.1 Policymakers .....	73
5.2.1.2 District and provincial departments of education .....	73
5.2.2 General recommendations .....	73
5.2.2.1 Teacher professional development .....	74
5.2.3 Recommendations for academic research .....	74
5.2.4 Establishment of science workshops in rural areas .....	75
LIST OF REFERENCES .....	76
APPENDIX A .....	89
APPROVAL OF RESEARCH PROPOSAL .....	89
APPENDIX B .....	90
ETHICAL CLEARANCE .....	90
APPENDIX C .....	91
REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOLS .....	91
APPENDIX D .....	95
REQUEST FOR APPROVAL TO CONDUCT RESEARCH IN THE SCHOOL .....	95
APPENDIX E .....	100
PARTICIPANT INFORMATION AND CONSENT FORM .....	100
APPENDIX F .....	105
GOODWILL PERMISSION REQUEST TO CONDUCT RESEARCH IN YOUR SCHOOL	105

APPENDIX G .....	110
CLASSROOM OBSERVATION INSTRUMENT .....	110
APPENDIX H .....	116
INTERVIEW PROTOCOL .....	116
APPENDIX I .....	119
QUESTIONNAIRES .....	119
APPENDIX J .....	128
STATISTICIAN’S ETHICS REVIEW REPORT .....	128
APPENDIX K .....	129
PROOF OF ATTENDANCE: ETHICS TRAINING .....	129
APPENDIX L .....	130
LANGUAGE EDITOR’S REPORT .....	130

## LIST OF TABLES

Table 0.1: The Inquiry-Based Science Education approach versus the traditional approach (ASSAf, 2011) .....	19
Table 0.1: Systems-thinking approach.....	24
Table 0.1: Demographics of participants from the Ngaka Modiri Molema and Bojanala districts in the North West province.....	33
Table 0.1: Characteristics of the Inquiry-Based Science Education approach and the learner-centred approach.....	64
Table 0.2: Illustration of models used to implement the successful use of ICT in teaching and learning .....	66

## LIST OF FIGURES

Figure 0.1: Bloom's Taxonomy (revised) (Marzano & Kendall, 2007) .....	25
Figure 0.2: Systems-thinking model.....	25
Figure 0.1: Ratio of male and female participants.....	34
Figure 0.1: Process of data collection (Maree & Nieuwenhuis, 2007, p. 82).....	41
Figure 0.1: Derived themes under the research questions .....	52
Figure 0.1: Presentation of the school settings in percentages.....	53
Figure 0.1: Teachers' qualification levels .....	56
Figure 0.1: Image of dull and non-science learning environment.....	58

# **CHAPTER 1**

## **INTRODUCTION TO THE STUDY**

### **1.1 INTRODUCTION**

There is general consensus that effective teaching and learning of science is a major concern, particularly in primary schools (Agan, 2004; Lacina & Block, 2011; Petersen & Treagust, 2014). According to James and Pollard (2011), effective teaching entails putting great emphasis on learners' contribution during the teaching process, giving support to learners and continuous scaffolding and allowing learners to build on personal existing knowledge. However, researchers have identified gaps within the field of science education that most countries consider critical (Agan, 2004; Petersen & Treagust, 2014; Skamp, 2012). For example, the Australian Academy of Science (2011) highlighted some gaps between the ideal science classroom (resembling a 21st century classroom) and the actual science classroom (resembling static classrooms, similar to most 19th century classrooms). The identified gaps included lack of resources, poor infrastructure, poor curriculum delivery and lack of human resources (i.e. teachers) (Rennie et al., 2001). The insight from the Australian Academy of Science report denotes some of the challenges and reasons why most countries hardly succeed in achieving 21st century science classroom goals. Nevertheless, for effective teaching and learning to take place, Heystek (2016) argues that good leadership needs to support the curriculum. The "missing link" between leadership and the managing of resources bears challenges to the current discourse of low science performance in the natural sciences and the technology intermediate phase (Bantwini, 2017; Delvin, Kift, & Nelson, 2012; Heystek, 2016). Heystek suggests that good leadership leads to overall improvement of the quality of education. Mpeta (2013) agrees with the latter.

In Mpeta's (2013) opinion, South Africa shows a low performance in science, which calls for attention. Research indicates that low performance in science education in most South African schools may have been caused by ineffective teaching and learning practices and leadership skills (Heystek, 2016; Mpeta, 2013). These studies conclude that, in order to "revive" science education and "do away" with poor performance, strategies need to be applied which involve collaborative relationships between teachers and learners and the sound practising of leadership skills of all stakeholders in sciences (Delvin et al., 2012). The researcher is of the view that good leadership (in particular) plays a crucial role in eradicating poor performance in science education. Nevertheless, this argument suggests that poor performance, lack of resources and under-qualified natural science teachers are contributing factors caused by poor leadership (Cronje; 2015; De Beer, 2016; Mothwa, 2011).

Additional trends with respect to poor learner performance in science education are evident in the Trends in International Mathematics and Science Study (TIMSS) report (International Association for the Evaluation of Educational Achievement [IEA], 2015). The TIMSS results indicate that countries like Singapore, Hong Kong, Korea, Chinese Taipei and Japan continue to dominate the international ranking for mathematics, science and technology. Also evident from these results is that there are gaps in mathematics, science and technology teaching and learning in other countries, including South Africa, Morocco, Malaysia, and Egypt (IEA, 2015), to name but a few. It appears that most of the African countries still struggle to fight their way up to the top rankings of science education globally. Research indicates that even though the teaching and learning of science has received considerable attention, it still remains one of the problematic issues in the education system in the African countries (Set, Hadman, & Ashipala, 2017), which is a cause for great concern.

The poor performance of learners resulting from the lack of resources or mismanaged resources may be a reason for decay in the quality of education (DBE, 2011). A report by the National Education Infrastructure Management System (2011) showed that in 2011, there were a total of 24 793 schools in South Africa and only 3 772 schools had science laboratories. The report also indicated that out of the 3 772 schools with laboratories, only 1 231 laboratories were stocked, which amounted to 15%. Chalufour (2010) suggests that more attention is necessary to develop strategies that will improve these generic problems faced in science education, which will increase learners' academic performances in general and elevate the bar for quality education. The quality in science education is essential and needs to be emphasised, but the results from this cited report are not to be extrapolated to communicate the core aim of this study, as there are other factors that may not have been communicated in previous studies.

Thus, the analysis of the teaching and learning of Earth and Beyond strand in natural science and technology is critical and necessary, as there seems to be dearth of literature in this area. Earth and Beyond is a strand in Natural Science and Technology in the intermediate phase and comprises the following topics: Planet Earth; Surface of the Earth; Sedimentary rocks; Fossils; The Solar System; Movements of the Earth and Planets; Movement of the Moon, etc. (DBE, 2011, p. 14). In each topic from the strand, the teachers are given the opportunity to expand on theories and to propose and organise learning experiences that will assist learners in contextualising their knowledge. Teachers do this by contextualising the content in their science classrooms (DBE, 2011). It is therefore crucial to gain knowledge about the factors that facilitate or hinder the successful teaching and learning of the Earth and Beyond strand in the intermediate phase, hence the proposed study.



## **1.2 PROBLEM STATEMENT**

Despite some of the published research or studies archived in various university repositories, there is still hardly literature on the teaching and learning of the Earth and beyond strand in the Intermediate phase (Hadman, 2017; Hine, 2015). This indicates a knowledge gap in the teaching and learning of the Earth and Beyond strand. A study by Lombaard (2015) also indicates the insufficiency of research in the subject Natural Science and Technology in general in the North West province. Zondo (2015) also reflects some evidence on the dearth of literature in the Earth and Beyond strand.

The existing research, as the DBE (2011) asserts, indicates that most schools still struggle with teachers who have limited pedagogical content knowledge (PCK) and content knowledge (CK), which takes a toll on the education system. Shulman (1987) argues that it is necessary for teachers to recognise and reflect on why they teach certain content matter the way they do and also to explore innovative ways of teaching the content. However, learners who do not learn independently (self-directed learning) are consequently unable to acquire the necessary skills and knowledge they need in mathematics, natural science and technology (Ingersoll, 2003). In Ingersoll's (2003) view, this prevalent challenge demotes science education and continues to demotivate future science teachers to a certain extent. Thus, as Adane et. al (2012) believes, it is essential that the reasons behind poor academic performance in science are examined and that possible intervention strategies are implemented so that the quality of science education is maintained and every learner receives the necessary skills and content knowledge to enter the world of work.

### **1.3 SIGNIFICANCE OF THE STUDY**

This study contributes to the academic literature in science education as it focuses on the analysis of teaching and learning of the Earth and Beyond strand in the subject (Natural Science and Technology). It also contributes by filling the gap that exists between theoretical and practical aspects of the problem. The study further contributes to the promotion of effective teaching practices and the sharing of informative ideas (on the effective teaching and learning of Earth and Beyond). The study also contributes by helping to identify various factors that need to be considered for teachers in order to present Earth and Beyond effectively so that learners may benefit academically (Luneta, 2012). Furthermore, the study identifies the gaps between what facilitates and hinders teaching and learning in the Earth and Beyond strand.

### **1.4 RESEARCH QUESTIONS**

#### **1.4.1 Primary research question**

The primary research question of this study was: What are the factors that hinder or facilitate the successful teaching and learning of Natural Science and Technology in the strand Earth and Beyond in the intermediate phase?

#### **1.4.2 Secondary research questions**

The study was further directed by the following secondary research questions:

- How do learners learn the Earth and Beyond strand inside and outside of the classroom in the intermediate phase?
- What are the factors that hinder the effective teaching and learning of the Earth and Beyond strand in the grade 5 Natural Science and Technology classroom?
- What are the factors that facilitate the effective teaching and learning of the Earth and Beyond strand in the grade 5 Natural Science and Technology classroom?

- What are teachers' perceptions regarding the teaching and the learning of the Earth and Beyond strand in grade 5?
- What are the factors that need to be considered when teaching the Earth and Beyond strand?

## **1.5 AIMS AND OBJECTIVES OF THE STUDY**

### **1.5.1 Research aim**

The primary research aim of the proposed study was to analyse the teaching and learning of Earth and Beyond in Natural Science and Technology in the intermediate phase.

### **1.5.2 Research objectives**

The objectives of the study were as follows:

- to ascertain how learners learn the Earth and Beyond strand inside and outside of the classroom in the intermediate phase;
- to evaluate the factors that hinder effective teaching and learning of Earth and Beyond in the grade 5 Natural Science and Technology classroom;
- to evaluate the factors that facilitate effective teaching and learning of Earth and Beyond in the grade 5 Natural Science and Technology classroom;
- to analyse and comprehend the perceptions that teachers have on teaching the Earth and Beyond strand in grade 5 classrooms;
- to generate the factors that need to be considered when teaching Earth and Beyond.

## 1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY

One of the limitations of this study was time constraints as teachers were busy during the data-collection period. Most of the teachers were busy with the final term (3) assessment and therefore some were not very eager to present lessons. This negatively impacted the classroom observations protocol. Another limitation was that teachers from rural schools used scholar transport to and from work – therefore the researcher was unable to request extra time to engage them in the post-interviews she had planned.

The delimitations of this study include that the study was conducted in two school districts in the North West province and only focused on Natural Science and Technology teachers in grade 5. This means that the findings cannot be generalised across the North West province and the rest of the intermediate phase. The research focuses only on the Earth and Beyond strand; however, during the interviews, the participants mentioned the other strands.

## 1.7 CLARIFICATION OF CONCEPTS

- **Natural science and technology:** According to the Curriculum Assessment Policy Statements (CAPS), science and technology is a systematic way of looking for explanations and connecting the ideas we have by integrating technology within the knowledge of science (DBE, 2011). It is also the relationship between scientific and technological engagements that bridge the gap between economic, social and environmental factors (DBE, 2011).
- **Earth and Beyond as a strand:** Earth and Beyond as a strand in Natural Science and Technology is a theme in which Earth and space is taught (DBE, 2011). There are various topics that fall under the strand including: Planet Earth, The Sun, The Moon, and Rocket Systems (DBE, 2011).

- **Scientific knowledge (concepts):** Scientific knowledge is knowledge accumulated through a systematic study and organised by general principles. For example, “Mathematics is the basis for much scientific knowledge”, the content of a field of knowledge (Bloor, 1976).
- **Effective teaching:** Effective teaching entails putting great emphasis on the learners’ contribution during the teaching process, giving support to learners and continuous scaffolding, and allowing learners to build onto their existing knowledge (James & Pollard, 2011).
- **Effective learning:** Effective learning is continual learning, learning in conducive environments, so that all learners acquire knowledge effectively (James & Pollard, 2011).

## 1.8 DIVISION OF CHAPTERS

### Chapter 1

This chapter introduced a brief body of scholarship focusing on past and recent research on the teaching and learning of Natural Science and Technology. Some of the findings discussed from the body of scholarship included existing trends of the teaching and learning of Natural Science and Technology in the Earth and Beyond strand, reasons behind poor performance, and lack of support and resources. The problem statement and research questions which guided the study were also provided. The aims, objectives and significance of the study, followed by the limitations and delimitations, were outlined as a pathway directing the reader towards the focus of the study. Finally, under clarification of concepts, the researcher explained the terminology to be used throughout the dissertation.

## **Chapter 2**

The literature review and theoretical framework outlined the literature studies integrated within the field of Natural Science and Technology and their contributions to this study's objectives. The subheadings included: Natural Science and Technology teaching in the intermediate phase; Challenges and successes in the teaching and learning of the subject; and finally, science education theories underpinning the study.

## **Chapter 3**

The first section of the chapter discussed the research design. This was followed by the research methodology, which navigated the steps, followed by the data collection, storage, coding and analysis utilised by the researcher. The chapter was concluded by a description of the context, participants and sampling, and ethical considerations.

## **Chapter 4**

Hereunder the findings of the study were presented and discussed with the aim to highlight to the reader how the research question has been answered. Reference to chapter 2 was provided to illustrate how the theories embedded within the study are incorporated in the findings presented.

## **Chapter 5**

In the final chapter, the researcher summarised the findings of the study with reference to all the chapters. Recommendations were also made as to how the study contributes to various stakeholders, including teachers, learners, subject specialists of Natural Science and Technology and policymakers.

## **CHAPTER 2**

### **LITERATURE REVIEW AND THEORETICAL FRAMEWORK**

#### **2.1 INTRODUCTION**

According to De Vos and Strydom (2011), it is important for a researcher to set a theoretical framework that enables the reader to understand the nature of the study. This solidifies the foundation of the study and proves to the reader that the scientific knowledge expressed by the researcher is convincing and presented in a systemic manner (De Vos & Strydom, 2011, p. 28). Other scholars (e.g., Boote & Beile, 2005, p. 7) deduce that literature ought to contain thorough coverage, synthesis and methodology in order for it to speak to the reader. They also concur that good literature should be an intense discussion of past and current theories that answer the research question (Boote & Beile, 2005). In an attempt to accomplish this, this research takes an approach to provide a critical discussion of the theories and models that underpin this study. This chapter outlines the theories and models that support the knowledgebase of this study. The Inquiry-Based Science Education theory as well as the learner-centred design approach, commonly known as the learner-centred approach, is examined with regard to their contribution to the successful teaching and learning of Natural Science and Technology. Also, in chapter 2, the systems-thinking model in terms of its contribution to science education and the successful teaching and learning of the Earth and Beyond strand, in particular, is deliberated upon. These theories and model are analysed to assist the reader to gain perspective on the observed relationship between the scientific theories and the research question.

## **2.2 NATURAL SCIENCE AND TECHNOLOGY IN THE INTERMEDIATE PHASE**

The South African White Paper on Science and Technology (1996) firmly states that science education is considered to be among the requirements for creating development and sustainability with regard to wealth and quality of life. This statement emphasises the ability that science education imposes to elevate the standard of a country or to change a country's status from being a developing country to being a developed country. In its norms and standards with regard to Natural Science and Technology, the Department of Basic Education (DBE, 2011) promises to nurture and instil a science-society attitude in all its stakeholders (including teachers, learners, parents, community, etc.). This is merely one of many efforts to stop the society from degrading to a non-science republic. Evidently, more needs to be done in order to build a science- and technology-efficient society. Matt Bevin states that, "While it may seem small, the ripple effects of small things are extraordinary" (Bevin, n.d.). As the quote suggests, this study aimed to analyse the factors that hinder the successful teaching and learning of Natural Science and Technology in the Earth and Beyond strand in order to contribute to the eradication of the bigger problem that is being observed.

The CAPS introduces Natural Science and Technology as follows: first, science is an orderly way of looking for explanations and connecting the ideas we have. It also adds that, in Science certain methods of inquiry and investigation are generally used, and these methods lend themselves to replication and a systematic approach to scientific inquiry that attempts at objectivity (DBE, 2011, p. 8). Second, technology is viewed as the use of a combination of knowledge, skills and available resources to develop solutions that meet the daily needs and wants of society (DBE, 2011, p. 8). The CAPS also stipulates that, in order for its objectives to be accomplished in terms of its strategic plan towards Natural Science and Technology, economic and environmental factors and a wide range of



attitudes and values need to be considered when developing technological solutions. According to literature, Technology also advances learners' knowledge: technological methods include identifying needs, planning, designing, making and evaluating products (DBE, 2011 p. 8; Bantwini, 2015; Bihi, 2014; Black, Harrison, Osborne & Duschl, 2004). Integrated Science and Technology entails the scientific as well as the technological aspects of natural sciences (DBE, 2011, p. 9-10). Science and technology have made a major impact, both positive and negative, on our world (DBE, 2011, p. 9).

Various other studies have reported that the way in which science subjects (including Natural Science and Technology) are taught in schools and the learning environment are core determinants of learner performance and the successful teaching and learning of Natural Science and Technology in general (King, 2007; Onwu, 2000; Schwartz, 2006). Some reported challenges relating to the teaching and learning of Natural Science and Technology include the following (Onwu, 2009; Onwu & Kyle, 2011; Anderson, 2009):

- Teaching is not done in a way that allows learners to link the content to their everyday life experiences;
- Science education is taught in an uninteresting fashion, which leaves learners less intrigued about the subject knowledge;
- Higher-order thinking skills are not promoted or reflected in teachers' lesson planning;
- A sense of confidence lacks in learners and they are unable to make autonomous decisions based on their learning experiences.

With reference to the factors mentioned above, it is deduced that without the serious consideration of context, the successful teaching and learning of Natural Science and Technology cannot be achieved. More so, the successful teaching and learning of the

Earth and Beyond strand cannot be stable. The Earth and Beyond strand formally covers content which comprises the following (DBE, 2011, p. 14):

- Planet Earth;
- The Sun;
- The Earth and the Sun;
- The Moon.

The questionable challenge, though, is that in terms of the teaching of Natural Science and Technology, many teachers have countered the contextual approach to teaching (Jenkins & Pell, 2006; Osborne & Collins, 2001; Stears et al., 2003). Through research, they have voiced their concerns which mounted up one greater distress, namely the inequalities in terms of context that exist within the science education structures and education as a whole. One of the context-based approaches which have been attempted by most teachers is science curriculum development (Gilbert, Bulte, & Pilot, 2006). In this approach, scientific content is embedded within real-life experiences or situations. Thus, learners learn science through what they encounter on a daily basis. By the implementing this approach, learners are able to see the relevance of science in their lives and in society (Specific aim 3: Science, Technology and Society) (DBE, 2011, p. 10) and ultimately, teaching and learning of Natural Science and Technology – in this case, particularly the Earth and Beyond strand – can be taught and learnt successfully. This leads us to the next sections about the factors that hinder and facilitate the successful teaching and learning of the Earth and Beyond strand in Natural Science and Technology in the intermediate phase.

## **2.3 SOME CHALLENGES IN THE TEACHING AND LEARNING OF SCIENCE EDUCATION**

There is universal consensus that poor performance in Natural Science and Technology is caused by various factors, such as poor teaching methods, poor assessment practices, lack of resources to demonstrate content, and lack of content knowledge and PCK by teachers (Bantwini, 2017; International Mathematics and Science Study, 2015; King, 2007; Mpanza, 2013). With regard to poor teaching methods practised by teachers, it seems as though the biggest challenge they face is that they do not possess their “own” teaching styles. They tend to utilise teaching methods which their teachers used to implement when they taught them during their school years (Bantwini, 2015). More literature on this dilemma seems to be communicating this idea (Hora, 2013; Owens, 2012). Owens (2012) concludes that this way of teaching leaves these teachers with no creativity and no enthusiasm, which ultimately have a negative impact on the successful deliverance of content to learners. Owens (2012) also adds that this is an irrelevant approach to teaching as it focuses on teacher-centredness rather than learner-centredness which incorporates constructive learning. Constructive learning, according to Kafyulilo, Fisser, and Voogt (2015), refers to a learning process whereby a learner is afforded an opportunity to learn through constructing or creating his or her own understanding and knowledge of the world through experiences. In other words, they (learners) use real-world problem solving to develop their own understanding of a certain phenomenon. This is affirmed by Gardner (1991), who confers Constructivism is an important teaching approach which can lead to the successful teaching and learning of any subject matter.

Regarding poor assessment practices, research has highlighted the following factors that may contribute to poor or ineffective assessment practices (Herman, Adchbacher & Winters, 1992; Wallace, 2013):

- higher-order thinking and problem-solving skills;
- involving real-world applications;
- use of tasks that represent meaningful, instructional activities.

It is also important to mention (with reference to this study's research question) that in order for assessment strategies to be effectively applied, teachers need to consider what Wallace (2013) refers to as 21st century skills and alternative assessments. Twenty-first century skills is a common term recently used in education due to its meaning which addresses the idea that we live in the 21st century and our approaches to teaching or communication to learners nowadays need to accommodate the times we live in (Corcoran, Dershimer, & Tichenor, 2004; Wallace, 2013). For this study's research question to be answered, the researcher has prioritised analysing the factors that hinder the successful teaching and learning of Natural Science and Technology. In order to equalise the study, the factors that facilitate the successful teaching and learning of the Earth and Beyond strand also need to be addressed.

## **2.4 SUCCESSFUL TEACHING OF SCIENCE**

Ironically, the same factors that hinder successful teaching and learning are reported to facilitate the successful teaching and learning of Natural Science and Technology when turned around (Gardner & Hill, 1991; Iwu et al., 2016). The use of poor teaching strategies can be eradicated by enforcing the idea of teaching through different rather than one teaching strategy. It is noted that the CAPS does not prescribe particular strategies or methodologies (DoE, 2012). Therefore, teachers are able to explore different types of teaching strategies and apply them in their classroom. Teaching strategies go hand in hand with learning styles (Rickinson & Lundholm, 2008). Rickinson and Lundholm (2008) emphasise that learning experiences are created and only effective through the

implementation of good teaching strategies. They also add that, with relation to teaching strategies within the context of science, there is a need for teachers to focus on the research-based understandings of scientific learning processes. In agreement, Lotz-Sistka (2011) adds that any content (work) that is research-based adds to the quality of education. Thus, a teacher who infuses research into the content knowledge transferred to learners is more likely to attain good learner performance in science than a teacher who does not allow for the scientific learning processes to take course in their learning.

Assessment plays an essential role in teaching and learning and needs to be practised by both the teacher and learners (Feuerstein, Falik, & Rand, 2006). It is suggested that the teacher and learners take ownership of the work which needs to be assessed, whether formal or informal. In review of the Natural Science and Technology CAPS and with reference to this study's objectives, assessment is described as a continuous and thoroughly planned process of identifying, gathering, interpreting and diagnosing information regarding the performance of learners (DBE, 2011, p. 65). It is, however, the teacher's obligation to make sure that the type of assessment selected is relevant and developmentally appropriate to what learners are expected to do in terms of their knowledge domain. Nonetheless, literature indicates that most teachers remain demotivated due to the lack of resources, and this later impacts their confidence in teaching the content, especially in science education (Bantwini, 2017). Aggravating the situation is that science education encompasses both theoretical work and practical work which need a variety of resources to be at the disposal of the teachers so that they can demonstrate scientific concepts with ease (DBE, 2011).

## **2.5 THEORETICAL FRAMEWORK**

In De Vos and Strydom's (2011) view, it is important for a researcher to set a conceptual and theoretical framework that will enable the reader to understand the nature of the study. This solidifies the foundation of the study and proves to the reader that the scientific knowledge expressed by the researcher is convincing and presented in a systemic manner (De Vos & Strydom, 2011, p. 28). Other scholars (Boote & Beile, 2005, p. 7) deduce that literature ought to contain thorough coverage, synthesis and methodology in order for it to speak to the reader. They also concur that good literature review should be an intense discussion of past and current information that answers the research question (Boote & Beile, 2005).

In an attempt to accomplish this, this research takes an approach to provide a critical discussion of the theories and models that underpin this study. Chapter 2 outlines the theories and models that support the knowledgebase of this study. The Inquiry-Based Science Education (IBSE) theory as well as the learner-centred design approach commonly known as the learner-centred approach is examined with regard to their contribution to the successful teaching and learning of Natural Science and Technology. Also, the systems-thinking model in terms of its contribution to science education and the successful teaching and learning of the Earth and Beyond strand, in particular, are deliberated upon. These theories and model are analysed to assist the reader to gain perspective on the observed relationship between the scientific theories and the research question.

### **2.5.1 Inquiry-Based Science Education (IBSE) Theory**

According to Beerer and Bodzin (2004), the IBSE incorporates the following key elements, which are often used by scientists in their scientific research: it is based on observation

and experimentation; asking questions; making hypothesis; designing investigations; grappling with data; drawing inferences; redesigning investigations; building and revising theories. In addition, Harlen and Allende (2009, p. 11) suggest that IBSE comprises experiences that enable learners to develop an understanding about the scientific features of the world around them through the development and use of inquiry skills. The term inquiry skills entail that learners question or investigate a certain phenomenon based on self-explanation, self-exposure and self-evaluation. According to Academy of Science of South Africa (ASSAf) (2011), IBSE can be traced back to the 1950s, when Jean Piaget prepared an investigation on the different ways in which young children think and process information. ASSAf (2011) claims that during the 1960s and 1970s, many scientists became concerned with how children developed conceptually, particularly primary school children. This brought more scientists on board to research systems which may be endorsed to develop learner thinking skills as well as their developmental processes, especially in science education. The IBSE theory was then steered by science educationists to promote its use and practice.

According to the Inter-Academy Partnership (IAP) (2006, p. 4), IBSE in practice is when learners are able to learn through their own thinking and teachers play their role of facilitating and leading learners to develop inquiry skills as well as providing them with the necessary resources they need. This entails that both parties (the teacher and learners) should play their differentiated roles in making sure that the scientific goals are reached successfully. Table 2.1 below tabulates the role of the teacher and that of the learner in the IBSE approach versus the traditional approach. This provides a clearer understanding of the expectations of all the role players when implementing the IBSE approach in the teaching and learning of science.

**Table 0.1: The Inquiry-Based Science Education approach versus the traditional approach (ASSAf, 2011)**

IBSE	TRADITIONAL
1. Focus on using and learning content as a means to develop	1. Focus on mastering of content and less emphasis on development of skills
2. Learner-centred	2. Teacher-centred
3. Teacher is a facilitator of learning	3. The teacher focuses on giving information and the learners must receive it
4. Emphasis on 'how we come to know what we know'	4. Emphasis on 'what we know about science'
5. Learners are more involved in the construction of knowledge through active involvement	5. Learners are recipients of knowledge and less questioning is expected
6. Assessment focuses on the progress of skills development and content understanding	6. Assessment is focused on the one right answer
7. Learners are encouraged to search and make use of resources beyond the classroom and school	7. Resources are limited to what is available in the school and there is no emphasis on the use of resources in learners' outside environment
8. Emphasis on learning things through experimentation	8. Emphasis is on memorising scientific concepts

In the light of the table above, one can readily make an assumption that the teaching approach of this theory requires learners to be given an opportunity to watch an object or phenomena in the real world and experiment with it (IAP, 2006). During their learning process, they argue, discuss and make inferences based on what they see,



simultaneously developing their cognitive, linguistic and communication skills (Diale, 2010). This highlights the importance of partnership within the structures of IBSE. For IBSE to work effectively, active participation of other stakeholders – namely, parents, local community members, librarians, higher education institutions, and local education scientists – who would support and mentor both teachers and learners in the teaching-learning processes, is needed.

There has been consensus amongst some developed countries about the successes of implementing the IBSE approach. For instance, in France and Australia, the following conclusions were drawn from reports about the implementation of this theory in science education:

- In 2004, it was shown that more than 35% of children really practise science in their classroom, whereas only 3% did so when the theory was implemented, thus representative of the effectiveness of the IBSE approach (Folco & Lena, 2005, p. 16).
- Positive feedback from teachers, society and higher education was received about the implementation of IBSE.

In Costa Rica, for example, the Department of Education in partnership with the National Academy of Sciences of Costa Rica took an initiative of introducing the IBSE approach with an objective to assist teachers with application of the inquiry-based methodology, particularly for the Costa Rican context (IAP, 2017). This approach also signified the importance of “context” in the learning environment of young children. Peers (2010), claims that all universities need to have compulsory educational programmes for prospective teachers that will develop their knowledge on the teaching approach in IBSE.

These countries have a common understanding of the benefits achieved through using the IBSE approach.

In developing countries, like South Africa, there is growing consensus concerning the importance of promoting inquiry-based teaching and learning (Ramnarain & Hlatwayo, 2018). Ramnarain and Hlatwayo (2018) further state that the implementation of IBSE continues to be a challenge for many teachers, especially in rural schools. In South Africa, IBSE is accepted in the latest national curriculum document (CAPS). This is reflected under Specific Aim 2, which specifies that learners should develop “scientific skills by ‘doing science’” (DBE, 2011, p. 16-17).

### **2.5.2 Learner-centred approach**

Learner-centred teaching methods shift the focus of activity from the teacher as knowledge bearer to the learners as knowledge recipients (Jossey-Bass, 2016). This means that these methods include active learning or active learner participation in which learners solve problems, answer questions, articulate questions of their own, deliberate, explain, debate and brainstorm during the teaching and learning process. According to Jossey-Bass (2016), when cooperative learning is encouraged, learners are able to work in groups and solve problems in autonomous and interdependent ways. This means that these learners are able to take ownership of their work and build on their scientific and technological skills. This method or approach to teaching closely relates to inquiry-based learning, case-study based instruction, problem-based learning, project-based learning and discovery learning (Baeten, Dochy, & Struyven, 2012). According to Soloman and Felder (1991), learner-centred methods have continually been proved to be superior to the traditional teacher-centred approach to instruction. Felder (1991) has written numerous papers on the successful use of learner-centred teaching methods in science education.

Learner-centred instruction stems from the constructivist learning theory and represents a countermovement to traditional teacher-centred pedagogical practices (McAuliffe & Eriksen, 2002). Teachers who use learner-centred teaching view content knowledge through lenses of social and interpersonal practices and therefore prioritise learners' individual processes of building subjective knowledge and understanding rather than encouraging them to memorise the subject matter (Baeten et al., 2012). These teachers must be comfortable with the improbability that comes with self-reflection and change, both in teachers and learners (McAuliffe & Eriksen, 2002). This implies that the teachers must be spontaneous in their teaching method and not have fixed structures set out in their planning.

For this research, the learner-centred approach is beneficial as it speaks to the Natural Science and Technology curriculum's specific aims, which state that learners should be afforded the opportunity to learn through experience or "learn through doing" (DBE, 2011). Place learning or contextual learning at the centre of the classroom environment is also critical, as both teacher and learners share the responsibility for creating a meaningful learning experience in their own context. Finally, it is also important to mention a limitation of the learner-centred approach. This approach to teaching promotes independence in learners and the way they choose to acquire knowledge. The consequence of this approach is that, in the process of learning, misconceptions develop, and teachers may not make sure that these misconceptions are timely eradicated during the learning process (Vanthournout et al., 2004; Wilson & Fowler, 2005).

### **2.5.3 Systems-thinking model: seeing the forest through the trees**

Systems' thinking is referred to as an important tool in understanding and real-world phenomena (Schuler, Fanta, & Reiss, 2018). This means that interconnected components

are studied jointly. This is how the Natural Science and Technology curriculum prescribes its content to teachers (DBE, 2011). The following definition provides a clear understanding of what systems thinking entails (Kordova, Moti, & Miller, 2018, p. 313):

*Systems thinking is a discipline for seeing wholes, a framework for seeing interrelationships and repeated patterns of events rather than just isolated incidences, seeing patterns of change rather than static “snapshots”.*

Through this definition the researcher outlines the following characteristics of systems thinking (Broks, 2016):

- promotes higher-order thinking;
- encourages learners to work independently, which later fosters autonomous decision-making;
- learners are engaged in experiential learning;
- content-related work is studies in collaboration.

Table 2.2 illustrates how Natural Science and Technology teachers can implement the systems-thinking approach when they teach the Earth and Beyond strand (Richmond, 2000):

**Table 0.1: Systems-thinking approach**

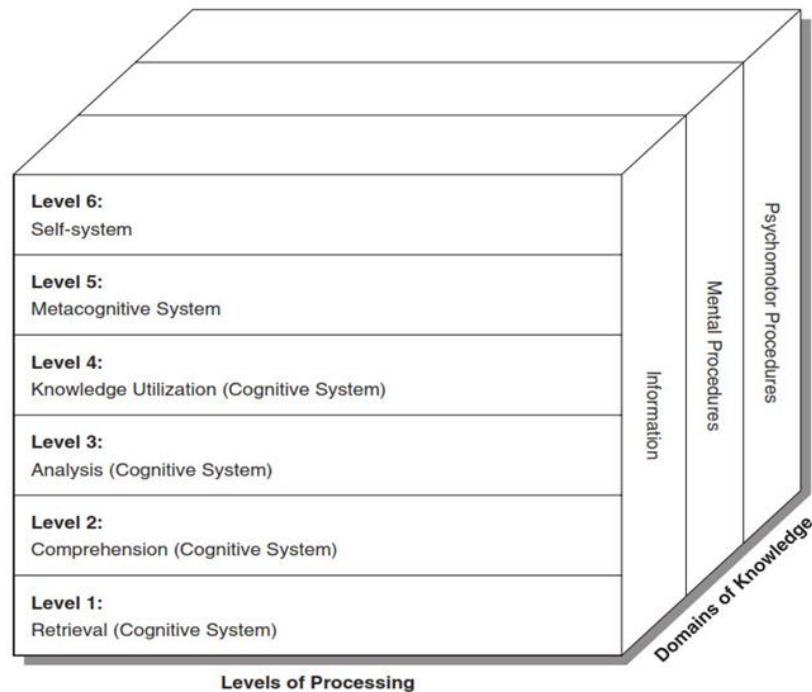
<b>SYSTEMS THINKING SKILL</b>	<b>PRACTICING THE SKILL</b>
<b>Dynamic Thinking:</b> Framing a problem in terms of a pattern of behavior over time.	Construct behavior over time graphs; think of events as interesting points in a variable's overall trajectory over time.
<b>System-as-Cause Thinking:</b> Seeing internal actors who manage the policies and "plumbing" of the system as responsible for a behavior.	Instead of blaming, ask "How could those within the system have been responsible?" or "What could those within the system have done to make it more resilient to external shocks?"
<b>Forest Thinking:</b> Seeing beyond the details to the context of relationships in which they're embedded.	Focus on similarities rather than differences.
<b>Operational Thinking:</b> Understanding how a behavior is actually generated.	Ask "What is the true nature of a process?" rather than "What are all the factors that influence the process?"
<b>Closed-Loop Thinking:</b> Viewing causality as an ongoing process, not a one-time event, with effects feeding back to influence causes, and causes affecting each other.	Take a "laundry list" and try to understand how the items on it might influence each other.
<b>Quantitative Thinking:</b> Knowing how to quantify, though you can't always measure.	Ask what key "soft" variables have been left out of analyses, and ruminate about the implications of including them in your model.
<b>Scientific Thinking:</b> Knowing how to define testable hypotheses.	"Shock" a computer model by drastically changing the values of certain variables, to see how the model holds up.

Also, it is important to point out that this approach is closely linked to constructivism. The constructivism theory proposes that a human being is an active learner who constructs his/her knowledge of experience on his/her efforts to give meaning to that experience (Richmond, 1993; Richmond, 2000). In this study, teachers should encourage learners to construct their knowledge by means of active experience and learning. Social constructivism recommends that learners learn concepts or construct meaning about ideas through their interaction with others and with their world and through interpretations of that world by actively constructing meaning (DBE, 2011; Richmond, 1993; Richmond, 2000). Vygotsky promotes the use of constructivism and states that "learners construct knowledge or understanding as a result of thinking and doing in social contexts" (Vygotsky, 1986).

After the researcher reviewed numerous authors, it seems that the systems-thinking approach closely links to Bloom's taxonomy of higher-order thinking. The figures below

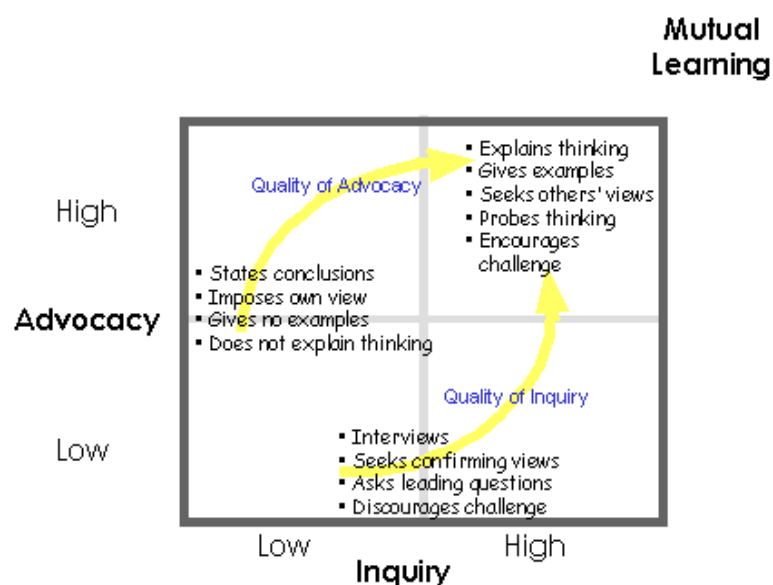
illustrate the interconnectedness of Bloom's taxonomy of higher-order thinking and the systems-thinking model (Hopper & Stave, 2008; Anderson & Krathwohl, 2001):

**Figure 1.2** The New Taxonomy



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**Figure 0.1: Bloom's Taxonomy (revised) (Marzano & Kendall, 2007)**



**Figure 0.2: Systems-thinking model**

The figures above indicate the relationship between Bloom's taxonomy and the systems-thinking model that the researcher recommends for the teaching and learning of the Earth and Beyond strand. The relativeness of these models is indicated in how they both give attention to content (information), mental procedures and psychomotor procedures.

## **2.6 SUMMARY**

This chapter has thoroughly discussed the theories and models that underpin this study. An outline of the theories and models that support the knowledgebase of this study has been critically discussed. The IBSE theory as well as the learner-centred design approach was studied in terms of their contribution to the successful teaching and learning of the Earth and Beyond strand in Natural Science and Technology. Also, the systems-thinking model and its contribution to the Earth and Beyond strand was unpacked. The theories and model analysed in this chapter has provided a perspective on the observed relationship between the scientific theories and the research question. The next chapter provides a thorough discussion of the research design that underpins this study as well as the methodological aspects of the study.

## **CHAPTER 3**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **3.1 INTRODUCTION**

In the first section of this chapter, the research design is explained. As the aim of this study states, the teaching and learning of the Earth and Beyond strand in grade 5, at schools in the Bojanala and Ngaka Modiri Molema districts, was critically analysed. The methodological aspects of this study are discussed, with reference to the research design, the research approach, and the research methods. Under research methods, the following aspects are discussed: context of the study; the pilot study; participants and sampling; data generation; coding and analysis. A detailed explanation of the quality criteria and trustworthiness is then provided, followed by ethical considerations and the role of the researcher.

#### **3.2 RESEARCH DESIGN**

The term paradigm, as originating from linguistics, refers to a model or a set of legitimated assumptions and a design for collecting and interpreting data (Barker, 2003, p. 312). This is where the quantitative and qualitative paradigms in research are spoken of. In science education, the term is commonly used to deliberate on Kuhn's *Structure of Scientific Revolutions* (Kuhn, 1970) where his perspective on this concept gives reference to three important aspects of science education, namely nature, growth, and development of the sciences. Regarding the term methodology, Terre Blanche and Durrheim (2004) describe methodology as the instrument which validates the research findings. These authors, in addition, assert that methodology entails how the researcher intends to investigate the subject matter and what methods and strategies the researcher would implement to



convince the reader of the statistical legitimacy of the research (Terre Blanche & Durrheim, 2004). Furthermore, a research design, in Allen's (1976) view, certifies and ensures that the study proceeds methodically and describes how the researcher strategizes to implement the research plan and tackle the problem.

In the view of Mouton (2001, p. 175), a research design involves planning, structuring and executing the investigation in a way that certifies that the results are valid and reliable. In other words, the research design is regarded as a pathway or map that leads the reader through the researcher's determinations and plans throughout the study. It focuses on answering the following questions: what was done; how it was done; where it was done; who were the role players involved; and why was it done.

In this study, the researcher used a mixed-methods approach from a post-positivist perspective. The mixed-methods research followed an explanatory sequential design, which allowed for collection of quantitative and qualitative data at different times. By using a mixed-methods approach, the researcher could undertake an inquiry process of understanding the phenomenon well enough to see it both objectively and pragmatically (Creswell, 2007). As Denzin and Lincoln (2005) suggest, the researcher also allowed multiple responses from participants by approaching the problem triangularly. The researcher's decision to use the mixed-methods approach was guided by the sentiments of Brown and Elliot (2015) who claim that these methods (qualitative and quantitative) are not rival, but characteristically complementary research approaches that can inform and guide each other.

Leatherdale and Robertson-Wilson (2015) suggest that the quantitative dimension of the research is concerned with attaining measurable information – in this case, factors that facilitate or hinder teaching and learning of the Earth and Beyond strand in the Natural

Science and Technology classroom. For this purpose, a questionnaire was deemed an appropriate research tool. The qualitative dimension looked closely at teachers' personal views of factors that hinder or facilitate their teaching and how they can possibly overcome these hindrances and promote good practices. Hence, in this dimension, the focus was on classroom observations and individual interviews.

According to McRoy (1995), the qualitative research paradigm, rooted in an anti-positivistic, interpretative approach, is idiographic and universal in nature. It aims to understand social life and the meaning people attach to everyday life. The qualitative research paradigm used in this study widely refers to research that stimulates participants in terms of meaning, experience or perceptions (McRoy, 1995). This means that it produces descriptive data that reflect the participants' own articulated words. One major characteristic of this approach is that it involves recognising the participants' beliefs and values on a personal level that underlie the phenomena (Basterra, Trumbull, & Solano-Flores, 2011; Carter & Hurtado, 2007; Stage, 2007a, 2007b; Van Lier, 2004). As a qualitative researcher it is important to also be concerned with *understanding* the nature of the participants' answers instead of only focusing on *description*. This mixed-methods study was concerned with non-statistical approaches and unlike quantitative studies, focused on smaller purposively selected samples (Baez, 2007; Stage, 2007b; St. John, 2007).

Marshall and Rossman (1999, p. 46) propose that the following guidelines are characterised as criteria for mixed-methods approaches:

- It is research that cannot be done experimentally for practical or ethical reasons;
- It is research that delves in depth into complexities and processes;
- It is research for which appropriate variables are yet to be recognised;

- It is research in the human service professions, such as the teaching profession;
- It is research that seeks to discover where and why policy, folk wisdom and certain practice do not work;
- It is research on unidentified societies or innovative systems;
- It is research on informal and unstructured associations and processes in organisations;
- It is research on real, as opposed to stated, organisational goals.

From the above-listed characteristics, the important features to highlight are the following:

- research that cannot be done experimentally for practical or ethical reasons;
- research that delves in depth into complexities and processes;
- research for which appropriate variables are yet to be recognised,
- research in the human service professions, such as the teaching profession; and
- research that seeks to discover where and why policy, folk wisdom and certain practice do not work.

These features speak to current study in a fundamental way. The researcher's choice pertaining to the research paradigm was motivated by Creswell (2013), who concurs that it is important that the research paradigm complements the research question and is consequently able to answer the research question meticulously.

In conclusion, it is also important to accentuate that within a paradigm lays theories and models that play a role in answering the research question of a particular study (Mouton & Marias, 1990). The researcher was constantly reminded of the research questions, which were ultimately answered through the use of the research design.

### **3.3 RESEARCH CONTEXT**

The study was undertaken in the North West province. The North West Provincial Department of Education consists of four school districts, namely Dr Kenneth Kaunda, Dr Ruth Segomotsi Mompati, Ngaka Modiri Molema, and the Bojanala district. Based on the rankings according to learner performance in mathematics, science and technology, the North West province was among the low-performing provinces in science subjects (Kent, Kruger, & Du Toit, 2016). This study focused only on two school districts namely, the Ngaka Modiri Molema district and the Bojanala district. The motivating factor was based upon reports on these districts' poor Natural Science and Technology results in the overall academic performance, which was evident in most of their schools (North West Department of Education and Sport Development Annual Report, 2015).

From each district, two circuits were purposively selected based on schools with very poor learner performance in science. Initially, from each circuit, five schools were purposively selected to participate in the study, totalling 20 schools from four circuits. However, eight schools with a total number of 10 participants finally formed part of the study. This equated to working with a 50% participant ratio instead of the 100% expected ratio. This did not discourage the researcher as the contexts consisted of private and public schools as well as rural and township settings that provided the researcher with an opportunity to compare and contrast the variations.

### **3.4 RESEARCH METHODOLOGY**

In the previous section, this study was defined as an interpretivist study informed by a positivist paradigm. This implies that the researcher had to carefully consider the data generation, data analysis and participant recruitment that best suited this study to ensure that it correlated with what an interpretivist approach entails. In the subsequent sections this is discussed in more detail. This mixed-methods research followed an explanatory

sequential design, which allowed for the collection of quantitative and qualitative data at different times. By using a mixed-methods approach, the researcher was able to undertake an inquiry process of understanding the phenomenon well enough to see it both objectively and pragmatically (Creswell, 2007).

### **3.4.1 Participant recruitment**

It is unlikely and a challenge to include an entire population in a research study (Maree & Pietersen, 2007, p. 172). Therefore, in this study, the researcher opted to make use of sampling. Sampling means selecting a few groups or people, usually sharing criteria, which the researcher deems representative of the total populace (Maree & Pietersen, 2007). One needs to keep in mind that there are numerous ways to select a sample for a study (Nieuwenhuis, 2007b, p. 79). In this study, purposeful sampling was considered the most suitable method.

The study involved teachers from independent and ordinary public rural and township schools teaching Natural Sciences and Technology in grade 5 classes in the intermediate phase. Several teachers were selected based on their availability and willingness to participate in the study. The researcher therefore developed selection criteria suitable for this study, which were successfully implemented. The following criteria ensured that the researcher's idea and plan proceeded as had been proposed in the early stages of the research:

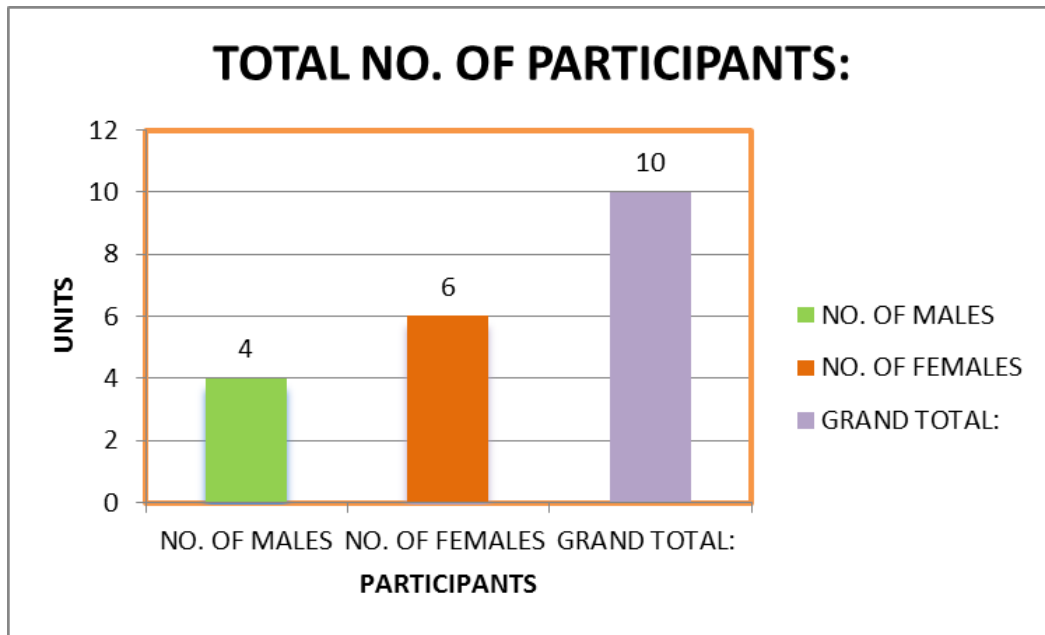
- All the participants were Natural Science and Technology teachers in the field;
- The sample included participants from the Ngaka Modiri Molema and Bojanala districts of the North West province.

The demographics of the participants are illustrated in Table 3.1, according to the two districts, in no particular order. The information represents the sample for the questionnaires and interviews.

**Table 0.1: Demographics of participants from the Ngaka Modiri Molema and Bojanala districts in the North West province**

Participant	Gender Male (M)/ Female (F)	Age group	Nationality	Teaching experience in years	Quintile	School location	Teacher highest qualification	No. of learners in classroom
1.	M	35-39	non-South African	10-14	3	Urban	B.Ed.	50-54
2.	M	35-39	South African	15-19	3	Township	B.Ed.	40-44
3.	F	50-54	South African	20-24	4	Township	B.Ed.Hons	35-39
4.	M	35-39	non-South African	1-4	3	Rural	Education Diploma	35-39
5.	M	30-34	South African	15-19	2	Township	PGCE -7	40-44
6.	F	30-34	South African	5-9	1	Rural	B.Ed.Hons	45-49
7.	F	35-39	South African	5-9	1	Rural	B.Ed.	35-39
8.	No participation from participant no. 8							
9.	F	25-29	South African	<1	2	Township	B.Ed.	45-49
10.	F	50-54	South African	10-14	2	Township	Diploma	45-49
11.	F	40-44	South African	10-14	2	Township	B.Ed.Hons	45-49

The number of participants in a research study plays an important role in how the research question will be answered (Maree & Pietersen, 2016). It was therefore the researcher's responsibility to ensure that the number of participants who participated in the study was adequate and that the selected participants fitted the criteria as was indicated earlier. This study's male-female ratio was almost objectively balanced, with males totalling 60% and females totalling 40%. It is also important to mention that, out of the total number of participants, one female participant did not show up for the meeting. Figure 3.1 illustrates the participant ratio and its significance is discussed in more detail in chapter 4.



**Figure 0.1: Ratio of male and female participants**

The primary participants in the study were Natural Science and Technology teachers. Ten teachers from two districts were selected to form part of the final sample. All teachers had to complete questionnaires protocols and engage in an interview with the researcher. The sample comprised of teachers from public rural schools (with a focus on quintile 1-3 schools) who taught Natural Science and Technology in the grade 5 class level. One teacher from each school was selected to complete the final sample size, although in one of the schools, three teachers participated in the data-collection process. This amounted to 10 participants whose responses and comments during the data-collection processes were used to substantiate the body of scholarship presented in chapter 4. Cohen *et al.* (2011) state that although non-probability samples are not representative enough, they are often used in small-scale studies because they are far less complicated to set up and less expensive. Qualitative interpretive studies usually use several types of non-probability samples, which include, among others, convenience sampling, quota sampling, snowball sampling, and purposive sampling (Van Driel, Verloop, & De Vos, 1998). A purposive non-

probability sampling strategy was used in this study. According to Cohen et al. (2011), purposive sampling is usually used to access data from people who have in-depth knowledge about an issue.

### **3.4.2 Research instruments**

For the quantitative dimension, two phases were implemented. The first phase was to develop and pilot the questionnaires (which served as the pilot study) and in the second phase, the administration and analysis of the questionnaire (which served as an official instrument) were conducted. The qualitative dimension formed part of the third phase of the study, which involved classroom observations and individual interviews with teachers. These data-collection strategies are discussed in detail under the 'research instruments' section.

Various research instruments, which intended to gather rich and sufficient data that comprehensively addressed the research questions, were used in this study. The following research instruments were employed to collect data in this study:

- questionnaires;
- interviews;
- classroom observations.

#### **3.4.2.1 Questionnaires**

The questionnaires served to get an initial overview of what the teachers' experiences are (Anderson, 1989). According to Maree (2007) and Bell (2005), the following aspects are of great importance when designing a questionnaire and this study asserts all these factors:

- Appearance of questionnaire: the proposed questionnaire is of a professional standard; there is a clear heading in bold letters that affirms the purpose of the



questionnaire; all questions are numbered clearly; and there is ample space provided for the answers.

- Question sequence: the sequencing of the questions is done chronologically (based on the topic's development), for example; the questions begin with an "easier" to a more complex question.
- Wording of questions: the wording of the questions is easy to understand but also pose an academic temperament to encourage seriousness in the answering thereof.
- Response categories: these categories are clear and do not allow for ambiguity in the participants' responses.

Bell (2005) and Maree (2005) claim that the application of these aspects when designing questionnaires encourages questionnaires to be natural, ready-to-use instruments to produce valuable data that can later be used to generate information. Nevertheless, the researcher needed to ensure that the data are reliable and valid (Mayan, 2001). Durrheim and Wassenaar (2002) assert that, by applying triangulation to the methods (which include the data-collection instruments), the researcher can determine if there are any discrepancies in the findings, hence the researcher made use of a second and third instrument to triangulate the findings. The researcher developed a questionnaire that measured the quantitative aspect of the research (as noted by Bell, 2005 cited in Maree & Pietersen, 2007). The questionnaire comprised of Likert scale and open-ended questions that elicited teachers' views with respect to: factors affecting the teaching and learning of the Earth and Beyond strand in Natural Science and Technology; how learners learn the Earth and Beyond strand inside and outside of the classroom; what factors facilitate the successful teaching and learning of the Earth and Beyond strand; the teachers'

perceptions of teaching and the learning of Earth and Beyond; and what factors need to be considered when teaching Earth and Beyond.

#### **3.4.2.2 Interviews**

Holstein and Gubrium (2003) describe interviewing in qualitative research as a unique form of conversation which provides the researcher with empirical data about the social world by simply asking the participants about their lives and experiences. Conducting interviews allows the researcher to gain participants' cooperation by establishing a relationship with them, which in the end facilitates the production of high response rates (Leedy & Ormrod, 2001). To obtain useful data, the researcher used semi-structured interviews as they allowed for standardisation and consistency (Nieuwenhuis, 2016). In other words, the use of semi-structured interviews generated rich qualitative and factual data.

#### **3.4.2.3 Classroom observations**

Nieuwenhuis (2003), states that although observations are highly selective and subjective and might cause the researcher to be biased, they do play a big role in helping the researcher gain a deeper insight into and understanding of the phenomenon being observed. In this study, the researcher was a complete observer (Nieuwenhuis, 2003). For the study to have unbiased results, the researcher ensured that all observations were made using the customised observation tool informed by the literature as being standardised. This ensured that the study kept its exploratory nature intact. This form of research is obtrusive and allows the researcher to be "an outsider", eliminating the possibility of being subjective (Nieuwenhuis, 2003). Another way the researcher could limit bias was by using appropriate data-collection methods – in this case, the observation tool

comprised of sections and subsections to allow for easy information division and extraction.

### **3.5 DATA GENERATION**

The first set of data was collected through the administering of the questionnaires. The researcher initially planned to distribute 100 questionnaires across the two districts (50 questionnaires per district) in the North West province. A total number of 20 questionnaires were distributed to the sampled circuits and teachers (first, the Ngaka Modiri Molema district, followed by the Bojanala district). The final sample consisted of 10 participants from both districts. Due to time constraints and the unavailability of some teachers, the researcher was unable to reach the desired number of participants. A time schedule for the data collection, which clearly illustrated when and how data were to be collected from the participants, was used.

Data were further collected through in-depth face-to-face semi-structured interviews with the participants. However, the researcher could not conduct pre- and post-interviews due to time constraints. By using pre- and post-interviews, the researcher could differentiate between the participants' responses and how each interview might be related to the previous interview. The purpose of the pre-interviews would have been to find out what the participants' responses were before conducting the classroom observations (Maree & Pietersen, 2007). During the post-interviews, the researcher would have analysed how the participants' responses relate in terms of previous interviews. Nonetheless, the researcher was able to obtain valuable data from only the post-classroom observation interviews.

Each interview lasted for approximately 20 minutes (or more) and was audio recorded to ensure quality and authenticity (Maree, 2007). The interviews were conducted during school hours in an office/staffroom to ensure privacy (preferably during the participants' administrative period to avoid disruption of teaching and learning). The purpose of the interview(s) was to address the following research question: What are teachers' perceptions of Earth and Beyond and the hindering and contributory factors that lead to

the successful teaching and learning of Earth and Beyond at grade 5 level? Interviews were conducted soon after the quantitative data were collected through the questionnaires. The final sample of participants, who were selected through purposive sampling, were interviewed and each of the participants had to answer eight questions during the interview (see Annexure A for sample interview questions). During this phase, the researcher wished to obtain a deeper understanding of the experiences of the participating teachers.

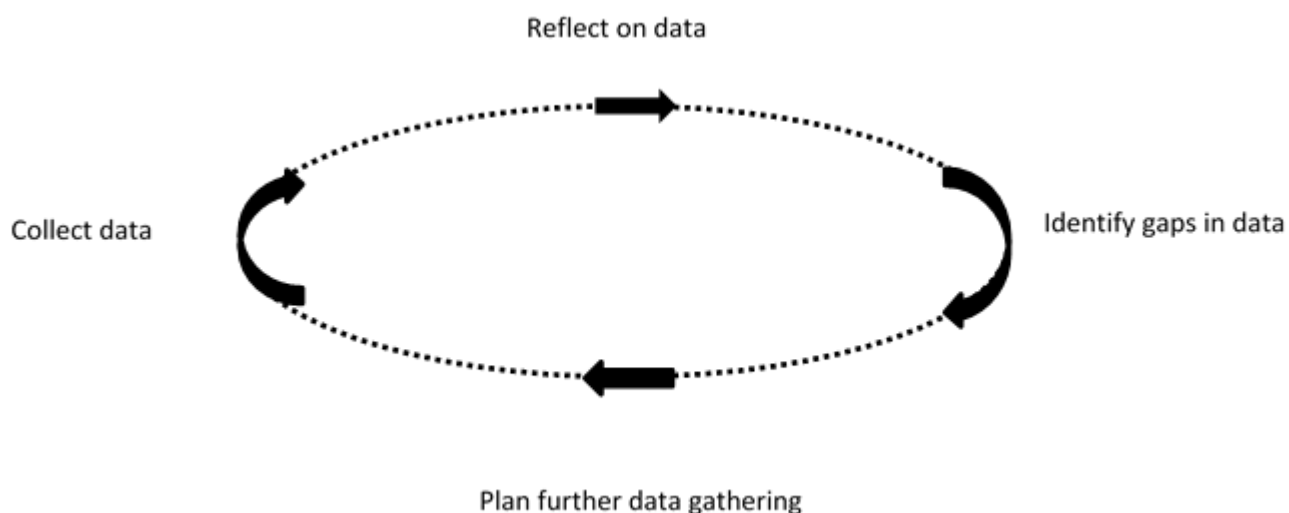
In the last phase of the data collection, a classroom observation was conducted during the teaching and learning of a science lesson. The researcher conducted classroom observation, using a developed observation tool to capture the data. By undertaking classroom observations, the researcher could make cross-references to the interview data. According to the literature, data collection and generation is a cyclical process that continues until the data is saturated (Maree & Nieuwenhuis, 2007). It is important to also mention that, out of the 10 participants, only two participants were engaged in the classroom observations due to time constraints. One participant formed part of the pilot study, and the other formed part of the other participants in the Ngaka Modiri Molema and Bojanala districts.

During the data-collection process, the researcher ensured that all the participants felt confident and were at ease throughout the entire process so that all the needed data was obtained to complete a functional, well-prepared report on the data collected. To accomplish this, a semi-scheduled timetable for meetings with the selected schools and teachers was employed to ensure that the research schedule was followed unfailingly.

After the sampling, the next important step was to decide on the most appropriate system to collect data that were valuable and worth publishing (Nieuwenhuis, 2007b, p. 74). As this study was a mixed-methods research study, the researcher initially planned to collect

data using three data-collecting instruments: first, a questionnaire protocol; second, an interview template; and third, a classroom observation tool. The classroom observations were minimal (only one classroom observation), because the teachers did not have time as it was assessment period for most schools. This is discussed in more detail in chapter 4.

Data collection and generation is a cyclical process that continues until the data is saturated. This is illustrated in the Figure 3.2:



**Figure 0.1: Process of data collection (Maree & Nieuwenhuis, 2007, p. 82)**

### **3.6 DATA STORING**

All the data collected were safely stored, maintaining confidentiality, organisation and interpretation thereof during the process of data analysis.

- Questionnaires were scanned to a computer and kept in a zip file to which only the researcher had access to.
- The hard copies of the questionnaires were safely stored in steel locker. These questionnaires will be destroyed after seven years.

- Recordings of interviews were stored on the researcher's personal computer, which was password-protected and to which only the researcher had access. The recordings that had already been transferred to the computer drive and backed up, were deleted from the recorder. The interviews will be kept for seven years and will be completely erased/ deleted thereafter.

During the classroom observation, the researcher used an anecdotal recordkeeping system (Nieuwenhuis, 2003) where she recorded short descriptions of basic actions observed during the classroom observation. These were stored and locked away in a cabinet to ensure security and confidentiality. The key-accessed cabinet is only accessible to the researcher to ensure safekeeping.

### **3.7 DATA ANALYSIS**

De Vos (2005) defines data analysis as a process whereby raw data is scrutinised, assisting the researcher to identify important patterns and building a framework of what the data is expected to tell. This entails bringing sequence, structure and significance to the data gathered during the data-collection phase. Woods (2011), states that qualitative data analysis is the best way to explain difficult issues. However, Johnson, Dunlap and Benoit (2010) maintain that qualitative data are massive and difficult to analyse. They refer to it as *mountains of words* and for this reason, it is less organised and more challenging to analyse as compared to quantitative data, but they do report on strategies that would make its analysis as efficient as possible.

In this study, a color-coding system was used to analyse the data carefully. This analysis was done in a manner which protected the participants' views to ensure that their voices were not lost (Ebersöhn, Eloff, & Viljoen, 2007, p. 140). The recordings of the audiotapes were played numerous times during the transcription phase. In order to ensure reliability of

the data, the researcher transcribed the audio-recorded interviews personally. As Parson (1997) maintains, it is binding for the transcriber to play the recordings for accurateness of information to be ensured. Maxwell (1966) also cautions that it is problematic to pile up transcripts because it makes the final analysis of the data difficult to handle. Since the researcher in this study is a former Natural Science and Technology teacher, it is important to mention that being bias during the analysis was possible (Nieuwenhuis, 2007). Therefore, to avoid being bias, bracketing was used. Bracketing is when a researcher inscribes his or her own point of view in brackets beside the opinions of the participants (Lichtman, 2013, p. 321). This method was effectively implemented during the data-analysis phase.

Though researchers in the positivist paradigm prefer a deductive data-analysis strategy, in the interpretive (naturalistic) paradigm, most prefer inductive data-analysis, which is more likely to help them identify the multiple realities potentially present in the data (Lincoln & Guba, 1985). For this study, data were analysed in an interpretive manner and in natural contexts so that the research question was answered as best as possible. After all, the naturalistic paradigm implies that realities are in essence complete aspects (wholes) that cannot be understood in isolation from their contexts (Lincoln, 1985).

The data in this study were tabulated. The data were analysed according to the primary and secondary research questions below, which incorporated the themes as listed:

- What are the factors that hinder or facilitate the successful teaching and learning of Natural Sciences and Technology in Earth and Beyond in the intermediate phase?
- How do learners learn Earth and Beyond inside and outside the classroom?
- What are the factors that hinder the successful teaching and learning of Earth and Beyond?



- What are the factors that facilitate the successful teaching and learning of Earth and Beyond?
- What are teachers' perceptions of the teaching and learning of Earth and Beyond?
- What are the factors that need to be considered when teaching Earth and Beyond?

The questions were used as themes, which led the researcher through answering the main research question and achieving the research aim. This also ensured that the data were not misinterpreted. A data-analysis strategy was employed to make sure that all data were safe, and interpretation thereof was categorised according to how the teacher managed the classroom, classroom setting and atmosphere, learner-teacher interaction, teacher-learner interaction, and teacher PCK.

Before data coding and analysis, the researcher had organised the data into qualitative and quantitative data categories, then sorted it in the following terms: (where, when, why and how was it collected) (Nieuwenhuis, 2010). The researcher utilised colour-coded folders to sort the data and label them to allow for easy retrieval of information. According to Nieuwenhuis (2010), coding refers to the process of reading through transcribed records of data and then categorising data into logical elements. For this particular research, *in vivo coding* through a software program was used to code the data. This type of data coding is typically used for narrative data analysis – therefore the researcher chose to use this form of data analysis to arrive at valid and reliable results.

### **3.7.1 Questionnaires and interviews**

During the data coding and analysis of the questionnaires and interviews, the researcher used color-coding as a mechanism to sort the data into categories. The researcher then applied themes and subthemes to the different responses, which she later used to develop

a full analysis of the data and later a descriptive narration of the findings. A four-column format was utilised. In the first column, the questionnaire questions and the interview questions were outlined respectively. In the second column, responses of the participants were recorded, followed by a third column for the themes that emerged from the responses. Lastly, in the fourth column, the subthemes (if available) were outlined. This served as the first phase of coding. In the second phase, the researcher used the color-coded transcripts of both the questionnaires and interviews to develop more detailed results and information. In this phase, the SPSS analytics program was used to analyse the data in a more comprehensive manner for the finest and most accurate results (Field, 2009).

### **3.7.2 Classroom observations**

For the analysis of classroom observations, a descriptive-reflective tool was used to analyse the data accurately (Nieuwenhuis, 2010). The classroom observation data were analysed through the use of a template designed to communicate the following: the date and time of observation; the situation and setting of the event; the participants involved; the actions observed by the researcher; and finally, reflection by the researcher, which was done soon after the event (classroom observation). During the data analysis, the process was simple yet sensitive. The field notes played an essential role in completion of this type of questionnaire analysis. The researcher recorded all observations using a checklist, and a series of images was captured to avoid loopholes in the researcher's observations. By capturing images, the researcher's intention was to also to record verbal and nonverbal behavioural patterns.

### **3.8 ROLE OF THE RESEARCHER**

The researcher's role entailed that of being an active and equal partner in the research process. In other words, the researcher did not enter the community as an expert with the intention to conduct research in a community; rather, the researcher entered and engaged as an equal partner and all participants involved were considered as co-researchers in the process. The researcher had to continuously reflect on her position in the research process in order to ensure credibility. She often engaged with her supervisor about the research process and aspects thereof, which allowed for reflexive conversations, the discussion of possible challenges and how the challenges could be addressed. This reflection, in turn, contributed to the trustworthiness of the study (Shenton, 2004; Tracy, 2010).

### **3.9 QUALITY CRITERIA AND TRUSTWORTHINESS**

According to Lincoln and Guba (1985), quality criteria and trustworthiness involve establishing the following:

- Credibility: confidence in the 'truth' of the findings;
- Transferability: showing that the findings have applicability in other contexts;
- Dependability: showing that the findings are consistent and could be repeated;
- Conformability: a degree of neutrality or the extent to which the findings of a study are shaped by the participants and not researcher bias, motivation, or interest.

Credibility means the research findings are in line with reality (Merriam, 1998). According to Lincoln and Guba (2000), researchers have the responsibility to record data accurately. In line with this view, after the interviews, the participants were afforded an opportunity to elaborate on questions that they felt were not fully answered in the questionnaires. Ten questionnaires were completed by the participants, followed by 10 interviews. In addition,

two classroom observations were conducted: one during the pilot study and another during the official data-collection process. According to Guba (1981) and Brewer and Hunter (1989), triangulation, which is the use of different methods in collecting data, ensures that the participants' shortcomings are balanced.

As Merriam (1998) argues, findings from a small number of particular individuals and settings are applied to other situations or populations whenever they are rich in information. Erlandson et al. (1993) suggest the impossibility of generalisability because of the specific context in which the study occurs. In this study, there were two contexts, namely rural area schools and township area schools. Also, in addition, the schools that were selected to participate in the study ranged from quintile 1-3, no-fee schools.

Finally, regarding confirmability the questionnaires, interviews and observations were different data techniques employed in the study to ensure confirmability through triangulation so as to reduce the researcher's bias (Shenton, 2004). In agreement, Diehl, Guion and McDonald (2011) state that triangulation is used in qualitative research to ensure validity of the study as a research question is analysed through various perspectives.

### **3.10 ETHICAL CONSIDERATIONS**

Charles and Mertler (2008) suggest that, in order for any research to uphold its moral value, ethical considerations need to be considered. They warn researchers to be scrupulously ethical with their work to ensure credibility. Lincoln and Guba (1985) also support the latter, claiming that trustworthiness of a research study is important to evaluating its worth. Lincoln and Guba (1985) furthermore stress another important aspect, which is to make sure that the participants are at ease throughout the entire study.

For this research, the researcher undertook measures to increase the trustworthiness of the study. Not only should a researcher aim to ensure quality and trustworthiness, but there are ethical guidelines that need to be followed to improve trustworthiness. This indicates the link between quality criteria, trustworthiness and ethical considerations. According to O'Neill and Norris (2006, p. 184), ethics entails the rules or standards governing the proper conduct of the members of a profession. In addition, moral misconduct is a part of ethics which could lead to a researcher being guilty of misconduct, resulting in the researcher being charged (O'Neill & Norris, 2006). Fabricating results, falsifying data and fragmented reporting are ways of acting immorally and unprofessionally during research (O'Neill & Norris, 2006, p. 184).

The researcher ensured that there was full consent, confidentiality and trustworthiness between her (the researcher) and the participants. Maree and Nieuwenhuis (2007) attest to this by stating research should, as far as possible, be based on participants' free, voluntary informed consent. This implies that the researcher has full responsibility to explain to the participants what the research entails. In this study, the participants were made aware of all developments in the research and its structures. Participants were aware of their right to refuse to participate; they understood the extent to which confidentiality was to be maintained; they were aware of the potential uses of the data; and they were reminded of their right to re-negotiate consent (Ladson-Billings, 1998, p. 10).

Finally, consent alone does not absolve the responsibility of researchers to anticipate and guard against potential harmful consequences for participants (Delgado et al. 2001, p. 4). Therefore, the researcher had to make sure that the extent to which the questions were stated in the questionnaire was not at all harmful or dehumanising to the participants. The researcher also had to take the responsibility to make sure that the participants' responses were kept confidential and safe. To avoid unethical research in this study, the following

ethical considerations, as set out by Maree and Van der Westhuizen (2007, p. 41-42) were followed:

- Ethical clearance for this study was obtained from the North-West University Faculty of Education, which stated that the researcher could begin with data collection for the study (Appendix B).
- The North West Province Department of Education and Sport Development was contacted by the researcher to seek permission to conduct the research (Appendix C).
- Permission was granted by the various schools in the Ngaka Modiri Molema and Bojanala districts. The principals signed a declaration form stating their affirmation for the study (Appendix D).
- The participants signed an informed consent to participate in the research (Appendix E). In the form, the study was explained, and details were provided with regard to the roles of the participants and the researcher. This was presented and explained to participants at the first meeting.
- The identities of participants were kept anonymous throughout the research process.
- Participation in the research was voluntary, and the participants knew that they could withdraw from the process at any time.

These ethical considerations and measures of trustworthiness formed an important part of the research as it is the researcher's responsibility to make sure that all participants are protected and encouraged to participate in a study.

### **3.11 RELIABILITY AND VALIDITY**

To ensure reliability of the results, the test-retest reliability instrument was applied. The researcher administered a pilot study questionnaire instrument, also referred to as logical reliability, before the initial data collection (Pietersen & Maree, 2010, p. 215). However, Pietersen and Maree (2010) also state their awareness of the limitation of using this method as it can easily fail if the time lapse between the two occasions is too short and the participants remember their first responses from the first occasion and consequently respond in the same manner. In order to avoid this, a suitable and convenient time schedule was customised to avoid unreal responses from participants. Validity of the results is an important aspect of research, and therefore face validity and criterion validity (Pietersen & Maree, 2010) were used to ensure that the results were valid and could be used in the interest and completion of the research. Firstly, to ensure face validity, the researcher met all participants personally and secondly, to ensure criterion validity, the participants were selected based on criteria stipulated in §3.4.1.

### **3.12 ANONYMITY AND CONFIDENTIALITY**

According to Burns (2000), both the researcher and participants must have a clear understanding of the importance of confidentiality and anonymity. The researcher ensured this by presenting the terms of the study well in writing to all participants so that they had an opportunity to read the written consent and based on their decision, sign a copy for record keeping. The researcher discussed the importance thereof to the participants and made sure that there was a unified understanding between her and the participants so as to avoid any unethical practices during the data-collection process.

# **CHAPTER 4**

## **FINDINGS AND DISCUSSION**

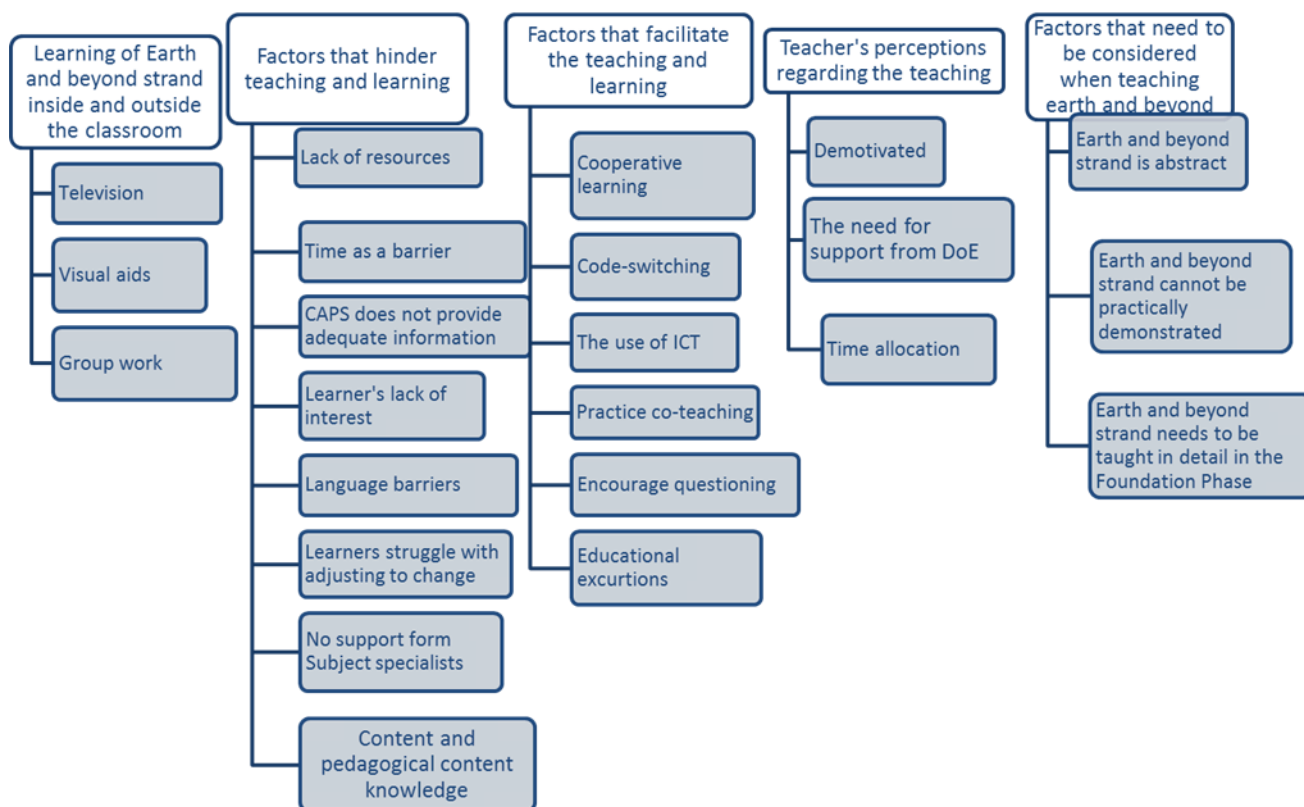
### **4.1 INTRODUCTION**

The previous chapter discussed the research design and methodology that were applied in this study. Part of the chapter included a discussion on the paradigm and the rationalisation for choosing a mixed-methods interpretive approach. The research tools that were employed for gathering data were described step by step so as to ensure that the reader understood how data were collected and how the data were analysed so that the research question could be answered.

This chapter reports on the collected data. Participants' direct words are also used to illustrate the data. This is especially helpful and encouraged by scholars who ascertain that by doing this, the researcher is able to "reach the reader" (De Vos, Strydom, Fouché, & Delport, 2011; Creswell, 2007, 2008; Henning, Van Rensburg, & Smit, 2004; Maree, 2007). The researcher also discusses the presented data by integrating the reviewed works and the theoretical framework which was discussed in detail in chapter 2.

By reviewing various scholarly works, conducting classroom observations, interviews and the completion of questionnaires by the participants, the researcher observed a pattern and coded the pattern into themes. These themes guided the researcher regarding how to provide a thorough description of the data (Bruce & Berg, 2001). For the researcher to gain a deeper understanding of the teachers' teaching of the Earth and Beyond strand, the main question was divided into different subquestions. The findings presented represent the study's core aim being answered (Ziegler, Pettibone, & Vohland, 2017; Zeigler, Praehofer & Kim, 2000). Figure 4.1 represents the themes that derived from the questions:

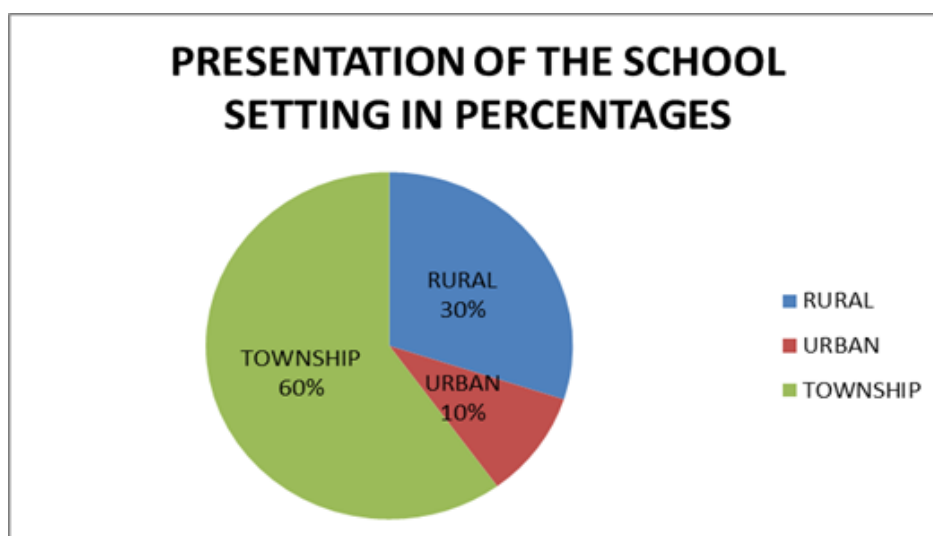




**Figure 0.1: Derived themes under the research questions**

## **4.2 SETTING: LEARNING OF EARTH AND BEYOND INSIDE AND OUTSIDE OF THE CLASSROOM**

The demographical information is beneficial to the study's outcomes as "context" plays a role in the successful teaching and learning of any subject, especially in science subjects like Natural Science and Technology (Praehofer & Kim, 2000). As indicated in the graph below (Figure 4.2), 60% of the visited schools were located in the township, whereas 30% were located within rural areas and only 10% were located in the urban areas.



**Figure 0.1: Presentation of the school settings in percentages**

The teaching and learning context play a vital role in the learning of science. A study conducted by Kazeni (2013) emphasises the importance of context when teaching science. Kazeni's (2013) study sought to determine, from the learners' point of view, how important context is and what role it plays in their learning processes. The results of the study showed that the context and way in which science is taught has a major impact on the results of learner performance.

#### **4.3 TEACHERS' PERSPECTIVES REGARDING HOW LEARNERS LEARN THE EARTH AND BEYOND STRAND**

When participants were asked about how their learners learn the Earth and Beyond strand, most teachers stated that learners learn the strand through multi-media, like television, visual aids, and the use of information communications technology (ICT). However, the teachers from the rural schools mentioned how extremely challenging it was to teach Earth and Beyond successfully. They mentioned that most of their learners did not have access to television or even internet to make references to what they learn in the classroom:

*...Some of these poor children have not even seen a uhm... a television. They only use what they have in the textbooks. But even the textbooks are not enough, so it's difficult, really, it is...*

From what is stated above, it seems as though teachers from rural surroundings find it exceptionally difficult to demonstrate the Earth and Beyond strand due to the fact that the learners are not exposed to multimedia and technology. This consequently demotivates learners and they, in turn, are unable to take ownership of their own work. Two teachers out of the 10 shared a common view as to how their learners engage in the learning of the Earth and Beyond strand inside and outside the classroom. They mentioned the use of group work activities where learners are afforded an opportunity to understand the work content from their peers. According to the teachers, this was especially useful and could work effectively if a teacher strategizes and plans group work activities that are content-related and appropriate, developmentally appropriate and curriculum-aligned. It is, however, significant to add that, even though group work was highly recommended in the participants' responses, two of the teachers added that group work takes time and was not beneficial to all the learners in the classroom as it does not accommodate all three main learning styles:

*...You know, yes you can use group work when my learners learn about the strand, but what about those learners who are not confident to work in groups. Like those quiet ones Mam...*

*...Even though group helps the learning, we do not have time. There is so little time and the content... like the subject matter is enormous. The ATP needs to be followed otherwise... do you understand Mam? ...*

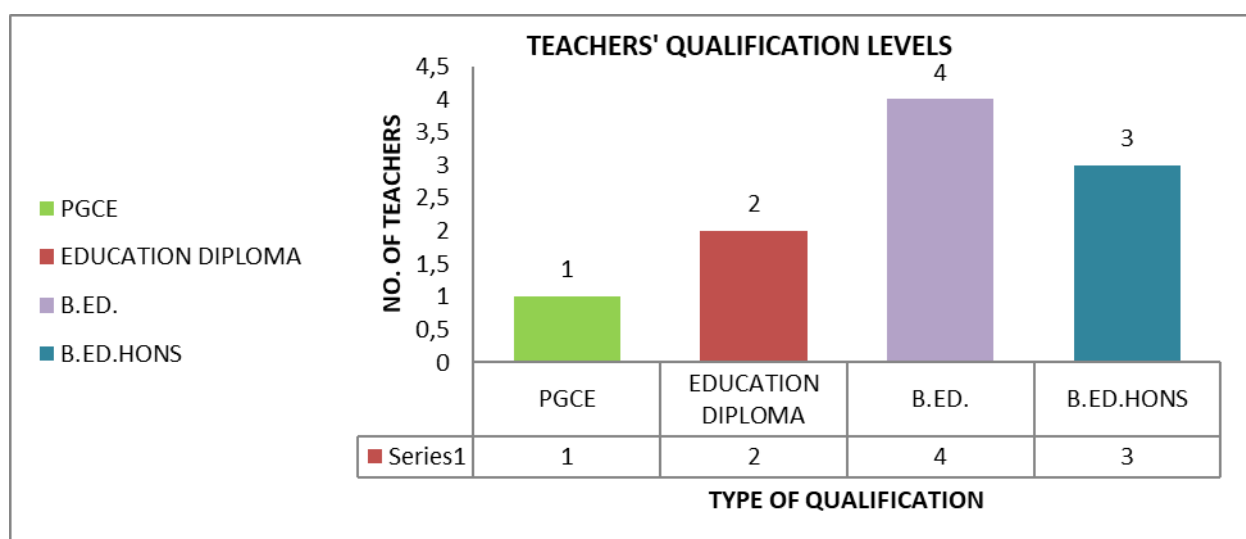
As was communicated by the two teachers above, group work is one way in which learners learn the Earth and Beyond strand; but, then again, it also takes away teaching time. In addition, it seems that teachers were unable to make use of group work in devotion because some learners were not able to learn in groups. In support of using group work so that learners acquire knowledge inside and outside the classroom, Beerer and Bodzin (2004) suggest that the inquiry-based learning approach is beneficial and accommodates all learning styles. For example, the teacher can focus on two to three concepts in one lesson because learners work faster and encourage one another to comprehend the work (Bodzin, 2004). Also, one characteristic of inquiry-based learning is that it is learner-centred, and learners are encouraged to search and make use of resources beyond or outside the classroom and the school, thus owning their work and developing a love for Natural Science and Technology (Breerer & Bodzin, 2004). As a concern, the annual teaching plan (ATP) is a blueprint of the Department of Education (DoE) which stipulates the teaching frames which teachers across all platforms need to abide to. The CAPS was originally adapted to meet the needs of learners. It has also been designed to enable learners to develop to their potential based on a curriculum that supports their cognitive abilities. These said learners are granted the opportunity to achieve in all learning areas (including Natural Science and Technology) where they can be successful and peruse further education in the years to come. Unfortunately, most of the teachers who were interviewed shared a concern about how they were not supported by the DoE at district and circuit level. This brings us to the factors that hinder the successful teaching and learning of the Earth and Beyond strand.

## 4.4 FACTORS THAT HINDER THE SUCCESSFUL TEACHING AND LEARNING OF THE EARTH AND BEYOND STRAND

### 4.4.1 Insufficient content knowledge

The findings indicate that the remaining 70% of teachers did not engage in any professional development programme. This arose concern as Natural Science and Technology is a content- and practical-based subject which requires teachers to be content and pedagogically knowledgeable. Rogan and Grayson (2003) claim that teachers' abilities to implement the curriculum successfully are determined by the type of support they receive from various structures (different education departments).

Another factor which plays a role in the performance or hindering of a school subject is the level of proficiency of teachers in terms of content knowledge (CK) and pedagogical content knowledge (PCK) (Ziegler, 2017). The researcher saw fit to report on the teachers' qualification information, because their qualifications generally determine how they are professionally developed to teach a certain subject, in this case, Natural Science and Technology. Figure 4.3 illustrates the teachers' qualifications:



**Figure 0.1: Teachers' qualification levels**

As also indicated in the literature, one of the factors that hinder the successful teaching and learning of Earth and Beyond in Natural Science and Technology is teachers' insufficient CK and PCK (Ingersoll, 2003). This is confirmed by the figure above, which clearly indicates that, out of the 10 participants, only 30% had an honours degree. When additionally asked about development in terms of their CK, one teacher stated that he or she did not earn enough in order to study further.

*...I have children at university and unfortunately, I cannot be studying at the same time with my children, it is financially straining...*

#### **4.4.2 Lack of teaching and learning resources**

All 10 interviewed teachers indicated that the inadequacy and lack of resources had a very disturbing effect on how teachers taught and how learners learnt the Earth and Beyond strand. The question on access to learning-teaching support material (LTSM) was asked out of scope and the teachers replied that, since there were too many learners, these apparatus break, get stolen and therefore do not last long. What was also interesting from the findings was that not only the teachers from the rural areas complained about the lack of resources and even the availability of these resources in their schools and classrooms. According to Mpeta (2013), for quality teaching and learning to take place, all learners ought to have access to their own textbook for every subject. Goal 19 of the *Action Plan to 2019: Towards the Realisation of Schooling 2030* (DBE, 2012) is to ensure that each learner has access to the minimum set of textbooks and workbooks required, according to the national policy (National Developmental Plan [NDP], 2011). In search of quality education for all children, the DBE (2012) requested Stats SA to assist by including questions on access to workbooks and textbooks by learners who attend school. These questions on the access to exercise books and textbooks were included to assist the DBE

in tracking the delivery of workbooks and textbooks to schools across the republic. The main objective with regard to workbooks is on Mathematics and Language in grades 1 to 9, whereas the focus is on access to all textbooks in grades 10 to 12. This prospect in terms of developing the education holistically is clearly failing as other subjects, like Natural Science and Technology, are marginalised. In the researcher's opinion, the Department of Basic Education needs to equally prioritise all learning areas across the curriculum so that learners from all spheres of the country are encouraged to pursue whichever subject they wish to. It is therefore strongly anticipated that most teachers who teach these "marginalised subjects" are discouraged because of the lack of resources. The images below (Figure 4.4) were taken by the researcher as proof that most of the classes at the participating schools did not represent a science-learning environment. As is depicted, the walls are dull, with barely any posters of the work that is taught in class. This again proves that teachers have no understanding of the importance of considering different learning styles in their classrooms, and there are little or no resources which they can use in their classrooms.



**Figure 0.1: Image of dull and non-science learning environment**

The interviewed teachers also mentioned that subject specialists did not support them in any way, and thus they needed to make financial compromises.

*...The Departmental officials who do come here do not bring anything, they just come to find faults and leave...They write a report and leave, that's all. What about the support that they need to give us? ...I even buy stuff with my own money...*

Lack of teaching aids or resources, as mentioned by most of the participants, was a sensitive matter in the DBE. As noted in the above quote, teachers bought some teaching materials from their pockets due to a lack of support in this regard. Also insightful from the above teacher's quote, was the nature of support the Natural Science teachers were receiving from their district officials. Evidently, the district officials were viewed as being on a fault-finding mission rather than being supportive with materials and otherwise – a perception that was unpleasant.

#### **4.4.3 Lack of human resources – shortage of teachers**

The lack of human resources also played a vital role in the effectiveness of teaching and learning. Teachers further also complained about crowded classrooms, which they claimed were hindering the successful teaching and learning of the Earth and Beyond strand in Natural Science and Technology. One of the teachers said:

*...What is very much discouraging teachers the most is the circumstances we work under... Like for example, we are forced to teach plus minus 50 learners in one classroom, which makes teaching very difficult, especially NS and Tech*



*because it requires a lot of time and energy, it is really impossible. Our Department does not care. Teachers are hospitalised from stress. (Pauses). A number of teachers I personally know resigned last year; our situation is really bad...*

According to the above quote, the teacher-learner ratio was not considered in some schools, leaving teachers with too many learners to teach. This, of course, had a negative outcome as many teachers were discouraged and even hospitalised for stress. Studies show that, not only is our education system in a crisis due to a dearth of teachers, but every year, a large number of exceedingly skilled teachers leave their careers in search of greener pastures (News24, 2017). For example, in 2013, studies revealed that the education system needs between 25 000 and 30 000 teachers every year; yet the higher education and training system produced between 6 000 and 8 000 teachers a year, with about 10 000 teachers in a good year (News24, 2017). It is therefore evident that resources, whether teaching resources or human resources, have a tremendous effect on how the teaching and learning of not only the Natural Science and Technology subject, but any subject, is sustained.

#### **4.4.4 Curriculum Policy**

The CAPS document is prescribed to ensure the successful delivery of content knowledge (DBE, 2011). However, when asked about how the CAPS supports teaching and learning of the Earth and Beyond strand, 50% of the interviewed teachers concluded that the curriculum statement does not provide any details of how teachers should approach the teaching of this content knowledge. The teachers mentioned that the time allocation recommended in the CAPS was not sufficient for Natural Science and Technology and particularly the Earth and Beyond strand:

*...The Earth and beyond strand is very difficult and needs time. The stipulated time allocated for NS and Tech is three and a half hours, but it is barely enough to cover the work that is prescribed. These people [Department of Education] do not understand our frustration. How can you be able to... to... teach in such a short time allocation? We need more time...*

It is clear from the above quote that the CAPS disregarded the background and kind and quality of learners the teachers had. Also suggested here is the fact that the CAPS for grade 5 Natural Science and Technology does not accommodate those learners who would need more time to comprehend the work. The time allocated for the subject is not enough to cover the theoretical as well as practical work.

#### **4.4.5 Learners' lack of interest and language barrier**

The issues of lack of interest from learners and language barrier also emerged under factors that hinder the successful teaching and learning of the Earth and Beyond strand. The teachers expressed a common view on learners' lack of interest in the subject matter and how language also played a role in affecting the subject's success. The researcher paired these two aspects because the teachers explained that lack of interest in the subject was as a result of learners not understanding the language of instruction, which was English. All the learners in these schools were Sesotho- and Setswana-speaking learners who were taught in English at school. Again, teacher consensus on this issue made the researcher realise the challenge that teachers have to deal with on a daily basis. Even though resources, over-crowdedness and lack of support played a role in ineffective content deliverance, language seemed to be the greatest challenge, because one can have all the teaching aids that are needed in a classroom, but if the language of instruction does not reach the designated group of learners, then the use of resources is in vain.

When asked to elaborate on this, eight teachers confirmed that the motivation behind the challenge of language of instruction is the fact that learners from township and rural schools are often taught in their mother tongue. For the Bojanala and Ngaka Modiri Molema districts, these languages often include Setswana, Sesotho and sometimes, Afrikaans.

The findings also show that the teachers' approaches to teaching the Earth and Beyond strand involved a code-switching so that learners could grasp the content.

*...I need to always make sure that my learners are with me, like they understand me when I speak. I know that the language of instruction is English, but how do I teach them difficult concepts like "rotation and revolution"? They only speak English in the classroom, which is the only time that they engage in the language of instruction. It is a disaster to ask them to do orals. They are shy and they do not... uhm... show that they are confident enough...*

From the above perception, it is clear that teachers are eager to help learners achieve their outcomes and subject goals, but with the frustrations they encounter, it becomes difficult to get their breakthrough in terms of subject goals for the themselves as well as the learners.

#### **4.4.6 Lack of support from district officials**

Teachers raised their concerns regarding the support structures within the DoE. Some of the teachers voiced their grievances pertaining to the lack of support from their subject specialists.

*... Excuse me, but I really don't know what is the work of these subject advisers, because they do not advise us on anything. Really...*

As seen in the above quote, subject specialists or subject advisors do not support Natural Science and Technology teachers. In a study on *District officials' perspectives regarding factors that impede the attainment of quality basic education in a province in South Africa*, Bantwini (2018) expounds on how rural schools have reported to have lost their confidence in the district and provincial departments. Also, Bantwini (2018) stated in his report that this complaint is not only by poor-performing schools, but also by those schools who achieve their set academic standards. This implies that there is a “blame-shifting” occurrence between teachers and their support structures (i.e. district and provincial levels).

#### **4.5 FACTORS THAT FACILITATE THE SUCCESSFUL TEACHING AND LEARNING OF THE EARTH AND BEYOND STRAND**

When the teachers were asked about the factors that facilitate successful teaching and learning, cooperative learning stood out. With reference to chapter 2, IBSE and the learner-centred approach could be introduced to Natural Science and Technology teachers. This is mainly because of how these two theories' interconnectedness in terms of their characteristics could be beneficial to cooperative learning. The characteristics of these theories are exceptionally similar. Table 4.1 provides the similarities between IBSE and the learner-centred approach:

**Table 0.1: Characteristics of the Inquiry-Based Science Education approach and the learner-centred approach**

CRITERIA	CHARACTERISTICS OF IBSE	CHARACTERISTICS OF THE LEARNER-CENTRED APPROACH
<b>LEARNING</b>	Focus on using and learning content as a means to develop	Focuses on multiple content areas that the learners use to develop their own understanding
<b>APPROACH</b>	Learner-centred	Constructed by learners
<b>TEACHER'S ROLE</b>	Teacher is a facilitator of learning	Teacher scaffolds learners during their tasks, but does not help them with finding the answers
<b>EMPHASIS IS ON</b>	Emphasis is on 'how we come to know what we know'	Emphasis is on learning things through experimentation
<b>PURPOSE</b>	Learners are more involved in the construction of knowledge through active involvement	Group work is encouraged
<b>ASSESSMENT</b>	Assessment focuses on the progress of skills development and content understanding	Development of scientific as well as technological skills is pertinent

When probed to elaborate on some of the strategies they applied in cooperative learning, the participating teachers mentioned characteristics from both IBSE and learner-centeredness. For example, one of the teachers mentioned using the learner-centred approach in order to foster cooperative learning.

*...I use group work as a strategy to when I teach in my classroom; it helps my learners to understand the work better and to develop working together with other learners...*

The above quote indicates that there is consensus around the use of cooperative learning in the Earth and Beyond strand. Teachers also agreed on the use of ICT in the teaching and learning of the Earth and Beyond strand. Seven of the 10 teachers indicated that they did not have technological devices that they could use in order to better demonstrate the Earth and Beyond strand. They mentioned that the Earth and Beyond content was non-concrete, and they consequently lost hope in accomplishing the subject goals or specific aims. With regard to specific aim 3, learners should be able to make connections with real-life situations and relate to the content in practical ways. In addition, four of the teachers from the rural schools reported that they were frustrated and demotivated because they had no technological facilities and that even their learners were unable to use ICT. However, it is important to also remark on the resistance among teachers, in general, to use ICT. One of the teachers stated that she went beyond measures to take her personal laptop to school in order to use it for showing videos and other visuals that may help her students comprehend the content to the best of their ability:

*... I use my own laptop, or let me say PERSONAL LAPTOP to teach these learners. But what if it breaks? I am not happy about it...*

What was worrying about this was the fact that not all teachers applied such measures and therefore only a few learners benefited from the action. Another disturbing fact was that the few teachers who took such risks were never rewarded or even recognised. In contrary, some teachers seemed too have the resources available, but never had the courage to utilise them.

*... Our school does have a maths lab, but no one uses it...*

According to the National Education Collaboration Trust (NECT, 2016), the use of ICT in teaching and learning supports educational processes and promotes numerous levels of teaching and learning within any context. The NECT also advocates for the use of technology or ICT in Science and Technology subjects. In South Africa, the Notions of learning, ICT in Education, Model for learning design, and Bloom's taxonomy framework are models that have been tried and tested in order to improve education in terms of performance through the use of ICT. This is especially relevant to this study's literature on integrating Bloom's taxonomy in the concept to promote successful teaching and learning of the Earth and Beyond strand. With regard to Bloom's taxonomy framework, it is clear that it incorporates curricular activities that allow learners to progress from recalling facts to being able to produce new knowledge and construct knowledge based on original work. Arguably, teachers need to be conscious of the advantages of employing technology in the teaching and learning of Natural Science and Technology, particularly in the Earth and Beyond strand. Table 4.2 illustrates the use of ICT within educational models, including Bloom's taxonomy as was deliberated on in chapter 2.

**Table 0.2: Illustration of models used to implement the successful use of ICT in teaching and learning**

MODEL	FOCUS	ELEMENTS OR DIMENSIONS
<b>Bloom's taxonomy</b>	Classify educational objectives Structure curricular activities	A progression from recalling facts to producing new and original work
<b>TPACK frame work</b>	Emphasises key knowledge elements required for teaching with technology	Technological, pedagogical, and content knowledge, and overlaps between these
<b>NIMB frameworks</b>	Describe the ways in which ICTs can be used in teaching and learning, based on integration of a number of models	The effect of notions of learning, ICT in education, and models of learning design on the progression of learning as

		described by Bloom's taxonomy
<b>UNESCO framework</b>	Outlines the various dimensions of ICT competencies that a teacher needs to develop in order to teach with technology	Describes a teacher's development in terms of the ability to improve technology literacy, create knowledge, and deepen knowledge

It is important to highlight that there are structures put in place in support of the use of ICT from micro- to macro levels in the DoE. Co-teaching and educational excursions formed part of the facilitating factors related to the effective teaching and learning of the Earth and Beyond strand. Only 30% of the interviewed teachers from the Bojanala district asserted how co-teaching had facilitated their teaching in the Earth and Beyond strand.

*...We work together as a team, when one of us does not understand how we can explain the content; we just knock next door...*

This response suggested that co-teaching does in fact play a role in uplifting the teaching and learning of the Earth and Beyond strand. However, some of the teachers said that they did not engage in co-teaching because it was time-consuming. Educational excursions were also mentioned by one of the teachers as being part of strategies that assisted Earth and Beyond content delivery and learning. The teacher stated that, in his 10 years of teaching, learners have been taken to the planetarium once. He added:

*...But when we took the learners to the planetarium, they enjoyed the... the trip, but what did they learn? ... I don't think they learned anything because they did not understand English. Remember our children only learn English in grade 4 for the first time...*



As is understood from the quote above, the use of educational excursions – for example, the planetarium – are not always effective for demonstration purposes. The teacher here explained how the language of instruction (English) again plays a role in the success of demonstrating science to young children, particularly at primary school level.

#### **4.6 TEACHERS' PERCEPTIONS REGARDING TEACHING**

Based on the factors detailed in the first section of this chapter, teachers seem to be demotivated. The most prevalent factor included the need for support from provincial- and district-level departmental officials (subject specialists). At the time of the study, many teachers felt that they were not supported and consequently, they were on alert when visited by the subject advisors, since they viewed them (the subject advisors) as being on a fault-finding mission. The other issue was the time factor. Teachers stated that the time allocated for grade 5 Natural Science and Technology was insufficient and therefore they were unable to complete the content as they needed to focus on theory and practical work in just 3.5 hours per week (DBE, 2011).

Overall, it seems as though grade 5 teachers were not enthusiastic about the content under the Earth and Beyond strand in Natural Science and Technology. This was due to internal and external factors, as acknowledged earlier in this chapter.

Some of the factors that need to be considered in this regard are that the Earth and Beyond strand is nonconcrete, therefore it cannot be practically demonstrated, and that Earth and Beyond should be taught from early grades (and in the language of instruction) to build a foundation so that teachers would not struggle with teaching the content at grade 5 level.

Regarding the findings identified in this chapter, there was consensus that the successful teaching and learning of the Earth and Beyond strand needs attention. Although teachers were trying to improvise and teach to the best of their abilities, they evidently needed support from their leaders. To achieve the recommendations made in the next chapter, researchers and education specialists (namely the DBE) need to be acquainted with what is happening on ground level. Teachers are suffering in silence and in order to sustain the development of education in South African schools, intervention measures need to be employed.

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 CONCLUSION**

The aim of this chapter is to present the concluding remarks and to make recommendations based on the research findings. The conclusion and recommendations mainly focus on summarising the findings and evaluating whether the objectives of the study have been achieved. Firstly, a summary of the findings of the data, as reported in the previous chapter, is provided to emphasise the critical aspects that emerged from the findings. Finally, in conclusion, recommendations are made.

##### **5.1.1 Teachers**

Based on the findings of this study, Natural Science and Technology teachers encounter challenges in the teaching and learning process of the Earth and Beyond strand, more so at the grade 5 level. With reference to one of the study's objectives, the researcher's aim was to identify the factors that hinder the successful teaching and learning of the Earth and Beyond strand. Most of the teachers' approaches to teaching the strand involved using learner-centredness methods to assist them to demonstrate the subject content knowledge to their grade 5 learners. Although this approach was prevalent amongst teachers, there is no evidence that other teachers use the same approach.

##### **5.1.2 Learners**

With regard to learners, the researcher observed that most teachers did not take into account the importance of learning styles that learners possess, because they lacked PCK and lacked understanding of the importance of considering learners' learning styles in

science education. Teachers also mentioned how difficult it was to demonstrate the strand's content with ease because of the language barrier learners encountered. In addition, the lack of resources in their schools was also a challenge, crippling the teaching and learning opportunities of this strand. In the researcher's opinion, this gave a striking sketch of the countless challenges and their impacts on the teaching and learning of Natural Science and Technology with particular reference to the Earth and Beyond strand.

It is common knowledge that scientific concepts are grasped much more easily when teachers demonstrate the subject content knowledge to the learners. Grade 5 learners are still very fresh-minded and enjoy manipulating and practical activities. Thus, the best way teachers can support these young minds in science, is by promoting demonstrations and doing practical activities. This is an important observation that the researcher made, as it was aligned with the first objective of the study, which focused on how learners learn the Earth and Beyond strand inside and outside the classroom, as well as the third objective of the study, which focused on the factors that facilitate the successful teaching and learning of the Earth and Beyond strand.

It was also clear from this study that teachers were fairly familiar with effective teaching strategies that can assist them in demonstrating the content in the Earth and Beyond strand. This was shown in the findings that emerged through all three data-collection instruments used in this study. Consequently, it is suggested that teachers implement the learner-centred approach and the systems-thinking approach in order to teach Earth and Beyond effectively. This is supported in the teachers' responses under the question: What are the factors which facilitate the successful teaching and learning of the Earth and Beyond strand? However, the success of learner-centredness and systems thinking depends on how teachers implement these approaches in order to better their teaching. Also, it depends on the support offered by their management and leadership in their school

and at district and provincial levels. Therefore, for this study, it was important to understand teachers' perceptions regarding the teaching and learning of the Earth and Beyond strand. This information helped the researcher to understand how learners comprehend the Earth and Beyond strand.

### **5.1.3 Professional development**

It is also vital that teachers understand the importance of their own professional development with regard to Natural Science and Technology. Teacher professional development in this regard would assist to stimulate their confidence in CK and PCK in Natural Science and Technology and particularly the Earth and Beyond strand.

In conclusion, a serious gap is evident in the teaching and learning of Natural Science and Technology and the Earth and Beyond strand. Curriculum policy, language of instruction and lack of resources (including human resources) are some of the factors that hinder teachers' teaching and learners' learning of the Earth and Beyond strand. Teachers in this study were equally convinced that the DoE did not do enough to assist them in their daily endeavours of teaching science subjects successfully.

## **5.2 RECOMMENDATIONS**

The findings from this study may be used as a starting point to address other factors that facilitate and hinder the teaching and learning of Earth and Beyond in the science classrooms of all South African schools. Besides the learner-centred approach and the systems-thinking model, further research can explore many other complementary models that would assist teachers to demonstrate the Earth and Beyond strand effectively. These approaches would ultimately contribute to the overall effective teaching and learning of Science and Technology and would improve learners' attitudes so that they pursue science subjects in secondary and tertiary education. It is the responsibility of teachers,

policymakers and parents to join hands in this initiative so that the performance of Natural Science and Technology learners is elevated to match the standards of other developed countries around the world.

### **5.2.1 Recommendations for intervention strategies**

Language intervention strategies must be designed for learners who are taught Natural Science and Technology in a language other than their mother tongue. This study has highlighted the difficulties confronting teachers with respect to language barriers. Although language is only one of many barriers, it could make a difference. It would imply that teachers extend their CK and PCK.

#### **5.2.1.1 Policymakers**

Teachers in the study grieved over the time allocated for the teaching and learning of Natural Science and Technology. It is important for policymakers to strongly consider consequences of time inefficiency in the teaching and learning process.

#### **5.2.1.2 District and provincial departments of education**

It is highly recommended that support to teachers is provided. Teaching aids and resources are inadequate and should therefore be addressed and supplied. By not providing teachers with the necessary teaching materials, they lose their morale in teaching the content to the best of their abilities.

### **5.2.2 General recommendations**

- The integration of the IBSE approach in science should be materialised.
- Provide sufficient information on the importance of the IBSE approach for science education, especially in rural and township schools.

- Analyse the following matters to ensure successful implementation of the IBSE approach:
  - Teacher-learner interactions in the science classroom;
  - Learner-learner interactions in the science classroom;
  - Lesson engagement;
  - Teacher and learner perceptions about science.

#### **5.2.2.1 Teacher professional development**

- Schools should send Natural Science and Technology teachers for IBSE training courses.
- Schools should approve financial aids for science teaching and learning equipment.
- Continuous teacher professional development in science areas should be supported and encouraged.

#### **5.2.3 Recommendations for academic research**

It is recommended that future researches investigate multiple other strategies that would facilitate the successful teaching and learning of the Earth and Beyond strand. This would assist teachers in their approaches to teaching the content in the said subject.

Further studies are also necessary to explore how language barriers can be eliminated in the teaching and learning of science. Learners' language proficiency was highlighted by all the participants during the interviews. Further, nine participants highlighted that they code-switched during lessons, whereas one of the participants, who was non-South African, mentioned that he could not code-switch as he did not understand the learners' home language (Setswana).

- Provide research-based evidence on the successful effects IBSE has on the teaching and learning of Natural Science and Technology, Earth and Beyond.

#### **5.2.4 Establishment of science workshops in rural areas**

The research findings indicated that there is a need to assist teachers with regard to ways in which the Earth and Beyond strand can be demonstrated in the classroom. This was inferred from the 90% of teachers who pointed out that they experienced complications in demonstrating science concepts under Earth and Beyond. A workshop in this regard could eradicate these challenges.



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# APPENDIX A

## APPROVAL OF RESEARCH PROPOSAL



6 June 2018

To Whom It May Concern

RE: Student name: **Ms NN Motaung**; Student number: **22229477**; **MEd – Physical Science Education with Natural Science Education**

I hereby confirm that the research proposal of the above mentioned student was approved on the Scientific Committee of the Research Outside Entities committee meeting of 17 May 2018.

Research title:

**Analysis of teaching and learning of the Earth and Beyond Strand in the Intermediate phase in two districts, North West Province**

Should you have further enquiries in this regard, you are welcome to contact Prof Washington Dudu at 018 389 2833 or by email at [Washington.Dudu@nwu.ac.za](mailto:Washington.Dudu@nwu.ac.za) or Ms Erna Greyling at 018 299 4656 or by email at [Erna.Greyling@nwu.ac.za](mailto:Erna.Greyling@nwu.ac.za).

Yours sincerely

Prof W Dudu  
Deputy Dean: Research and Innovation

# APPENDIX B

## ETHICAL CLEARANCE



### Faculty of Education

#### MINUTES

Meeting: Research Ethics Committee of the Faculty of Education  
Date of meeting: 20 September 2018  
Time of meeting 9:00  
Meeting room: Room 299E, Building C6

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#### 1 Approval of ethics applications at previous meetings which were approved with minor changes that should be made

1.1 Project head	Prof B Bantwini
Student/Team	N Motaung
Ethics number	NWU-00474-18-A2
Title	Analysis of the teaching and learning of the Earth and beyond strand in the intermediate phase, in two districts, North West Province
Time frame	21 June 2018 - 31 May 2019
Work distribution	Prof Marietjie Havenga Dr Doret Kirsten Dr Erika Fourie
Decision	The critical readers are satisfied with the final changes made and recommend that application can be approved. The committee approves the application.

Minute keeper: Ms E Greyling

Original details: (10000518) P:\Notules\2018\ESekkomitee\2018-09-20\2018-09-20 Minutes\_Research Ethics Committee of the Faculty of Education.docx  
18 September 2018  
File reference: 9.4

**APPENDIX C**

**REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN  
SCHOOLS**



Private Bag X6001, Potchefstroom  
South Africa 2520

Tel: 018 299-1111/2222

Web: <http://www.nwu.ac.za>

**(Faculty of Education)**

Researcher: Miss NN Motaung

Tel: 078 012 9473

Email: [nellytia@yahoo.com](mailto:nellytia@yahoo.com)

Research supervisor: Professor B.  
Bantwini

Tel: 018 299 1852

Email:

[bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Tel: 018 299 1852

Email: [bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Date:

Dear Superintendent General

**Request for Permission to Conduct Research in the Schools**

I, Ms Nellytia N Motaung from the North West University in Potchefstroom herewith wish to requests your approval to conduct a study on *“Analysis of the teaching and learning of*



*Earth and beyond in the grade 5 level of The Intermediate Phase.*” The Curriculum and Assessment Policy Statement views the main task of teaching as to build a framework of knowledge for learners and to help them make connection between the ideas and concepts in their minds. It therefore continues to state that learners should be guided to understand not only scientific knowledge and how it is produced, but also environmental and global issues. This research study is premised on the idea that high-quality natural science effective teaching and learning is vital and fundamental for learner success and advancement in life.

The study will be undertaken in two school districts: Ngaka Modiri Molema district and the Bojanala district. The primary participants of the proposed study will be the Natural Science and Technology Education teachers and subject advisors. From each district ten teachers will be selected to form part of the final sample, totalling twenty teachers. The sample of the proposed study will comprise of teachers from the public rural schools teaching Natural Sciences and Technology in the grade 5 class level of the Intermediate phase.

A questionnaire has been designed to collect information for this study. A total number of 100 questionnaires will be distributed to the sampled teachers in their respective districts and schools. The second instrument will be face-to-face, semi-structured in-depth pre-and-post interviews with the teachers. With their permission, an audio tape recorder will be used to capture the interviews. Later, all the interviews will be transcribed verbatim and pseudonyms will be used for confidentiality purposes. In the last phase of the data collection, a classroom observation will be conducted during the teaching and learning of a natural science and technology lesson, using a developed tool.

Please note that participation in this project is completely voluntary. The participant may decline altogether or refuse any questions you do not wish to answer during the interviews or completion of a questionnaire. They may also withdraw from participation after beginning with the project as they choose and their decision to participate, decline, or withdraw will have no effect on their current status at or future relations with the school district and the North West University.

There are no known risks in this project beyond those encountered in everyday life. Amongst the benefits of participating in this project is the opportunity to reflect on the issues that will be discussed and also receive the compiled report. The participants' responses will be kept strictly confidential, and no one other than the research staff will know their perspectives pertaining to the project. Pseudonyms will be used immediately after receiving data to protect their identity. All the data will be kept secured.

If teachers agree to participate in this project, they will be asked to sign a consent letter and a hard copy of the letter will be provided to them to keep for their records. Also, if they wish, we will send them a summary of the research results.

Additionally, the district natural science subject advisors will be invited to participate in semi-structured interviews. The focus will be on professional development available to teachers as well as their opinion regarding the teaching and learning of *Earth and beyond* in natural sciences and technology at the Intermediate phase.

Sir/Madam, we wish to thank you and hope that our request will meet your favourable condition. In case you have any questions please do not hesitate to contact us.

Yours in Education

PRINCIPAL INVESTIGATOR



NN Motaung

Tel: 078 012 4973 (C)

018 299 1852 (O)

Supervisor e-mail: [bongani.bantwini@gmail.com](mailto:bongani.bantwini@gmail.com) or

[bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Researcher email: [nellytia@yahoo.com](mailto:nellytia@yahoo.com) or  
[Nnellytiam@gmail.com](mailto:Nnellytiam@gmail.com)

## APPENDIX D

# REQUEST FOR APPROVAL TO CONDUCT RESEARCH IN THE SCHOOL



Private Bag X6001, Potchefstroom  
South Africa 2520

Tel: 018 299-1111/2222

Web: <http://www.nwu.ac.za>

**(Faculty of Education)**

Researcher: Miss NN Motaung

Tel: 078 012 9473

Email: [nellytia@yahoo.com](mailto:nellytia@yahoo.com)

Research supervisor: Professor B.

Bantwini

Tel: 018 299 1852

Email:

[bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Tel: 018 299 1852

Email: [bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Date:

## **Request for Approval to Conduct Research in your School**

I, Ms Nellytia N. Motaung from the North West University herewith wish to request your approval to conduct a research, which involves teachers from the Intermediate Phase (IP) who teach natural science and technology in the grade 5 level. Before you give approval, please acquaint yourself with the information below.

The details of the research are as follows:

### **TITLE OF THE RESEARCH PROJECT:**

***Analyse the teaching and learning of Earth and beyond in two districts of the North West province.***

RESEARCHER: Ms Nellytia N. Motaung

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 078 012 4973  
018 299 1852

SUPERVISOR: Prof. Bongani D. Bantwini

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 018 299 1852  
078 9523719

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

Contact person: Ms Erna Greyling, E-mail: Erna.Greyling@nwu.ac.za, Tel. (018) 299 4656

This study has been approved by the Ethics committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee.

### **What is this research about?**

The primary research aim of the proposed study is to analyse the teaching and learning of *Earth and beyond* in natural sciences and technology at the Intermediate phase. The study will focus on the following objectives:

- Ascertain how learners learn the *Earth and beyond* strand inside and outside of the classroom in the intermediate phase.
- Evaluate the factors that hinder effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Evaluate the factors that facilitate effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Analyse and comprehend the perceptions that teachers have on teaching the *Earth and beyond* strand in the grade 5 classroom.
- Generate the factors that needs to be considered when teaching Earth and beyond.

### **Participants**

The primary participants of this study will be the:

- Intermediate phase - grade 5 teachers
- Subject Advisors

### **What is expected of the participant?**

A questionnaire has been designed to collect information for this study. Some grade 5 teachers will be asked to participate in two in-depth semi-structured interviews lasting between 30-60 minutes each. With their permission, an audio tape recorder will be used to capture the interviews. If they agree to the interviews, classroom observations of science teaching will also be conducted twice on separate occasions in their classroom. All the interviews will be transcribed verbatim and pseudonyms will be used for confidentiality purposes.

Please note that participation in this project is completely voluntary. You may at any time of the process decline altogether or refuse any questions you do not wish to answer during

the interviews or when completing the questionnaire. You may also withdraw from participation after beginning with the participation process and your decision to participate, decline, or withdraw will have no effect on your current status at or future relations with the school district and the North West University.

### **Benefits to you as participant**

The project will NOT provide any monetary incentives as benefits to the participants. The only benefits for the participants will be the opportunity to engage on the issues discussed. Later there will be a workshop to discuss the study findings and they will receive the compiled report for their reference.

### **Risks involved for participants**

There are no known risks to participation in this project beyond those encountered in everyday life.

### **Confidentiality and protection of identity**

All your responses and your identification will be kept strictly confidential. To report some of the information, pseudonyms will be used to protect the identity of the districts, Subject Advisors, schools and the teachers.

### **What will happen in the unlikely event of some form of discomfort occurring as a direct result of your taking part in this research study?**

Should you have the need for further discussions after the interview, you may contact my supervisor (Professor Bantwini) and he will professionally assist in the matter.

### **Who will have access to the data?**

1. Confidentiality will be ensured by only revealing this consent form to the researcher and the supervisor.
2. Reporting of findings will be communicated to you in the form of a report.
3. All data will be kept safe and secure electronically by the researcher; on a password protected computer and hard copies will be kept confidentially by the student.

## Dissemination of findings

The findings will be disseminated through:

- 1) M ED. Dissertation
- 2) Conference presentations (National/International)
- 3) Paper/article publication in peer reviewed journals (National/International)

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

## **DECLARATION BY PARTICIPANT:**

By signing below, I ..... agree to approving the research study entitled:

***Analyse the teaching and learning of Earth and beyond in two districts of the North West province.***

### **I declare that:**

- I have read this information and consent form and understand what is expected of me in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurized to take part.
- I may choose to leave the study at any time and will not be penalized or prejudiced in any way.
- I may be asked to leave the research process before it has finished, if the researcher feels it is in my best interests, or if I do not follow the research procedures, as agreed to.

Signed at (place)\_\_\_\_\_ on (date) \_\_\_\_/\_\_\_\_/20\_\_\_\_

\_\_\_\_\_  
**Signature of participant**

\_\_\_\_\_  
**Signature of witness**



## APPENDIX E

### PARTICIPANT INFORMATION AND CONSENT FORM



Private Bag X6001, Potchefstroom  
South Africa 2520

Tel: 018 299-1111/2222

Web: <http://www.nwu.ac.za>

#### **(Faculty of Education)**

Researcher: Miss NN Motaung

Tel: 078 012 9473

Email: [nellytia@yahoo.com](mailto:nellytia@yahoo.com)

Research supervisor: Professor B.  
Bantwini

Tel: 018 299 1852

Email:

[bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Tel: 018 299 1852

Email: [bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Date:

**Dear Subject Advisor**

### **PARTICIPANT INFORMATION AND CONSENT FORM**

I, Ms Nellytia N. Motaung from the North West University herewith wish to request your approval to conduct a research, which involves teachers from the Intermediate Phase (IP) who teach natural science and technology in the grade 5 level. Before you give approval, please acquaint yourself with the information below.

The details of the research are as follows:

**TITLE OF THE RESEARCH PROJECT:**

***Analyse the teaching and learning of Earth and beyond in two districts of the North West province.***

RESEARCHER: Ms Nellytia N. Motaung

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 078 012 4973  
018 299 1852

SUPERVISOR: Prof. Bongani D. Bantwini

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 018 299 1852  
078 9523719

**FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE**

Contact person: Ms Erna Greyling, E-mail: [Erna.Greyling@nwu.ac.za](mailto:Erna.Greyling@nwu.ac.za), Tel. (018) 299 4656

This study has been approved by the Ethics committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee.

**What is this research about?**

The primary research aim of the proposed study is to analyse the teaching and learning of *Earth and beyond* in natural sciences and technology at the Intermediate phase. The study will focus on the following objectives:

- Ascertain how learners learn the *Earth and beyond* strand inside and outside of the classroom in the intermediate phase.
- Evaluate the factors that hinder effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Evaluate the factors that facilitate effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Analyse and comprehend the perceptions that teachers have on teaching the *Earth and beyond* strand in the grade 5 classroom.
- Generate the factors that needs to be considered when teaching Earth and beyond.

### **Participants**

The primary participants of this study will be the:

- Intermediate phase - grade 5 teachers
- Subject Advisors

### **What is expected of you as participant?**

If you agree to participate in this project, a semi-structured in-depth interview lasting between 30-60 minutes will be conducted with you. With your permission, an audio tape recorder will be used to capture the interviews. The interview will be transcribed verbatim and pseudonyms will be used for confidentially purposes. Please note that also involved in the study are teachers who will also be interviewed, observed teaching and lesson that will also be video recorded with their permission.

Please note that participation in this project is completely voluntary. You may decline altogether or refuse any questions you do not wish to answer during the interviews and completion of questionnaire. You may also withdraw from participation after beginning with the project as you choose and your decision to participate, decline, or withdraw will have no effect on your current status at or future relations with the school district and the North West University.

### **Benefits to you as participant**

The project will NOT provide any monetary incentives as benefits to the participants. The only benefits for the participants will be the opportunity to engage on the issues discussed. Later there will be a workshop to discuss the study findings and you will receive the compiled report for your reference.

### **Risks involved for participants**

There are no known risks to participation in this project beyond those encountered in everyday life.

### **Confidentiality and protection of identity**

All your responses and your identification will be kept strictly confidential. To report some of the information, pseudonyms will be used to protect the identity of the districts, Subject Advisors, schools and the teachers.

### **What will happen in the unlikely event of some form of discomfort occurring as a direct result of your taking part in this research study?**

Should you have the need for further discussions after the interview, you may contact my supervisor (Professor Bantwini) and he will professionally assist in the matter.

### **Who will have access to the data?**

4. Confidentiality will be ensured by only revealing this consent form to the researcher and the supervisor.
5. Reporting of findings will be communicated to you in the form of a report.
6. All data will be kept safe and secure electronically by the researcher; on a password protected computer and hard copies will be kept confidentially by the student.

### **Dissemination of findings**

The findings will be disseminated through:

1. M.Ed. dissertation
2. Conference presentations (National/International)
3. Paper/article publication in peer reviewed journals (National/International)

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

**DECLARATION BY PARTICIPANT:**

By signing below, I ..... agree to take part in a research study entitled:

***Analysis of the teaching and learning of Earth and beyond strand in two districts, North West Province***

**I declare that:**

- I have read this information and consent form and understand what is expected of me in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurized to take part.
- I may choose to leave the study at any time and will not be penalized or prejudiced in any way.
- I may be asked to leave the research process before it has finished, if the researcher feels it is in my best interests, or if I do not follow the research procedures, as agreed to.

Signed at (place) \_\_\_\_\_ on (date) \_\_\_\_/\_\_\_\_/20\_\_\_\_

\_\_\_\_\_  
**Signature of participant**

\_\_\_\_\_  
**Signature of witness**

**APPENDIX F**

**GOODWILL PERMISSION REQUEST TO CONDUCT  
RESEARCH IN YOUR SCHOOL**



Private Bag X6001, Potchefstroom  
South Africa 2520

Tel: 018 299-1111/2222

Web: <http://www.nwu.ac.za>

**(Faculty of Education)**

Researcher: Miss NN Motaung

Tel: 078 012 9473

Email: [nellytia@yahoo.com](mailto:nellytia@yahoo.com)

Research supervisor: Professor B.  
Bantwini

Tel: 018 299 1852

Email:

[bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Tel: 018 299 1852

Email: [bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za)

Date:

Dear SGB Members,

**Goodwill Permission Request to Conduct Research in your School**

I, Ms Nellytia N. Motaung from the North West University herewith wish to request your goodwill permission to conduct a research, which involves teachers from the Intermediate

Phase (IP) teaching natural science and technology in the grade 5 levels. Before you give approval, please acquaint yourself with the information below.

The details of the research are as follows:

**TITLE OF THE RESEARCH PROJECT:**

***Analysis of the teaching and learning of Earth and beyond strand in two districts, North West Province***

RESEARCHER: Ms Nellytia N. Motaung

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 078 012 4973  
018 299 1852

SUPERVISOR: Prof. Bongani D. Bantwini

ADDRESS: North West University  
Faculty of Education  
Potchefstroom

CONTACT NUMBER: 018 299 1852  
078 9523719

FACULTY OF EDUCATION RESEARCH ETHICS COMMITTEE

Contact person: Ms Erna Greyling, E-mail: Erna.Greyling@nwu.ac.za, Tel. (018) 299 4656

This study has been approved by the Ethics committee of the Faculty of Education of the North-West University and will be conducted according to the ethical guidelines of this committee.

**What is this research about?**

The primary research aim of the proposed study is to analyse the teaching and learning of *Earth and beyond* in natural sciences and technology at the Intermediate phase. The study will focus on the following objectives:

- Ascertain how learners learn the *Earth and beyond* strand inside and outside of the classroom in the intermediate phase.
- Evaluate the factors that hinder effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Evaluate the factors that facilitate effective teaching and learning of *Earth and beyond* in the grade 5 natural science and technology classroom.
- Analyse and comprehend the perceptions that teachers have on teaching the *Earth and beyond* strand in the grade 5 classrooms.
- Generate the factors that needs to be considered when teaching Earth and beyond.

### **Participants**

The primary participants of this study will be the:

- Intermediate phase - grade 5 teachers
- Subject Advisors

### **What is expected of the participant?**

A questionnaire has been designed to collect information for this study. Some grade 5 teachers will be asked to participate in two in-depth semi-structured interviews lasting between 30-60 minutes each. With their permission, an audio tape recorder will be used to capture the interviews. If they agree to the interviews, classroom observations of science teaching will also be conducted twice on separate occasions in their classroom. All the interviews will be transcribed verbatim and pseudonyms will be used for confidentiality purposes.

Please note that participation in this project is completely voluntary. You may at any time of the process decline altogether or refuse any questions you do not wish to answer during the interviews or when completing the questionnaire. You may also withdraw from participation after beginning with the participation process and your decision to participate, decline, or withdraw will have no effect on your current status at or future relations with the school district and the North West University.



### **Benefits to you as participant**

The project will NOT provide any monetary incentives as benefits to the participants. The only benefits for the participants will be the opportunity to engage on the issues discussed. Later there will be a workshop to discuss the study findings and they will receive the compiled report for their reference.

### **Risks involved for participants**

There are no known risks to participation in this project beyond those encountered in everyday life.

### **Confidentiality and protection of identity**

All your responses and your identification will be kept strictly confidential. To report some of the information, pseudonyms will be used to protect the identity of the districts, Subject Advisors, schools and the teachers.

### **What will happen in the unlikely event of some form of discomfort occurring as a direct result of your taking part in this research study?**

Should you have the need for further discussions after the interview, you may contact my supervisor (Professor Bantwini) and he will professionally assist in the matter.

### **Who will have access to the data?**

7. Confidentiality will be ensured by only revealing this consent form to the researcher and the supervisor.
8. Reporting of findings will be communicated to you in the form of a report.
9. All data will be kept safe and secure electronically by the researcher; on a password protected computer and hard copies will be kept confidentially by the student.

### **Dissemination of findings**

The findings will be disseminated through:

1. M Ed. Dissertation
2. Conference presentations (National/International)
3. Paper/article publication in peer reviewed journals (National/International)

If you have any further questions or enquiries regarding your participation in this research, please contact the researchers for more information.

**DECLARATION BY PARTICIPANT:**

By signing below, I ..... agree to approving the research study entitled:

***Analysis of the teaching and learning of Earth and beyond strand in two districts, North West Province***

**I declare that:**

- I have read this information and consent form and understand what is expected of me in the research.
- I have had a chance to ask questions to the researcher and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the research process before it has finished, if the researcher feels it is in my best interests, or if I do not follow the research procedures, as agreed to.

Signed at (place)\_\_\_\_\_ on (date) \_\_\_\_/\_\_\_\_/20\_\_\_\_

\_\_\_\_\_  
**Signature of participant**

\_\_\_\_\_  
**Signature of witness**

# APPENDIX G

## CLASSROOM OBSERVATION INSTRUMENT



### Classroom Observation Instrument Grade 5 Natural Science and Technology

#### SECTION A: DEMOGRAPHICS

A. Mark with an ☒ the appropriate box that represents your response.

A1: Gender:

Male	Female	Other
1	2	3

A2: Age

20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
1	2	3	4	5	6	7	8	9

group:

A3: Race group:

African	Coloured	Indian	White	Other
1	2	3	4	5

A4: Nationality:

South African	Non-African	Other
1	2	3

A5: Teaching experience:

<1	1-4	5-9	10-14	15-19	20-24	25-29	30-34	34+
1	2	3	4	5	6	7	8	9

A6: Quintile:

Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1	2	3	4	5

A7: Location of your

Rural	Urban	Township	Other
1	2	3	4

schools:

A8: Highest qualifications:

Diploma	FDE/Higher ED Diploma	B.Ed./B.Sc./B.S.Ed.	B.Ed./BSc Hons/Hons	Master's	Doctorate
1	2	3	4	5	6

A9: No. of learners in your classroom:

Classroom	1-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
	1	2	3	4	5	6	7	8	9	10	11	12

## SECTION B: CLASSROOM SETTING

B1. Description of the classroom:

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B2. Description of visual support materials on walls:

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---

B3. Seating arrangement (gender, special needs, language, space etc.):

---

---

## SECTION C: PRESENTATION AND CURRICULUM

C1. Is the lesson introduced with a pertinent question relevant to the topic?

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---

C2. Are the outcomes of the lesson communicated to the learners? Explain.

---

---

---

C3. Are the outcomes of the lesson clear? Explain.

---

---

---

C4. Are all misconceptions eliminated during the lesson presentation of the teacher?

Yes ☐ no ☐

C5. Is the lesson grade appropriate (CAPS)?

---

---

---

---

C6. Lesson instructions: Are the learners sure of what they need to do?

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---

---

---

### SECTION D: TEACHER – LEARNER INSTRUCTION

D1. Participation: Is the lesson teacher-centered or is it learner-centered, explain?

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---

---

D2. Does the teacher use relevant teaching methods or styles which the learners can relate to?

---

---

---

D3. Does the teacher consider the different styles which learners possess in the classroom?

---

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### SECTION E: ASSESSMENT

E1. Are all the aims taken into consideration during the lesson?

AIMS: 1. Know science                      yes ☐    no ☐  
          2. Do science                        yes ☐    no ☐  
          3. Apply science                      yes ☐    no ☐

E2. When does the teacher check for understanding?

- ☐ Before the lesson
- ☐ During the lesson
- ☐ After the lesson

Comments:

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---

E3. Do the learners ask questions?

---

---

---

E4. Does the teacher provide learners with answers to help them achieve the lesson objectives?

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#### SECTION F: OBSERVATION CHECKLIST

To what extent does the following happen when you are teaching natural science and technology? Make a cross X to indicate your choice:

NO.	THE TEACHER	PAR TLY AGR EE	AGR EE	PARTL Y DISAG REE	DISAG REE
F1.	The teacher is well prepared				
F2.	There is evidence of planning of the lesson				
F3.	The planning of the lesson is CAPS aligned				
F4.	Shows interest throughout the lesson				
F5.	Begin a session by determining learners' prior knowledge on the topic.				
F6.	Encourage learners to share their science ideas with the class				
F7.	Use teaching strategies that promote learner inquiry				
F8.	Choose different teaching strategies for different instructional purposes				
F9.	Setting appropriately challenging expectations for learners				
F10 .	Ask learners to explain reasoning behind an idea				
F11 .	Use group work as a teaching approach				

F12 .	Use variety of assessment methods				
F13 .	Maintain an orderly, purposeful learning environment for science learning				
	<b>LEARNERS</b>				
F14 .	Shows understanding, enthusiasm and interest				
F15 .	Ask questions and are reflective of their learning				
F16 .	Learners solve science problems on their own				
F17 .	Learners show active participation during the lesson				
F18 .	Are able to work in groups (if or when instructed by the teacher)				
F19 .	Learners work on science investigations on their own				

General comments:

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### SECTION G: TEACHER SUPPORT AND CONTINUOUS PROFESSIONAL DEVELOPMENT

Which of the following is covered or addressed by your current professional development?  
Rate it's coverage using a cross X

N O	CONTENT AREA	IMPROVED MY TEACHING			
		PAR TLY AGR EE	AGR EE	PARTL Y DISAG REE	DISAG REE
G1.	The promotion of the inquiry-based teaching approach.				
G2.	Provide techniques/ strategies to promote problem solving.				
G3.	Present ways to nurture a sense of classroom community.				
G4.	Offer opportunities to learn new methods of teaching and learning theories.				

G5.	Provide multiple assessment methods/approaches as part of classroom practice.				
G6.	Provide resources to allow teachers take advantage of CPD/PD activities				
G7.	Implementation of learnt knowledge to teachers' classrooms.				
G8.	Attend to teachers' immediate classroom needs and interests.				
G9.	Intellectually engages and addresses the complexities of teaching				

General comments:

---



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# APPENDIX H

## INTERVIEW PROTOCOL



### INTERVIEW PROTOCOL

#### SECTION A: DEMOGRAPHICS

**A. Mark with an ☒ the appropriate box that represents your response.**

A1: Gender:

Male	Female	Other
1	2	3

A2: Age group:

20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
1	2	3	4	5	6	7	8	9

A3: Race group:

African	Coloured	Indian	White	Other
1	2	3	4	5

A4: Nationality:

South African	Non- South African	Other
1	2	3

A5: Teaching experience:

<1	1-4	5-9	10-14	15-19	20-24	25-29	30-34	34+
1	2	3	4	5	6	7	8	9

A6: Quintile:

Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1	2	3	4	5

A7: Location of your schools:

Rural	Urban	Township	Other
1	2	3	4

A8: Highest qualifications:

Diploma	FDE/Higher ED Diploma	B.Ed./B.Sc./B.S.Ed.	B.Ed./BSc Hons/Hons	Masters	Doctorate
1	2	3	4	5	6

A9: No. of learners in your classroom:

Classroom	1-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
	1	2	3	4	5	6	7	8	9	10	11	12

## SECTION B

B1. What are the factors that hinder the successful teaching and learning of Natural Sciences and Technology in the Earth and beyond strand?

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B2. What are the factors that facilitate the successful teaching and learning of Natural Sciences and Technology in the Earth and beyond strand?

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B3. In your experience, how do most learners learn/comprehend the Earth and beyond strand inside the classroom?

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B4. How do most learners learn/comprehend the Earth and beyond strand outside the classroom?

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B5. What strategies have you implemented in order to combat the hindrances in the Earth and beyond strand?

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B6. Have these strategies worked, or is there no improvement in terms of their implementation?

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B7. How are new concepts introduced to learners in the Earth and beyond strand?

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B8. How do you perceive learner's attitudes in the NS/Tech classroom, in the strand Earth and beyond?

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B9. Is there anything else that you would like to add with regard to the teaching and learning of the Earth and beyond strand?

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# APPENDIX I

## QUESTIONNAIRES



### Questionnaire

The North West University invites you to participate in a study that *“Analyses the teaching and learning of the Earth and beyond strand in two North West province districts, South Africa”*. Please be informed that participation in this research survey is voluntary and that you may withdraw at any time you wish. There are no known risks to participating in this project. Your cooperation is highly appreciated, and your responses are of most importance in achieving the aim of this study and most importantly in the promotion of quality teaching and learning.

This survey will take 30-40 minutes of your time. Please read the instructions provided carefully and respond to all the questions. All your responses and your identification will be kept confidential. We appreciate your answering the questions in an honest and thoughtful manner as this will help ensure quality results from this study. Should you have any questions about this study, please do not hesitate to contact Prof Bantwini (Supervisor/ Study Leader) at the following e-mail address and telephone numbers:

[bongani.bantwini@gmail.com](mailto:bongani.bantwini@gmail.com) / [bongani.bantwini@nwu.ac.za](mailto:bongani.bantwini@nwu.ac.za).

Phone: +2778 952 3719  
+2718 2991858

And the researcher: Miss NN Motaung  
[nellytia@yahoo.com](mailto:nellytia@yahoo.com)  
Phone: +2778 012 4973

### SECTION A: DEMOGRAPHICS

A. Mark with an ☒ the appropriate box that represents your response.

A1: Gender:

Male	Female	Other
1	2	3

A2: Age

20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
1	2	3	4	5	6	7	8	9

group:

A3: Race group:

African	Coloured	Indian	White	Other
1	2	3	4	5

A4: Nationality:

South African	Non- South African							
1	2							
<1	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35+
1	2	3	4	5	6	7	8	9

A5: Teaching experience:

Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
1	2	3	4	5

A6: Quintile:

Rural	Urban	Township
1	2	3

A7: Location of your

schools:

A8: Highest qualifications:

Diploma	FDE/Higher ED Diploma	B.Ed./B.Sc./B.S.Ed.	B.Ed./BSc Hons/Hons	Masters	Doctorate
1	2	3	4	5	6

A9: No. of learners in your classroom:

Classroom	1-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
	1	2	3	4	5	6	7	8	9	10	11	12

## SECTION B: TEACHING AND LEARNING

**B1. To what extent do you agree with the following statements regarding your teaching of the Earth and Beyond strand? Indicate your choice by using a cross**

**☒ in the relevant box.**

No.	Statement	Agree	Partly agree	Partly Disagree	Disagree
<b>TEACHER</b>					
B1.1	I am well prepared to teach Earth and Beyond Strand	1	2	3	4
B1.2	There is evidence of planning of the lesson	1	2	3	4
B1.3	I plan my lessons according to CAPS for Natural	1	2	3	4

	Science and Technology Ed				
B1.4	When teaching, I show interest throughout the lesson	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.5	I always begin a new lesson by determining learners' prior knowledge on the topic	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.6	I encourage learners to share their science ideas in the classroom	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.7	I use teaching strategies that promote learner inquiry	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.8	I choose different teaching strategies for different instructional purposes	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.9	I set appropriately challenging expectations for learners	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
B1.10	I ask learners to explain their reasoning behind an idea/notion	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>

**B2. To what extent do you agree with the following statements regarding your learner's reception of the Earth and Beyond Strand? Indicate your choice by using a cross ☒ in the relevant box.**

No.	Statement	Agree	Partly agree	Partly Disagree	Disagree
B2. 1	Learners are encouraged to share their science ideas with the class	1	2	3	4
B2. 2	Learners work on science investigations independently	1	2	3	4
B2. 3	Learners freely inquire about what they are learning	1	2	3	4
B2. 4	Learners ask questions during the lesson	1	2	3	4
B2. 5	Learners are reflective of their learning	1	2	3	4
B2. 6	Learners solve science problems on their own	1	2	3	4
B2. 7	Learners show active participation during the lesson	1	2	3	4
B2. 8	Are able to work in groups when instructed to by the teacher	1	2	3	4
B2. 9	Learners are enthusiastic about the Earth and Beyond Strand	1	2	3	4
B2. 10	Learners are conscious of Earth and beyond Strand concepts throughout the lesson	1	2	3	4

**B3. On the scale below, please indicate your confidence level with respect to each of the following items by making a cross X to indicate your choice.**

No.	Activity	High	Moderate	Low	None
B3.1	Ability in teaching the concepts in the Earth and beyond strand	1	2	3	4
B3.2	Understanding of the science concepts in the Earth and beyond strand.	1	2	3	4
B3.3	Effective planning of the learning environment to teach science concepts in Earth and beyond strand.	1	2	3	4
B3.4	Effective management of the learning environment to teach science concepts in the Earth and beyond strand	1	2	3	4
B3.5	Planning scientific investigations for the learners.	1	2	3	4
B3.6.	Helping learners investigate relationships in scientific contexts in Earth and beyond strand	1	2	3	4
B3.7	Helping learners solve problems in scientific environmental contexts in the Earth and beyond strand	1	2	3	4
B3.8	Assisting learners interpret and apply scientific knowledge.	1	2	3	4
B3.9	Helping learners demonstrate an understanding of the integration between science and technology in the Earth and beyond strand	1	2	3	4
B3.10	Encourage learners to demonstrate an understanding of the interrelationships between science and the environment	1	2	3	4
B3.11	Encouraging science learning communities in the classroom	1	2	3	4
B3.12	Assessment of learners' science understanding	1	2	3	4
B3.13	Use of the results to continuously guide instruction	1	2	3	4

**B4. Please read the following statement and mark with an ☒ the appropriate box that represents your response.**

B4. 1 Indicate the number of learners in the natural science and technology classroom.

15-20	21-30	31-40	41-50	51+
1	2	3	4	5



**B4.2** How often are you invited to subject meetings by the Head of Department (HOD) at your school? Please state clearly how often in a term this happens.

0 times a term	1-4 times a term	5-9 times a term	10-14 times a term	15+ times a term
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

**B4.3** How often are you invited to subject meetings by the subject head in a quarter?

0 times a term	1-4 times a term	5-9 times a term	10-14 times a term	15+ times a term
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

**B4.4** How many hours per week do you spend on Natural Science and Technology preparation? Please mark with an ☒ in the box which represents your response.

Less than an hour	One hour	Two hours	Three hours	Four hours	Five or more hours
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>

**B4.** What strand in natural sciences and technology do you find the most challenging in the grade 5 curriculum?

No	Strand	Mark with an X
1	Life and living	
2	Earth and Beyond	
3	Energy and Systems	
4	Matter and materials	

**B4.6** To what extent would you say that you have had adequate CAPS training?

High	Moderate	Low	None
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>

**B4.7** Have you had any Natural Sciences and Technology workshops in the last 3 months?

Yes ☐

No ☐

**B4.8** What is normal frequency of district workshops for the NS Grade 5 teachers per quarter?

1 time	2 times	3 times	4 times	5 or more times
1	2	3	4	5

**B4.9** What is your perspective regarding the level of importance of teaching Earth and beyond in the grade 5 classroom?

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**B4.10** What are the challenges in teaching the Earth and beyond strand in the classroom?

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**B4.11** What could be done to enhance effective teaching and learning of the Earth and beyond strand?

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To what extent would you say you are able to use the NS CAPS document: Use the provided scale 1-5 below to indicate your extent:

Scale	Percentage	Selection (mark with an X)
1	0-15%	
2	16-30%	
3	31-60%	
4	61-80%	
5	81-100%	

## SECTION C: CONTINUOUS PROFESSIONAL DEVELOPMENT

**C1. On the scale below, please indicate how Continuous Professional Development with respect to each of the following items has improved your teaching. Make a cross ☒ to indicate your choice.**

No.	Content Area	Improved my teaching			
		AGR EE	PAR TLY AGR EE	PARTL Y DISAG REE	DISAG REE
C1.1	Teacher-learner relations/interactions	1	2	3	4
C1.2	The promotion of the inquiry-based teaching approach.	1	2	3	4
C1.3	Provide techniques/ strategies to promote problem solving.	1	2	3	4
C1.4	Present ways to nurture a sense of classroom community.	1	2	3	4
C1.5	Offer you opportunities to learn new methods of teaching and learning theories.	1	2	3	4
C1.6	Provide multiple assessment methods/approaches as part of classroom practice.	1	2	3	4
C1.7	Provide resources to allow teachers take advantage of CPD/PD activities	1	2	3	4
C1.8	Strategies to Implement the learnt knowledge to the classrooms.	1	2	3	4
C1.9	Attend to teachers' immediate classroom needs and interests.	1	2	3	4
C1.10	Intellectually engages and addresses the complexities of teaching	1	2	3	4

## SECTION D: ASSESSMENT

**D1. On the scale below, please indicate how often the following happens in your classroom. Make a cross ☒ to indicate your choice.**

No.	Items	Almost Never	Seldom	Often	Almost Always
D1.1	Assesses learners' activities continuously during the teaching of a natural science lesson?	1	2	3	4
D1.2	Have sessions for learner-teacher consultations	1	2	3	4
D1.3	Have sessions for teacher-parent consultations	1	2	3	4
D1.4	Give timely feedback to learners	1	2	3	4
D1.5	Use assessment to enhance instruction	1	2	3	4

## SECTION E: ADDITIONS

General comments: Is there anything that you would like to add regarding the teaching and learning of Earth and Beyond Strand in your classroom?

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## APPENDIX J

### STATISTICIAN'S ETHICS REVIEW REPORT



#### STATISTICIAN'S ETHICS REVIEW REPORT

Title of the study	Analysis of the teaching and learning of the Earth and beyond strand in the intermediate phase, in two districts, North West Province
Ethics application nr.	
Applicant's name	Bantwini (and Motaung)
Reviewer's code	Erika Fourie
Date of review	21 August 2018

Element		Comments
1	1.1 Power calculation (sample size) and sampling technique for random sampling	
	1.2 Sample size and sampling technique for non-random sampling	
2	Study design	
3	Method of data collection (Questionnaire/Medical files, etc.)	
	When using a questionnaire:	Although it has been indicated that the pilot study will not be undertaken anymore <i>Section 5.15 Monitoring of Research</i> is still referring to a pilot study.
	3.1 Face validity	See attached document for additional comments regarding face validity after the previous corrections have been made.
	3.2 Technical aspects	
4	Proposed statistical analyses	
5	Was a statistician consulted in the planning of the study or research?	
6	General comments	

#### Recommendation for status of the application

Approved	<input checked="" type="checkbox"/>
Approved with changes	<input type="checkbox"/>
Disapproved	<input type="checkbox"/>

Reviewer's signature

Date

21/08/2018

## APPENDIX K

### PROOF OF ATTENDANCE: ETHICS TRAINING



NORTH-WEST UNIVERSITY  
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Health Sciences Ethics Office for Research,  
Training and Support  
Tel: 018 299 2092  
Fax:  
Email: [minrie.greeff@nwu.ac.za](mailto:minrie.greeff@nwu.ac.za)

18 May 2017

Dear Nellytia Motaung

#### PROOF OF ATTENDANCE

This letter certifies that you have attended the 2 day ethics training, entitled:

#### The Basics of Health Research Ethics

presented by Prof Minrie Greeff (Head of the Health Sciences Ethics Office for Research, Training and Support) on 2 and 3 May 2017.

This proof of attendance, as recognised by HREC and the Ethics Office, NWU, is valid for 3 years and expires on the 3<sup>rd</sup> of May 2020.

Yours sincerely

A handwritten signature in black ink, appearing to be 'Minrie Greeff'.

Prof Minrie Greeff  
Head of Health Sciences Ethics  
Office for Research, Training and Support

A handwritten signature in black ink, appearing to be 'Awie Kotzé'.

Prof Awie Kotzé  
Dean of Faculty of Health Sciences

# APPENDIX L

## LANGUAGE EDITOR'S REPORT

**Dr. JACKIE DE VOS**

Academic copy editor / Akademiese teksredakteur

BA (Psychology & Communication studies), BAHons (Psychology) (NWU)  
MEd, PhD (Educational Psychology) (NWU)  
BAHons (Translation) (UNISA)  
MA (Linguistics) (UNISA)  
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Jackie de Vos

acadwritingconsult@icloud.com

### LANGUAGE EDITING

30 October 2018

To whom it may concern

This letter serves to confirm that the following dissertation was edited:

"Analysis of teaching and learning of the Earth and Beyond Strand in the  
Intermediate phase in two districts, North West Province"  
(NN Motaung)

The onus rests on the client(s) to work through the proposed track changes and to accept or reject proposed changes. Clients must also make certain that all sources/references have been cited.

Yours sincerely,

Dr Jackie de Vos