Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners

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By

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Declaration of Originality

I, Lindiso Desmond Funani (98F6566), declare that this research is my own original work that was submitted at Rhodes University and has not been previously submitted form for assessment or a degree in any other higher education institution. All the ideas and citations drawn from other people used in this study are acknowledged and indicated in the reference list.

Signature:  Date: February 2024

Dedication

This study is dedicated to my brilliant and outrageously loving and supporting partner Busisiwe (MaRhadebe – her clan name) Stamper, our exuberant, sweet, and kind-hearted children, Wothando and Okuye. I am truly thankful for having you in my life. This study is also dedicated to my mother Thembisa Funani (Madlamini) who has always loved me unconditionally and whose good examples have taught me 'Ubuntu' and that I should work hard for the things that I aspire to achieve.

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Abstract

The Curriculum and Assessment Policy Statement (CAPS) document mandates that teaching and learning should start with the knowledge and experiences of learners from home or communities when teaching Natural Sciences. The aim is to bridge the gap between the science content learned in the school classroom and the science accessible to learners in their homes and community environments. CAPS claims that it 'embraces local indigenous knowledge' but it does not specify how this should be done in schools. As a result, little or no integration of Indigenous Knowledge (IK) is enacted in many of our schools in South Africa and learners seem to find science inaccessible and irrelevant to their everyday lives. It is against this backdrop that this interventionist study sought to mediate learning of electrostatics through harnessing *stories* on cultural beliefs and practices about lightning to Grade 7 township school learners.

This study is located within the interpretivist and Indigenous research paradigms, central to which is to develop a greater understanding of how people make sense of the contexts in which they live and work. Within the Indigenous research paradigm, I focused on the Ubuntu perspective. Furthermore, this study was conducted in an under-resourced school located in the Sarah Baartman District, Eastern Cape Province of South Africa. The participants were Grade 7 Natural Sciences learners and two Indigenous Knowledge Custodians (IKCs). In addition, one Natural Sciences teacher was my critical friend. Focus group interviews (sharing circles), group activities, observations (participatory and lesson observation), and learners' journals were used to gather data. Vygotsky's sociocultural theory and Ogunniyi's Contiguity Argumentation Theory were used as theoretical frameworks in this study.

The findings of the study revealed that both the group activity and the presentations by the Indigenous Knowledge Custodians on *stories* on cultural beliefs and practices about lightning enabled learners' argumentation and sense-making of electrostatics. The study thus recommends that science teachers should make efforts to tap into the cultural heritage of IKCs to make science accessible and relevant to learners' everyday life experiences.

Keywords: Natural Sciences, Electrostatics, Lightning, Indigenous Knowledge, Sociocultural Theory, Contiguity Argumentative Theory

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Abbreviations and/or Acronyms

BEd:	Bachelor of Education
CAPS:	Curriculum Assessment Policy Statement
CAT:	Contiguity Argumentation Theory
DAIM:	Dialogical Argumentation Instruction Model
DBE:	Department of Basic Education
DoE:	Department of Education
FGI:	Focus Group Interview
IK:	Indigenous Knowledge
IKCs:	Indigenous Knowledge Custodians
MKO:	More Knowledgeable Other
MTBBE:	Mother Tongue Based Bilingual Education
TIMSS:	Trends in International Mathematics and Science Study
TMESD:	Transformative Model of Education for Sustainable Development
ZPD:	Zone of Proximal Development

CHAPTER ONE: SITUATING THE STUDY

1.1 Introduction

The main goal of my study was to mediate learning of electrostatics through stories on cultural beliefs and practices about lightning to Grade 7 township school learners. This chapter presents the context of the study; situating the researcher in the study; the statement of the problem; purpose and significance of the study; the research goal; objectives, and research questions; theoretical frameworks; key concepts; the thesis outline, and chapter summary. The focal point of this study was to look at the role of using Indigenous Knowledge (IK) and argumentation in learning school science. In addition, the study wanted to ascertain how learners deal with the possible conflicts that occur during the learning process. For example, the reason why lightning was used in this study is that static electricity, and to a large extent, current electricity forms a major component of science. That is, lightning was used in this study to mediate learning of electrostatics.

1.2 Context of the Study

Since the attainment of democracy, South Africa seems to have responded positively to the call for the integration of IK into science. This is intended to supplement Western methodologies and approaches used in science classrooms to teach science (Aikenhead, 2006; Taylor & Cameron, 2016). The use of Western approaches alone is found to be alienating to non-Western learners as they seem to make learning science abstract and generally out of touch with the reality of learners' worldviews (Gwekwerere, 2016). To ameliorate this, the Curriculum and Assessment Policy Statement (CAPS) requires teachers to recognise learners' prior everyday knowledge and experiences from their homes and communities (Department of Education [DoE], 2011). For instance, in Grade 7, teachers are required to integrate learners' IK into the topic of static electricity.

Based on my 19 years of teaching experience both as a high school and higher primary science teacher and eight years as a school principal, I have noticed that most of the Black township learners seem to lack the necessary confidence to choose Physical Sciences in Grade 10. Most

learners seem to lose interest in Grade 7 and thus end up choosing other subjects rather than Physical Sciences and Mathematics. Consequentially, this could have serious implications in terms of South Africa not having enough scientists in the future. I assume that one of the reasons for this gloomy picture could be that science is probably taught in decontextualised ways. That is, some science concepts that indigenous learners learn in class are not familiar to them and have no relevance to their daily lives (Aikenhead & Jegede, 1999; Gwekwerere, 2016). That impinges directly on the learning of science.

In this regard, Jegede (1999) cautions that any science curriculum that does not consider the worldview of the learners, risks destroying the framework through which the learner is likely to understand and interpret the science concepts. Jegede (1999) further accentuates that all learning is mediated by culture and takes place in a social context. Lending support, in their study, Angaana et al. (2016) proffer that learners do not come to the science classroom with empty minds about natural science phenomena but instead come with knowledge from their homes or community.

Moreover, the cultural influence of the home cannot be disregarded in science teaching. Learners' sociocultural background knowledge, which is the lens through which they interpret experiences, ought to form part of science classroom discourses (Mavuru & Ramnarain, 2020). In this regard, Mavuru and Ramnarain (2020) caution that if the teacher does not consider the learners' prior knowledge and their sociocultural background, they might alienate those learners in the science class.

1.3 Situating Myself in the Study

I grew up in Hope Fountain, a farm that is 30 kilometres away from Grahamstown (now called Makhanda), in the Eastern Cape. I was raised by my grandmother. I remember that on the farm, a significant number of people believed that lightning was a powerful black magic tool that could be sent by the offended to strike and kill their target. My grandmother used to live in fear when there was lightning. She used to tell us *stories* or incidents of people who were struck by lightning while in their homes or under the shelter of trees. Most times, the *stories* she would tell about the circumstances in which someone was struck by lightning did not make sense. That is why it was easy for me to believe that witchcraft exists and that your enemies may decide to kill you by sending lightning bolts to strike you. Likewise, she used to tell us the many ways to prevent oneself from being struck. For example, she would not allow us to play

outside when there was a thunderstorm with lightning; also, we should not stand under a tree when there is lightning.

When I started school, however, none of this information was mentioned in class. As a result, I must admit that I struggled to understand the topic of electrostatics because my science teacher did not include IK on the topic of electrostatics. He just followed what was in the textbook. As a science teacher for many years, I also used and followed the textbook to teach science lessons. Although I valued the Indigenous ways of learning that I learnt from my community, I did not know how to integrate them into my science lessons – most of my learners were not coping and their interest in coming to the science class was minimal.

In 2018, I enrolled at Rhodes University for BEd honours in science education. I met a caring and motivating supervisor Professor Kenneth Ngcoza, a true proponent of Ubuntu and IK. Professor Ngcoza imparted the value of IK to his students. I also met a great community of practice, and as colleagues we shared everything, supporting each other to develop academically and eventually become skilled teachers. Enrolling with Rhodes University helped me a lot in enhancing my teaching strategies. I gradually started integrating IK in my science lessons and my learners seemed to enjoy science lessons and their interest in science increased. Moreover, ever since I integrated IK into my science lessons, I noticed that learners participate actively, and they are always eager to attend my science lessons.

1.4 My Positionality and Reflexivity in the Study

Holmes (2020) describes positionality as an individual's worldview and the position they adopt about a research task and its social and political contexts. That is, positionality is a factor that impacts the way we do our research and how the people we work with perceive us (Powell, 2022) and "reflects the position that the researcher has chosen to adopt within a given research study". Powell (2022) further posits that positionality consists of the researcher's ontological and epistemological assumptions. Cohen et al. (2018) assert that the relationship between the researcher and participants is not the same in terms of power. For example, they state that mostly, those with more power research those with less power.

Berger (2015) avers that positionality can have several impacts including the ability to gain access and information that a respondent is able, or willing, to share. Positionality, therefore, can be seen to affect the totality of the research. Thus, in this study, I was acutely aware of the challenges of my position and power concerning the learners who were involved in my study.

For instance, as a school principal and a Grade 7 Natural Sciences teacher who has been teaching the subject for 18 years, my participants especially the learners, may think that I am more knowledgeable, while I am a learner as well.

To address the issue of positionality, I used clan names to address all my participants to create and build a good rapport and trust with all of them who were involved in this study. I also told them that I was conducting this research project *with* them and not on them as reiterated by Ngcoza and Southwood (2015). They stress that participants should be aware that the research is a collaborative endeavour. This means that the researcher and participants work together, with mutual understanding and respect, rather than the researcher being seen as an external observer who is simply extracting information. Moreover, I made sure that my participants understood that they were not obliged or forced to participate in my study which was conceptualised as a community of practice. I explained to them that participation in the project was 100% voluntary, and they were free to withdraw their participation at any time if they wished to do so. However, it should be noted that I politely did this as it might have sounded disrespectful to them (Mutanho, 2021).

On the other hand, reflexivity entails reflecting and taking action throughout the research process (Holmes, 2020). That is, reflexivity is the action of carefully thinking and critically pondering the implications of the different decisions of the research project. It is about how the researcher will put actions in place to guarantee, not just the well-being of their participants, but also the reliability and validity of the data collection process (Holmes, 2020). For Chilisa (2012), reflexivity refers to the assessment of the influence of the researchers' background and ways of perceiving reality, experiences, ideological bases and interests during the research. She goes on to say that the researcher is the main data collector, and the researcher also analyses, interprets and reports the findings. It is important, therefore, that the researchers' thoughts, feelings, frustrations, fears, concerns, problems and ideas are recorded throughout the study.

Consequently, reflexivity aids researchers in exploring their positionality and understanding how they construct knowledge. In this study, I engaged in reflexivity throughout the research process to ensure trustworthiness. I draw attention to the participants as opposed to "brushing them under the carpet" and pretending that they did not have any impact or influence. I was open with the participants and accepted that they were part of the research.

1.5 Statement of the Problem

The South African CAPS curriculum supports the integration of IK. This is reflected in Outcome 3, which states:

> Valuing indigenous knowledge systems: Acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution (Department of Basic Education. (DBE), 2011, p. 5)

This policy aims to redress colonial imbalances by making science accessible to learners from different socio-economic and cultural backgrounds (DBE, 2011). In this regard, and as alluded to earlier, Mavuru and Ramnarain (2020) accentuate that science teachers should take into consideration their learners' sociocultural contexts to make science accessible to learners from poor socio-economic backgrounds. Hence, the CAPS document encourages teachers at all levels to wisely consider learners' existing knowledge to create new knowledge. This is grounded on the assumption that learning begins with the learners' motivation and experiences. However, this seems to be a challenge since the curriculum document does not give clear guidelines on how IK should be integrated into science teaching (Mayana, 2020). As a result, it seems that teachers need to use their discretion which results in different interpretations depending on their understanding of the different worldviews, that is, IK and Western science (Ogunniyi, 2007a). Hence, the driving force behind this study was to unpack the conflicting and possible resolutions to integrate IK into Western science as learners have to engage in modern school science while holding on to their traditional values. This gap in the curriculum encouraged me to conduct this intervention-based study, which focused on mediating learning of electrostatics through stories on cultural beliefs and practices about lightning to Grade 7 township school learners.

1.6 Rationale and Significance of My Study

The purpose of this interventionist study was to mediate learning of electrostatics through *stories* on cultural beliefs and practices about lightning to Grade 7 township school learners. The study sought to integrate learners' beliefs about lightning into the science lesson on electricity. The integration of learners' belief in lightning in this study was aimed at promoting their conceptual understanding of electrostatics. It was also hoped that this study might raise learners' curiosity about their everyday experiences and motivate them to want to learn science. I anticipated that the *stories* about cultural beliefs and practices on lightning might make my

science lessons relevant and hence enable my learners to cross the border between home or community to school science (Aikenhead & Jegede, 1999).

Hopefully, this study might improve learners' scientific understanding of electrostatics and provide some insights into how IK influences (or not) the Grade 7 Natural Sciences learners sense making of the topic of electrostatics when the community members share their IK on lightning. It was also anticipated that the study might also improve my practice and other science teachers' practices on how to integrate IK into science teaching and learning. This might eventually contribute positively to learner engagement and stimulate their enthusiasm and motivation to learn science. Lastly, it was also hoped that the study might provide an opportunity for community members to get actively involved in their children's education.

1.7 Research Goal, Objectives and Questions

In this section, I discuss the research goal, objectives, and research questions of this study.

Research goal

The main goal of my study was to mediate learning of electrostatics through stories on cultural beliefs and practices about lightning to Grade 7 township school learners.

To achieve this goal, the following objectives had to be met:

1. To find out what kind of *stories* about cultural beliefs and practices on lightning Grade 7 learners know from their homes and the community.
2. To find out how the *stories* presented by the Indigenous Knowledge Custodians on the cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences learners to argue and make sense of the topic of electrostatics.
3. To find out how the exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners from a township school to argue and make sense of the topic of electrostatics.

Research questions

1. What kind of *stories* about cultural beliefs and practices on lightning do Grade 7 learners know from their homes and the community?

2. How do the *stories* presented by the Indigenous Knowledge Custodians on the cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences to argue and make sense of the topic of electrostatics?
3. How do exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners from a township school to argue and make sense of the topic of electrostatics?

1.8 Theoretical Frameworks

This study was informed by two theories, namely Vygotsky's (1978) sociocultural theory and Ogunniyi's (2007a) Contiguity Argumentative theory (CAT). The two theoretical frameworks were chosen because of their amenability to classroom discourse dealing with phenomena on which learners might be holding conflicting worldviews. I used sociocultural theory as a lens to determine how learners learn through social interactions (among themselves and with the IKCs) and how learning takes place in a social-cultural context. That is, this study aligned itself with perceptions of learning that consider it a socialization process that engrosses learners around them (Aikenhead, 2000). I also used CAT to understand my learners' views and contradictions on the topic of electrostatics and the integration of IK into science lessons.

1.9 Definitions of Key Concepts

This section discusses key concepts used in this study.

Attitude

In this study, attitude refers to learners' negative or positive beliefs (Kendra, 2023; Mavuru & Ramnarain, 2017) towards the integration of IK into science lessons.

Conceptions

Conceptions are views that the learners have about the subject and what they believe is needed in learning the subject (Atallah et al., 2010). In the context of this study, the subject concerned is science.

Dialogical argumentation

Dialogical argumentation involves one making a claim and using evidence to logically back one's position. It also involves people proposing alternative views, challenging the claims

made by others, and finally coming to a consensus through convincing evidence (Ogunniyi, 2007a, b).

Dispositions

Disposition is a habitual predisposition to act in a particular way when an opportunity presents itself. Disposition can be negative or positive. It is all about the attitude of someone regarding a situation (Graven, 2012).

Lightning

Lightning is a flash of electrical discharge often accompanied by thunder and rain.

Indigenous Knowledge

A system of thought peculiar to people of a local geographical location or sociocultural environment. Knowledge and skills that have been developed outside the formal education system enable the communities to survive (Khuphe, 2014).

Practical activities

Hands-on practical activities are activities in which learners work individually or in groups, handling and observing the objects or materials they are studying (Millar, 2010).

Prior knowledge

Prior knowledge is the learners' existing knowledge before instruction. That is, it indicates the alternative conceptions possessed by the learner in a particular subject (Nhase, 2019).

Sense-making

Sense-making is a process in which people make sense of information and develop a shared understanding (Nikodemus, 2017).

Social interaction

Social interaction is a process of reciprocal influence exercised by individuals over one another during social encounters (Vygotsky, 1978).

Zone of proximal development (ZPD)

According to Vygotsky (1978), the ZPD is the distance between the actual development level as determined by intended problem-solving under the guidance of an adult or in collaboration with more knowledgeable others (MKO).

1.10 Thesis Outline

This study was conducted at Eluxolweni Primary (pseudonym), a township school in Sarah Baartman District, in the Eastern Cape, South Africa. This thesis is presented in seven chapters.

Chapter One

This chapter presented the background of the study, the statement of the problem, the purpose and significance of the study, the research goals, objectives, and research questions. Lastly, this chapter also highlighted and briefly discussed the theoretical and analytical framework of the study.

Chapter Two

This chapter provides an overview of the relevant literature concerning IK integration into science teaching and learning. Sections 2.2 to 2.12 are on the scientific explanation of electrostatics, traditional view of lightning, lightning in the school curriculum, learners' attitude towards learning science, learners' prior knowledge, indigenous knowledge, hands-on practical activities and visualisation, role of language in science teaching and learning, storytelling to impart science knowledge, conceptual framework, and chapter summary.

Chapter Three

The third chapter discusses the theoretical and analytical frameworks that underpin the study. Vygotsky's (1978) sociocultural theory and Ogunniyi's (2007a) CAT are discussed. Within CAT, I used the Dialogical Argumentation Instructional Model (DAIM) in this study.

Chapter Four

The research methodology and research design underpinning this study are addressed in this chapter. Likewise, two paradigms, namely the interpretive and Indigenous research paradigms focused on the Ubuntu perspective are discussed. In addition, the research site where the study

was conducted and the sampling of the participants, such as the learners, two IKCs and the teacher who was a critical friend are provided. In addition, my positionality is also addressed. The chapter addresses the data-gathering tools such as group activities, observations, group interviews and journal reflection and their purpose in the study. Lastly, ethical considerations such as validity and trustworthiness are highlighted.

Chapter Five

In this chapter, qualitative data generated from group activities, the presentations by the two IKCs and learners' reflections are presented and analysed. These data sets are discussed with the theoretical and analytical frameworks and literature in the study.

Chapter Six

In this chapter, the data on learners' conceptions, dispositions, and interest shift or not because of the presentations by the two Indigenous Knowledge Custodians (IKCs) and the lesson that integrates IK is presented, analysed and discussed.

Chapter Seven

In this chapter, an overview and summary of the main findings of the study from all three research questions is presented. Likewise, I present some recommendations and limitations of the study and discuss areas for further research. I also present a summary of my reflections throughout my learning journey. Lastly, an overall conclusion of the study is presented.

1.10 Chapter Summary

In this chapter, I introduced the study and described the background of the study which triggered my interest to conduct this research with my learners. The statement of the problem, the significance of the study, the research goal, and the questions of the study were discussed. Lastly, I highlighted the data-gathering techniques and the theoretical and analytical frameworks of the study. In the next chapter, I discuss the literature relevant to the study as well as the conceptual, theoretical, and analytical frameworks that underpinned it.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This study aimed to mediate learning of electrostatics through stories on cultural beliefs and practices about lightning to Grade 7 township school learners. It was triggered and motivated by the need to make science relevant and accessible to my learners.

In this chapter, I discuss literature pertinent to this research. I begin by giving an overview of the topic of electrostatics. Secondly, I discuss literature on cultural beliefs about lightning. Thirdly, I deliberate on the importance of *storytelling* in imparting science knowledge and IK.

2.2 Scientific Explanation of Electrostatics

Electrostatics is the study of electric forces and electric charges that create those forces. It is also defined as the study of imbalanced charges in matter, voltage, and electric fields (Beaty, 2009). Electrostatics encompasses phenomena resulting from the interaction of stationary or moving electrical charges, where the interaction is due solely to the charges and their positions and not due to their motion (Lacks, 2021). These charges can neither be created nor destroyed but can be transferred from one object to the other. For example, when perspex and wool are rubbed together, perspex loses electrons to the wool. Hence, the perspex becomes positively charged and the wool becomes negatively charged.

Similarly, lightning is an electrostatic charge at a huge scale. When storm clouds gather, the wild air turbulence inside them causes a separation of electrical charges. Usually, negative charges accumulate in the lower part of the cloud, while positive charges build up on the earth and the upper part of the cloud. As air is a poor conductor of electricity and the resistance in the air is often overtaken by the attraction of charges resulting in lightning (Williams, 2015). See Figure 2.1 below which explains the formation of lightning.

Figure 2.1: Shows lightning formation (source: www.orbitaltechs.com)

As a part of the learning outcomes in the CAPS document, learners are required to come up with their own experiences of the phenomenon of static electricity. Therefore, studying electrostatics in grade 7 provides a comprehensive foundation in physics, fosters critical thinking and problem-solving skills. It also introduces learners to practical applications that impact technology and the environment. It also prepares them for future academic pursuits and careers in Science, Technology, Engineering, and Mathematics (STEM) fields while nurturing an appreciation for the role of science in addressing global challenges and improving quality of life. As the learners delve into the world of electrostatics, they embark on a journey of discovery that connects classroom learning to real-world applications that inspires lifelong curiosity about the natural world and its phenomena.

The scientific views on electrostatics that are taught in school are very different from the traditional views and are in discord with each other. This might confuse and clash in learners' minds. Also, most teachers struggle to synchronise the two views.

2.3 Traditional View of Lightning

The Nobel Peace Prize winners laureate Archbishop Desmond Tutu and Nelson Mandela coined the phrase 'rainbow nation'. They provided the metaphor to describe the mix of cultures and languages that make up the South African nation (Mpofu, 2020). Within diverse societies and cultures, there are innate, fixed belief systems surrounding lightning. For instance, Mahapa (2002) posits that in many rural areas in South Africa, witchcraft is viewed as the cause of lightning deaths. As a result, many people are being killed and victimised in villages and farms

as they are accused of witchcraft. In such communities, people believe that lightning can be sent through the practice of witchcraft to kill an enemy.

These traditional beliefs and practices are being used to explain and interpret some of the things that happen in the communities. Young members of traditional societies are supposed to grow up to learn and believe these without question. However, this creates conflicts when what learners learn at school is not in agreement with traditional worldviews (Jegede, 1993; Ogunniyi, 2007a). This study attempted to establish the indigenous beliefs and practices about lightning held by the learners that I teach to mediate the learning of electrostatics.

2.4 Lightning in the School Curriculum

To provide a thorough overview of what the curriculum from NSTech (Natural Sciences and Technology) to Physical Sciences (FET – Further Education and Training) says about lightning, I will break down the relevant aspects based on general educational standards in South Africa.

In the NSTech (Grades 4–6) curriculum, which covers foundational science education, the concept of lightning is generally introduced in the context of weather and natural phenomena. Learners learn about different weather phenomena, including storms and lightning. The focus is often on understanding the basic formation and effects of thunderstorms. Also, basic concepts of static electricity are covered which are linked to understanding lightning as a form of electrical discharge.

In Natural Sciences (Grades 7–9) learners delve deeper into natural phenomena and their scientific explanations. Learners are introduced to electricity in a more structured way, learning about static electricity, electric fields, and basic circuits. This sets the groundwork for understanding lightning as a discharge of static electricity, including detailed explanations of how thunderstorms create lightning, including cloud formation, charge buildup, and discharge. Learners are expected to understand the basic safety protocols during thunderstorms, including the importance of lightning rods and shelter.

In the Physical Sciences FET (Grades 10–12) curriculum, learners are expected to investigate how lightning is covered in relation to electromagnetic phenomena, including electrical fields and forces. They must also be able to make detailed analysis of the physics behind lightning, including the role of electric fields, ionization of air, and the electrical discharge process.

2.5 Learners' Attitude Towards Learning Science

The driving force behind this study was the conflict and possible resolution to the integration of IK with WS. Jegede (1993) accentuates that when learners have to digest Western science, while at the same time holding on to their traditional views, conflict may arise which can hold back their understanding of the topic. Concurring, Fasasi (2017) avers that learners in the traditional setting, where day-to-day activities are still substantially influenced by the cultural beliefs and practices of the people, exhibit poor achievement in science.

Cobern (1996) deduces the reason for this. He maintains that science as currently imparted reflects Western history and foundational beliefs or worldviews. Hence, this leads to negative attitudes towards the study of science and a confused psychological state of mind. Jegede (1993) further posits that a learner who is not positively disposed to or has a sociocultural background that is different to the learning of science would find it hard to learn science actively and as a result, would tend to develop a negative attitude towards science. Ogunniyi (2007a) therefore suggests that to minimise any difficulties the indigenous explanations should be integrated into school science.

2.6 Learners' Prior Knowledge

A plethora of South African science education research in IK is from a constructivist framework (Hewson, & Ogunniyi 2011). In this regard, Stott (2016) accentuates that an important component of constructivism is the recognition of learners' prior knowledge. In addition, the constructivist perspective further posits that knowledge is not passively received from the world or authoritative sources but is constructed by individuals or groups making sense of their experiential world (Nhase, 2019). Even though prior knowledge is sometimes viewed as a hindrance to the acquisition of scientific knowledge (Taylor & Cameron, 2016), that view led to research on misconceptions or alternative conceptions.

However, treating prior knowledge as misconceptions has been disputed since prior knowledge has also been seen as useful to the learners' cognitive growth (Stott, 2016). Hewson (2011), for instance, argues that learners' prior knowledge indicates the alternative conceptions as well as the scientific conceptions possessed by the learner. An essential factor in developing an integrated knowledge framework is to create a learning environment in which learning means actively constructing knowledge and skills based on prior knowledge (Tobias, 1994). This

means that teachers need to have different strategies to work with learners as they come with various experiences.

Furthermore, inadequate, or fragmented prior knowledge is important to consider because if there is a mismatch between the teachers' expectations of the learners' knowledge and the learners' actual knowledge base, learning may be hampered from the start of the studies (Hailikari, 2008). The most important single factor influencing learning is what the learners already know.

Similarly, Vygotsky (1978) accentuates that learners' learning begins before they attend school and any learning a learner encounters in school always has a previous history. Vygotsky (1978) argues that prior everyday knowledge is the kind of knowledge that the learners possess and explore through their social and material environments and learn through communication. This means that learners come to the science class with their own prior knowledge, conceptual understanding, skills and beliefs (James et al., 2019). When they are presented with problems or new information, their prior knowledge and experience influence their thinking. New learning is constructed on prior knowledge. The more the teachers understand what the learners already think, the more they can help them to engage their prior knowledge, the more likely they are to learn well and the less likely they are to misinterpret the material in the course (James et al., 2019).

Roschelle (2017) posits that neglecting prior knowledge can result in the learners learning something opposed to the educators' aims, no matter how well those aims are executed in a classroom. This means new knowledge does not replace prior knowledge, rather new knowledge re-uses prior knowledge. Also, prior knowledge could be in the form of IK.

2.7 What is Indigenous Knowledge?

Khuphe (2014) avers that IK is community-based knowledge which is unique to a given culture or society and has developed as the culture has evolved over many generations. This means people make use of their wisdom and accumulated knowledge from their forefathers. Shava (2013) posits that IK is transgenerational because it is passed on from one generation to the other orally, symbolically or through dance and cultural practices. That is, IK is knowledge that is characterised by its embeddedness in the cultural web and history of people including civilizations and forms the backbone of social, economic, scientific and technological identities

(Odora-Hoppper, 2005). Similarly, Ogunniyi and Hewson (2008) view IK in the African context as the knowledge that existed before Africa was colonised.

Sharing the same sentiments, Kibirige and Van Rooyen (2006) accentuate that IK is a legacy of knowledge and skills unique to a particular indigenous culture and involves wisdom that has been developed and passed on over generations – it is traditional wisdom derived from the practical engagement with the environment for survival. It is orally transmitted based on experience, learnt through repetition, and constantly changing. Building on this Gadzirayi et al (2006) proffer that IK manifests through, among other things, language, beliefs, values, customs, artefacts, games, food, rituals and ceremonies and elders are the custodians of this knowledge. As custodians of IK, elders are regarded as educators of children, youth and adults and are the communities' storytellers and historians, whose stories are used as educational tools to sustain communities' cultures and traditional practices (Iseke & Brennus, 2011) Hence, Vygotsky (1978) refers to them as the MKOs.

To support this view, Ogunniyi (2007a) proffers that IK is a conglomeration of knowledge systems, which is redemptive, holistic and transcendental of human experience with the cosmos. That is, our forebears would not have survived if they had not been able to learn about the natural world they depended on (DoE, 2011. UNESCO (1999) notes that all the definitions of IK make it clear that is locally bound and indigenous to a specific area, culture-specific, non-formal knowledge that is orally transmitted from generation to generation without being officially documented.

Several scholars such as Cajete (1999), Kibirige and Van Rooyen (2006), and Hewson and Ogunniyi (2011), to mention a few, recommend that IK be acknowledged in school science curricula; this will connect school science to the learner's cultural background and help improve their learning as participation from learners will help them become insightful and active. These scholars regard the integration of IK into science lessons as a positive step that could provide opportunities for debate on the interaction between Western and indigenous worldviews (Mushayikwa & Ogunniyi, 2011). Le Grange (2007) argues that integrating IK into Western science teaching facilitates learning. That is, integrating IK into WS will hopefully help bridge the gap between learners' school experiences and their home experiences while at the same time allowing them to develop their abilities to their full potential, gain confidence and self-esteem, and use their creativity to gain life skills as well as making informed decisions.

Le Grange (2007) also cautions us of the hazards of disregarding learners' IK. He posits that disregarding learners' IK can lead to "cognitive dissonance" as the learners try to reconcile science and IK. In this regard, learners are experiencing a cognitive conflict within their minds as they try to reconcile conflicting ideas from science and IK. Science education in South Africa is of great concern as the number of learners who are doing science is decreasing rapidly and the results are getting poorer. South African learners have been performing badly in international surveys such as the Trends in International Mathematics and Science Study (TIMSS).

Jegede (1999) propounds that to remedy such situations and through collateral learning, teachers need not patronize and dishonour the IK that the learners bring to the classroom because it serves as the support against which they learn science. Hence, Kibirige and Van Rooyen (2006) point out that science teaching is enriched when IK is used as indigenous prior knowledge in the classroom and can thus be used as a starting point to explore concepts associated with WS. In this regard, Mahapa (2004) points out that integration is not merely about acknowledging learners' prior knowledge, but it is about doing something about learners' prior knowledge. The integration of learners' prior knowledge therefore implies that there should be a compromise between the two worldviews because promoting the use of IK has been identified as one of the principles of the national CAPS.

Similarly, Jegede (1999) reckons that a learner cannot perform well in a Western science classroom if their Indigenous Knowledge is ignored. Hence, the South African curriculum policy includes IK in the curriculum statement, referring to it as a way of trying to bridge the gap between two worldviews. Ogunniyi (2007a) also recommends that if the scientific worldview wants to succeed in traditional cultures, it should not try to accede to or demean the traditional cultures but should try and assist people in meeting modern challenges. It is precisely for these reasons that a large body of literature calls for the integration of IK into school science.

IK forms part and parcel of traditional communities in South Africa and elsewhere in the world. In South Africa, IK was deprived of inclusion in the science curriculum before the democratic dispensation in 1994. Khuphe (2014) views this segregation of IK as due to the Western attitude of viewing IK as primitive, uncivilised and barbaric and the assumption that local people have nothing to offer. As a result of this, Ogunniyi (2008) and Odora-Hoppers (2002) as well as a

lot of other science education scholars have embarked on studies on how to integrate IK into school science. Ogunniyi (2007a) argues that the most important reason for introducing a new curriculum in any country is often based on historical, political or socio-economic reasons. To support this view, scholars such as Mukwambo et al. (2014) in their call for Africanisation of the curriculum accentuate that IK promotes teaching and learning scenarios in which both teachers and learners engage in knowledge construction in the full diversity of culture and race, and ethnic and religious practices of all people to bring common understanding.

Aikenhead and Jegede (1999) argue that learners live two realities – at school and at home and they flip back and forth between these two realities – these scholars refer to this as border crossing. They further suggest that IK can be used to enable border crossing between home and school science. The time has come for science teachers and African teachers, to reconsider integrating IK into their science classrooms; perhaps then more township learners will choose science and the deteriorating trend will be a thing of the past. Likewise, Mhakure and Otulaja (2017) speak about culturally sensitive pedagogies. It is against this backdrop that this study focused on mediating learning of electrostatics through stories on cultural beliefs and practices about lightning with Grade 7 township school learners.

The role of integrating IK into the science classroom can be succinctly explained by adapting the Transformation Model of Education for Sustainable Development (TMESD) framework as espoused by Chikomori et al. (2019). Chikomori et al. (2019) proffers that the TMESD framework consists of three sub-processes of learning.

The first sub-process is the learning process of 'knowing the present' where students learn intellectually and or experientially about the present situation of society, communities and human activities (Chikamori et al., 2019). This process clarifies that because it was known in the past that the topic of electrostatics is a challenge to learners and some community members, at present it is known that teaching the topic of electrostatics in a science classroom without considering the learners' IK poses a considerable challenge to learners. Hence, the curriculum can be transformed by sharing cultural knowledge in the science classroom to mediate the concept of static electricity to make sense of the topic of electrostatics.

The second sub-process is the 'retroductive' learning process. Chikamori et al. (2019) posit that the 'retroductive' learning process is the general method of scientific inquiry that asks or

imagines what would, if it were real, bring about, produce, cause or explain the phenomenon. These scholars accentuate that the retroductive process is divided into sub-activities. In the first sub-activity, the students examine the past. In the second sub-activity, they use retroductive logic to consider past structures, mechanisms and events that brought about the current anticipated problems (Chikamori et al., 2001).

The integration of IK plays a role in the retroductive learning process. During this process, the IKCs shared their cultural knowledge of lightning and made it accessible to the learners. As the IKCs shared their cultural knowledge on lightning learners could tie the concept to their prior knowledge to understand the concept of static electricity. Chikamori et al. (2019) aver that learners consciously consider the present, and learn from the first learning process, connecting with what they know from the past. When learners grasp the concept of static electricity from 'retroductive learning' they will go through a retroductive learning process. Learners will likely comprehend most of what is related to static electricity and will be encouraged to use their IK to help them understand and make sense of electrostatics. This study process is thus summarised below.

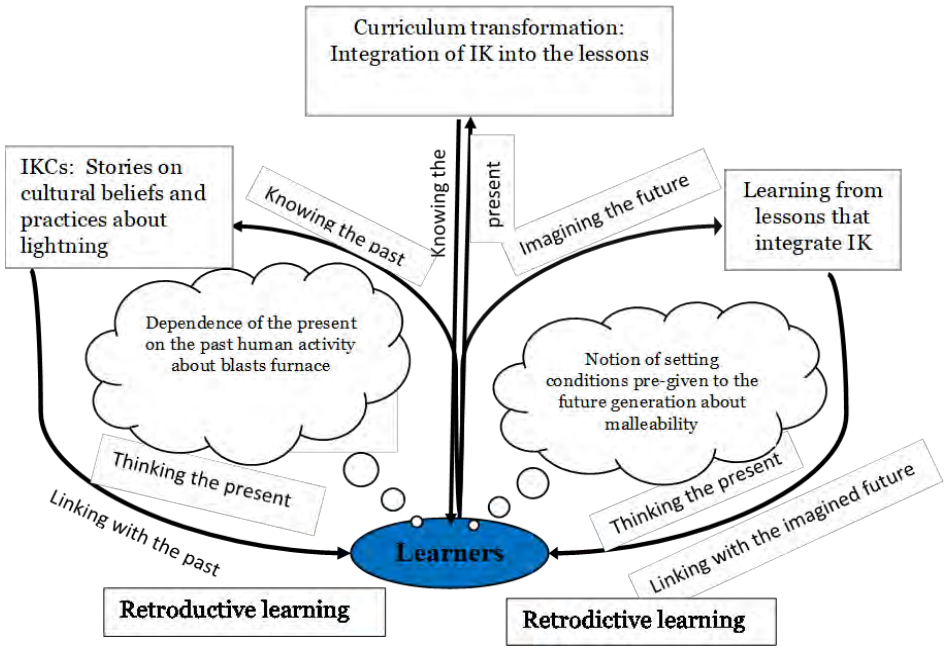


Figure 2.2: Shows the learning process regarding integrating IK in the science classroom (adapted from Chikamori et al., 2019, p. 9)

Furthermore, Jegede and Aikenhead (1999) explain that sometimes conflict arises as the result of the differences between learner culture and school culture. These scholars posit that the

duality of thoughts is created in the memory of schemata of indigenous learners when they learn Western science. Jegede (1999) posits that four types of learning denote the degree to which conflicts can be resolved. These are parallel, simultaneous, dependent and secured.

Hence, Mavuru and Ramnarain (2017) emphasise the importance of considering learners' sociocultural backgrounds. These scholars posit that the school curriculum should consider what learners already know at home to link that with school science. It is recognised, however, that teachers themselves should be able to cross cultural borders to be able to integrate both these worldviews in their lessons (Aikenhead, 1999).

However, amid the benefits of integrating IK into the science curriculum as suggested by many scholars, the literature reveals that there are some shortcomings. Scholars such as Horsthemke and Schafer (2007) warn that not all IK is relevant to science. In this regard, these scholars proffer that although there are valid and sound pedagogical arguments for integrating IK into science curricula, there is a need to be cautious not to include anything and everything in the curriculum under the banner of science. Building on this, Mukwambo et al. (2014) accentuate that IK needs to be properly scrutinised before it is used so that there is a possibility of exposing any contradictions that might come or be embedded in it. These scholars further caution that IK is deeply rooted in people's beliefs and highly localised of which some are entrenched in 'myths' that are difficult to explain in the scientific sense. For example, most African cultures believe that lightning can be sent by individuals who have the power to do so (Webb, 2013). In South Africa, the belief is widespread that a traditional healer *(Ixhwele*) possesses such superhuman powers. A belief such as this can present a barrier to learners from these cultures when it comes to accommodating scientific principles and facts related to electrostatics and lightning (Mukwambo et al., 2014).

Similarly, scholars such as Cobern and Loving (2001), postulate that IK should not be seen as the solution to teaching science, as problems may arise when it is integrated into teaching. To elaborate, Le Grange (2007) avers that learning using IK may cause cognitive conflicts between scientific language and everyday language. This is because learners should replace their existing knowledge with the new knowledge that they are acquiring through schooling. According to Le Grange (2007), learners might have problems using the scientific concepts that are required in science classrooms. Concurring, Mukwambo, et al. (2014) also suggest that most science concepts are not yet developed in the indigenous language and science concepts

are not always explicit in most indigenous practices – yet the Africanisation of the school science curriculum calls upon the teachers and learners to attach scientific explanations to IK. In addition, Seehawer (2018a) argues that despite acknowledging IK as one of the seven principles of education, IK has to date remained a mostly rhetoric add-on that leaves teachers wondering about how to proceed.

Furthermore, Southerland (2000) bemoans that forcing all forms of knowledge about nature and naturally occurring events into concepts of science sets no boundaries for the limits of science. Lending support Cobern and Loving (2001) contend that the comments that IK is embedded in a spiritual system and cannot be ignored take the form of a hypothesis. These scholars further posit that presuppositions do not describe what science is but what science presupposes about nature. They therefore accentuate that these presuppositions are not adequate reasons for any individual to be involved with science. Likewise, Horsthemke and Schafer (2007) reject the impulse of ownership of knowledge along the ethnic and indigenous divisions, and further posit that the term IK is being used uncritically by politicians to further their agendas.

However, although there are contrasting views on the integration of IK into the science classroom, there has been a modern-day global shift towards recognising the importance of IK. Large bodies of literature have been advocating the integration of IK into school curricula, in particular within science. Taking the argument forward, Aikenhead (2001) argues that omitting IK amounts to cultural assimilation and makes indigenous learners struggle with social and academic adaptation as well as their self-esteem. He further asserts that indigenous learners should be advantaged by their cultural identity and language and not be disadvantaged by them. Lending support, Mavuru and Ramnarain (2017) posit that it is vital to provide meaningful and culturally relevant experiences to learners which promote knowledge in a local context. Assenting, Shizha (2007) argues that integrating indigenous science and Western modern science liberates learners and teachers from cultural alienation. It is against this backdrop that this study focused on integrating IK into science lessons to mediate the learning of electrostatics in a Grade 7 Natural Sciences class.

2.8 Hands-on Practical Activities and Visualization

Practical work in any science teaching and learning is an activity in which learners work individually or in groups and handle or observe the object they are studying (Millar, 2010).

Considering this, the National Curriculum of South Africa clearly stipulates that practical work must be part of teaching, learning and assessment. In South Africa, of the 100 marks allocated for school-based assessment, 75 are allocated for assessing the theoretical content and 25 for assessing the practical work (DoE, 2011).

According to Hodson (1990), practical work includes the science experiments or demonstrations selected for the learners to do or observe in class. It also includes the hands-on activities used to teach and learn the concepts and theories of physics (Nhase, 2019; Ramnarain & Mavuru, 2021). Millar (2010) argues that practical activities of observing and intervening are important for promoting understanding.

Maselwa and Ngcoza (2003) also echo the same sentiment that hands-on practical activities help learners' conceptual understanding of science concepts as they are encouraged to predict, explain, explore, observe and explain when carrying out practical activities. Such assertions are supported by Woodley (2009) and Asheela et al. (2020) who postulate that the purpose of quality hands-on practical activities is to help learners develop their understanding of scientific concepts and make sense of them. Concurring, Niyitanga et al. (2021) proffer that science theories are mastered in practices in teaching and learning activities. Thus, teaching and learning through practical work are among the methods that undoubtedly facilitate knowledge transfer and skills acquisition in teaching and learning events (Niyatinga, 2021).

Despite high praise for using practical work in science lessons, some scholars question their effectiveness in the science classroom and learning. Stiller et al. (2017), for instance, contend that a practical work setup can be complicated. Thus, learners may perceive the practical work process as confusing and unproductive for their learning. Hudson (1990) also claims that practical work may be applied in a way where learners only follow the instructions given by the teacher which means they do not need to use creativity or cognitive thinking to process. Thus, practical work is a waste of time and is confusing and counter-productive (Hudson, 1990). Responding to this, Maselwa and Ngcoza (2003) caution that hands-on practical activities should not only be about learners using their hands to manipulate the materials but instead learners should use their minds, record scientific concepts which they can use to develop mind maps, and further develop concept maps.

However, Scanlon et al. (2002) believe that practical work has an obvious role in developing science learners' conceptual and procedural understanding. Niyatinga et al. (2021) argue that

learning science without practical work is like learning how to drive a car by merely reading its operating manual. Hence, in this study, practical work was deemed relevant, as effective practical activities build a bridge between 'hands-on' and 'minds-on' activities (Woodley, 2009).

In the context of this study, presentations by the teacher and community members were viewed as visual representations and were meant to mediate learning on the topic of electrostatics in the grade 7 Natural Sciences class. This coheres with Mavhunga and Rollnick's (2013) assertion that representations play a significant role as they serve as teaching aids that could assist learners to make sense of what is being taught. This suggests that visual representations play an important role in how learners make sense of science concepts which was the motive of this study. Hence, this study offered learners an opportunity to visualize and observe presentations by the teacher and IKCs to enhance learning.

2.9 Role of Language in Science Teaching and Learning

Language plays a crucial role in the transmission of IK (Battiste, 2005). Masondo (2013) concurs with this notion, as he asserts that language communicates the traditions, customs, morals and values of a people. In his seminal work, Vygotsky (1978) avers that language is the most vital tool with which knowledge can be constructed. Agreeing, Oyoo (2017) claims that effective teaching and learning requires language, whether it is written in books or shared orally during classroom discussions. Msimanga and Lelliott (2014) claim that some learners may not be confident in using English, hence, they should be allowed to use their home language to engage with difficult concepts.

In agreement, Ekele and Milcah (2016) and Mavuru and Ramnarain (2019) echo that the incorporation of the home language helps to boost the indigenous learners' self-esteem which ultimately increases their engagement in the classroom. Hence, in the Sarah Baartman District where this study was conducted, the medium of instruction in most schools is English. Of course, some schools offer dual medium instruction, in that case, the medium of instruction would be English and Afrikaans. There is a pilot programme of Mother Tongue Based Bilingual Education (MTBBE) which started in 2017, whereby Mathematics and Natural Sciences are taught in isiXhosa. Currently, in the piloted schools, MTBBE is being implemented in Grade 6.

However, English still prevails as the language of teaching and learning in NS, particularly affecting those in the township and rural schools "where there are learners who lack English language proficiency to fully engage with curriculum in the classroom" (Mavuru & Ramnarain, 2019, p. 2). In circumstances like these, teachers tend to use learners' home languages to explain scientific concepts for meaningful learner understanding (Probyn, 2009). In science classrooms in most rural and township schools, there is what Mavuru and Ramnarain (2019) call a "cultural clash", wherein the learners' home language and culture encounter the culture of science as encapsulated in the Western worldview (Cobern, 1998). Mavuru and Ramnarain (2019) allude that it is through language that learners can construct knowledge and make sense of science. The rationale is that using learners' home language when teaching science tends to empower learners as they can express their thoughts fluently and eloquently (Nhase, 2019; Nieto, 2004).

In this way, the language becomes a cultural resource which can make science relevant. It must therefore be recognised that the use of indigenous languages mediates the learning of science. Despite the benefits of the use of indigenous languages, Lo et al. (2018) suggest that the strategy of using the mother tongue to scaffold learners during the integration of IK into science might be a challenge if teachers lack pedagogical tools to navigate making scientific concepts understandable. My study also observed that although the curriculum calls on teachers to integrate IK into their classrooms, they encounter multiple challenges in doing so. Yet, one of the strategies used by indigenous people to transmit knowledge is *storytelling* (Iseke, 2013; Tzou et al., 2019). Hence, in the context of this study, the home language (isiXhosa) was used to mediate learning of the topic of electrostatics using *storytelling.*

2.10 Storytelling to Impart Science Knowledge

According to Seehawer (2018), *storytelling* is a traditional way of communication that plays an important role in transferring values belonging to a culture from one generation to another. Also, *storytelling* acts as a powerful pedagogical tool that helps people process their daily experiences. Likewise, Joubert (2019) posits that *storytelling* has been used to pass on wisdom, knowledge and culture and to strengthen social bonds since the earliest time of humankind's existence. Similarly, Tzou et al. (2019) assert that storytelling is a practice in indigenous cultures that sustains communities and validates the experiences and epistemologies of indigenous people. That is, *storytelling* was, and is, the foundation of a way of life and has occurred over many generations as a way of sharing. Iseke (2013) further proffers that

storytelling affords opportunities to express the experience of indigenous people in indigenous language and nurtures relationships and sharing of IK and culture. Therefore, *storytelling* is part of Indigenous methodology because they hold within them knowledge while simultaneously signifying relationships.

I still remember the stories that our grandparents and the community elders used to share with us to pass down important and meaningful information. For instance, they would narrate folk stories to pass down the principles, values, norms, beliefs and expectations of our society. For example, they used to talk about a bundle of chopped sticks that could not be broken if they were held together. This story was about strength in numbers and unity. These stories are used to shape values and cultural learning in familiar places – everyday discourses at home and in the community Hence, Iseke (2013) asserts that *storytelling* is a pedagogic tool for learning about life and enforcing morality.

Concurring, Tzou et al. (2019) postulate that *storytelling* plays a big role in presenting and making visible other ways of knowing and being. In this study, *storytelling* was thus used by the IKCs to share their *stories* on cultural beliefs and practices about lightning to Grade 7 Natural Sciences learners which we subsequently integrated into our lessons to make science relevant and accessible to learners.

2.11 Conceptual Framework

A conceptual framework is a system of concepts, assumptions, expectations and beliefs that together provide and support the understanding of the research (Maxwell, 2013). In this study, my conceptual framework consisted of the following concepts: conceptions, dispositions and sense making. I now discuss each of these below.

2.11.1 Conceptions

Atallah et al. (2010) posit that conceptions are how learners perceive the subject and what they believe makes sense and is required of them to learn. That is, conceptions of learning are derived from the accumulative effects of previous educational and other experiences, and so tend to be relatively stable and influence, to some extent, ways of thinking and acting (Roberts, 2011). Concurring, Chan (2011) refers to conceptions as understanding of knowledge and changes in personal opinions through learning. Simply put, the degree of learners' interest and effort invested in the subject depends on the perceptions of learners towards science. Atallah

et al. (2010) accentuate that conceptions have two components: knowledge and beliefs. Knowledge has to do with actual subject content knowledge (scientific concepts) whereas beliefs have to do with what learners encounter in their everyday lives.

Expanding on Atallah et al.'s seminal work, Perkins (2008) and Richardson (2011) point out that there are two types of conception approaches: the deep approach and the surface approach. In the deep approach, the learners construct meaning, relate ideas and use evidence while in the surface approach, learners reproduce learning materials for assessment (Lin et al., 2012; Richardson, 2011). In this study, the intention was to expose the learners to various cultural beliefs and local knowledge about lightning and explore whether such exposure would have any influence on their conceptions of science. It is recognised also that conceptions are related to dispositions and hence in the next section, I discuss dispositions.

2.11.2 Dispositions

To Graven (2012), a disposition is a habitual predisposition to act in a particular way when an opportunity presents itself. Disposition can be positive or negative – it is all about the attitude of someone regarding a situation. It is traits or characteristics that lead a person to follow certain choices or experiences Similarly, Atallah et al. (2010) highlight that dispositions are beliefs that are exhibited by frequent and conscious behaviours towards learning a subject. These researchers hold a common view that disposition is a learnable and changeable human quality that is not fixed, which develops through interactions with the world and in response to problems in social and physical environments. Sharing the same sentiment, Crick and Goldspink (2014) proffer that dispositions can be maintained in and through learners' engagement with their environment.

Agunbiade et al. (2017) point out that the literature reviewed showed that there is no consensus on the definition of disposition among researchers but emphasised that all researchers seem to agree that developing a positive disposition is essential for success and achievement in learning. Similarly, attitude can be defined as how a person views and evaluates something or someone, a predisposition or a tendency to respond positively or negatively towards a certain idea, object, people, place or situation (Vargas-Sanchez et al., 2016).

Likewise, Kendra (2023) defines attitudes as a learnt tendency to evaluate things in a certain way. This can include evaluations of people, issues, objects or events. Such evaluations are often positive or negative, but they can also be uncertain at times. Thus, attitudes are one of

psychology's fundamental concepts because they help to explain people's decisions and actions. Kendra (2023) avers that attitudes can also be explicit and implicit. Explicit attitudes are those that we are consciously aware of and that influence our behaviours and beliefs. Implicit attitudes are unconscious but still influence our beliefs and behaviours.

In this study, dispositions and attitudes are used interchangeably because both (attitudes and dispositions) have to do with the personal feelings of an individual towards the object. It thus focuses on attitudes as an indicator of dispositions. Moreover, I have used attitude to describe disposition. Positive attitudes can influence the performance of learners (Anwer et al., 2012). If the learners are positive about learning science, they may score better marks than those with negative attitudes. Similarly, Ben-Chaim et al. (2000) emphasise that learners' positive dispositions are also influenced by motivation. When learners' dispositions are increased positively, they will lead them to be fully engaged and effective in classroom activities. Their dispositions may also be influenced by the connection between the curriculum and the home environment (integrating cultural relevance into the curriculum) as the first step in learning as suggested by Agunbiade et al. (2017). Teachers should strengthen the positive (desired) disposition qualities in learners such as independence, self-motivation, creativity and resilience (Carr & Claxton, 2002; Da RosVoseles & Fowler-Haughey, 2007).

Concurring, Sheldrake et al. (2017) argue that to foster the attitudes of learners, teachers need to apply different teaching and learning approaches that can inspire and engage the learners. Also, Mavuru and Ramnarain (2017) accentuate that learners show great interest in learning if what is taught is related to their sociocultural settings. In this study, I was interested to see what my learners' dispositions would be about learning what was taught in class if it was related to their sociocultural settings (Mavuru & Ramnarain, 2017; Ngcoza & Southwood, 2015).

Likewise, the study hopes that the integration of IK into the topic of electrostatics might in some way contribute positively towards the learners' dispositions towards science. In my view, conceptions and dispositions are related to sense-making, and in the next section, I discuss sense-making which might influence the learning of science and specifically electrostatics in the context of this study.

2.11.3 Sense-making

Wieck et al. (2005) define sense-making as a process in which people jointly make sense of information and develop a shared understanding. It assumes that individuals have different

interests and perspectives and often see information in different ways. When people come together to discuss their different perspectives a deeper and more reliable shared understanding can result. Lending support, Nikodemus (2017) proffers that one useful way of understanding sensemaking is to view it as a collaborative process in which information is translated into knowledge and then wisdom.

Weick et al. (2005) further express that sense-making increases motivation since the person is making sense of what is being discussed. Sense making is about interpreting the clues that can be found in the environment (Maitlis, 2005) that make the situation meaningful. Sense-making enables learners to understand the situation that is being discussed. Nyambe (2008) points out that if the teaching and learning environment includes the understanding and knowledge of learners' culture and language, as proposed by Vygotsky (1978), then learners are more likely to understand and make meaning of the subject materials presented to them. Nhase (2019) also argues that meaningful information can be stored for long-term memory, which enables the learners to retrieve this information for future use.

In addition, integrating IK into teaching makes teaching and learning interesting as suggested by Kibirige and Van Rooyen (2006) for it allows the learners to make sense of the concepts learnt. The IK makes the concepts learnt accessible and relevant as learners relate them to their experiences and cultural practices (Lemke, 2001). As a result, IK should be another way of knowing that can be used to understand scientific concepts and thereafter contribute to meaningful learning (Mandikonza, 2007). This implies that it encourages the learners to become involved in discussions with one another to make sense of the concepts taught in the classroom.

Integrating IK into the teaching of electrostatics might enable the learners to make sense of this concept by interpreting the scientific knowledge that is embedded therein. One could then encourage learners to write out the scientific concepts that emerge from the stories presented by the two IKCs on traditional beliefs and practices about lightning. In this study, mind maps and concept maps were used to see if the learners could write down and connect the scientific concepts that emerged from the stories presented by the two community members (Asheela, 2017). They were also used to encourage the learners to share ideas about the concepts that were learnt and discuss how these concepts are related to each other.

2.11.4 Argumentation

Argumentation can be defined as the communicative activity of producing and exchanging reasons to support, defend or challenge a position in a situation of doubt or disagreement (Dutilh, 2022). Argumentation requires learners to engage with evidence and to make claims based on the extent to which other's claims can be substantiated (Osborne et al., 2004). That is, argumentation is seen as a reasoning strategy and promotes critical thinking. However, not all arguments are amenable to logical reasoning since learners hold multiple worldviews about phenomena.

Teaching science involves introducing learners to the ways of talking and thinking of the science community. Driver et al. (2000) posit, that if learners are not allowed to talk and debate their ideas, it makes it difficult for them to learn science concepts. In the context of this study, therefore, argumentation was central as it was hoped that the intervention would help learners use the IK about lightning in understanding the scientific explanations of the concept of electrostatics. That is, argumentation as a teaching strategy and learning method could facilitate border crossing (Aikenhead & Jegede, 1999).

2.12 Chapter Summary

In this chapter, I discussed literature relevant to the topic of electrostatics. For example, I discussed the scientific and cultural views of electrostatics. I discussed lightning in the curriculum. I further discussed the literature on the learners' attitudes towards learning science and literature relevant to learners' prior knowledge. I considered literature on IK, hands-on practical activities and visualization, and the role of language in science teaching and learning. I further explored the literature based on *storytelling* to impart scientific knowledge. Lastly, I discussed literature relevant to the conceptual framework, that is, conceptions, dispositions, sense-making, and argumentation. In the next chapter, I explain the theoretical and analytical frameworks that underpinned this study.

CHAPTER THREE: THEORETICAL FRAMEWORKS

3.1 Introduction

This study was informed by two theories, namely Vygotsky's (1978) sociocultural theory and CAT as espoused by Ogunniyi (2007a). These theoretical frameworks are chosen because of their amenability to classroom discourse dealing with phenomena on which learners might hold conflicting worldviews. These frameworks also provide the necessary context for inductive, deductive and analogical reasoning. I used the sociocultural theory as a lens to determine how learners learn through social interactions (among themselves and with IKCs) and how learning takes place in a social-cultural context. That is, this study aligned itself with perceptions of learning that consider learning a socialisation process that engrosses learners around them (Aikenhead, 2000).

Furthermore, CAT was used in this study to understand my learners' views and contradictions on the integration of IK into science lessons. In addition, there is a consensus in literature (Ogunniyi, 2007a, b) that by engaging in argumentation, learners will enhance their ability to think and argue about issues related to science and consequently improve their understanding of science concepts and relate what they have learnt to their daily endeavours. Within CAT, I used the DAIM in this study. It was hoped that this would ameliorate the river crossing process between the perceptions of lightning that learners bring to school and what they learn in science, eventually helping mediate learning of the topic of electrostatics.

3.2 Theoretical Framework: Vygotsky's Sociocultural Theory

Vygotsky's (1978) sociocultural theory of human learning describes learning as a social process and that human intelligence begins in society or culture. This means that learning is the link between social interactions and human development. Vygotsky (1978) also believes that social interaction plays an important role in learners' learning. Such interaction could be between the learner and the teacher and the learners themselves, where there is a more knowledgeable other who helps those learners who are struggling (Stott, 2016). The major thesis of Vygotsky's (1978) sociocultural theory is that the cultures of the learner, the teacher and the whole education system play fundamental roles in the development of cognition.

In his seminal work, Vygotsky (1978) avers that everything is learnt on two levels, first through social interaction with others and then integrated into the individual's mental structure. Concurring, Sedlacek and Sedova (2017) argue that learners' active participation happens in a social context and learners learn best when they interact with others and with the teacher and community members (Nuntsu, 2020). This suggests that every higher mental function in a child's cognitive development is twofold: first, on the social level and later, on the individual level. Within Vygotsky's (1978) sociocultural theory I focused on the following tenets, namely mediation of learning, culture and language, social interactions and the ZPD. I now discuss each of these concepts below.

3.2.1 Mediation of learning

In his seminal work, Vygotsky (1978) posits that mediation of learning introduces the cultural tools needed to attain goals and make learning meaningful. Through the mediation of learning using language as a cultural tool, a teacher can explain some challenging concepts the learner should learn. In this regard, Vygotsky (1978) argues that language is the carrier of culture as it transmits all information about culture, in both verbal and written form. For Vygotsky (1978), cognitive development results from the internalisation of language. He places communication at the centre of sociocultural theory by arguing that the thought is completed in words.

Vygotsky (1978) further asserts that language is a cultural tool and human instrument of communication. He, therefore, avers that humans use speech as a tool to master their surroundings. To support this view, Kibirige and Van Rooyen (2006) posit that IK is transmitted orally. Hence, in this study, I will invite two IKCs who are knowledgeable about the cultural beliefs of lightning and will use such cultural knowledge to mediate the learning of electrostatics. Learners will be allowed to interact socially and share with other learners their stories about the cultural knowledge of lightning.

3.2.2 Culture and language

In his seminal work, Vygotsky (1978) proffers that the relationship between language and culture is deeply rooted. He avers that language is used to maintain and convey culture and cultural ties. Moreover, language is a cultural tool that is related to the development of the mind (Vygotsky, 1978). This means that language in social interactions and relationships plays a vital role in learning. Mika (2019) posits that without language, it would be impossible to socialise and interact because language is regarded as a potent cultural tool through which

learning and thinking are shaped. In addition, children learn their language and culture from the society in which they were born. In the process of learning, they also develop their cognitive abilities. Hence, the two community members who are more culturally experienced will share stories on the cultural beliefs about lightning. In addition, since these stories will be presented by the community members in a local language, it might help learners to understand the concept better.

3.2.3 Social interactions

According to Vygotsky (1978), learning is a socially mediated process in which learners develop the meaning of their environment with the help of more knowledgeable others (MKOs). He believes that social learning comes before cognitive development in children and that children construct knowledge while playing. Lending support, Kibirige and Van Rooyen (2006) accentuate that IK is a legacy of knowledge and skills unique to a particular indigenous culture and community and involves wisdom that has been developed and passed on over generations. Concurring, Ngcoza (2017) emphasises that each community member is responsible for sharing new knowledge and discoveries with other community members. He further posits that learning is rooted in all human activities, mostly in their upbringing, the community they live in, religion and culture. Furthermore, Vygotsky (1978) observed a gap between what a child can do alone and what they can achieve with adult or peer guidance. This led to the theory of the ZPD.

3.2.4 Zone of proximal development

Vygotsky (1978, p. 86) accentuates that, ZPD is the "distance between the actual development level as determined by independent problem solving and the level of potential development level as determined through problem solving under adult guidance or collaboration with more knowledgeable peers". Bruner (1986) describes the role of the knowledgeable other as that of scaffolding learners from one level of understanding to another. This draws from the idea that learning takes place within the ZPD.

In his seminal work, Vygotsky (1978) posits that when a learner is at their ZPD for a particular task, providing the appropriate assistance will help the learner advance to achieve the task. Once the learner, with the benefit of assistance masters the task, the assistance can then be removed, and the learner will then be able to complete the task on their own. Shabani (2016) asserts that the ZPD implies that a less knowledgeable person experiences developmental

changes through interactions with more significant others who can be a mentor, teacher, or parent. In this study, stories on lightning shared by the IKCs could be a good example for exploring higher order thinking skills that the participants can obtain.

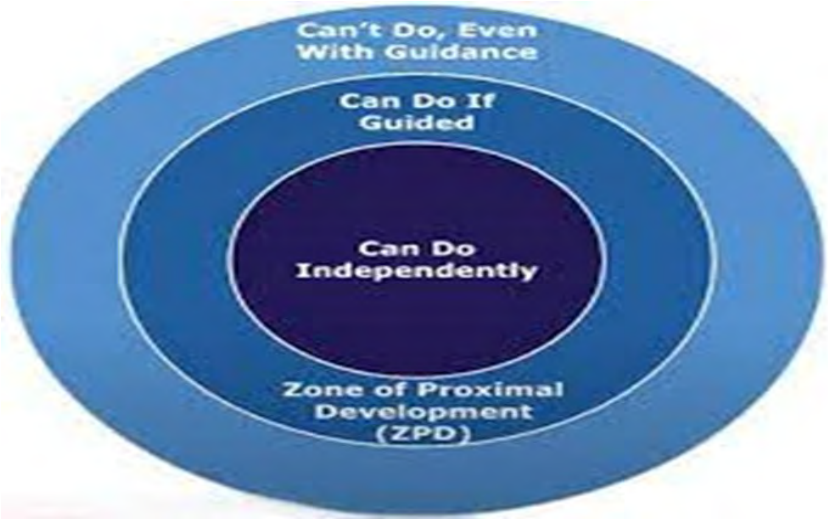


Figure 3.1: Shows Vygotsky's (1978) ZPD

3.3 Ogunniyi's Contiguity Argumentative Theory

Ogunniyi's (2007a) Contiguity Argumentative Theory (CAT) asserts that two worldviews can readily rely on each other to create an optimal cognitive state. That is, two different co-existing systems of thought, such as science and IK, tend to readily pair with each other in the minds of the learners to create the most favourable cognitive state. Also, CAT holds that claims and counterclaims on any subject matter within fields like science and IK can only be justified if no system dominates the other. That way, learners will be able to negotiate the meanings across the two distinct systems of thought to integrate them. In this regard, Ogunniyi's (2007a) CAT assumes that when two cultures or systems of thought meet, they seek some form of co-existence through the process of conceptual appropriation, accommodation, integrative reconciliation, and adaptation. Ogunniyi (2007a) further posits that CAT explains the dialogical framework for resolving the incongruities that normally arise when two competing thought systems such as science and IK meet.

Hence, CAT was used in this study as an analytical tool to explain how learners resolve conflicts arising between the scientific and indigenous views of lightning. Furthermore, within CAT, I used the DAIM as it gives learners the chance to freely share their views by reflecting on what they have learnt and changing their minds in the face of a stronger argument (Fakudze,

2021). Also, it creates a discursive classroom environment where teachers and learners argue, discuss, dialogue and learn together with the ultimate aim of reaching a consensus on various issues at stake. The DAIM has been found to enhance learners' conceptual understanding and class participation and increase interest in the topic being discussed (Angaama et al., 2016; Ogunniyi, 2011a).

Similar to CAT, in a DAIM-driven classroom argumentation takes place in individual, small-group and large-group settings (Ogunniyi, 2011a). For example, in the context of this study learners were divided into groups of six learners; they were given ample time to argue and make claims/counterclaims supported with evidence to maintain their stances. In this regard, my role was that of a facilitator. At the end of the lesson, the learners had to come up with a conclusion about the topic. In the process they were able to express their views freely without feeling intimidated, they externalised their thoughts, cleared their doubts and even changed their minds – their critical thinking was challenged and developed (Ogunniyi, 2011a). It was also hoped that the DAIM might provide valuable theoretical underpinnings to analyse the learners' arguments during the social interactions as espoused by Vygotsky (1978).

Ogunniyi (2007b) proffers that CAT is divided into five categories in which conceptions within a learner's mind can move when dealing with conflicting worldviews such as science and IK. These five categories also explain the movement of conceptions among learners involved in dialogues warranting the conscription of scientific and IKS-based conceptions. According to Ogunniyi (2007a) and Hewson (2011), these categories are the following.

3.3.1 Dominant

This is a powerful idea that effectively explains an event, predicts facts or resonates with an acceptable social norm and sense of identity. For example, among amaXhosa, there is a belief that lightning can be sent to the enemy. Equally, to prevent being struck you must use *umuthi* (herbs from the *sangomas*).

3.3.2 Suppressed

An idea becomes suppressed in the face of valid and convincing evidence or established social norms. Indigenous ways of knowing have been suppressed in the school curriculum. For example, in the context of this study, the idea of putting tyres on top of houses to prevent being struck, in terms of science is not true, as tyres cannot prevent the house from being struck.

3.3.3 Assimilate

A less powerful idea might be consumed by a more powerful one in terms of the persuasiveness or adaptability of the dominant idea to give context. Therefore, it is easy to change your views if you are convinced and shown evidence about the phenomenon.

3.3.4 Emergent

There may be circumstances where no prior knowledge about a phenomenon exists, and new knowledge has to be acquired or developed. For example, in the context of this study, learners believe that someone can send lightning but after the lesson, they have acquired new knowledge about lightning.

3.3.5 Equipollent

This is when a learner's worldview is influenced by two competing and/or co-existing worldviews, for example, science and IK, with comparably equal intellectual force without necessarily resulting in cognitive dissonance or conflict (Le Grange, 2007). This is akin to Jegede's (1995) collateral learning, for example, learners learn from home or the community not to stand under a tree when there is lightning – equally, science is saying the same.

Ogunniyi (2007a) and Hewson (2011) also aver that the five cognitive states above are not static but dynamic and can change from one form to another. Hence, the context in which a given discourse takes place dictates what cognitive states an individual displays. The study attempted to determine whether these states of cognition are exhibited during the argumentation lesson as the learners were trying to understand the concept of lightning from two distinctly different worldviews such as Western science and IK.

Expanding on the seminal work of Ogunniyi (2007a), Govender (2014) posits that argumentation plays a critical role in advancing knowledge. Therefore, in the context of my study, it was hoped that CAT might provide valuable theoretical underpinnings to analyse the learners' arguments during the social interactions as espoused by Vygotsky (1978). It was also hoped that it might help me understand the learners' input during interactions and when analysing their journal reflections. Ogunniyi (2007a) contends that CAT is contextually based, and it can be applied in two or more thought systems. Thus, CAT was viewed as a relevant analytical framework for this study.

The frameworks discussed above are deemed relevant to this study in that they highlight the value of cultural and social components of making sense of the natural world. These frameworks also suggest that teachers need to consider and exploit the ideas that learners bring from home or community to the science classroom.

3.4 Chapter Summary

In this chapter, I discussed the theoretical and analysis frameworks that were employed in this study. I started by describing the theoretical framework and its purpose in the research. I then discussed Vygotsky's (1978) sociocultural theory. I discussed its concepts, namely mediation of learning, social interaction and the ZPD. I then moved on to discuss the analytical framework. I gave a brief overview of what an analytical framework is and its importance in the research. I then discussed Ogunniyi's (2007a) CAT supplemented with the DAIM. I discussed its five cognitive categories, namely dominant, suppressed, assimilated, emergent and equipollent and also gave examples of each cognitive state. In the next chapter, I discuss the research methodology employed in this study.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

The previous chapter looked at the theoretical frameworks that informed this study. This chapter outlines the research methodology that was followed in conducting this study. This chapter briefly discusses and justifies the research paradigm underpinning the study, followed by the research design employed in this study, sampling procedures, the data-gathering techniques and procedures that were used for data collection and analysis. Finally, the validity and ethical considerations undertaken when conducting this study are discussed. The chapter ends with a chapter summary.

4.2 Research Paradigm

Creswell (2016) postulates that a research paradigm is a lens through which a researcher distinguishes worldviews. Concurring, Bertram and Christiansen (2020) posit that a research paradigm refers to ways of viewing the world and guiding research. These scholars further accentuate that a research paradigm represents a particular worldview that defines what is acceptable to research and how the research should be done. In the context of this study, a combination of the interpretive and Indigenous research paradigms was used to study how learners make sense of the topic of electrostatics during the lesson using stories on traditional beliefs and practices about lightning. A combination of the interpretive and Indigenous research paradigm was used. Within the Indigenous paradigm, I focused on the Ubuntu perspective**.**

4.2.1 Interpretivist paradigm

According to Bertram and Christiansen (2020), the interpretivist paradigm is based on the notion that reality is multi-layered and complex and a single phenomenon can have multiple interpretations. Sharing similar views, Thomas (2013) elaborates that the key to interpretivism is to make sense of the understandings that people we are talking to have about the world and how we can in turn interpret and understand them. Bertram and Christiansen (2020) also postulate that an interpretive paradigm seeks to describe and understand how people make sense of their world, and how they make meaning of their actions in their contexts. Based on

this perspective, this paradigm seemed to be well-suited for this study that focused on human experiences. Similarly, Babones (2016) also accentuates that interpretivism attempts to understand the world from the perspective of its participants. Hence, interpretivists seek to describe and understand human agency, behaviour, attitudes, beliefs and perceptions (Bertram & Christiansen, 2020).

In this regard, the interpretive phenomenological approach asserts that we do not live in a singular social reality but rather in multiple socially constructed views of social reality (Babones, 2016). Concurring, Bertram and Christiansen (2020) posit that the premise of interpretive research is that access to reality (whether given or socially constructed) is only through social construction such as language, consciousness and shared meanings. These scholars further aver that the interpretive paradigm is underpinned by observation and interpretation. Based on these perspectives, I deemed an interpretive paradigm to be most appropriate for this study, whose focus was on human experiences, behaviours and attitudes (Bertram & Christiansen, 2020). It is against this background that in this study an interpretivist paradigm was employed.

However, the interpretivist paradigm has been critiqued in the sense that the researcher might make an interpretation of their own experiences rather than of the people directly involved (Creswell, 2007). Perhaps it is this viewpoint of the researcher's biases that makes it descriptive at the expense of explanatory. Also, the interpretive paradigm is criticised for only focusing on providing descriptions of contexts without seeking to change or improve them (Creswell & Creswell, 2018).

It is for these reasons in this study I complemented the interpretive paradigm with the Indigenous research paradigm (Chilisa, 2012). For, instance, participants may not be equally credible, unbiased or knowledgeable about the phenomenon of interest. Inadequate trust between participants and the researcher may hinder full and honest self-representation by participants and such trust-building takes time (Cohen et al., 2018). As an attempt to address this limitation, I complemented the interpretive paradigm with the Ubuntu paradigm, whereby learners and I had an opportunity to interact with IKCs, to interpret and understand the science embedded in the traditional beliefs and practices about lightning.

4.2.2 Indigenous research paradigm

Chilisa (2012) argues that the Indigenous research paradigm is based on a holistic approach which strives towards a balance between different areas of life and does not separate intellectual, social, political and spiritual forms of human life from each other. An Indigenous research paradigm entails a process that involves a critique and resistance to Euro-Western methodological imperialism and hegemony. It also calls for the adaptation of conventional methodologies by including perspectives and methods that draw from IK, languages, metaphors, worldviews, experiences and philosophies of formerly colonised, historically oppressed and marginalised social groups.

In that regard, it is a process that is informed by modern critical theory, postcolonial theory, critical race theory and notions of decolonisation, resistance, struggle and emancipation (Chilisa, 2012). It challenges researchers to invoke IK to inform ways in which concepts and new theoretical frameworks for research studies are defined, where new tools for collecting data are developed and the literature base broadened so that people depend not only on written texts but also on the largely unwritten texts of the formerly colonised and historically oppressed peoples.

Within the Indigenous research paradigm, I focused on the Ubuntu perspective. Chilisa (2012) refers to Ubuntu as the glue that holds African communities together. Also, the need to combine the interpretive and Ubuntu paradigms was partly influenced by Khupe and Keane (2017) who stress that African researchers need to develop methods that align with participants' lived experiences and cultural values that recognise the place of local culture in shaping the identities of communities. This philosophy has become crucial in reviewing African education systems. For example, Mkabela (2015) portrayed that the Ubuntu paradigm suits African research activities as it focuses on African IK and their behaviours. Similarly, Goduka (2005) argues that African research must be done in a respectful way that is rooted in the indigenous way of knowing.

Ubuntu is a "philosophy that is a collective effort characterised by the spirit of togetherness which sees human needs, interests, and dignity as of fundamental importance and concern" (Higgs, 2008, p. 453). In this regard, Le Grange (2007) posits that the use of Ubuntu is not about wanting to live in the past but rather is a way of harnessing togetherness and living in harmony. This means that Ubuntu is concerned with the welfare of the whole community as

opposed to individual needs and interests. Ubuntu comes from the Xhosa phrase "*Umntu ngumntu ngabantu"*, which means "I am because you are". The word means that a person is a person through other people. Ubuntu is that nebulous concept of common humanity and oneness: humanity, you and me both. Simply put, it is the spirit of togetherness (Seehawer, 2018b). Sharing the same sentiments, Khupe (2014) argues that Ubuntu is a concept that occurs in many Southern African cultures. It is known as 'both' in Sotho, 'unhu' in Shona and 'Ubuntu' in isiXhosa. It means being human.

Ubuntu philosophy promotes the common good of society and is also a way of understanding reality. Khupe (2014) further contends that the principles of Ubuntu are part of the social fabric of rural communities. These principles include communalism, respect, inter-reliance, supportiveness, cooperation, caring for each other, kindness and participation in the common good. Moreover, Ubuntu is reinforced by concern for the welfare of others. Seehawer (2018b) posits that in an Ubuntu paradigm, the knowledge is generated and validated through discussions with the concerned community. In other words, the views and opinions of members of the community are equally valued and considered important to the validation of different knowledge emerging from the communal discussion. Seehawer (2018b) accentuates that there should be mutual respect between the researchers and participants. That suggests that researchers should respect the indigenous people and the communities where they are carrying out their research.

The Ubuntu paradigm aligns well with the sociocultural theory of Vygotsky (1978), which claims that people's actions are greatly influenced by the social, cultural and historical contexts of the activities that they share with the other people in their lives. Through social interaction, learners make meaning out of the activities they are exposed to. It is for these reasons that I married the Ubuntu paradigm with the interpretive paradigm as it recognised the integral importance of the participants' interactions. Also, I chose to employ the Ubuntu perspective in this study so that I could establish strong, respectful relationships with participants and interact with them more lucidly because I wanted to research "with" them not "on" them. Furthermore, I used the Ubuntu perspective because it focuses on indigenous African cultures and seeks explanations and solutions to extenuated problems faced by Africans (Mkabela, 2015). This reverberates well with the purpose of this study. Within these paradigms, a case study research design was applied as explained below.

4.3 Research Design

A research design is often described as a plan of how the researcher will systematically collect and analyse the data that is needed to answer the research questions (Bertram & Christiansen, 2020). These scholars further accentuate that the research design seeks to answer questions such as: what evidence or data must the researcher collect to answer the research question, how will the researcher collect the data and what will the researcher do with the data once they have been collected? Hence, a qualitative case study design was deemed most appropriate for this study.

4.3.1 Case study research design

According to Heale and Twycross (2017), a case study is an intensive, systematic investigation of a single individual, group, community or some other unit in which the researcher examines in-depth data relating to several variables. Lending support, Bertram and Christiansen (2020) assert that a case study allows deeper exploration and provides a full and thorough understanding of particular lived experiences of participants. These scholars further aver that case studies involve observing what it is like to be in a particular situation, so they are generally descriptive in nature (Bertram & Christiansen, 2020).

In essence, a case study gives the researcher analytical power to increase knowledge about social phenomena. According to Creswell (2007), a case study is a comprehensive method of data collection in social research. Yin (2009) suggests that case studies have a particular ability to answer the '*why*' and '*how*' research questions, rather than simply the '*what*' questions. Therefore, they have the potential to evaluate or explain why a particular phenomenon did or did not work. It allows a researcher to examine issues in depth, rather than looking at multiple instances superficially.

Hence, my case in this study was learners from a Natural Sciences class from a township school in the Sarah Baartman District. I also employed the service of Zizi as my critical friend who had experience in teaching Natural Sciences. His role was very important in this study. He took some field notes, and at the end of the lesson, we discussed and analysed the lesson together. In addition, his field notes and reflections were important for the triangulation of data in this study.

Furthermore, a case study was deemed appropriate in this study because I intended to obtain in-depth information on how to integrate IK into electrostatics. Hence, this study explored selected community members' cultural beliefs and practices about lightning with a view to co-developing model lessons that integrated such IK. My unit of analysis, therefore, was the social interactions, participation, and learning experiences during the presentations on stories and traditional beliefs about lightning by the community members. The reason for this research approach was to research how Natural Sciences teachers could integrate IK for the effective teaching of electrostatics from knowledge received from the IKCs. Moreover, the case study was best suited for this study because it resonates well with my two complementary theories that were employed to analyse the data in this study, that is Vygotsky's (1978) sociocultural theory and Ogunniyi's (2007a) CAT.

4.3.2 Research goal, objectives, and research questions

In this section, I discuss the research goal, objectives and research questions of this study.

4.3.2.1 Research goal

The main goal of my study was to mediate learning of electrostatics through *stories* on cultural beliefs and practices about lightning with Grade 7 township school learners. To achieve this goal, the following objectives and research questions were addressed.

The research objectives were to establish:

1. The kind of *stories* about cultural beliefs and practices on lightning do Grade 7 learners know from their homes and the community.
2. How the *story* presentations by the Indigenous Knowledge Custodians on cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics.
3. How the exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics.

4.3.2.2 Research questions

1. What kinds of *stories* about cultural beliefs and practices about lightning do Grade 7 learners know from their homes and the community?
2. How do the *story* presentations by the Indigenous Knowledge Custodians on the cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics?
3. How do exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics?

Within the context of this study, participatory observation was employed using Ogunniyi's (2007a) Dialogical Argumentation Instruction Model (DAIM).

4.3.3 Methodological framework: DAIM

The DAIM is used as a means for negotiating science and IK and its main aim is to reach a consensus (Diwu & Ogunniyi, 2012). In essence, the consensus must be reached in class that both Western science and IK should stay together and not compete but complement each other. It was hoped that after the consensus had been reached the learners might acknowledge that science is embedded in cultural practices. Akin to CAT, Ogunniyi (2007a) maintains that DAIM takes the position that these two worldviews should be equal before real integration takes place. That is, the playing field must be levelled so that the integration can take place.

Furthermore, Ogunniyi (2007a) believes that when the playing fields are levelled for integration to take place, then this might make learners participate and benefit from these two perspectives. That is, he believes that using DAIM as a teaching tool for scientific argumentation and for integrating IK into science classrooms enhances the teaching and learning of science concepts. That is, DAIM helps teachers to move from a situation where learners understand little or nothing about science concepts to one where they can talk and think about concepts themselves. Similarly, DAIM combines scientific and traditional worldviews about natural phenomena.

The DAIM was central to this study as it was hoped that the intervention would help learners use their IK about lightning to understand the scientific explanations of the concept. DAIM as a teaching and learning method, therefore, helps to facilitate the border crossing. In the context of this study, DAIM allowed my learners to participate and engage in arguments and they were able to ask questions, something that is unusual for learners in township schools in general.

Moreover, in the context of this study, it was hoped that exposure to DAIM might benefit my learners and contribute to a shift in their attitudes regarding the integration of IK into science lessons and to them being considerate of other's points of view. Furthermore, Diwu (2010) posits that learners who are exposed to DAIM develop skills beyond recall and conceptual understanding. In support, February (2016) accentuates that DAIM is a useful and effective tool to teach an integrated IK science curriculum for the benefit of the learners.

However, I am aware of the limitations of DAIM, for example, dialogical argumentation was new to all the learners and the process of argumentation needed to be explained in detail. Most learners thought of argumentation as a means of conflict and were conditioned to believe that argumentation among individuals normally ends up in a verbal or physical confrontation. Likewise, some learners do not learn to argue constructively without help from the teacher (Simonneaux, 2000) and in the context of my study, learners had trouble engaging as they were not used to argumentation. The use of English as the language of instruction was also challenging for them as they were unable to express their views logically. To curb this challenge, I allowed them to use their mother tongue.

Despite these limitations, scholars such as Langenhoven and Stone (2013) argue that DAIM creates an atmosphere where ideas may be raised and countered by the evidence and arguments of others. These scholars further argue that for the learners to reach the highest levels of critical thinking they must apply dialogical arguments in reaching decisions. To achieve this, I formulated the following stages:

1. Group activity.
2. Presentations by IKCs.
3. Consolidation lessons.
4. Journal reflections.
5. Focus group interviews (sharing circles).
6. Conversations with two IKCs.

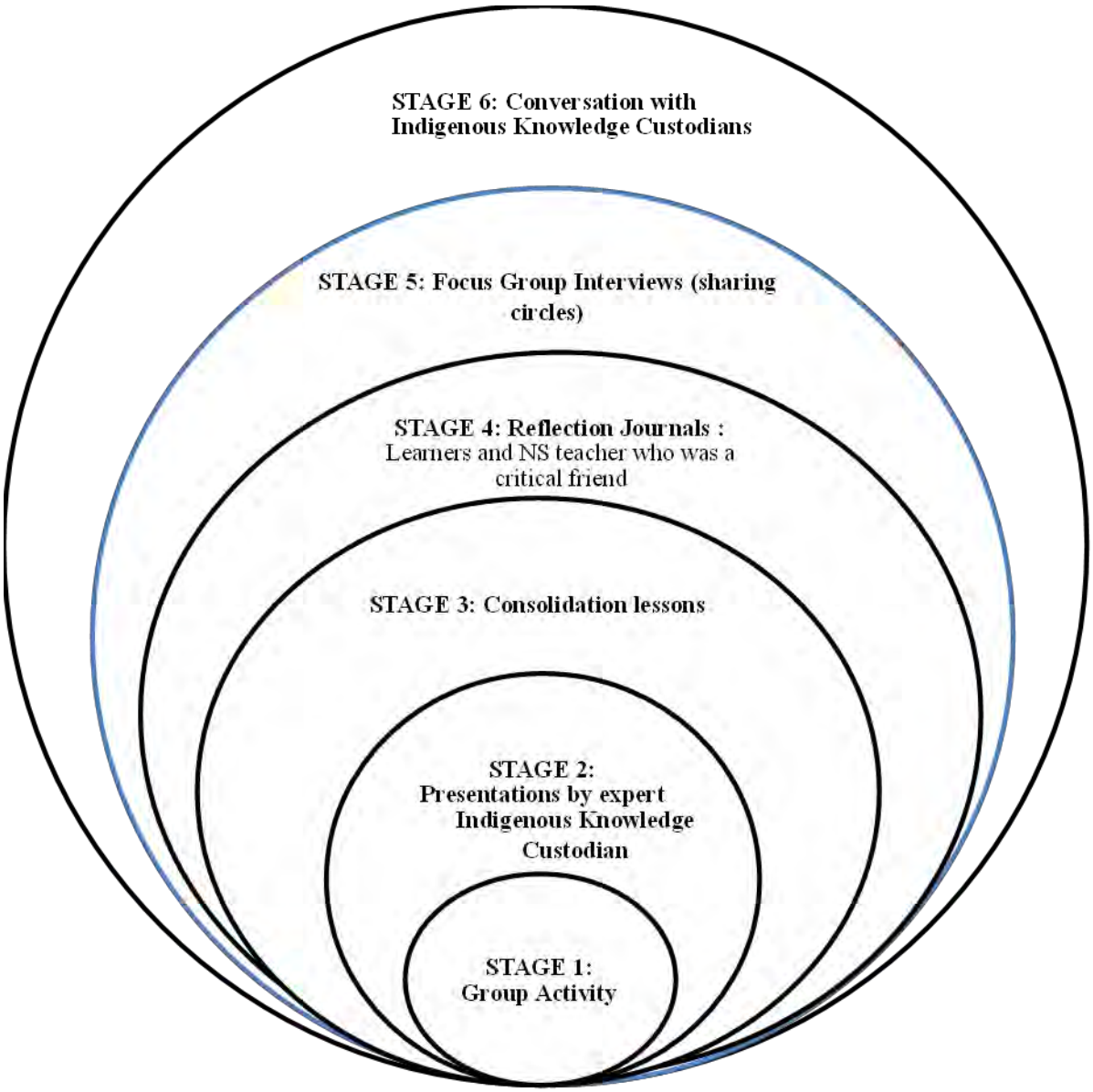


Figure 4.1: Dialogical Argumentation Instruction Model (adapted from Langenhoven & Stone, 2013, p. 5)

In contrast to Langenhoven and Stone's (2013) model, for Stage 1 (group activity), learners had to work in groups to find (research) *stories* on cultural beliefs and practices about lightning from their homes and communities. They were divided into groups of six and were required to present these *stories* to the class. Stage 2 (presentations by IKCs and participant observation): Here I invited two IKCs to present some *stories* on cultural beliefs and practices about lightning. Stage 3 (consolidation lessons): I consolidated the lessons and focused on the science concepts related to lightning that emerged from the presentations by the IKCs. Stage 4

(reflection journals): These reflective journals were from learners and the Natural Sciences teacher who was my critical friend. These journals were intended to establish how the Grade 7 learners' conceptions, dispositions and interest towards science shifted/evolved (or not) because of the presentations by the IKCs on *stories* on the cultural beliefs and practices about lightning. Stage 5 (focus group interviews): These interviews were used to establish the learners' conceptions, dispositions and interest towards science after the intervention. Stage 6 (conversation with the IKCs): Consistent with the Ubuntu paradigm (Seehawer, 2018), I went back to the IKCs to find out how they felt about presenting to my learners. They reflected that they were pleased to go to school and present to learners even though they were not educated to do so. Furthermore, they commented that they were impressed with how my learners participated and argued during their presentations.

In this regard, Ogunniyi (2015) accentuates that DAIM promotes argumentation starting from the individual (intra-argumentation), followed by small groups (inter-argumentation) and finally the whole group (trans-argumentation), where at the end collaborative consensus is reached. Likewise, I used DAIM in this study to focus on the social interactions among the learners (Vygotsky, 1978) with the aim for them to reach a consensus through argumentation.

4.3.4 Research site and participants

The school where this study was conducted was built in 1973. It is in the township of Makhanda, in the Sarah Baartman District of the Eastern Cape, South Africa (see Figure 4.1 below). The school has old infrastructure and does not have a library or a science laboratory. However, the school is well maintained, and the grounds are well looked after, providing a good environment for teaching and learning. It is a township primary school from grades R to 7, with a learner population of 584 of which 308 are girls and 276 are boys. These learners mostly come from poor families. Their parents do not earn much and some of them are not working at all.

Some of these learners are being raised by single parents and some of them are being raised by their grandparents and are dependent on the social grant provided by the government. As a result, the school is classified as a quintile 3 school (no fee-paying school). The school has a staff complement of 15 and thus the teacher-to-learner ratio is 1:39. The school is functional and is marked by high teacher commitment, presence, and learner discipline. The school is highly reputable in the community for excellent academic results and extramural curricular

activities such as rugby, soccer, and marimba music. The school has been known for producing respectable members of the community ever since it was established. Below is the map of the District where the school is situated.

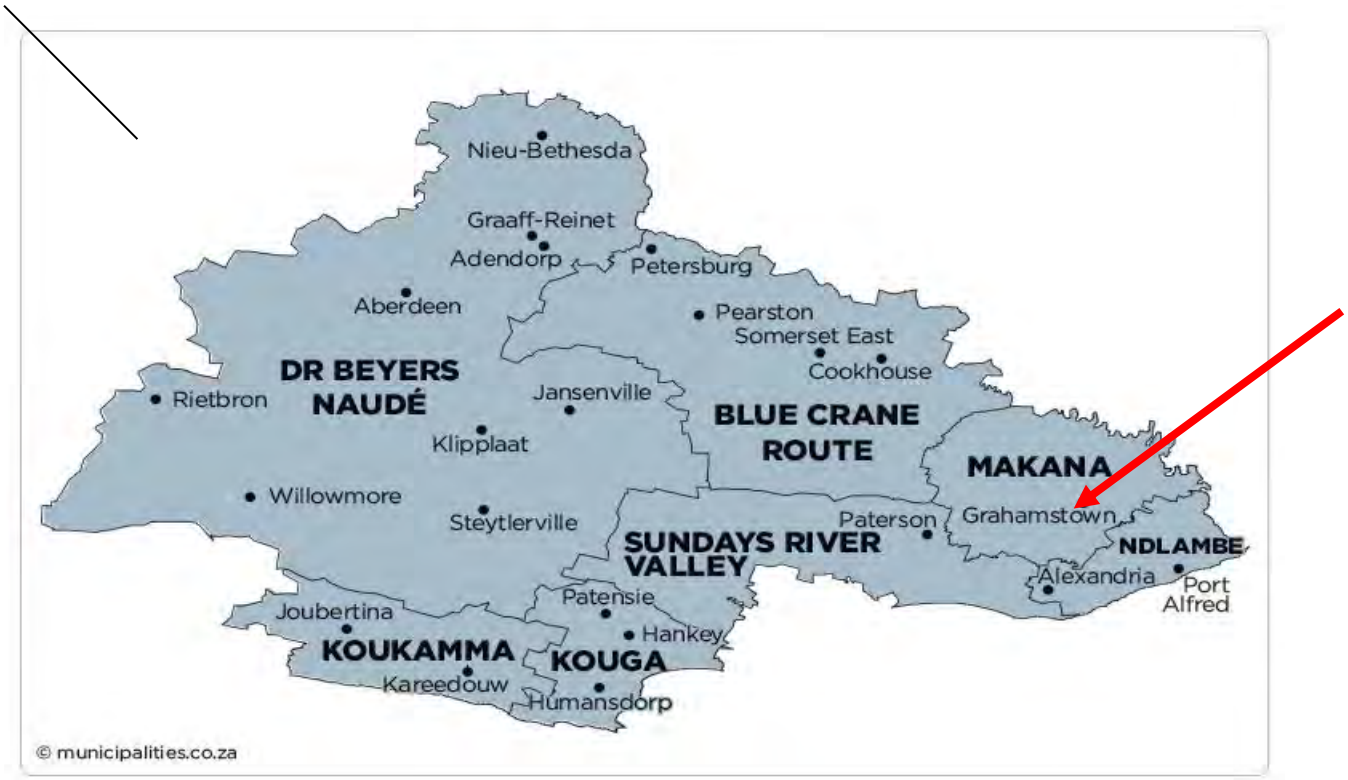


Figure 4.2: Shows map of the Eastern Cape with Sarah Baartman District where the study was conducted (South Africa District Municipality wax.sa.co.za)

Convenient and purposive sampling was used in this study (Bertram & Christiansen, 2020). Purposive sampling was employed in this study because it allows researchers to select participants who have specific characteristics or expertise relevant to the study. In addition to selecting participants who meet specific criteria, purposive sampling enhances the relevance of the data. This method helps to ensure that the sample includes individuals who can provide the most meaningful and detailed information regarding the research focus. This ensured that the data collected was directly related to the research questions. The school is convenient because it is where I am a school principal and a Natural Sciences teacher. It was hoped that this would make interacting with my research participants easier as I already work with them daily. In addition, a Grade 7 class was purposively selected because I teach them Natural Sciences. Also, the topic of electrostatics is part of the syllabus in this grade.

Likewise, two IKCs were purposively selected as they were deemed suitable willing to share their cultural heritage also they were more knowledgeable about cultural beliefs and practices as they grew up in rural areas.

4.3.5 Data-gathering methods

Data gathering is a systematic process of gathering and measuring accurate data from a variety of relevant sources that enables one to answer stated research questions and evaluate outcomes (Jovancic, 2021). Mills (2018) avers that using different data-gathering techniques allows the gathering of rich data and helps with the triangulation of data. Lending support, Bhandari (2023) postulates that triangulation of data strengthens the research and increases the credibility trustworthiness, validity and reliability of the study.

Hence, the following data-gathering methods were employed to generate qualitative data to answer my three research questions. The data-gathering methods used were focus group interviews (sharing circles), group activity, observation (participatory and lesson observation), and learners' reflective journals. I now discuss these below.

4.3.5.1 Focus group (sharing circles)

According to Barrett and Twycross (2018), a focus group is a method of data collection in which a researcher speaks with a group of participants about issues related to the research question. These scholars also posit that a focus group offers qualitative researchers an efficient method of gathering the views of many participants at one time. In addition, the fact that many people are discussing the same issue together can result in an enhanced level of debate (Barrett & Twycross, 2018). Hence, this method of data gathering was deemed appropriate for this study because it resonates well with Ogunniyi's (2007a) CAT which was employed as an analytical framework in this study.

I was, however, mindful of some limitations when focus group interviews are used. For instance, a few vocal participants may dominate other members during the interviews and some participants may conform to the responses of others even if they do not agree. I addressed these by making sure that all learners involved in the focus group interviews took turns in giving answers. In this study, the Grade 7 Natural Sciences class consisted of 36 learners, and they were divided into six groups of six members and the gender balance was considered. From

each group, one learner was chosen by the group members to represent them in the focus group interview that consisted of six participants.

4.3.5.2 Group activity

Similarly to Mayana's (2020) and Nuntsu's (2020) studies conducted in South Africa, I assumed that this method would provide me with rich data and allow learners to interact freely and engage in arguments to express themselves (Ogunniyi, 2007a). Sedlacek and Sedova (2017) maintain that a group activity has the potential to maximise active participation and social interactions among the participants. I also used a group activity in this study to create a non-threatening classroom climate for the learners so that they could relax and feel free to express themselves. Giving learners a group activity during this stage helped me to determine learners' individual prior knowledge and the data generated helped to answer the research questions.

Sedlacek and Sedova (2017) maintain that a group activity has the potential to maximise active participation. Hence, in this study, learners were divided into six groups of six learners and gender balance was considered to find information at home or community on cultural beliefs and practices associated with lightning. The groups were given an opportunity to discuss the following questions:

- What cultural beliefs related to lightning do you know from home?
- What cultural practices related to lightning do you know from home or community?
- What relevance do these cultural beliefs and practices have in science?

Learners' responses were written on posters which learners subsequently used to make some presentations to the entire class. Such presentations were intended to promote group discussions and argumentation among the learners (Nuntsu, 2020; Ogunniyi, 2007a) to answer my research question one. I planned 60 minutes for this task, but it went beyond by 40 minutes, the reason being that learners seemed to enjoy the activity. They asked me to let them finish the task. Every one of them was eager to present and share their knowledge about lightning. Learners in this study were therefore viewed as co-researchers as they were allowed to find information concerning lightning and related cultural beliefs and practices from their community, something that resonates well with Vygotsky's (1978) sociocultural theory, my

chosen theoretical framework for this study. Throughout the group activity, I noted that learners' interaction and participation were very high.

Data from the group activity informed the co-planning of a model lesson that integrated IK. Subsequently, my critical friend and I sat down and co-planned and developed a lesson plan, which I then taught to the class while the critical friend observed. Co-planning and subsequent discussions helped us to get a better understanding of IK related to electrostatics.

4.3.5.3 Observation (participatory and lesson observation)

Observation can be classified either as non-participant or participant observations, depending on the role played by the observer. Ivankova (2015) defines observation as the process of observing and recording behaviours and interactions of people in natural settings to explore individuals' experiences in a study. Thus, Maxwell (2013) points out that to have a better understanding of your study, you should be a participant in your study. This provides a powerful way of learning people's behaviours and provides an advantage to the researcher to collect data directly from real-life experiences (Cohen et al., 2018).

According to Cohen et al. (2018), observation is the technique researchers use to generate data in a social situation and this technique resonates both with Vygotsky's (1978) sociocultural theory and Ogunniyi's (2007) CAT. In this study, I was a participant observer to gain some insight into how learners learn in their social environment. The purpose of observation is to gain first-hand experience and data on a phenomenon (Bertram & Christiansen, 2020). This is a powerful personal data-gathering strategy and is not reliant on others' perceptions. It might give insights into aspects that could be difficult to access in other ways.

Cohen et al. (2018) assert that quality observations are more than just looking – they state that the researcher should closely monitor the facts and practices of the target groups without attempting to change them. Thus, I observed how the learners were interacting, participating and learning (or not) during the presentations made by the IKCs and observed what exactly was taking place. In addition, it allowed me to dig deeper to find out things which may be hidden through enquiry (Creswell, 2016). Furthermore, the presentations on *stories* on cultural beliefs and practices about lightning made by the two IKCs also helped me to gain insight into learners' participation and understanding of the value of IK when teaching science.

The participatory observation took place when participants were observing the two IKCs' presentations on IK, beliefs, and practices on lightning. Each community member was allowed to present a lesson. This allowed me to gain more insight into specific points of view. Hence, I positioned myself as a co-learner during this research process. Also, lesson observations happened when I taught the topic of electrostatics to my learners, and my critical friend observed and videotaped the lesson.

Participatory observation is one of the data-gathering techniques that are associated with an interpretive paradigm; thus, I used this tool to answer my research questions. I needed to be a participant observer to see, hear, feel and observe what actually took place (Bertram & Christiansen, 2020). This also helped me to find out about social interactions as explained by Vygotsky (1978). I also observed the behaviours and attitudes during the IKCs' presentations. Being a co-learner and participatory observer in this study, I had an opportunity to observe how participants interacted and posed questions during the IKCs' presentations. However, being a participant observer was a bit challenging for me. I needed to divide my time well so that I could both concentrate on observing and gathering rich data from the discussions.

4.3.5.4 Learners' reflective journals

Reflective journals are notes that learners prepare to reflect on what they understand. That is, reflective journals are written documents that learners create as they think about various concepts, events or interactions over a period to gain insights into self-awareness and learn (Khan, 2019). Concurring, Alt et al. (2022) argue that reflective journal writing is an effective pedagogical tool for nurturing learners' lifelong learning skills. A reflective journal is an active learning method designed to promote higher order thinking skills. Wallin and Adawi (2018) aver that a reflective journal aims to express the self-observation of the learning process and evidence of reflection. Encouraging learners to engage in reflective journal writing has been acknowledged as an essential goal in education.

Hence, in this study, participants were encouraged to record learning-related incidents during the learning process and mostly after they occurred. Similarly to Mayana's (2020) study conducted in South Africa, I provided the learners with four guiding questions they had to reflect on: how they found the lessons; what areas of the lessons they did not understand; which sections they understood, and which sections they felt they needed help from the teacher and the IKCs? I am, however, aware that giving learners guiding prompts may have limited their

reflections, as it might only show what the researcher wanted to see. These journal reflections provided learners with opportunities to express their attitudes and critically reflect on the activities they were engaged in. I hoped that the journals might give me more insights and highlight how the IK presentations had changed learners' conceptions, dispositions, and sense making towards the integration of IK into the learning of science concepts.

Table 4.1: Shows the tools, methods and purpose for gathering information

Stage	**Method to be used to gather data**	**Purpose**	**Research question**
Stage 1	Focus group interview (sharing circles)	To establish what kind of *stories* on cultural beliefs and practices about lightning do Grade 7 learners know from their homes and the community.	1
Stage 2	Presentation by two IKCs and participants' observation	The IKCs present stories on cultural beliefs and practices about lightning.	2
Stage 3	Participatory and lesson observation	How learners interact and learn during the presentations by the two IKCs.	2
Stage 4	Lesson consolidation, lesson integrating IK	Lesson consolidation focusing on science concepts emerged from the presentations by two IKCs.	3
Stage 5	Journal reflections	To find out the Grade 7 learners' conceptions, dispositions and interest towards science or not as the result of the presentations by the two IKCs.	2 & 3
Stage 6	1. Conversation with expert community members 2. Focus group interviews	To ascertain how they felt about presenting to my learners. To ascertain the learners' conceptions, dispositions and interest towards science after the intervention.	3 & 2

4.3.6 Data Analysis

McMillan and Schumacher (2014) define data analysis as the process a researcher uses to reduce data to a story and its interpretation. Lending support, Cohen et al. (2018) aver that data analysis involves organising, accounting for and explaining the data. Concurring, Bertram and Christiansen (2020) posit that data analysis is the process of reducing large amounts of collected data to make sense of it. These scholars further posit that data analysis is the range of

processes and procedures whereby a researcher moves from data that have been collected into an explanation and interpretation of the people and situation the researcher is researching.

Hence, this study employed the qualitative data analysis method to analyse the data collected. A thematic approach to data analysis was employed. That is, data was analysed inductively through colour coding data and identifying categories and sub-themes. Merriam (2009) suggests that coding is a way of assigning some sort of short-hand notes so that data can be easily retrieved. The coding technique was applied to all data generated via the group activity, observations (participatory and lesson observation) and learners' reflective journals. The common sub-themes were combined to form themes that were subsequently linked to literature or theory that informed this study. Episodes reflecting social interactions and participation took place during the presentations from the IKCs and were videotaped.

The data was analysed focusing on four concepts embedded in Vygotsky's (1978) sociocultural theory. These concepts are social interactions, language and culture, mediation of learning and the ZPD. In addition, Ogunniyi's (2007a) CAT five cognitive states were used to analyse data emerging from the group discussions between the learners, IKCs and myself. Participants were given feedback after data analysis. Kumar (2023) accentuates that learners who receive feedback may make improvements accordingly. That is, constructive feedback plays a vital role and motivates learners to perform better.

4.3.7 Validity and Trustworthiness

According to Cohen et al. (2018), validity is an important key to effective research as it measures how accurate and credible the findings of the research study are. Likewise, Humphreys et al. (2021) argue that validity is the of being logically or factually sound. However, in qualitative research. Validity may be addressed by being honest and transparent, through the depth, richness, and scope of data gathered, the participants approached and the extent of triangulation (Cohen et al., 2018). Triangulation of data and member checking are some of the ways to ensure that the data is valid and trustworthy as reiterated by Salano (2020).

In this study, enhancing the trustworthiness was achieved through the triangulation of qualitative methods. There were longstanding and vibrant discussions within the study regarding the value of triangulation. To ensure trustworthiness in this study, I used a variety of data-gathering techniques for triangulation purposes, extending from Bertram and Christiansen (2020) who postulate that the value of research is strengthened by its trustworthiness. In

addition, I chose the method of inquiry of gathering stories through sharing circles (Chilisa, 2012; Lavallée, 2009). Sharing circles were used to capture participants' experiences related to the information provided for this study. Connelly (2016) argues that trustworthiness is a degree of confidence in data interpretation and methods used to ensure the quality of research.

Moreover, to ensure the validity of this study, I used multiple data collection techniques such as focus group interviews (sharing circle), group activities, and journal reflections. I believe answers from the group activity subsequently informed what questions to ask during the presentations by the IKCs. I also believe that by inviting the IKCs to make presentations on stories about the cultural beliefs and practices about lightning, culture would lend itself to being a validation process for the integration of IK into science teaching. My critical friend also helped me with the validation and trustworthiness of the data generated. I will also present my study findings at the SAARMSTE Eastern Cape Chapter colloquiums and SAARMSTE conferences to validate my data.

4.3.8 Ethical Considerations

In this section, I discuss different aspects of ethical considerations in this study.

4.3.8.1 Respect and Dignity

Mkabela (2015) avers that researchers should show respect for individuals, their privacy, and confidentiality. That is, researchers working with human subjects ought to be guided by ethical principles of respect for persons. As such, facilitating free and informed consent is a key ethical standard to consider when conducting social research. The human rights of the participants were respected in this study. For instance, their anonymity and privacy were protected throughout the research process. During the signing of consent letters, I assured the participants and the two IKCs that their participation was voluntary and that they had the right to withdraw at any time during the study if they wished to do so. I also reminded the two IKCs that their presentations would be done at a convenient time and venue (school). The IKCs were told that the presentations would be recorded, and they were asked to give consent. The information gathered would not be shared with any third parties without their permission.

4.3.8.2 Transparency and honesty

For transparency and honesty, participants were given consent forms, and these were signed by both participants and participants' parents/guardians, indicating that they understood and agreed to the terms and conditions of the research study. The community members were visited to adhere to the African ethics of showing respect and interest in the participants' IK. I also visited participants to cement our relationships, to discuss the planned research study and to seek consent from the participants which they agreed to without hesitation.

4.3.8.3 Accountability and responsibility

The study was conducted following the principles of ethical policy and guidelines for educational research. My responsibility as a researcher was to create a conducive environment during the research journey. Also, I am aware that I am responsible for safe safekeeping of all the data collected. All research data (questionnaire responses, interview notes, video and audio tapes) and equipment have been stored on an external hard drive and kept safely in a lockable cupboard. I was also in constant communication with my supervisor for his guidance.

4.3.8.4 Integrity and academic professionalism

To ensure integrity and academic professionalism, an accurate account of the data generated by the instruments used was ensured. Moreover, this study is my own work, using my own words and, where I have drawn from other people's work, I have referenced it according to the Department of Education's protocols. There are no fabrications, manipulations and misreporting of data. The data captured was given to the participants to verify that what had been captured was correct. Lastly, this study was conducted in such a way that it was free from or explicitly disclosed any political, racial, religious or other bias (David & Resnik, 2010).

4.4 Chapter Summary

In this chapter, I described the research design and methodological orientations used in this study. I also outlined the research goal and questions of this study. The research site, participants, sampling and my positionality and reflexivity are also discussed. I explained how the data was gathered and analysed. The issues of validity and trustworthiness were explained, and ethical issues were considered and then discussed. In the next chapter, I present, analyse

and discuss the data generated from the focus group interviews (sharing circles), group activity, observation (participatory and lesson observation), and learners' reflective journals.

CHAPTER FIVE: GROUP PRESENTATIONS AND PRESENTATIONS BY THE INDIGENOUS KNOWLEDGE CUSTODIANS

5.1 Introduction

The main goal of this study was to mediate learning of electrostatics by using stories on cultural beliefs and practices about lightning to Grade 7 township school learners. In the previous chapter, I presented the research design and methodology informing this study. In this chapter, I thus present, analyse, interpret and discuss data generated from observations during the learners' group activity and the presentations made by the IKCs. The data presented here was aimed at addressing my three research questions:

- What kind of *stories* about cultural beliefs and practices on lightning do Grade 7 learners know from their homes and the community?
- How do the presentations by the two IKCs on *stories* on cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense making of the topic of electrostatics?
- How do the exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics?

5.2 Summary of the Qualitative Data Generated During the Group Activity

This section starts by presenting the biographical information (Table 5.1) of the Grade 7 Natural Sciences learners of Eluxolweni Primary School who participated as my co-researchers in this study. This is followed by Table 4.2 which shows the codes and pseudonyms used in the discussion of data.

Table 5.1: Profiles of the Grade 7 Natural Sciences learners who participated in the study

Biographic information	Categories	Learners' codes	Total number
AGE	12	L1F, L2F, L3F, L4F, L5F, L6F, L7F, L8F, L9F L10F, L11M, L12M, L13M, L14M, L15M	15
	13	L16F, L17F, L18, L19F, L20F, L21F, L22M, L23M, L24M, L25M, L26M, L27M	12
	14	L28F, L29F, L30F, L31F, L32M, L33M, L34M, 35M, L36M	9
GENDER	Male	L11M, L12M, L13M, L14M, L15M, L22M, L23M, L24M, L25M, L26M, L27M, L32M, L33M, L34M, L35M, L36M	16
	Female	L1F, L2F, L3F, L4F, L5F, L6F, L7F, L8F, L9F, L10F, L16F, L17F, L18F, L19F, L20F, L21,F L28F, L29F, L30F, L31F	20
MOTHER TONGUE	isiXhosa	L1- L38/M/F	36

Table 5.2: Keys and pseudonyms used in data discussion

Learners 1-36 Male/ Female	L1-L36
Group 1–6	Smart Kids (SKs), 6 Geniuses (6 Gs), Lightning Girls (LGs), Education Blazers (EBs), Education Kids (EKs), Archie Empires (AEs)
Reflection Learner 1–36	RL1- RL36

In this group activity, learners were divided into six mixed groups composed of six (boys and girls) to gather information from the community on cultural beliefs and practices about lightning. To ensure that the data generated from the group activity was relevant to the study, learners were given three guiding questions to focus on and direct their discussions in their groups. The following questions were given to learners to guide them:

1. What cultural beliefs related to lightning do you know from home?
2. What cultural practices related to lightning do you know from home or the community?
3. What relevance do these cultural beliefs and practices have in science?

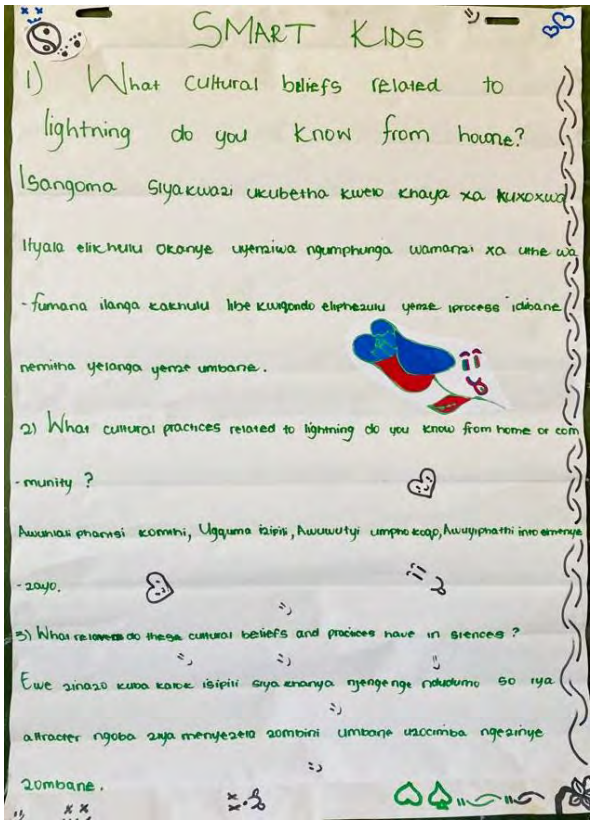
The learners were given time in class to discuss in their groups and then write down their findings on newsprints. The learner decided to name their groups. In their group discussions, I noticed that each member of the group felt a sense of belonging and they felt valued as a member of their group. This resonates well with the Ubuntu paradigm used in this study (Seehawer, 2018). Some learners affirmed that they appreciated being in the group when I asked them. LF5 elucidated that "*Ndiyavuya kwaye ndiziva ndamkelekile kuba ndiyinxalenye yale group*" (I feel delighted and valued to be part of the group). This authenticated that I was doing research with them rather than on them as accentuated by Ngcoza and Southwood (2015) after group discussions, each group was allowed to discuss their findings with the entire class as shown below.

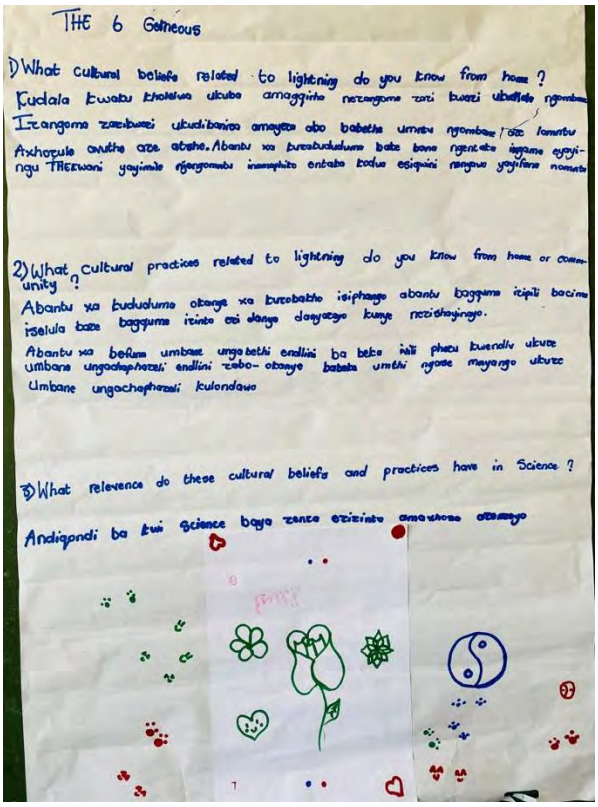
Figure 5.1: Shows groups brainstorming

Figure 5.2: Shows groups presenting to the entire class

After each group presentation, the class was given about five minutes for questions and answers. The learners exceeded the five minutes given to them because the discussions were exciting, and learners actively participated throughout the presentations. I thus ended up exceeding the one-hour period I planned for the lesson by 30 minutes. It could be interpreted that this was an indication that learners had an interest in what they were doing.

All six groups gave presentations, and data from all presentations were used in this analysis process. The groups were given codes as shown in Table 4.2 above. For example, SKs refer to Smart Kids, 6Gs (6 Geniuses), LG (Lightning Girls), EBs (Educational Blazers), EKs (Educational Kids) and AEs (Archies Empires). These codes are used throughout this data analysis. The learners used newsprints for their presentations as shown in Fig 5.3 below. The learners' presentations followed the guiding questions given to the learners beforehand.





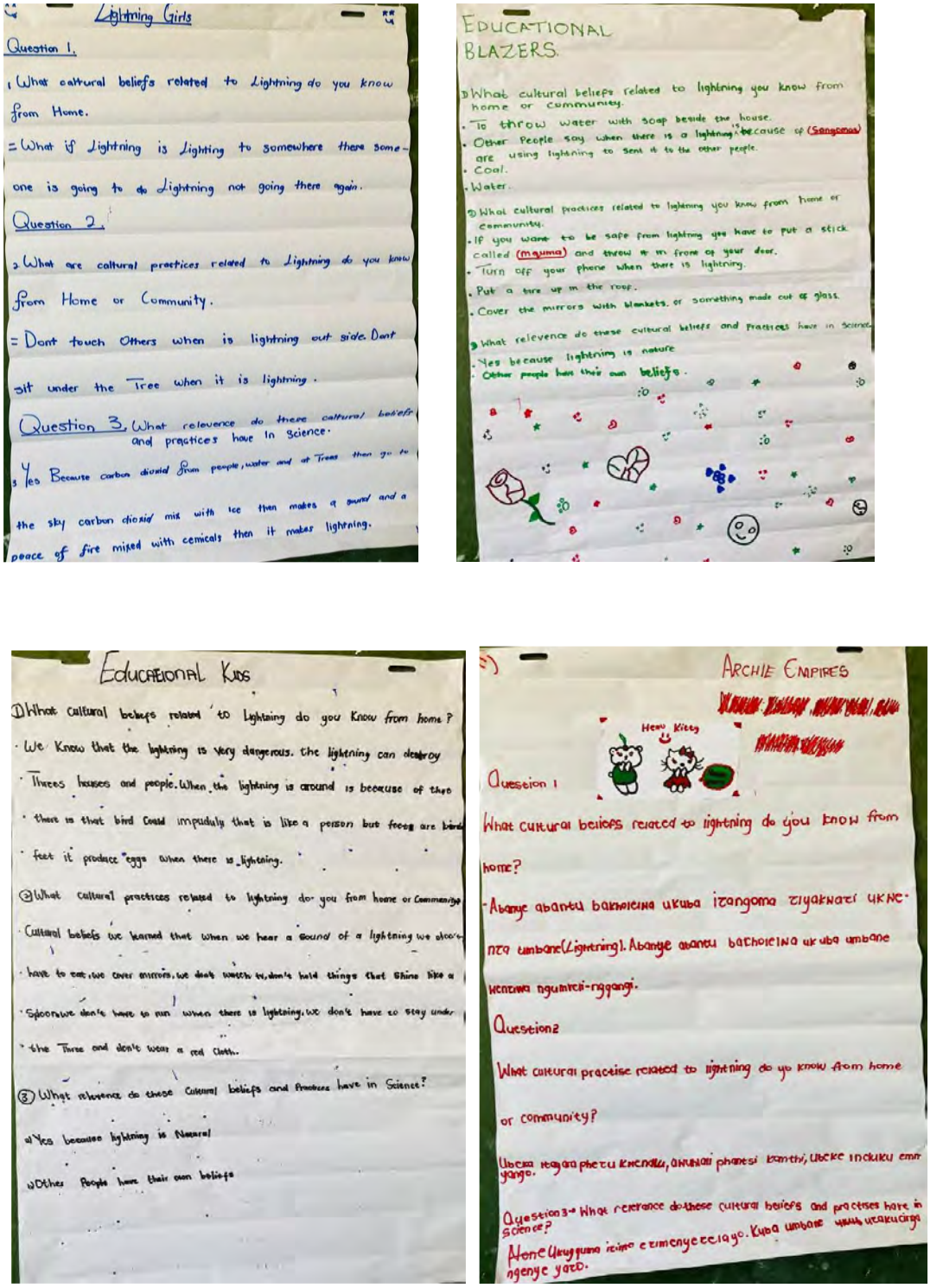


Figure 5.3: Newsprints presented by the groups

From the learners' presentations, three themes emerged, namely cultural beliefs related to lightning, cultural practices related to lightning and relevance to science (or not). These themes were then used to discuss data to answer research question one of the study. I went through the six presentations of the learners, summarised them and presented them in Table 5.3 below.

Table 5.3: Showing a summary of groups responses from the group activity

From guiding question	Group					
	Smart Kids (SKs)	6 Geniuses (6 Gs)	Lightning Girls (LGs)	Educational Blazers (EBs)	Educational Kids (EKs)	Archie Empires (AEs)
Theme 1: Cultural beliefs related to lightning	Xhosa people believe that isangoma (traditional healer) can send lightning to punish an enemy	People believe that traditional healers can mix their herbs to produce lightning	There is a bird that looks like a person, it is called impundulu. When it lays eggs, it produces lightning	People believe that when there is lightning God is angry, and the house or a person is struck as it is punishment from God	There is a bird that looks like a person but has birds feet, this bird is called impundulu, it causes lightning	Abantu bakholelwa ukuba izangoma ziyakwazi ukwenza umbane (people believe that traditional healers can create lightning)
Theme 2 Cultural practices related to lightning	Akuhlali phantsi komthi xa kubaneka (you do not sit under a tree when there is lightning) Akutyiwa (do not touch it) Akuyiphathi into emenyezelayo (do not touch shiny objects)	Cover mirrors Switch off cellphones Put tyres on the roofs	Do not touch other people when there is lightning Do not sit under a tree	To be safe put a stick called unquma in front of your door Switch off your phone Put a tyre on top of your roof Cover mirrors	Do not eat Cover mirrors Do not touch metals	Beka itayara phezu kwendlu (put a tyre on the roof) Do not sit under a tree Put a stick near the door
Them 3: Relevance to science	There is relevance because mirrors reflect lightning	There is some relevance because lightning is nature	We find no relevance because we do not think that scientists do what we are doing	There is no relevance because there is no proof that these things done by amaXhosa are working scientifically	There is relevance because lightning is nature	There is some relevance, covering mirrors prevents lightning reflection

To further make sense of this data, I used Ogunniyi's (2007a) CAT five cognitive states during the discussion and analysis. The five cognitive states are dominant, suppressed, assimilation, emerging and equipollent. In Table 4.2 the popular results of all six groups connote that there is a belief among the Xhosa people that there are people (witches, traditional healers) who can mix herbs to produce lightning and use it to punish an enemy (dominant). In this instance, SKs and 6Gs stated that "*Isangoma (traditional healer) can send lightning to punish an enemy".*

According to 6Gs, there is the belief that traditional healers can mix their herbs to produce lightning. Also, LGs mentioned that there is a bird that looks like a person, it is called an impundulu. When it lays eggs, it produces lightning and witches use this bird to kill enemies. Furthermore, EBs elucidated that no one has ever seen this bird laying eggs but there is belief that when laying eggs, it makes lightning. This cultural belief might be incongruous with scientific views and creates cognitive dissonance (Le Grange, 2007). According to Mukwambo et al. (20017), a belief such as this can present a barrier to learners from these cultures when it comes to accommodating scientific principles and facts related to electrostatics and lightning.

During presentations, learners asked questions. For example, L26 asked: "*How is it possible for the herbs mixed turn to be a bolt of lightning and be sent to a specific target?*" (suppressed). The response from 6Gs was that the witches and sangomas use spirits to direct lightning to their targets. In addition, EKs specified that when there is lightning everyone should sit down in the room to avoid being struck by lightning. They mentioned that taller objects have a higher chance of being struck by lightning than shorter objects (equipollent). Also, L28 asked: "*Ingaba yinyani ukuba ubeke intonga phambi komnyango unciphisa amathuba okungena kompane endlwini*?" (Is it true if you put a stick in front of your door you minimise chances of lightning getting in the house?). EBs said: "*Yes, as our culture told us that, also it is true because umnquma (Oleaeuropaea susbsp.) is very water absorbent and thus more apt to conduct and attract lightning strikes so umnquma will attract the bolt so towards it preventing it going into the house*" (dominant).

L3F asked: "*Ingaba itayara elibekwe phezukwndlu liyanceda na ukukhusela umbane?*" (Does the tyre on top of the roof help prevent lightning?) The AEs mentioned that there is a belief that tyres trap the lightning bolt to the ground and there is also a belief that lightning is caused by evil spirits. So, tyres are good at chasing away the evil spirit (dominant). This explanation triggered discussions among the learners. The 6Gs agreed that they were aware of the belief and they were told by their parents, that in some of their homes, there are tyres on top of the

roofs. This validates that local knowledge is passed on orally from generation to generation (Kibirige & Van Rooyen, 2006).

L11M asked: "Why the tyres are put on top of the roof if they are meant to trap the lightning bolt to the ground?" L16F quickly responded and said: "The rubber in a tyre acts as an insulator so lightning will not penetrate". L12M did not agree to the fact that the bolt will not penetrate he said: "*Ewe i*rubber *etayareni liyi* insulator *kodwa kwi*voltage *encinci, voltage esembaneni inkulu kakhulu ayinakunqandwa litayara"* (Yes, the rubber in a tyre act as an insulator at low voltages, the voltage in a lightning bolt is far too high to be stopped by tyres).

Some learners nodded their heads as a sign of assenting to this explanation. Some learners disagreed with L13M and said: "*Onke amakhaya anamatayara ekuhlaleni zange abethwa ngubane*" (All the homes in our community that have tyres on the roof have never been struck by lightning). I observed that their spiralling arguments (Ogunniyi, 2007a) and their interactions seemed to lead learners to think deeply about these beliefs and that they tried to make sense of these beliefs. This resonates well with Kibirige and Van Rooyen (2006), that cultural beliefs should be debated to minimise some misconceptions. In agreement, Horsthemke and Schaefer (2007) warn against any assumption that anything indigenous should be accepted or embraced as science. Despite the debates, other learners seemed not to be convinced by some of these beliefs. This shows the importance of employing CAT as an analytical framework and lens to analyse data.

For example, L9F asked: "*Why people must not stand in the room when there is lightning*"? L6 who seemed to be more knowledgeable (Vygotsky, 1978) mentioned that taller objects have a higher chance of being struck by a lightning bolt than shorter objects. In addition, L2 enquired about the logic of putting a stick in front of the door. Again, the EKs mentioned that *umnquma* (*Oleaeuropaea susbsp*.) is very water absorbent and thus more apt to conduct and attract lightning strikes. So, *umnquma* will attract the bolt towards it preventing it getting into the house (dominant). To me, this accentuates the importance of considering the learners' sociocultural background when teaching science as championed by Mavuru and Ramnarain (2017).

During the presentations, I observed that throughout the group activity session, learners' participation was very high, denoting positive dispositions. This reverberates well with Vygotsky (1978), who avers that learners learn best through social interactions. How learners

argued their points of view provided a learning opportunity for the learners (Ogunniyi, 2007a), and clearly showed that the learners' conceptualisation and sense-making of electrostatics was positive. In addition, during this, I noticed that even learners who are usually quiet in class and hardly show interest in learning were participating during the group activity. I deemed this as an indication that the learners found the learning environment less threatening and that they felt accepted in their groups, their contributions were welcomed, and they were contributing effectively to the lesson. Learners showed ardent interest and eagerness to learn – this shows beyond doubt that Vygotsky (1978) was correct when he foregrounded the role of social interactions and the language used during teaching and learning.

5.3 Presentation by the Indigenous Knowledge Custodians

This section commences by presenting the profiles (see Table 4.4) of the two IKCs who were invited to present a lesson to the Grade 7 Natural Sciences learners of Eluxolweni Primary School on stories on cultural beliefs and practices about lightning. The knowledge from the presentation by the two IKCs was then used to co-generate a lesson plan that incorporated IK as espoused by Orell and Philaju (2020). These scholars aver that cooperation between home and school is seen as an integral part of the function of schools, which is why the integration of IK is necessary and should be reinforced. Similarly, Shizha (2007) proposes that when IK is visible in science lessons, it allows learners to develop their ability to gain confidence and self-esteem. Also, it helps learners link school experiences to what they know from home or their communities and Aikenhead and Jegede (1999) refer to this as border crossing.

Table 5.4: Profile of the two community members

Pseudonym	Age	Gender	Education	Home language	Place of birth	Other languages	Occupation
Tshawe	38	Male	Standard 9	isiXhosa	Makhanda	English, Afrikaans	Unemployed
Jwarha	50	Male	Standard 4	Isixhosa	Makhanda	Afrikaans	EPWP

Figure 5.4: Showing the two IKCs (Tshawe on the left and Jwarha on the right)

Figure 5.4 above shows the two community members who co-presented their experiences and knowledge on stories and cultural beliefs about lightning to the Grade 7 Natural Sciences learners. They were given pseudonyms, for instance, community member 1 is Tshawe and community member 2 is Jwarha. These pseudonyms are used throughout the study.

The background of the two IKCs shows that there were both similarities and contrasts between them. isiXhosa was their home language and were both males. Tshawe was born and bred in Makhanda. He was raised by his grandparents who were traditional healers. He could not finish school and went up to Standard 9. When he was about to start Standard 10, he got very sick and he could not even see. He was taken to the traditional healers, and they were told by the traditional healer that: "*Umfana kufanele amnkele ingulo yakhe, kufanele ukuba abe sisangoma"* (The boy must accept his calling. He must train to be isangoma). He then went for training and was healed.

Jwarha was born and raised in Southwell (a farm 30km from Makhanda). His mother gave birth at home, and she was assisted by the elderly women on the farm to deliver the baby. He grew up on the farm. He started sub-A when he was 10 years old. When he was 15 years old, he was forced by the owner of the farm to quit school to go work for him. He worked as a garden boy. Jwarha had never been to town until he was 20 years old.

5.4 Summary of the Presentations by the two IKCs

In this section, I present the summary of the presentations by the two IKCs which were videotaped with their permission. I then transcribed the videos into stories. I now present, analyse and discuss the data from the various episodes from the *stories* from the group activity, the two IKCs' presentations and the learners' reflections. I picked out some episodes and then merged common sub-themes to form themes concerning the theory and literature. Themes and sub-themes are shown in Table 5.5 below.

The two IKCs came to the class with much indigenous knowledge as the custodians of indigenous practices. The learners were so curious about what these IKCs were going to present in class. To their surprise, they were dumbfounded by the cultural beliefs and practices embedded in lightning.

Table 5.5: Shows themes emerged from the data and supporting theory and literature

Themes	Sub-themes	Literature review	Theory Framework
Theme 1: Nature of Interaction	Learner talk Asking questions Excited Curious Listening attentively	McRobbie and Tobin (1997) Lemke (2001) Sedlacek and Sedova (2017)	SCT: Vygotsky (1978)
Theme 2: Nature of Participation	Explaining Educing prior knowledge Stimulated arguments and dialogue	Sedlacek and Sedova (2017) Roschelle (2017); Kuhlane (2011); Rollnick (2013) Khupe, 2014 Ogunniyi (2007a); Govender (2014)	SCT: Vygotsky (1978) CAT: Ogunniyi(2007,a,b)
Theme 3: Nature of Learning Opportunity	Promoting border crossing Promoted argument and dialogue Using language as a resource Showing understanding	Aikenhead and Jegede (1999) Ogunniyi (2007a); Langenhoven and Stone (2013) Hewson et al. (2009) Kibirige and Van Rooyen (2006) Mavuru and Ramnarain (2019)	CAT: Ogunniyi(2007a); Ogunniyi and Hewson (2008); Govender (2014)

5.4.1 Nature of interaction between the IKCs and learners

The two IKCs co-presented a lesson on stories on cultural beliefs and practices associated with lightning to the Grade 7 class of Eluxolweni Primary School. From my observation, the learners were relaxed, excited and curious as they watched the community members presenting in their class. The language of isiXhosa played a sterling role in creating a conducive learning environment in the classroom (Diwu & Ogunniyi, 2012).

Jwarha commenced the lesson by asking if any of the learners knew what causes lightning. He asked the learners: "*Zintoni ezenza umbane*?" (What causes lightning?) Khuhlane (2011) and Mavunga and Rollnick allude to this as elicitation of prior knowledge. One of the learners, L14M, explained and said: "*Umbane wenziwa kukungqubana kwamafu*" (Lightning happens when there is friction in the clouds). Jwarha nodded his head in agreement with L14M and said: *"Good, unyanisile"* (You are telling the truth) and explained further and said: *"Xa kududuma esibhakabhakeni amafu ayangqubane okwakungqubana kwenza kuphume iintlantsi, kuyafana noku rhuqa intsimbi endleleni izakukhupha Umlilo"* (During a thunderstorm, there is a friction in the atmosphere that friction produces sparks, it is the same when you drag a metal in the tarred road there will be sparks). I also contributed to this discussion and explained that except for its size and power, lightning is not different from the sparks you create by shuffling your feet on the carpet –both are electrical charges caused by the rubbing of one object against another. I did this to make sure that there were no misconceptions in terms of scientific explanations.

Tshawe raised his hands and said to the learners that we need to go back to our roots. This statement resonates well with Chikamori et al.'s (2019) view of taking into consideration the past (retroduction) to move to the future (retrodiction). When he said this, I noticed that the learners looked relaxed and were listening attentively to him. They were ready to hear what he was going to say about cultural beliefs and practices on lightning. I realised that it is important to encapsulate the learners' attention so they can focus on the lesson. L5F asked this: *"Ingaba itayara elibekwe phezu kwendlu liyayikhusela indlu embaneni?"* (Does the tyre on top of the roof protect the house from being struck by lightning?) Tshawe said: *"Mna ndiyakholelwa ukuba zonke izindlu ezinamatayara phezulu azizange zikhe zibethwe ngumbane*" (I believe so because all the houses who have tyres on their roof have never been struck by lightning). Jwarha added and said: "*Itayara lenziwe ngerubber umbane awuphumeli kwi rubber kungokuba itayara ligxotha imimoya engendawo. Lonto yinto esikhule siyixelelwa ngabazali*

bethu nabo bexelelwa ngababo abazali" (Tyres are made up of rubber and lightning does not pass through the rubber and the tyre chases away evil spirits. This is what we grew up with being told by our parents and they were also told by their parents). I must indicate that I realised this might create a misconception and to avoid that, I addressed it during my presentation on the lesson that integrated IK when teaching the topic of electrostatics.

Learners interacted with the presenters and L32M further asked: "*Zintoni ekumele uzenze okanye ungazenzi ukuze ungabethwa ngumbane?"* (What does one must or must not do so that he/she does not get struck by lightning?) Jwarha smiled and said: "*Akufuneki ubephantsi komti*, *ukuba nibaninzi endaweni qelelelanani*, *sukuphatha amanzi okanye izinto ezimanzi*, *sukuphatha ucingo okanye izinto ezimenyezelayo, hlalelakude efestileni, hlala phantsi, sukuvasa"* (Stay away from trees, if you are group spread out, do not touch water or wet items, do not touch the fence, stay at least few meters from open widows, sit down, do not take a bath). Buti Mxobo added and said: "*Izipili ziyagqunywa, akumameli radio*, *akubukeli mabonakude akutyiwa, iZulu liyahlonitshwa*" (Cover mirrors, you do not listen or watch television).

After the presentation by the IKCs, I asked the learners – *Are there any other cultural beliefs and practices from the community you can share with us?* After a brief silence, L22M contributed that *"Utata omkhulu wam uthi zimbini indidi zombane, kukho lo wenziwa nguThixo xa enomsindo, kuzekubekho lo wenziwa ngabantu fori ukuthumela bonzakalise abanye abantu"* (My Grandfather says that there are two types of lightning: The one created by God when He is angry and there is man-made lightning that is sent to and harm enemies).

Both Jwarha and Tshawe nodded their heads in agreement with L22M. Tshawe further said: "*Ewe bakhona abantu abakwaziyo ukusebenzisa amayeza benze umbane bawuthumele ukonzakalisa iintshaba zabo*" (Yes there are people who can mix herbs to create lightning and send it to harm their enemies). Jwarha added and said: "*Kodwa ikhona indlela yokuzikhusela kulo mbane. Utshisa itayara uthathe uthuthu lalo ulidibanise nesibulala ntsholongwane udibanise namanzi aselwandle. Eliyeza uligqumelela kwikona zone zendlu liyayikhusela indlu kwithunyelo kaloku itayara ligxotha umoya ongendawo*" (But you can protect your home from this lightning, you burn a tyre and take the ash, mix it with household disinfectant and sea water a tire chases away evil spirit. Bury this mixture in the ground in four places around the house). Tshawe further added and said: *"Enye into encedaya liyeza ekuthiwa ngumsuzwana"* (Also

Lippia javanica helps to prevent being struck by lightning). All learners laughed, they thought he was talking about tooting. He was also laughing and said, "*Hayini andithethi ngokukhupha umoya ndithetha ngeyeza. Eliyeza uyalilima ulijikelezise indlu. Uyazi raba ngamagqabi alo apha emzimbeni ukuze ukhuseleke kumbane"* (No, I am not talking about tooting I am talking about a herb. You plant this herb around your home and rub your body with the leaves to protect yourself from sent lightning).

After the two IKCs answered there was some humour in the class between the learners themselves, they were excited and laughing. Those answers were debated as to whether they were 'myths' or 'facts'. This reverberates with Kibirige and Van Rooyen (2006) that cultural beliefs should be debated to minimise some misconceptions. Concurring, Horsthemke and Schaefer (2007) warn against any assumption that anything indigenous should be accepted or embraced as science. After the wonderful experience, we broke up for lunch and thanked the two IKCs for sharing their knowledge with us and we went home. I was humbled by the knowledge that these two IKCs had about traditional beliefs and practices about lightning and how they shared that knowledge with us. This experience inspired me to close the gap between classroom science and the community, what Aikenhead and Jegede (1999) refer to as border crossing.

Figure 5.5: Showing an interaction between the two IKCs and the learners

5.4.2 Indigenous knowledge beliefs and practices associated with lightning

During the presentation, I was a participatory observer. That is, I assumed the role of asking questions from the two IKCs to get a better understanding of what they were presenting, concerning the purpose of the study and clarifying where there were misconceptions. Cohen et

al. (2018) postulate that quality observations are more than just looking, rather the researcher should closely monitor the facts and practices of the target groups without attempting to change them. For instance, I asked them to explain any cultural beliefs and practices associated with lightning.

Tshawe responded excitedly and spoke: "*Ewe Tishala zininzi, umzekelo xa kududuma siyazigquma izipili nezinto ezimenyezelayo"* (They are so many sir, for instance when there is a thunderstorm, we cover shiny objects such as mirrors). L12M asked: "*Kutheni zigqunywa nje?"* (Why are the mirrors covered?) Jwarha responded by saying that "*Xa kududuma indlu iyashukuma, izipili zingawa zophuke, okunye xa umbane ubethe isipili sinakho ukophuka, iingceba zaso zingayingozi ebantwini. Ilaphu ekugqunywe ngalo linceda lonto*" (The shock waves caused by thunder can make vibrations that may make the mirrors fall and break, the mirror shards could be dangerous for people in the house, so the cloth prevents that). I was particularly awed by Jwarha's explanation. In my view, Jwarha had some knowledge of lightning although he is not a teacher per se, he managed to debunk the myth that mirrors could attract lightning. He also said:

> *We people have ancestors who are keeping watch over us all the time. It is therefore mandatory for us to make sure that the link with the ancestors is kept viable through constant prayers or worship of them, for instance slaughtering animals. It is believed that in return the ancestors protect us from dangers such as lightning.*

I observed that during their presentation the two IKCs were engaging the learners. They were asking questions throughout their presentations, and they were also complementing each other. This presentation strategy kept the learners alert and made them think; this talks to sense making which is championed by Vygotsky's (1978) conviction of social interaction. Also, the two IKCs were using pre-existing knowledge, beliefs and attitudes which could affect how they receive, understand and organise new knowledge (Mabonga, 2021). Their presenting approach made me accept that my teaching approach and style needed to be enhanced. Also, this experience sparked a greater need for me to make sure that the gap between classroom science and IK is closed, as espoused by Aikenhead and Jegede (1999). These scholars refer to this as border crossing.

5.5 Chapter Summary

In this chapter, I presented, analysed and discussed data generated from observations during learners' group presentations and presentations by the two IKCs. This was aimed at answering

the first and second questions of this study. The data generated from participatory observations showed that learners' participation and learning through social interaction was very high and that the learners were interested and engaged in the cultural beliefs and practices associated with lightning. That is, the data generated showed that when argumentation is used in a structured form it could provide a vital link for relating what learners study at school with what they do and learn in their sociocultural environments. In addition, the data revealed that the involvement of the two IKCs promoted learner talk (Lemke, 1990), argumentation (Ogunniyi, 2007a) and effective usage of the mother tongue as a cultural tool and human instrument of communication (Vygotsky, 1978).

Furthermore, the data generated showed that the learners and the two IKCs had common beliefs about lightning being caused by witches who are jealous of other people, and lightning being caused by traditional doctors who are hired to bewitch people by sending lightning to strike them. In addition, the findings revealed that some of these cultural beliefs and practices are not necessarily relevant to science and there is no scientific evidence that anyone can create and send lightning strikes. In the next chapter, I present, analyse, and discuss data generated from the lesson observations, focus group interviews (sharing circles) and learners' journal reflections.

CHAPTER SIX: LESSON OBSERVATIONS, FOCUS GROUP INTERVIEWS AND LEARNERS' JOURNAL REFLECTIONS

6.1 Introduction

In the previous chapter, I presented, analysed and discussed qualitative data generated from the learners' group activities and the presentation from the two IKCs. These were aimed at addressing my research questions one and two of my study. In this chapter, I thus present, analyse and discuss qualitative data generated from observations from my lesson presentation on electrostatics, focus group interviews (sharing circles) and learners' journal reflections. Such data was used to answer the following research question:

> How do exemplar lessons that integrate stories on cultural beliefs and practices about lightning enable/or constrain Grade 7 Natural Sciences learners' argumentation and sense making of the topic electrostatics?

6.2 Data Generated from Lesson Observations

In this section, I discuss and analyse the data generated from lessons on electrostatics and a lesson that integrated IK when teaching electrostatics. Also, 15 learners' journal reflections were analysed as well as the transcripts from the focus group interviews. All lessons were video recorded with the permission of the participants. To make the analysis and discussion easier, the data was coded, as shown in Table 6.1 below.

Table 6.1: Data-gathering tools and codes used in data discussion in this section

Data-gathering tools	Codes used in data discussion
Lesson on practical activities	L1PA–L36 PA
Lesson that integrated IK	L1LIK–L36LIK
Learners' journal reflections	L1J–L12J
Focus group interviews	FGI
Focus group codes	AEsFGI, EBsFGI, EKsFGI, 6GsFGI, LGsFGI, SKsFGI,

Twelve learners' journal reflections were analysed as only 12 learners submitted their journal reflections. Learners' journal reflections were coded as follows, L5J refers to learner 5 journal reflections and L8J refers to learner 8 journal reflections. Also, the codes for Archie Empires, Educational Blazers, Educational Kids, 6 Geniuses, Lightning Girls and Smart Kids groups are used throughout the study. Similarly, data from observations of lessons that integrated IK were also coded as L1LIK– L36LIK, where L12LIK refers to learner 12's lesson on IK and so on.

6.2.1 Data generated from the lessons about electrostatics

While presenting a lesson on electrostatics before the intervention lesson that integrated IK and science, learners seemed to be excited and were actively participating (Sedlacek & Sedova, 2017). As per the CAPS document (DBE, 2011), when teaching electrostatics, friction (rubbing) between certain materials such as plastic, perspex, glass, nylon, wool and silk, the aim is to teach that electrons are being transferred between the atoms of the two materials being rubbed together. Also, the electrons move from one material to another causing a positive charge on its surface and a negative charge on the surface of the other material. That is, only the electrons are transferred. In addition, like charges repel each other and unlike charges repel each other. Lastly, a discharge of the electrons causes sparks of static electricity.

The topic was electrostatics, and my first lesson was about electrostatic forces and charges. At the end of this activity, the learners should be able to:

- charge different objects through rubbing;
- distinguish between the two types of charges; and
- describe how electrons are transferred during rubbing.

Materials needed:

- Sellotape;
- pair of scissors; and
- ruler.

Lesson 1: Charging objects (learners worked in groups)

I asked the learners to cut three pieces of Sellotape, about 20cm long, label them 1, 2 and 3 and paste the third one on the table. They had to put the sticky parts of the first and second Sellotape pieces together. They had to pull them apart and hang them on the edge of the table about 30cm apart. They had to remove the third piece from the table and bring it closer to the hanging Sellotape pieces. I asked them to write down their observations and report back to the class.

Learners were excited and they were actively involved in their groups and came up with answers. For example, L21M answered excitedly: "*Xa usondeza usondeza le yesithathu kule yokuqala iyasondela kodwa xa uyisa kule yesibini iyabhekela"* (When the third piece is brought closer to the first piece it moves towards it). They continued with the activity in their groups until everyone was certain about the results of the experiment. I then explained to the class that an American scientist Benjamin Franklin called these electric charges positive (+) and negative (-).

Figure 6.1: Shows learners doing the practical activity

In the second activity, the learners had to remain in their groups and test the kind of charges on the charged Sellotape.

Materials needed:

- The first two sellotapes used in activity 1;
- glass rod; and
- silk cloth.

I asked them to rub the glass rod with the silk cloth, bring the charged rod closer to the Sellotape, observe what happens and answer the following question: Which of the Sellotape pieces were positive and which were negatively charged?

Learners took turns in their groups to rub the glass rod with the silk cloth and bring it closer to the Sellotape. They were excited when they saw the movement of the Sellotape. Learners were interacting (Vygotsky, 1978) and shouting "*Iyayitsala lena, iyayibhekelisa lena"* pointing at the Sellotape pieces (it attracts this one and it pushes this one away). I then asked them to answer the question. L30F answered and said: "*Le isondela kwirod inegetive, le ibhekelayo kwi*rod *i*positive*"* (The one that comes closer to the rod is negatively charged and the one that moves away from the rod is positively charged). I then asked how they came to that conclusion? L27M replied: "*Kaloku icharges ezifanaya ziyakhabana, ezingafaniyo ziyatsalana*" (Like charges repel each other and like charges attract each other).

Figure 6.2: Shows learners using a glass rod to test the kind of charge on the charged Sellotape

Learners' responses and positive interactions during the practical activity forced me to teach by putting more emphasis on forces between charges. The aim was to help the learners make sense of the concepts, such as attractive force, repulsive force and the impact of distance between electrostatic forces. For example, I highlighted that like charges are repulsed, that is they repel each other, and opposite charges attract each other. In addition, the closer the charges are the stronger the electrostatic force between them.

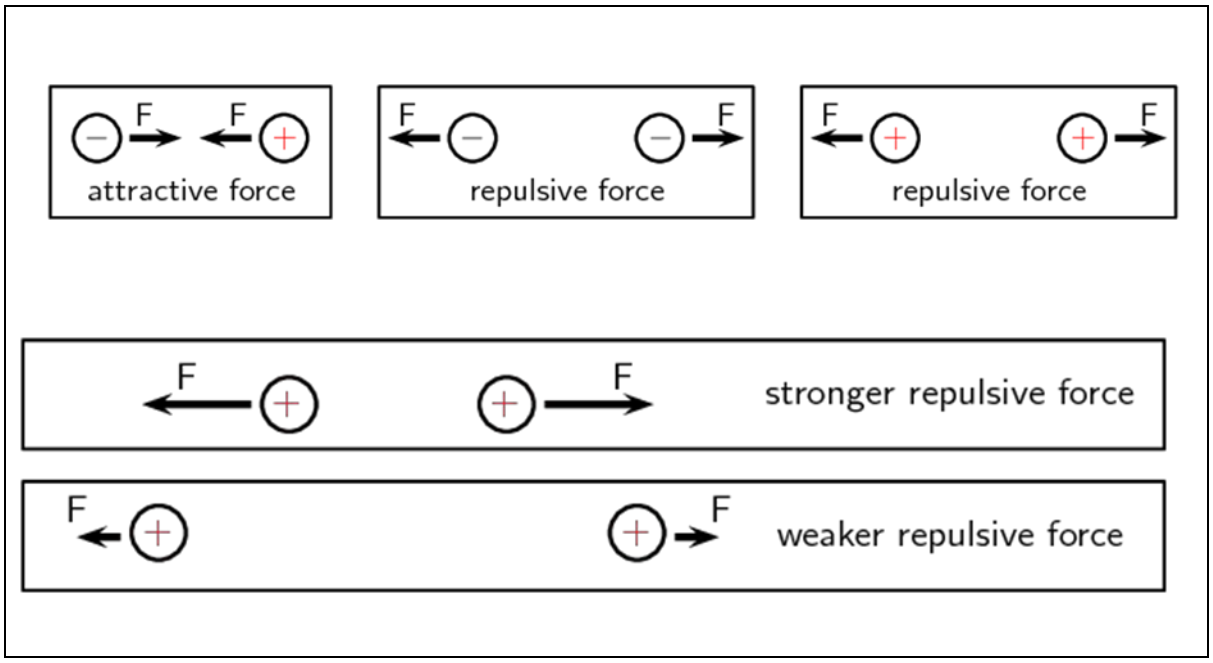


Figure 6.3: Shows electrostatic forces between the charges

I then asked the learners to test the charges on the Sellotape again, but this time they had to put the rod closer and observe what happened and then move it further away and observe what happened. Learners were excited to do this activity. For example, L34M said: "*Ndiyayibona ngoku ndiyakwazi ukuzibona xa zifana icharges ziyakhabana"* (I understand now I can tell when they are like charges, they repel each other). L21F then said: "*Ewe xa uyisondezile kwisallotape ikhaba ngamandla kwenye isallotape isondela kakhulu"* (Yes, if you bring it closer to the Sellotape it moves very close but if you are far the is little movement).

The interaction among the learners was positive – everyone, even those who are always problematic in class wanted a chance to use the rod to test the charges. L28F commented and said: "*This is fun it is like a magic*". It seemed learners were making sense of science when they were actively involved in the construction of knowledge (Millar, 2010). Similarly, I observed that learners seemed to be enjoying the practical activity and were in fact learning.

Their comments suggest that their ZPD had shifted positively (Vygotsky, 1978). That is, they have gained more knowledge of the concept. Similarly, language was used as a tool for communication and making sense of what was happening during the presentations – in this case, the home language (isiXhosa) and English made learners more relaxed, and they could express their views freely. I noticed that code-switching (the use of more than one language in discourse) in science teaching can improve teaching and learning. The language issue as a problem was also mentioned in Maselwa's (2003) thesis, where he investigated the effects of prior knowledge about lightning in the teaching of electrostatics. He argued that some learners could be reluctant to give their views because of a lack of proficiency in English.

6.2.2 Data generated from a lesson that integrated IK

After the presentations by the two IKCs, my critical friend (Zizi) and I co-developed a lesson plan that integrated IK when teaching the topic of electrostatics. We used the ideas of the IKCs and ours to develop a lesson plan on electrostatics. I asked Zizi to videotape and observe my lesson presentation as it is impossible for one to observe themselves. During my lesson presentation, I started by establishing the learners' understanding of the concepts from the previous lessons (negative electron, positive protons, repulsive and laws of charges). I gave them the following activity to do.

Activity 1

Two charged metals spheres hang and are free to move as shown in the picture below. The right-hand sphere is positively charged. The charge on the left-hand sphere is unknown.

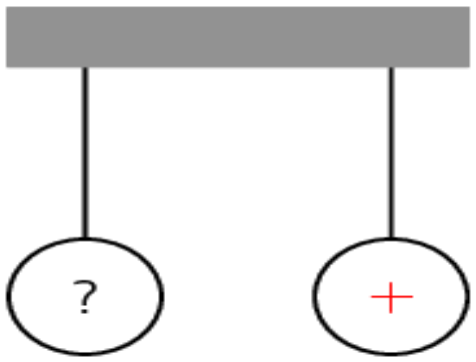


Figure 6.4: Shows two charged metals

The left sphere is now brought close to the right sphere.

1. If the left-hand sphere swings towards the right-hand sphere, what can you say about the charge on the left sphere and why?
2. If the left-hand sphere swings away from the right-hand sphere, what can you say about the charge on the left sphere and why?

Learners seemed excited when they were doing this activity, and they were all able to come up with the correct answers. At this point, I realised that they understood the laws of electrostatics, for example, charges repel each other and unlike charges attract each other. I then explained that the movement of the charge happens the same way as in the practical activities when there is lightning, but the charges are immensely strong.

I further explained that the lower clouds in the sky are negatively charged and the objects on the ground (earth) are positively charged. That is, there is an electric charge between lower clouds and the earth. Since opposite charges attract each other, the negative charge from the lower cloud always tries to move towards the earth. Similarly, the positive charge from the earth always tries to move towards the lower clouds. However, the air (insulator) between the lower clouds and the earth blocks this charge transfer. When the charge is stored in the lower clouds and is enormously increased, they surmount the insulating barrier from the air. As a result, the charge is transferred between the lower clouds and the earth. The lightning we see in the sky is due to this transfer. The taller subjects such as buildings, mountains and trees are commonly struck by lightning. So, lightning easily targets taller subjects on the earth's surface. That is why you are told by your parents not to stand under a tree when there is lightning.

Learners seemed excited about my lesson. For example, L7F said: "*Oh yilento sixelelwa ukuba masihlale phantsi sizole xa kubaneka"* (Oh, that is why we are told at home we must sit down and still when there is lightning because we might be the targets). L15M said: "*Yilento singavunyelwa ekhaya sidlale phandle ekhaya xa kubaneka*" (That is why we are not allowed to play outside when there is lightning). I then asked the learners to discuss among themselves to answer the following question.

1. Use your understanding of electrostatics to explain why your parents told you not to

    a) play outside the house during a lightning storm;
    b) touch water, swim or play with water during a lightning storm;
    c) sit under a tree when there is a lightning storm.

From my presentation, I noticed that learners seemed to have reservations about IK, even though I was happy with the level of participation during the lesson. Also, I noticed that learners wanted to make sense of what was being taught in class. They were linking the lesson and what they knew already from home. For example, L8F said: "*Utata Omkhulu uhla esithi masicime izinto ezisebenzisa umbane, TV ne radio ngoba umbane uzazimosha. Kungokuba umbane usebenza njenge electricity"* (My grandfather always advises us to switch off appliance such TV and radio because they will be damaged by lightning because lightning is related to electricity). L19F excitedly nodded and said: *"Iyavakala ke ngoku"* (It now makes sense).

It is evident that learners do come to science classrooms with some prior knowledge and experiences (Maselwa, 2004) about natural phenomena, in particular, lightning in the context of this study, which they acquired from their community. Pabale (2006) avers that when learners' cultural beliefs and experiences are included as examples when teaching science, it has the advantage of drawing learners' attitudes into the learning of science topics. The themes that emerged from the data sources generated from observations, journal reflections and focus group interviews are now discussed. Also, sub-themes were constructed and are presented in Table 6.2. They are presented with apropos theory and literature.

Table 6.2: Shows themes that emerged supported by the theory and literature

Themes	Theory/Literature
Understanding of IK by the learners	Kibirige and Van Rooyen (2006); Otulaja and Ogunniyi (2017), Iseke and Brennus, (2011); Joubert (2019)
Benefits of integrating IK into science lessons	Aikehead and Jegede (1999); Angaana et el. (2016); Mavuru and Ramnarain (2020), Gwekwerere (2016); Mushayikwa and Ogunniyi (2011)
Shifts in learning	Mavuru and Ramnarain (2017); Mavuru and Ramnarain (2020); Ogunniyi and Hewson (2008)

I now discuss each of these themes in detail below.

6.3 Understanding of IK by Learners

During the presentations by the IKCs, I noticed that my learners were listening attentively and responded well to the answers to the questions they posed. They also contributed to the lesson. To understand the learning that was created when the IKCs presented their lessons on cultural beliefs and practices about lightning, I asked them what they had learnt from the presentation.

Their responses showed that the integration of IK into science lessons makes the subject interesting and easier to understand. For example, LM10 responded and said:

> *I am happy to learn about the things my grandmother always teaches me at home, for instance, she always tells us that we must sit still when there is lightning, and we must not play outside because it is dangerous (LM10).*

Learners were happy because the two IKCs were teaching what their families taught them about stories on cultural beliefs and practices about lightning. These teachings have been transmitted orally from generation to generation (Kibirige & Van Rooyen, 2006). Gadzirayi et al. (2006) proffer that IK manifests through, among other things, language, beliefs, values, customs artefacts, games, food, rituals and ceremonies and elders are the custodians of this knowledge. As custodians of IK, elders are regarded as educators of children, youths and adults and are the communities' storytellers and historians, whose stories are used as educational tools to sustain communities' cultures and traditional practices (Iseke & Brennus, 2011).

Likewise, Joubert (2019) posits that storytelling has been used to pass on wisdom, knowledge and culture and to strengthen social bonds since the earliest time of humankind's existence. In the context of this study, these learners came with IK from their homes and communities and combined that with the presentations from the two IKCs. The IKCs presented some cultural beliefs which some learners were aware of, but they had taken it for granted because they were not taught about them at school. Given this, L30F attested that "*I learnt more about my cultural belief and practices on lightning and its importance in a science lesson. I cannot wait for another lesson that will integrate my culture".* This learner validated that he learnt many things he was not aware of or took for granted before the presentations about stories on cultural beliefs and practices about lightning. These presentations confirm their Ubuntu, as teaching children is not only the responsibility of the school but the community.

6.4 Benefits of Integrating IK into Science Classes

The comments and the reflections of the learners in this study revealed that there are positive benefits when IK is integrated into science lessons. For instance, L6F commented and said:

> *The presentation made by Buti Mxobo and Jwarha made me to understand how lightning occurs I wish that this mixing of knowledge from home could be done every time in our science lesson because it makes science easy to understand.*

This resonates well with Hewson and Ogunniyi's (2011) recommendations that IK be renowned in the school science curriculum. These scholars aver that this will connect school science to the learners' cultural backgrounds and help improve their learning as participation from learners will help them become insightful and active. These scholars regarded the integration of IK into science lessons as a positive step that could provide opportunities for debate on the interaction between Western and indigenous worldviews (Mushayikwa & Ogunniyi, 2011). Learner L27M commented and said: *"I have never imagined what I have learnt from my grandmother could be also taught in a science lesson and made me understand. I agree with you Themba this must not stop"*. Concurring, L3F reflected:

> *I agree with you my friend Mna I enjoyed this lesson I was not scared to contribute because the presenters presented what I already know from home, and we were allowed to express ourselves in our language. I am looking forward to the next lesson (L3F).an*

Le Grange (2007) argues that integrating IK into Western science teaching facilitates learning. That is, integrating IK into Western science will hopefully help bridge the gap between the learners' school experiences and their home experiences while at the same time allowing them to develop their abilities to their full potential, and gain confidence and self-esteem.

From these learners' comments, it could be deduced that they are in favour of the integration of IK during science lessons. These findings reverberate well with Jegede's (1999) argument that a learner can perform outstandingly in a Western science classroom without assimilating the associated values and that any science curriculum that does not take particular account of the indigenous worldview of the learner risks destroying the framework through which the learner is likely to interpret concepts. Similarly, that call made by learners that IK must be integrated into science lessons reiterates Aikenhead and Jegede's (1999) call that consideration of learners' everyday life-world has the potential to enable border crossing from home to school. Concurring, Hewson et al. (2009) argue that learners' new scientific knowledge is built on everyday experiences. It is therefore imperative that teachers start with what the learners know to move toward what they do not know so that they build new knowledge on the prior knowledge. During the process of knowledge building any misconceptions that are brought by prior everyday knowledge need to be addressed. It is therefore important that teachers should not treat learners as empty vessels when they come to science class. Learners do come to school with their own traditional views on matters.

Therefore, in the context of this study, learners agreed that the integration between these two worldviews is imperative in their science lessons. Therefore, the inclusion of cultural beliefs and practices about lightning can be said to have motivated the learners and helped them to develop an understanding of the topic of electrostatics. Similarly, it had a positive influence on learners' interest in science.

6.5 Evidence of a Shift in Understanding

From the comments of the learners after the presentations above it was evident that there were shifts in the learner ZPD. This can be seen in the table below.

Table 6.3: Shows evidence of learners' ZPD shift

Theme	Evidence
Improve understanding of the concepts of lightning	*The presentation made by Buti Mxobo and Jwarha and the lesson that integrated IK made me to understand how lightning occurs (L6F).* *I understand now I can tell when they are like charges, they repel each other, and unlike charges attract each other*
Sparked interest in learning science	*We were allowed to express ourselves in our language. I am looking forward to the next lesson (L3F).* ***I** learnt more about my cultural beliefs and practices on lightning and its importance in science lessons. I cannot wait for another lesson that will integrate my culture (L30F).*
IK as pre-knowledge	*I had never imagined what I have learnt from my grandmother could be also taught in a science lesson and made me understand the science lesson (L27M).*
Curriculum relevance	*I am happy to learn about the things my grandmother always teaches me at home, for instance, she always tells us that we must sit still when there is lightning, and we must not play outside because it is dangerous (L10M).*

6.5.1 Improved understanding of the concepts of lightning

After the presentations, the learners seemed to have a better understanding of the concept of electrostatics. For example, L33M commented and said: "*I understand now I can tell when they are like charges, they repel each other. Now I know how to protect myself properly from lightning because we talked about it and shared our views, I no longer believe in the traditional method because there is no evidence".* The learners seemed to like the integration of IK because IK is helpful in the learning of science. Thus, IK can be used as a stepping stone to learn

science. Mavuru and Ramnarain (2017) argue that to learn science, learners must be introduced to scientific concepts as a way of seeing and talking about phenomena. This engages learners in activities that relate their everyday concepts to scientific concepts.

6.5.2 Sparked interest in learning science

Some of these learners simply liked IK because it offered excitement and satisfaction as the following excerpts show.

> *We were allowed to express ourselves in our language. I am looking forward to the next lesson (L30F).*
>
> *I learnt more about my cultural beliefs and practices on lightning and its importance in science lessons. I cannot wait for another lesson that will integrate my culture (L5F).*

This resonates well with Khuphe (2014) who avers that IK must be integrated into science lessons to make it attractive and accessible to learners. The negativity that was evident in the learners in science lessons seems to have given way to innovative thinking. So, instead of complaining about the science being difficult to understand they found it easier to understand.

6.5.3 Social interactions

Sociocultural theorists favour teaching methods that promote social interactions among learners and between learners and their teachers. For instance, Chappell (2012) advocates dialogic teaching methods which she describes as any collective exchange of ideas in which learners talk to each other or to their teacher to share what they think and gain deeper insights into what they are learning. She maintains that dialogic teaching creates an opportunity for learners to co-construct meaning through interrogating their thought processes, criticising each other and debating and discussing, all of which lead to joint understanding and shared meaning. Her views resonate with Ogunniyi's (2007a) views who postulates that argumentation promotes learning, especially among adult learners. Similarly, Sedlacek and Sedova (2017) also found a correlation between talking and critical thinking in their study on dialogical teaching. In the context of this study, the teacher used group work as a strategy to encourage the learners to co-construct knowledge as they discussed stories and beliefs about lightning. In Vygotsky's view, learners develop higher mental skills through interactions with their peers and the MKO which promotes higher cognition (Mutanho, 2021). While in Vygotsky's theory the MKO is usually the teacher, in this study, this position was fluidly interchangeable among participants.

6.5.4 IK as prior knowledge

Angaama et al. (2016) argue that constructivist ideology holds that learners do not come to the science classroom with empty minds about natural phenomena but come with knowledge from their home backgrounds. In the context of this study, learners' pre-knowledge was taken into consideration, and it seemed to help learners to be more engaged in the lesson. For example, L27M commented and said: *"I have never imagined what I have learnt from my grandmother could be also taught in a science lesson and made me understand the science lesson".* In this regard, Khuhlane (2011) argues that the use of everyday knowledge in the science classroom increases the level of engagement of learners and that learners enjoy making links between their different experiences when the curriculum is designed to facilitate such links.

6.5.5 Curriculum relevance

Very often, learners do not have school science as part of their identity, and hence they feel "excluded" from the science class – this results in less meaningful engagement with science. In the context of this study, learners seemed to appreciate the integration of IK into the lesson. L10M commented and said: "*I am happy to learn about the things my grandmother always teaches me at home, for instance, she always tells us that we must sit still when there is lightning, and we must not play outside because it is dangerous".* This reverberates well with Anjali's (2023) sentiments that to make learning relevant and meaningful diverse perspectives and experiences must be incorporated into learning.

6.6 Chapter Summary

In this chapter, I analysed and discussed the data generated from lesson observations, focus group interviews and learners' journal reflections. These tools were used to answer question three of this study. In the next chapter, I present a summary of the findings, recommendations and conclusion of this study.

CHAPTER SEVEN: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

In the previous chapter, I presented, analysed and discussed data generated from participatory observations, focus group interviews (sharing circles) and learners' journal reflections. The three data-gathering tools were used for triangulation purposes. In this chapter, I thus present a summary of my findings and provide some recommendations thereof. I also suggest areas for future research. The limitations of this study and my personal reflections are also presented. The chapter ends with the overall conclusion of the study.

7.2 Overview of the Study

The main goal of my study was to mediate learning of electrostatics through stories on cultural beliefs and practices about lightning with Grade 7 township school learners.

To achieve this goal, the following research questions were addressed:

1. What kind of *stories* about cultural beliefs and practices on lightning do Grade 7 learners know from their homes and the community?
2. How do the story presentations by the IKCs on the cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences' argumentation and sense making of the topic of electrostatics?
3. How do exemplar lessons that integrate *stories* on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense making of the topic of electrostatics?

To answer these research questions, I used various data-gathering tools, namely group activity, observations (participatory and lesson observations), focus group interviews (sharing circles) and journal reflections. For research question 1, I used a group activity and newsprints written by the learners to get *stories* from their homes and the community on cultural beliefs and practices about lightning. Such information was imperative for this study as it allowed me to know what these learners' prior knowledge was as espoused by Metuja-Macula and Bytyqi-

Damon (2020) and Da Silver et al. (2023). These scholars suggest that teachers need to begin to explore a diversity of science instruction with prior knowledge that learners bring to class. Learners bring ideas to a classroom that are based on their prior experiences and learners of different cultural backgrounds frequently interpret science concepts differently from the standard scientific view (Kuhlane, 2011). That is, prior knowledge plays a vital role in the construction of new knowledge.

For research question two, two IKCs were humbly invited to make presentations on stories on cultural beliefs and practices about lightning to mediate the teaching of the topic of electrostatics. The rationale for inviting these IKCs to do presentations was to tap into the cultural heritage or funds of knowledge of community members as they are custodians of this knowledge. The data that emerged from research questions one and two were presented, analysed and discussed in Chapter Four of this study. Then again, data generated from lesson observations, focus group interviews and journal reflections were presented in chapter six. I now discuss the summary of my findings below.

7.3 Summary of the Findings

I present the summary of the findings in relation to each research question as illustrated below. I start with research question one as follows.

7.3.1 Research question one

> *What kind of stories about cultural beliefs and practices about lightning do Grade 7 learners know from their homes and the community?*

The data responding to this research question was also presented in Chapter Four (see sections 5.2 & 5.3). The findings from this study showed that some of the conceptions that the learners have about lightning are scientific whereas others are based on traditional beliefs and practices. The two views tend to clash with each other. The learners had prior conceptions about the causes of lightning. This included how lightning is formed, how it behaves and how people can protect themselves and their homes from being struck by lightning.

The learners believed that there are two types of lightning: the one that is natural (caused by God) and the one that is caused by traditional doctors and witches. The findings revealed that these learners have the scientific and/or traditional conceptions of lightning. Learners hold traditional/religious beliefs about lightning and these, among others, include:

- Lightning is caused by witches who are jealous of other people.
- It is caused by traditional doctors who are hired to bewitch people by sending lightning.
- It is a natural phenomenon and comes from God when He is angry.

Even though this study was conducted in a school that has dominantly isiXhosa-speaking learners, researchers such as Mahapa (2002), Pabale (2006) and Liphoto (2008) found similar conceptions among the learners of Basotho and Pedi people. This is an indication that the cultural beliefs of learners about the conception of lightning are similar across some cultures. However, in discussions on the learner's conception of lightning, it is evident from this study that learners come to classrooms with some pre-conceptions about lightning and that indeed the ideas that learners bring to science classrooms need to be addressed through appropriate learning programmes also espoused by Mahapa (2002). This validates the argument by scholars such as Kibirige and Van Rooyen (2006) who argue that IK is passed on orally from generation to generation is correct.

The study revealed that learners possess a lot of prior everyday scientific and non-scientific knowledge and experiences about lightning that they have acquired outside the school. The study revealed that there is a belief among the Xhosas that lightning is caused by evil spirits and tyres can chase away these evil spirits. That is why tyres are placed on the roofs they are chasing away evil spirits. It was revealed that this belief is based on spirituality and that there is no scientific evidence to support this belief. However, I believe that the discussions about the existence of this belief sparked arguments (Ogunniyi, 2007a) and hence evoked critical thinking in the learners, which is one of the aims of Natural Sciences.

The study also revealed that there is a belief among the Xhosas that there are ancestors who are watching and protecting people from the dangers of lightning. For people to be protected they need to pray and slaughter animals for these ancestors. Regarding the relevance of these beliefs to science, the study revealed that the learners found no relevance at all. Despite this, discussions and arguments enriched the learners' existing knowledge. Lastly, the study revealed that engaging the learners in their cultural beliefs and experiences enhances participation and facilitates learners' understanding of natural phenomena for instance lightning. They were thus able to think intuitively and synthesize their cultural beliefs and experiences from their contexts.

7.3.2 Research question two

> *How do the story presentations by the Indigenous Knowledge Custodians on stories on cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences' argumentation and sense-making of the topic of electrostatics?*

The study revealed that there were positive interactions between the learners and the two community members. The study showed that the interactions were mainly characterised by questions and answers, and they used the isiXhosa language which is their language of communication (Mavuru & Ramnarain, 2020). This resonates well with Vygotsky (1978) who posits that language plays a vital role in mediating learning.

It was revealed in the study that the IKCs probed the learners by asking more questions, what Mavhunga and Rollnick (2013) refer to as elicitation of prior knowledge. The two IKCs used this teaching strategy throughout their presentations even though they were not qualified teachers. I observed that the learners were listening attentively to the presentations and that indicated to me that they were interested and internalising the presentations.

The study also revealed that participation by learners during the presentations was very high. They contributed by asking questions of the two IKCs and others provided answers, for example, on the belief that tyres protect from being struck by lightning because it is an insulator. L11M asked: "*Why the tyres are put on top of the roof if they are meant to trap the lightning bolt to the ground?"* L16F quickly responded and said: *"The rubber in a tyre acts as an insulator so lightning will not penetrate".* L12M did not agree with the fact that the bolt would not penetrate, and he said: *"Yes the rubber in a tyre acts as an insulator at low voltages, the voltage in a lightning bolt is far too high to be stopped by tyres".* I observed that learners have prior knowledge of the belief that a tyre can protect people from being struck. The study allowed the learners to build on their prior knowledge as espoused by Kuhlane (2011).

In addition, the study revealed that the learners looked relaxed and enjoyed the presentations by the IKCs as they smiled and laughed. For example, when an IKC was telling them about the herb (*umsuzwana*) they all laughed thinking that he was talking about tooting. The study revealed that language plays a vital role in teaching and learning (Vygotsky, 1978), and this stimulated learners to interact, participate and learn during the presentations by the two IKCs and encouraged discussions among the learners. This resonates well with Vygotsky (1978) who

avers in his seminal work that language is the most vital tool with which knowledge can be constructed. Concurring, Msimanga and Lelliott (2014) claim that some learners may not be confident in using English, hence, they should be allowed to use their home language to engage with difficult concepts. Hence, in this study, the learners and my co-researchers were allowed to express themselves in isiXhosa the language they know best.

Lastly, it was revealed that the use of the mother tongue evoked learners' interest and understanding of the lesson. It is evident in this study that the mother tongue use promoted learner talk. This resonates well with Vygotsky (1978) who points out that language is the most important tool for thinking, the most important means of communication and assists in sense making. For example, learner L3F said: "*I agree with you my friend Mna I enjoyed this lesson I was not scared to contribute because the presenters presented what I already know from home, and we were allowed to express ourselves in our language. I am looking forward to the next lesson".* Ekele and Milcah (2016) and Mavuru and Ramnarain (2019) show that the incorporation of the home language helps boost the indigenous learners' self-esteem which ultimately increases their engagement in the classroom.

7.3.3 Research question three

> *How do exemplar lessons that integrate stories on cultural beliefs and practices about lightning enable and/or constrain Grade 7 Natural Sciences learners' argumentation and sense-making of the topic of electrostatics?*

Findings from this study revealed that the use of hands-on practical activities when teaching science concepts can influence learners' disposition, conceptions and sense making positively. This resonates well with Main (2023) who avers that when learners are given the ability to learn in a practical hands-on environment, they are very often engaged, stimulated and want to learn as much as possible. It was evident from this study that the learners' appetite for learning increased, and they were more willing to listen and pay attention. Similarly, findings from this study also showed that after presentations, the learners' ZPD seemed to have shifted, and they had a better understanding of the concept of electrostatics. For example, L6F commented and said: "*The presentation made by Tshawe and Jwarha and the lesson that integrated IK made me understand how lightning occurs".* Moreover, it is evident from this study that some learners shifted from cultural to scientific beliefs about lightning. For example, L33M commented and said: "*Now I know how to protect myself properly from lightning because we*

talked about it and shared our views, I no longer believe in the traditional method because there is no evidence".

Furthermore, in this study, the learners had to come up with their own explanations of the causes of lightning and protective measures against lightning before they were taught the science of lightning. This was done to relate the context with their experiences. Many learners have expressed their aspiration for IK-integrated science lessons. For example, L13M said: *"The presentation made by Tshawe and Jwarha made me understand how lightning occurs I wish that this mixing of knowledge from home could be done every time in our science lesson because it makes science easy to understand".*

Similarly, the findings from this study showed that Ogunniyi's (2007a) argumentation method of teaching used in this study made it easier to ascertain the learners' conception of lightning accurately. This is because Ogunniyi's (2007a, b) CAT contributes to bridging the gap between the two conflicting views, i.e. the cultural view and the scientific view. Moreover, arguing, sharing and discussing views and explanations helped learners to externalise their thoughts, clear their doubts and even made other learners change their conceptions about lightning.

Lastly, it is evident from this study that there are some scientific conceptions within the community's cultural beliefs and practices though the scientific explanations might not be known. For instance, children are culturally warned not to stand under a tall tree when there is lightning. It is considered one of the protective measures against lightning. This is also a scientific measure of protection against lightning as trees are prone to being struck by lightning.

7.4 Recommendations

Important findings were revealed from this study, and if these findings are considered, they have the potential to improve the implementation of the integration of IK into science lessons by Natural Sciences and Technology teachers. Based on these findings, several recommendations can be suggested for teachers. The recommendations from this study are discussed below.

7.4.1 Recommendations for teaching and teachers

Mabonga (2021) argues that learners conceptualise content and make sense of new ideas and experiences with ease during the teaching and learning process based on prior knowledge that they have about the topic under discussion, and this strengthens their foundation for learning.

The IK is part of the learners' prior knowledge which directly impacts their ability to accept new ideas (Hewson et al., 2009). It is, therefore, important for a teacher to start with what the learners know to move towards what they do not know so that they build new knowledge on the prior knowledge. During the process of knowledge building any misconceptions that are brought by prior knowledge need to be addressed.

Similarly, Natural Sciences and Technology teachers need to be aware of learners' sociocultural factors which influence science learning (Mavuru & Ramnarain, 2017). That is, the learners' sociocultural backgrounds which they bring to the classroom should be used as prior knowledge when teaching Natural Sciences. It is therefore recommended that teachers should be aware that learners are not empty vessels and that they have some knowledge from home and their community about natural phenomena. This knowledge affects both how they make sense of scientific concepts and the extent to which they are willing to participate during the teaching and learning process.

It is also recommended that the teachers should divert from textbook guidelines and design classroom tasks that bring in elements of IK that connect with science. In other words, the use of IK serves as a strategic point for exploring scientific concepts and inquiry procedures. It is recommended also that teachers and curriculum developers work together to develop learning materials that are culturally relevant and that teachers should plan activities carefully to link activities to learners' everyday experiences. Similarly, it is recommended that science and technology teachers need to attend professional development programmes which include curriculum design and developing materials. Such programmes would help teachers to develop teaching strategies that will enable them to elicit diverse learners' cultural beliefs and practices. It is also recommended that teachers should share teaching strategies by observing other's lessons to improve their pedagogical content knowledge.

Lastly, I recommend that science teachers should consider making use of IKCs in their teaching to help them teach the cultural beliefs and practices of the science lesson which serve as prior knowledge. For example, from the findings of this study, there were science concepts that emerged from the presentations of the two IKCs who presented stories on cultural beliefs and practices about lightning. Therefore, teachers should invite community members to share their cultural beliefs and practices, so that teachers can link the IK from the IKCs to classroom

science. Thus, teachers need to develop a community of practice and professional learning communities with community members as they are the custodians of IK.

7.4.2 Recommendations for further research

This study certainly has opened opportunities for possible further research on the integration of IK into science lessons. In this regard, further research could be done on the same topic addressed by the study, whereby the teachers could teach the co-developed model lessons that integrate IK into their classrooms while they are observed. Similarly, a further study could be done whereby the focus could be on investigating how teachers could be assisted to incorporate learners' cultural beliefs and experiences about lightning as a natural phenomenon to mediate learning of electrostatics in Grade 7 township Natural Sciences classes. Lastly, a further study could be conducted on the same topic addressed by this study. However, the focus could be on the views of Grade 7 learners on the integration of IK into the topic of electrostatics.

7.5 Limitations

The findings of this study do not directly contribute to the general body of education due to their limiting nature. The study involved only one school and a total of 36 learners. Therefore, the findings presented in this study do not represent the large number of learners in Sarah Baartman schools since it was limited merely to a small group of learners in a specific class, and it was context-specific. Therefore, the findings of the qualitative case study cannot be generalised to represent all Natural Sciences learners in the Sarah Baartman District or the entire Eastern Cape. The findings of this study were derived from data that was obtained from learners coming from an informal and poverty-stricken area. Therefore, it is difficult to claim that they hold for people from wealthy urban areas, however, they could provide insight into the integration of IK into teaching science.

Furthermore, the use of my own learners may have affected the findings of this study. The learners might have provided the kind of answers that they thought their science teacher wanted to hear. However, the use of more than one instrument has helped me determine the kind of understanding that is developed by the learners. The use of the home language was a huge advantage (Mavuru & Ramnarain, 2020) in this study, as social interaction and participation were enhanced as advocated by Vygotsky (1978). However, I was mindful of the fact that in the process of translating from isiXhosa to English, some meanings could be distorted. To rectify this limitation, Zizi (a critical friend) double-checked the translations to ascertain if what

was written was a true reflection of what was said and presented by the learners and the two IKCs.

Also, the delay in the ethical clearance process somewhat limited the time taken for the study. This delay reduced the amount of data that could have emerged from this study. The initial plan was to conduct the study early in the first and second term, but due to this ethical approval delay the data was collected in the third term of the year. That is, if I were to do the study again, I would make sure that I got the ethical clearance in good time.

7.6 My Personal Reflections

In 1998, I had a rare opportunity to register with Rhodes University to pursue a Human Movement Studies degree. I struggled a lot in my first year because of the new learning environment and culture of the university. There was no sign of Ubuntu. You had to conform to the culture. I passed some of the courses in my first year, but I could not cope at all in the second year because of family problems and I failed; unfortunately, I was excluded from the university. Fortunately for me, I had acquired a teacher's diploma from the Cape College of Education. In 2003, I went to work in Knysna as a Mathematics and Science teacher. In 2006, I enrolled at Nelson Mandela University doing a BEd part-time, specializing in Science and Mathematics.

In 2015, I found employment in Grahamstown. In 2016, I tried to enrol at Rhodes University to do my BEd honours and I failed the entrance test. I tried again in 2020 and I was accepted. I thought I would do science, but Professor Ngcoza introduced me to the concept of IK. I find indigenous lessons very interesting because they are trying to value the knowledge that the learners have from home. So, these lessons are based more on the learners' everyday lives and experiences (which I can relate to). Thanks to Prof Kenneth Ngcoza and Dr Chris Mutanho for how they introduced IK to me – they made it appealing and fascinating. I can now safely say that I am an advocate for the integration of IK, and it motivated me to study even further in this field to develop myself and improve my teaching methods.

After I had completed my honours at the end of 2020, I went back to school and shared my experience with my colleagues, including Zizi who was my critical friend. I informed my colleagues that this experience motivated me to study further, and I intended to focus on IK – I hoped that this would improve my teaching strategies. Also, I hoped that if I tapped into IK, I could make my science lessons more interesting and hopefully contribute positively towards

the academic performance of our learners in Natural Sciences. I went as far as recruiting my colleagues to also consider furthering their studies and doing IK. I guess I failed to convince them because they did not register.

In 2021, I registered for my master's degree in science education at Rhodes University. My research journey was a bit challenging and at the same time quite a rewarding experience. For instance, it was a challenge to come up with a research topic. Nonetheless, with the support of my two supervisors, Professor Kenneth Ngcoza and Dr Chris Mutanho as well as my colleagues in my great community of practice, I was helped to overcome this challenge.

Also, I had a challenge with ethical approval from the ethical committee. They kept sending my application back. I was told to change and fix some ethical issues, and after I fixed those issues, they would come up with something else. I felt that I was a target because the things that I was supposed to fix the other students were not asked to fix and they just got their ethical approval. Such an experience left a bitter taste in my mouth and the supervisors' alike. I was so frustrated that I wanted to quit my studies. This delay had an impact on this study. For example, I feel that I did not have enough time to collect the data for this study because I could not collect it before the ethical approval. Eventually, the ethics research committee approved my application in the third term of the year when I had intended to collect data in the first and second term of the year. I lagged behind other master's scholars who submitted their studies because they had enough time to finish their studies.

Notwithstanding, this journey was quite rewarding as it contributed positively to my professional development in so many ways. Firstly, the study equipped me with different skills that helped me enhance my teaching strategies. I have developed knowledge of how to integrate IK into my science lessons and teaching them. Secondly, this study has taught me to value and appreciate the knowledge that the community members have.

Thirdly, the study made me realise the importance of prior knowledge in teaching and made me reconsider tapping into what learners already know and involving them fully in the lessons when teaching. This is based on how the IKCs involved learners in their presentations on the cultural beliefs and practices about lightning. I was humbled by their presentations and the skills they had. I agree with Vygotsky (1978) that indeed, they are the MKOs.

Similarly, I learnt that language is an important tool in teaching and learning (Mavuru & Ramnarain, 2019). This study opened my eyes because I did not know that I could eventually teach science using IK. I found the research journey rewarding and fruitful and it allowed me to work with the learners as my co-researchers. The quality of work they produced during brainstorming and their level of participation during the group presentations showed me that our learners have potential, but they just need to be afforded opportunities.

Lastly, during this study, I have learnt that to attain the objective of the study I needed much patience, tolerance and wisdom to make the whole exercise a worthwhile endeavour. There were many constraints that I faced during this study, but it was an exciting journey and a learning experience. I am therefore grateful to my supervisors and colleagues who were helpful to me in this journey. Their selfless efforts and Ubuntu made it possible for me to finish this study. I am also indebted to my critical friend who was with me throughout this journey. Similarly, I wish to thank the two IKCs who agreed to come to my class and present stories on cultural beliefs and practices about lightning. Above all, learning with my learners was such an invigorating experience and I will treasure that for the rest of my life.

7.7 Conclusion

The main goal of this study was to mediate learning of electrostatics through stories on the cultural beliefs and practices about lightning to Grade 7 Natural Sciences learners. To achieve this goal, I used the following data-gathering methods: a group activity, lesson observations, focus group interviews and journal reflections. The findings of this study revealed that there are indigenous beliefs, practices and knowledge that can be integrated into the topic of electrostatics in Grade 7 Natural Sciences lessons.

The study revealed that there were positive interactions between the learners and the two IKCs. The study also revealed that participation by the learners during the presentations was very high and that the learners were learning during the presentations. After being exposed to the argumentation teaching strategy, the learners expressed their views about the need for a more argumentative learning environment whereby they would be able to express their views, share their ideas and learn from each other.

Learners were able to participate actively, argue and freely ask questions during the group presentations as well as during the presentations by the two IKCs. These learners also suggested

that IK-infused science instruction not only helped them understand school science better but also helped them learn more about their own culture, thus affording them some sense of social identity. Therefore, Ogunniyi's (2007 a, b) argumentation proved to be a useful and powerful instructional method for enhancing the learners' awareness of the scientific and cultural value of an indigenized science curriculum. In addition, it is evident in this study that the explanation of electric discharge helped the learners to link lightning and static electricity. However, despite perceptual changes among the learners, there are still those who held resolutely to the belief that witches could cause lightning. At the same time, they also accepted the scientific explanation of lightning. This dualistic viewpoint is what Ogunniyi (2007a) refers to as an "equipollent cognitive state". According to Ogunniyi(2007a), this mindset is not necessarily good or bad as long as the learners know which worldview is appropriate for a given context. It only becomes a learning hindrance when the two worldviews are incorrectly comprehended (Ogunniyi, 2007b).

Similarly, the study aimed to find out how lessons on electrostatics that integrated IK shifted (or not) Grade 7 learners' conceptions, dispositions, sense making and interest because of the presentations by the two IKCs. The findings revealed that most learners were positively influenced by integrating IK into the topic of electrostatics. The study thus recommends that there is a need for science teachers to earnestly consider their learners' sociocultural backgrounds during their science lessons.

In conclusion, the main findings of this study showed that the integration of indigenous practices and knowledge when teaching the topic of electrostatics to a Grade 7 Natural Sciences class improved social interactions among learners and provided them with a rare opportunity to discuss and argue. That is, social interactions among the learners made it possible for them to argue in class using CAT. Also involving IKCs who are custodians of these indigenous beliefs, practices and knowledge about lightning created a favourable and relaxed environment for both teachers and learners.

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Appendices

Appendix A(1): Ethics Clearance Letter

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Research Ethics Committee
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19 September 2023

Prof Kenneth Ngcoza

Education Department

K.Ngcoza@ru.ac.za

Dear Prof Kenneth Ngcoza and Mr Lindiso Funani

Re: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners

APPLICATION NUMBER: 2023-7186-7987

This letter confirms that your research ethics application has been reviewed and **APPROVED** by the Education Faculty Research Ethics Committee (EF-REC). Your permission letter(s) where applicable have been received and you are free to proceed with your study.

Approval is granted for 1 year. An annual progress report is required in order to renew approval for an additional period. You will receive an email notifying you when the progress report is due.

Should any substantive change(s) be made during the research process, that may have ethical implications, you should notify the Education Faculty REC Chair via email. This includes changes in investigators. The REC Chair will advise as to whether a new application is necessary.

Do keep this clearance letter secure and accessible throughout your study and after its completion. It will be needed when a thesis is examined and when publications are submitted to journals.

Please also submit a brief report to the REC Chair on the completion of the research. This can be done via email. The purpose of this report is to indicate whether the research was conducted successfully and whether any ethics-related matters arose that the committee should be aware of, in order to guide future studies. Sincerely,

Prof Eureta Rosenberg

Chair: Education Faculty Research Ethics Committee

Appendix B1: Letter to the District Director Department of Education

The District Director
Eastern Cape Department of Education
Sarah Baartman District
P/Bag X 1001
Makhanda
6140

Dear Mr Godlo

Subject: Request for Permission to Conduct Educational Research with Grade 7 learners at Archie Mbolekwa Primary School in Sarah Baartman District.

I am Lindiso Funani (Student number: 98F6566), a part- time student doing a Master of Science Education at Rhodes University, South Africa. I am also the School Principal and Natural Sciences and Mathematics teacher at Archie Mbolekwa Primary School. I hereby humbly request your permission to conduct a research study with learners at Archie Mbolekwa Primary School which is in your District starting from the 1st of August 2023 to the end of November 2023. The study will explore mediating learning of electrostatics through stories on cultural beliefs and practices about lightning to Grade 7 township school learners. These learners will be required to:

- Take part in a focus group interview (sharing circles).
- Work in groups to find information on stories on cultural beliefs and related practices about lightning in their homes and community and thereafter present their findings in class.
- Interact with the two community members who will be presenting stories on cultural beliefs and related practices about lightning and then identify any science concepts related to static electricity.
- Engage in hands-on practical activities using easily accessible resources on static electricity.
- Do mind maps and concept maps using the science concepts emerging from the hands-on practical activities.
- Write reflective journals to on their experiences of being involved in my interventionist study and which will hopefully improve their writing skills.

Written consent will be sought from the parents and/or guardians of the learners and from the learners' written assent. I will also work with a Grade 6 Natural Sciences teacher who will be my critical friend in this study. He will observe the learners when making their presentations and the community members (together with me) who will share stories about cultural beliefs and related practices about lightning. Additionally, he will also observe my lessons when doing hands-on practical activities with my learners. We will also reflect on the community members' presentations as well as on my lessons so that I can be able to make some improvements.

I would like to assure your office that, should I be granted permission, the research ethics will apply throughout the process of the study. Identity of the participants and their views will be treated with high degree of confidentiality and anonymity. In the final write-up pseudonyms will be used for the school and for all the participants in order to keep their identities anonymous. The Rhodes University Ethics Committee can be contacted on:

Rhodes University, Research Office, Ethics Coordinator: ethics-commitee@ru.ac.za

Telephone: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707 Room 220, Main Admin Building,

Drostdy Road, Grahamstown, 6139

Your consideration in this regard will be highly appreciated.

Yours Sincerely

LD Funani (Principal of Archie Mbolekwa Primary School and Rhodes University Student

Appendix B2: Letter to the Deputy Principal of Archie Mbolekwa Primary School

The Deputy Principal
Archie Mbolekwa Primary School
Makana CMC
Sarah Baartman District
Makhanda
6140

Dear Miss Joba

Subject: Request for Permission to Conduct Educational Research with Grade 7 learners at Archie Mbolekwa Primary School in Sarah Baartman District.

I am Lindiso Funani (Student number: 98F6566), a part- time student doing a Master of Science Education at Rhodes University, South Africa. I am also the School Principal and Natural Sciences and Mathematics teacher at Archie Mbolekwa Primary School. I hereby humbly request your permission to conduct a research study with learners at Archie Mbolekwa Primary School. The proposed topic of my research is: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners. The study will require the Grade 7 Natural Sciences learners to be co-researchers with me. I intend to conduct this study from the 1st of August 2023 to the end of November 2023. Learner will be required to:

- Take part in a focus group interview (sharing circles). Work in groups to find information on stories on cultural beliefs and related practices about lightning in their homes and community and thereafter present their findings in class.
- Work in groups to find information on stories on cultural beliefs and related practices about lightning in their homes and community and thereafter present their findings in class.
- Interact with the two community members who will be presenting stories on cultural beliefs and related practices about lightning and then identify any science concepts related to static electricity.
- Engage in hands-on practical activities using easily accessible resources on static electricity.
- Do mind maps and concept maps using the science concepts emerging from the hands-on practical activities.
- Write reflective journals to on their experiences of being involved in my interventionist study and which will hopefully improve their writing skills.

This research might help to bridge the gap between science content learnt in the school classroom and the science accessible to learners within their homes and community environment. This study might provide some insights on how IK might influence Grade 7 Natural Sciences learners' arguments and sense making of the topic on electrostatics when the community members share cultural stories about lightning and related cultural practices. Furthermore, the findings of this study might equip me on how to integrate indigenous knowledge in my science lessons which could motivate learners' participation and interest in science.

The lessons will be video recorded by Mr. Sineke (critical friend) who is a Grade 6 Natural science teacher. The lessons will be carried out during my normal lessons and learners are expected to listen and reflect on the presentations by two community members on the traditional beliefs about the causes and dangers associated with lightning and the possible traditional prevention methods. Kindly be informed that participation in this study is voluntary and there are no risks to learners. Learners who decided not to take part in the study will be accommodated as follows; a separate classroom room will be arranged for them, and they will be under the supervision of an education assistant. I will provide activities for those learners to work on. Additionally, they receive extra lessons during free periods or in the afternoon.

Learners who decided not to take part in the study will be accommodated as follows; a separate classroom room will be arranged for them, and they will be under the supervision of an education assistant. I will provide activities for those learners to work on. Additionally, they will receive extra lessons during free periods or in the afternoon. A written consent will be sought from the parents or guardians of the learners and the learner themselves.

Attached to this letter is:

(a) A copy of an ethical clearance certificate issued by the university.

(b) A copy of the research instruments which I intend to use in my research.

(c) A copy of the permission to conduct research letter from the Department of Education.

I would like to assure your office that, should I be granted permission, the research ethics will apply throughout the process of the study. The data collected (hard and soft copies) will be kept in the school safe in the strong room for at least a period of five years. The data collected will be used for reporting in my thesis and publications. The identity of participants and their views will be treated with high degree of confidentiality. In the final write-up pseudonyms will be used for the school and for all the participants in order to keep their identities anonymous. The data that will be collected will not be used for other purposes apart from this study. I am aware, however, that because we will be co-creating knowledge in this study, anonymity is not possible, but I would like to reassure you that ethical standards will be upheld at all times. Upon completion of the study, I undertake to provide you with feedback.

Should you require any further information, please do not hesitate to contact me or my supervisors. Our contact details are as follows Mr Lindiso Funani (lindiso.funani2@gmail.com)Prof Kenneth Ngcoza (k.ngcoza@ru.ac.za)Dr Chrispen Mutanho (chrispenmotahno@gmail.com)

Your permission to conduct this study will be greatly appreciated.

Yours sincerely

Lindiso Funani (Student Number: 98F6566)

The Rhodes University Ethics Committee can be contacted on:

Rhodes University, Research Office, Ethics Coordinator: ethics-commitee@ru.ac.za

Telephone: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707, Room 220, Main Admin Building,

Drostdy Road, Grahamstown, 6139

Appendix B3(A): Letter to the Natural Sciences Teacher (Critical Friend)

Enquiries: Mr. LD Funani
Cell number: 0738399536

Dear …….. (Teacher Name)

Re: **Participation in research on the integration of local or indigenous knowledge when teaching the topic on nutrition in the Grade 6 Natural Sciences class**

I am Lindiso Funani (Student number: 98F6566), a part- time student doing a Master of Science Education at Rhodes University, South Africa. I am also the School Principal and Natural Sciences and Mathematics teacher at Archie Mbolekwa Primary School. I hereby humbly request you to be part of my study as a critical friend to conduct at Archie Mbolekwa Primary School. The proposed topic of my research is: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners. The study will support learners to mediate learning of electrostatics stories on cultural beliefs and practices about lightning. Learners will be required to (a) collect data from community members, (b) present in class, (c) interact with two community members who will be presenting about indigenous knowledge and related cultural beliefs and practices about lightning, and these activities will be observed and videotaped. Your role will be to assist videotape the lessons, assist in co-planning of lessons that include indigenous knowledge and assist observe my lessons since I cannot observe my own lessons. I will videotape and interview the learners and the community members. A written consent will be sought from the parents or guardians of the learners' and the learners themselves. In addition, you will be required to check and verify the findings of the study. I plan to conduct the study from the 1st of August to the end of November.

Kindly be informed that participation in this study is voluntary. It is therefore your right to decide whether you wish to participate or not. Also, participants are free to withdraw at any time as they wish to do so. The identity and views of the participants will not be revealed, and I will maintain anonymity. In the final write-up pseudonyms will be used for the school and for all the participants in order to keep their identities anonymous. The data that will be collected will not be used for other purposes apart from this study. Should you agree to participate in the study, you are reminded that all information and data collected during the study must be kept confidential. The research ethics will apply throughout the process of the study. The data collected (hard and soft copies) will be kept in the school safe in the strong room for at least a period of five years. The data collected will be used for reporting in my thesis and publications.

Should you require any further information, please do not hesitate to contact me or my supervisors. Our contact details are as follows Mr Lindiso Funani (lindiso.funani2@gmail.com)Prof Kenneth Ngcoza (k.ngcoza@ru.ac.za)Dr Chrispen Mutanho (chrispenmotahno@gmail.com

Your consideration will be highly appreciated in this regard. Lastly, if you agree or do not agree to participate in this research, please complete the consent form below.

I …… (full name of the teacher), hereby confirm that I understand the content of this document and the nature of the research. I henceforth request you to indicate your choice by making an (X) in an appropriate box below:

Agree to participate in the study □, Secondly, I am aware that information about the study must be kept confidential and high level of professionalism is expected from myself.

Do not wish to participate in the study □

Signature: ---------- Date: ----------

Yours Sincerely

Lindiso Funani

The Rhodes University Ethics Committee can be contacted on : Rhodes University, Research Office, Ethics Coordinator: ethics-commitee@ru.ac.zaTelephone: +27 (0) 46 603 7727 f: +27 (0) 86 616 7707

Room 220, Main Admin Building,

Drostdy Road,

Grahamstown, 6139

Appendix B3(B): Informed Consent for Critical Friend (participant)

PROJECT TITLE: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners.

Mr Lindiso Funani, currently a master's student at Rhodes University, has requested my permission to participate in the above-mentioned research project. The nature and purpose of the research project and of this informed consent declaration have been clearly explained to me in a language that I understand.

I am therefore aware that:

1. The purpose of this interventionist study is to Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners.

2. I will be interviewed individually twice for a duration of maximum 45 minutes. The interview will take approximately 30-45 minutes and will be audio recorded with my permission.

3. That there will be participatory and observation during this study and I will spend a total of about 6 hours for all. The participatory and observation will be 2 and there will be one per day as I will be visiting the expert community members in their home after working hours. It will last between 2 to 3 hours. During the participatory and observation, data will be gathered through video recording, rich discussions, participant observation, journal reflections. The participatory and observation will be conducted at a place and time that is convenient to two expert community members. None of the participatory and observation be conducted during work hours and only the lesson observations will take place during this time.

4. During the research process, the researcher will conduct lesson observation in Grade 7 Natural Sciences classroom. One lesson observation will be carried at school where the critical friend will observe the lesson.
5. By participating in this research project, I will contribute to knowledge and understanding how the workshops have facilitated my knowledge.

6. My participation is entirely voluntary and should I at any stage wish to withdraw from further participation, I may do so without any prejudice.

7. I understand that participating in this study is voluntary and that I will not be compensated for participating.

8. The names of participants will be blocked in the thesis itself, unless if they express in writing their willingness to have their names included in the study.

9. There may be risks associated with my participation in the project. I am therefore aware of the following steps:

    a) All information shared in the group is strictly confidential and will not be used for purpose other than of the above-mentioned research project.
    b) All the data collected will be kept in a locked cupboard and electronic data will be kept in a computer and hard drive only accessible through a secure password kept by me; and
    c) The researcher intends to publish the research findings in the form of a thesis towards a master's degree in science education, and later present it in conferences or journal articles. However, confidentiality will be maintained.

10. Any further questions that I might have concerning the research or my participation will be answered by the Rhodes Masters student (lindiso.funani2@gmail.com) or the supervisor Professor Kenneth Ngcoza (k.ngcoza@ru.ac.za) and co- supervisor Doctor Chrispen Mutanho (chrismutanho49@gmail.com)

11. By signing this informed consent declaration, there are no legal implications.

12. A copy of this informed consent declaration will be kept in a safe place by the researcher.

I, ……have read the above information or confirm that the above information has been explained to me in a language that I understand. I am therefore aware of this document's contents. I have asked all questions that I wished to ask, and these have been answered to my satisfaction. I fully understand what is expected of me during the research.

I have not been coerced or pressurised in any way, and I understand that anonymity might not be possible because we will be co-creating knowledge in this study. I therefore voluntarily agree to participate in the above-mentioned research project.

…….. …….

Participant's signature Witness

Date …….. Date ……..

Appendix B4(A): Letter to the Community Members

Enquiries: Mr LD Funani
Cell number: 0738399536

Dear Sir

RE: PERMISSION LETTER: PRESENTATION AT ARCHIE MBOLEKWA PRIMARY

I am Lindiso Funani a part- time student doing master's in science education with Rhodes University, South Africa, and a Principal of Eluxolweni Primary School. I am a Natural Sciences and Mathematics teacher at Eluxolweni Primary School. I hereby humbly request your permission to be a research participant in my research project that I will be conducting with my Grade 7 Natural Sciences learners at Eluxolweni Primary School. The focus of the study will explore Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners. I plan to conduct the study from March 2023 to June 2023.

Since we will be focusing on the study on static electricity your main role will be to present to the Grade 7 Natural Sciences learners stories about cultural beliefs and practices about lightning.

Your participation in this study is completely voluntary and you can withdraw at any stage you wish. I will ensure that your identity is treated with high degree of confidentiality and anonymity.

I henceforth request you to indicate your choice by making an (X) in an appropriate box below.

Agree ☐

Not agree. ☐

Signature:.....

Your cooperation will be highly appreciated.

Yours Sincerely

LD Funani

I can be reached at 0738399536 or email (lindiso.funani2@gmail.com)

Note: My supervisor is Prof. Kenneth M. Ngcoza at Rhodes University, email address (k.ngcoza@ru.ac.za)

My co-supervisor Dr Chrispen Motanho, email address(chrispenmotahno@gmail.com)

Appendix B4 (B): IsiXhosa Translation

Imibuzo: Mr LD Funani
Umnxeba: 0738399536

Mnumzana obekekileyo,

Igama lam ngu Lindiso Funani umfundisintsapho kweNzululwazi neZibalo Eluxolweni Primary School. Ndicela ukuba ube yinxalenye kuphando olunxulumene nezifundo zam zakwiDynivesiti yase Rhodes.Uphando lwam ndizakulwenza Eluxolweni Primary School. Oluphando lunxulumene nokuphanda ukuba umdla wabafundi ungakhula okanye udodabale kusini na xa kufundiswa eZenzululwazi kwibanga lesihlanu kudityaniswa ulwazi nenkcubeko efumaneka eluntwini nasekuhlaleni ngokubanzi xa kufundiswa ngombane.

Oluphando luzakugxila kakhulu ekufundiseni nokucacisela abafundi notitshala weNzululwazi ukuba luthini ulwazi lwemveli nenkolo zabantu ngombane. Injongo ephambili yoluphando kukufumanisa ukuba kunakho kusini na ukuhlanganiswa kolwazi lwemveli neZenzululwazi yase Ntshona, ukuzama ukukhulisa umdla wabafundi kweZenzululwazi. Ndiyazithoba ndikucela kananjalo ukuba uzokusifundisa, ngolwazi lwemveli ngombane.

Ndakuvuyiswa yinxaxheba yakho koluphando. Imithetho yeDyunivesiti ke ayibopheleli abathathi nxaxheba lonto ithetha ukuba banakho ukurhoxa nangaliphina ixesha befuna. Ndiyakuqinisekisa nakanjalo ukuba ulwazi olufumaneke koluphando aluyikinikwa nabanina ngaphandle kwemvume yakho. Ukanti, igama lakho aliyikuchazwa esidlangalaleni ngaphandle kwemvume yakho. Siye ke safumanisa ukuba masenze oluphando lokuba sazi ukuba yintoni eyenza umdla nendlela abacinga ngayo abantwana xa beyinxalenye kusenziwa uphando nzulu kwizifundo zeNzululwazi ingakumbi ngofundo lombane.

Ukuba unombuzo malunga noluphando, nceda uqhagamshelane nam klomnxeba, 0738399536, lindiso.funani2@gmail.com okanye iinqgonyela endiphantsi kwazo uProf. Kenneth Ngcoza(k.ngcoza@ru.ac.za) (046-6037269) okwiSebe lwezeMfundo eRhodes Dyunivesiti, kwandye nogqirha Chripen Mutahno (chrispenmotanho@gmail.com)

Ndibamba ngazo zozibini

Ndiyakucela kwakhona ukuba uncede uzalise esisiqendu silandelayo.

Mna Mnumzana.....(igama lakho)

Ndiyavuma ☐ OKANYE Andivumi ☐ (khentha ngokufakela X) kwibokisi

Tyikitya.....

Inombolo yomnxeba.....

Appendix B5(A): Letter to the Parent(s)

Enquiries: Mr LD Funani
Cell number: 0738399536

Dear Sir

RE: Participation in research on the integration of local indigenous knowledge when teaching the topic static electricity in the Grade 7 Natural Sciences class.

I am Lindiso Funani a part- time student doing master's in science education with Rhodes University, South Africa, and a Principal of eLuxolweni Primary School. I am a Natural Sciences and Mathematics teacher at Eluxolweni Primary school. I hereby humbly request your permission to conduct a research study with your child who is studying at Eluxolweni Primary School. I intend to conduct the study from March to June 2023.

The focus of the study is to explore: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners. Kindly be informed that participation in this study is voluntary. It is therefore the right of the parent(s) to decide whether his/her child should participate or not. Also, participants are free to withdraw at any time as they wish to do so. The identity and views of participants will be treated with high degree of confidentiality and anonymity, and the data that will be collected will not be used for other purposes apart from this study.

If you have any questions about the research, please feel free to contact me at 0738399536, (lindiso.funani2@gmail.com) or my supervisor Prof. Kenneth Ngcoza at k.ngcoza@ru.ac.za and Dr Chrispen Mutanho at chrispenmutanho@gmail.com.

Lastly, if you agree for your child to participate in this research, please complete the consent form below.

I.....(full name of parent/ guardian, hereby confirm that I understand the consent of this document and the nature of the research. I hereby give permission to.....(name of the child) to participate in the study.

Yours Sincerely

LD Funani

Appendix B5(B): IsiXhosa Translation

Imibuzo: Mr LD Funani
Umnxeba: 0738399536

Mzali obekekileyo,

Igama lam ngu Lindiso Funani umfundisintsapho kweNzululwazi neZibalo Eluxolweni Primary School. Ndicela ukuba uvumele umntwana wakho ukuba yinxalenye kuphando olunxulumene nezifundo zam zakwiDynivesiti yase Rhodes.Uphando lwam ndizakulwenza Eluxolweni Primary School. Oluphando lunxulumene nokuphanda ukuba umdla wabafundi ungakhula okanye udodabale kusini na xa kufundiswa eZenzululwazi kwibanga lesihlanu kudityaniswa ulwazi nenkcubeko efumaneka eluntwini nasekuhlaleni ngokubanzi xa kufundiswa ngombane.

Oluphando luzakugxila kakhulu ekufundiseni nokucacisela abafundi notitshala weNzululwazi ukuba luthini ulwazi lwemveli nenkolo zabantu ngombane. Injongo ephambili yoluphando kukufumanisa ukuba kunakho kusini na ukuhlanganiswa kolwazi lwemveli neZenzululwazi yase Ntshona, ukuzama ukukhulisa umdla wabafundi kweZenzululwazi.Ndiyazithoba ndikwakucela ukuba uvumele umntwana wakho abeyinxalenye yoluphando.

Ndakuvuyiswa yimvume yakho koluphando. Imithetho yeDyunivesiti ke ayibabopheleli abathathi nxaxheba lonto ithetha ukuba banakho ukurhoxa nangaliphina ixesha befuna. Ndiyakuqinisekisa nakanjalo ukuba ulwazi olufumaneke koluphando aluyikinikwa nabanina ngaphandle kwemvume yakho. Ukanti, igama lomntwana wakho aliyikuchazwa esidlangalaleni ngaphandle kwemvume yakho. Siye ke safumanisa ukuba masenze oluphando lokuba sazi ukuba yintoni eyenza umdla nendlela abacinga ngayo abantwana xa beyinxalenye kusenziwa uphando nzulu kwizifundo zeNzululwazi ingakumbi ngofundo lombane.

Ukuba unombuzo malunga noluphando, nceda uqhagamshelane nam kulomnxeba, 0738399536, lindiso.funani2@gmail.com okanye iinqgonyela endiphantsi kwazo uProf. Kenneth Ngcoza(k.ngcoza@ru.ac.za) (046-6037269) okwiSebe lwezeMfundo eRhodes Dyunivesiti, kwanye nogqirha Chripen Mutahno (chrispenmotanho@gmail.com)

Ndibamba ngazo zozibini

Ndiyakucela kwakhona ukuba uncede uzalise esisiqendu silandelayo.

Mna Mzali/Mmeli.....(igama lomntwana wakho lakho), ka.....

Ndiyavuma ☐ Andivumi ☐ (khetha ngokufakela X) kwibokisi

Tyikitya.....

Inombolo yomnxeba.....

Appendix B6(A): Letter to the Learner

Enquiries: Mr LD Funani
Cell number: 0738399536

Dear.....(Learner Name)

RE: Participation in research on the integration of local indigenous knowledge when teaching the topic static electricity in the Grade 7 Natural Sciences class.

I am Lindiso Funani a part- time student doing master's in science education with Rhodes University, South Africa and a Principal of eLuxolweni Primary School. I am a Natural Sciences and Mathematics teacher at Eluxolweni Primary school. I hereby humbly request your permission to conduct a research study with you as my co-researcher, during teaching and learning of the topic static electricity. the study is to explore Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners. You will be requested to

- Collect data from community members.
- Present in class.
- Interact with community members who will be presenting about indigenous knowledge and related cultural practices about static electricity.

A written consent letter will also be sought from your parent or guardian. I intend to conduct the study in August 2023 to October 2023.

The focus of the study is to explore Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learner. Kindly be informed that participation in this study is voluntary. It is therefore your right to decide whether you wish to participate or not. Also, participants are free to withdraw at any time as they wish to do so. The identity and views of participants will be treated with high degree of confidentiality and anonymity, and the data that will be collected will not be used for other purposes apart from this study.
Please note: Extra support and activities such as worksheets, video lessons and other relevant teaching materials will be provided for all those learners who do not wish to be part of this research and they will not be disadvantaged in any way

If you have any questions about the research, please feel free to contact me at 0738399536, (lindiso.funani2@gmail.com) or my supervisor Prof. Kenneth Ngcoza at k.ngcoza@ru.ac.za and Dr Chrispen Mutanho at chrispenmutanho@gmail.com.

Lastly, if you agree for your child to participate in this research, please complete the consent form below.

I.....(full name of the learner), hereby confirm that I understand the consent of this document and nature of research. I henceforth request you to indicate your choice by making an (X) in an appropriate box below.

Agree to participate in the study. ☐

Do not wish to participate in the study. ☐

Signature:.....

Date:.....

Yours cooperation will be highly appreciated in this regard.

Yours Sincerely

LD Funani

Appendix B6(B): Child Participant's Assent Form

INFORMED CONSENT DECLARATION

(Child participant)

Project Title: Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners

Researcher's name: Mr Lindiso Funani

Name of participant:
……

1. Has the researcher explained what s/he will be doing and wants you to do?

YES	NO

2. Has the researcher explained why s/he wants you to take part?

YES	NO

3. Do you understand what the research wants to do?

YES	NO

4. Do you know that your name and what you say will not be shown to other people?

YES	NO

5. Did you ask the researcher any questions about the research?

YES	NO

6. Has the researcher answered all your questions?

YES	NO

7. Do you understand that you can refuse to participate if you do not want to take part and that nothing will happen to you if you refuse?

YES	NO

8. Do you understand that you may pull out of the study at any time if you no longer want to continue?

YES	NO

9. Do you know who to talk to if you are worried or have any other questions to ask?

YES	NO

10. Has anyone forced or put pressure on you to take part in this research?

YES	NO

11. Are you willing to take part in the research?

YES	NO

_____ _____

Signature of Child **Date**

Appendix B6(C): Isixhosa Translation

Mfundi obekekileyo…… (Igama lomfundi)

Igama lam ngu Lindiso Funani umfundisintsapho kwezeNzululwazi neZezibalo Eluxolweni Primary School (pseudonym). Ndicela ukuba ubeyinxalenye kuphando olunxulumene nezifundo zam zakwi Dyunivesithi yase Rhodes. Oluphando sizakulennza Eluxolweni Primary School. Oluphando lunxulumene nokuphanda ukuba umdla wabafundi ungakhula okanye udodabale kusini na xa kufundiswa eZenzululwazi kwibanga lesihlanu kudityaniswa ulwazi nenkcubeko efumaneka eluntwini nasekuhlaleni ngokubanzi xa kufundiswa ngombane.

Oluphando luzakuthatha izigaba ezintathu. Sigxile kakhulu ukufundisa nokucacisela abafundi notitshala weNzululwazi ukuba luthinina ulwazi lwemveli ngombane kwakunye neenkolo zakwantu. Injongo ephambili yoluphando kukujonga ukuba kungakwazi na ukuhlanganiswa ulwazi lwemveli neNzululwazi yase Ntsona, ukuzama ukukhulisa umdla wabafundi kwezeNzululwazi. Ndiyazithoba ndikwakucela kanjaqo ukuba uzokusifundisa, ngolwazi lwemveli ngombane kwakunye neenkolo zoluntu ezidibene nombane.
Ndakuvuyiswa yimvume yakho koluphando. Imithetho ye Dyunivesithi ke ayibopheleli abathathi nxaxheba lonto ithetha ukuba banako ukurhoxa nanini na xa befuna njalo. Ndiyakuqinisekisa nakanjalo ukuba ulwazi olufumaneke koluphando aluyikunikwa nabanina ngaphandle kwemvume yakho. Ukanti, igama lakho aliyichazwa esidlangalaleni ngaphandle kwemvume yakho. Ukuba uyavuma eyakho indima iyakuquka, (a) ukufilisha imibuzo yophando, (b) uyokufuna ulwazi kubantu abadala ekuhlaleni olungqamene noluphando, (c) wabelane nabanye abafundi eklasini ngophando lwakho, kwa (d) ubeyinxalenye yabafundi abzakufundiswa ziingcali zasekuhlaleni ngolwazi lwemveli olunxulumene noluphando, uzibuzele imibuzo kubo. Siye ke safumanisa ukuba masenze oluphando lokuba sazi ukuba yintoni eyenza umdla nendlela abacinga ngayo abantwana xa beyinxalenye kusenziwa uphando nzulu kwizifundo zeNzululwazi ingakumbi kufundo ngombane.

Ukuba unombuzo malunga noluphando, nceda utsalele umxeba kum kolu 0738399536, (lindiso.funani2@gmail.com), okanye ingqonyela nogqira u Prof.Kenneth M. Ngcoza kulomxeba 046 603 7269, (k.ngcoza@ru.ac.za) okanye Dr Chrispen Mutanho at chrispenmutanho@gmail.com.

Abakwisebe lezemfundo kwi Dyunivesithi yase Rhodes.

Ncincilili!!!

Ndiyakucela kananjalo ukuba uncede uzalise esi siqendu silandelayo
Mna mfundi ……. (Igama lakho).
Ndiyavuma □ OKANYE Andivumi □ (Khetha ngokufaka X) ukuthatha inxaxheba koluphando.

Tyikitya …….

Inombolo yomnxeba …….

Ozithobileyo

Lindiso Funani

INFORMED CONSENT DECLARATION

(Child participant)

Isihloko sophando: *Ukuncedisa ukufunda ngombane usebenzisa amabali agxile kwincubeko nenkolelo zakwantu kwibanga lesixhenxe*

Igama lomphandi : Mr Lindiso Funani

Igama lomthathi-nxaxheba: …….……

1. Ingaba umphandi ukucacisele yonke into azokuyenza kwakunye nafuna wena uyenze?

EWE	HAYI

2. Ingaba umphandi ukucacisele na ukuba kutheni efuna wena uthathe inxaxheba?

EWE	HAYI

3. Uyayiqonda na into ezanywa ekwenziwa ngoluphando?

EWE	HAYI

4. Uyayazi ukuba igama lakho nezinto ozozitsho koluphando azizokuboniswa abanye abantu?

EWE	HAYI

5. Umbuzile umphandi imibuzo nayiphi ngoluphando?

EWE	HAYI

6. Ingaba umphandi uyiphendule yonke imibuzo yakho?

EWE	HAYI

7. Uyaqonda ukuba ungangavumi ukuthabatha inxaxheba koluphando ukuba uyafuna, kwaye akukho nto izakwehlela ukuba akuvumanga?

EWE	HAYI

8. Uyaqonda ukuba ungayeka ukuthabatha inxaxheba koluphando nanini na xa uziva ungafuni ukuqhubeka?

EWE	HAYI

9. Uyazazi ukuba ungathetha nabani xa uziva ukhathazekile okanye unemibuzo ngoluphando?

EWE	HAYI

10. Ukhona umntu okunyanzelisa ngokuthabatha inxaxheba koluphando?

EWE	HAYI

11. Uyavuma ukuthabatha inxaxheba koluphando?

EWE	HAYI

_____ _____

Utyikityo lomfundi **Umhla**

Rhodes University, Research Office, Ethics
Ethics Coordinator: ethics-commitee@ru.ac.za
Telephone: + 27(0) 46037727, Room 220 Main Building
Drosty Road, Grahamstown,6139

Appendix C: Time Frame of Study

Table 1: Prosed time frame for this study

Activity	Start date	End date
1. Writing of research topic	January 2022	January 2022
2. Submission of refined research topic	February 2022	March 2022
3. Submission of the first draft research proposal	April 2022	June 2022
4. Submission of the final research proposal	July 2022	August 2022
5. Submission of refined and edited research proposal	January 2023	March 2023
6. Presenting my research proposal at the SAARMSTE EC CHAPTER	21March 2023	21 March 2023
7. Submission of research proposal to Higher Degree Committee	March 2023	April 2023
8. Submit a draft literature review, methodology chapters to my supervisor	April 2023	May 2023
9. Data collection	May 2023	June 2023
10. Data analysis and discussion of findings	July 2023	August 2023
11. Submit research first to my supervisors	September 2023	October 2023
12. Submission of final full thesis for examination	November 2023	December2023

Appendix D: Data Collection Method

TABLE 2: Shows the tools, methods, and the purpose for the gathering of information

Stage	Method to be used to gather data	Purpose	Research questions
Stage 1	Focus Group Interview (sharing circles)	To establish the stories about cultural beliefs and practices about lightning that the Grade 7 learners know from their homes and the community	1
Stage 2	Presentations by expert community members and participants observation	Expert community members present stories on cultural beliefs and practices about lightning	2
Stage 3	Participatory and observation	How learners interact and learn during the presentation by expert community members	3
Stage 4	Lesson consolidation	Lesson consolidation focusing on science concepts on lightning emerged from the presentations by the expert community members	2
Stage 5	Journal reflection	To find out how the Grade 7 learners' conceptions, dispositions and interest towards science or not as the result of the presentations by the expert community members on stories about cultural beliefs and practices on lightning	1 & 3
Stage 6	Focus group interviews	To ascertain the learners' conceptions disposition and interest towards science after the intervention	3

Appendix E: Focus Group Interview Schedule

1. What stories about cultural beliefs related to lightning you know from your homes and community?

2. What stories about cultural practice related to lightning you know from your homes and community?

3. What relevance does local knowledge of lightning from your home or community have at school?

4. What traditional practices at your home or community do you know about lightning? How are these related to science taught at school?

5. What local knowledge do you think would be important for learners to learn static electricity?

6. What else would you like to share with me regarding the integrating of local knowledge in science lessons

Appendix F: Group Activity Questions

1. What do you understand by the term local knowledge?
2. What are your views on the integration of local knowledge in science lessons?
3. What do you think could be the challenges for integrating local knowledge in teaching static electricity?
4. What are some traditional beliefs that you know from your home or community related to lightning?
5. What are some traditional practices that you know from home or community related to lightning?
6. What relevance does local knowledge of lightning from your home or community have at school?

Appendix G: Observation Schedule (adapted from Nikodemus, 2017)

Research Question 3:

How do the presentations by the expert community members on stories about cultural beliefs and practices about lightning and consolidation thereof enable and/or constrain Grade 7 Natural Sciences to argue and make sense of the topic static electricity.

Name of the school…….....Observation Date ……Grade……

Subject: ……... Number of Learners: …….

Lesson Topic: ……. Observer: …….

Social interactions	**Remarks**
The participation of learners during the lesson	
The interaction of learners in class with one another	
The interaction of learners in class with the teacher	
The interaction of learners with the community members	
How learners take other learners' views	
How learners are motivated in the lesson	
How learners treat one another	
Learners' courage to respond to their peers' thoughts and discussion	
Other things:	

Language	**Remarks**
The use of English and how it impacts participation	

How home language is used in class	
How learners' everyday experiences and ways of talking and knowing are expressed during the lesson	
Other things:	
Learner engagement	**Remarks**
The involvement of learners in active learning	
How learners are sharing information	
Learners' participation opportunity in questions and activities	
Learners' openness and interest in the lesson	
Others things:	

Attitudes	**Remarks**
Learners' view on IK	
Learners' interest in IK	
Leaners' enjoyment of the lesson as a whole	
Learners' feelings about the use of IK in the lesson	
Learners' attitudes before and after the lesson where IK is integrated	

Appendix H(A): Group Interview Transcriptions

Title

Mediating Learning of Electrostatics through Stories on Cultural Beliefs and Practices about Lightning to Grade 7 Township School Learners

The researcher is interested to find out the effect of integrating indigenous knowledge (IK) when teaching the topic of electrostics in grade 7 Natural Science class.

Researcher: Tell me about your experience in attending Natural Science lessons.

Group:

Researcher: What do you think are the reasons for your experiences that you have just mentioned

Group:

Researcher: How did you find the inclusion of indigenous knowledge during the teaching of static electricity

Group:

Researcher: Did the presentation made by the community members helped you to understand the topic of static electricity?

Group:

Researcher: What do you think are the reasons for your experiences you have just mentioned?

Group:

Group: Is there anything that you would like to suggest to whoever is responsible for science curriculum, so that learners can master the subject?

Group :

Appendix H(B): Collated and Colour Coded Responses from Focus Group Stimulated Recall Interviews

Question	Transcription	Similar statements	Sub-themes
1	**Responses from SKs** I enjoy sometimes, but sometimes it's hard. I don't always understand Natural sciences. Its ok but the concepts are difficult **Responses from AEs** The experience is good but the terms who being used are difficult Physics is hard. I don't know sometimes I enjoy sometimes I don't. Natural Science is not easy but I think I get it now. **Responses from EKs** I enjoy the lessons. Ngamanye amaxesha andiyazi nokuba kuthiwani, kodwa ngoku	Green: Dispositions Grey: On involving community members Yelow: Sense making Purple: Level of understanding	Positive dispositions Level of understanding Positive attitude towards the involvement of community members

	ndiyayilandela (Translation: sometimes I don't really understand, but now I understand). Iyo iNatural Science ayidlali, andiyiva nalento isencwadini, kubhetere noko ngoku (Translation: With a sigh, Natural science its hard, I don't even understand what is in the textbook) The lessons are fun		
2	**Responses from LGs** I like the presentations by the community member. The practical are nice and they make me understand. Ilanguage yinngxaki, nemibuzo ndingayiva (Translation: language is the problem, even the questions I don't understand). INatural Science icomplecated hayke iconcepts ziyandiconfuza zona (Translation: Natural is complicated, the concepts are confusing me).		

	Responses from EBs I think I need to work on the calculatios and maybe the teacher must help me with those calculations. Sometimes I don't follow in class and the textbook does not help me. Kuyaxhomekeka kwenziwa ntoni, like ngokuya bekukho abatata bekumnandi elwandle (Translation: It depands on what we are doing, like the time when the community members were presenting, it was nice at the sea) Maybe it's my attitude okanye yilandlela etitshwa ngayo, andiyazi (Translation: Maybe it's my attitude or it's the way it's being taught, I don't know). **Responses from SKs** Ndiyayithanda lento kubizwa abatata basicacisele ngolwazi abanalo(Translation: I like it when we invite the community members, to		

	explain things Lendlela kutitshwa ngayo ngoku ndiyayithanda (Translation: I like the way it is taught to us now) I Natural iyandibhida (Translation: Natural science confuses me I don't have a problem with Natural Scienc I understand what is being taught.		
3	**Responses from 6Gs** It was interesting I liked it. Abatata bacacisa kakuhle kwaye banika umdla (Translation: The community members explain well and they make it exciting) Ezinye izinto zenza isense kodwa ezinye andikaziqondi (Translation: some things make sense but I still don't understand other things)		

	Ininzi into esingayifunda kubantu abadala ngolwazi lwemveli (Translation: there is a lot that we could learn from the community members about indigenous knowledge. **Responses from EBs** I enjoy talking about local knowledge. Ezinye izinto abazithethileyo asiqali ukuziva, njengento yokuba akufuneki ume phantsi komthi xa kubanek (Translation: Some of the things they mentioned we have heard them before, like the belief that you do not stand under a tree when there is a lightning storm). Ndiyithandile lento yokuloba bekumnandi (Translation: I enjoyed fishing, it was nice). I liked it when they were explaining about how you protect yourself and your house when there is lightning it was interesting. **esponses from AEs** I find it interesting. It was fun.		
	I have learnt a lot from it.		

	Some things don't make sense		
4	**Responses from EKs** Yes **Responses from 6Gs** Yes **Responses from SK** Yes		
5	**Responses from EBs** Yes **Responses from LGs** Yes **Responses from SKs** Yes		

Appendix I(A): Journal Reflections

Instruction: Answer all the following questions

1. What have you learnt from these lessons?

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2. What have you enjoyed in this lesson?

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3. What have you <u>not</u> enjoyed in this lesson?

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   ……

   ……

4. What have you learn from the community members' presentation

   ……

   ……

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5. Did the presentations by the community members change (or not) your views about science?

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……...

Appendix I(B): Learners' Journal Reflections Colour Coded

Questions	L11FJ	L15MJ	L16FJ	L19FJ	L28FJ	L14MJ	L26MJ	L30FJ	L33MJ	L34MJ	L31FJ	L35MJ
1. What have you learnt from these lessons	I have learnt how the lightning is fromed	I have learn that air is an insulator	I know that it is dangerous to stand under a tree when there is lightning	I have learnt knew concepts such proton, electrons	I know that mirrors do not attract lightning	I have learnt that I should not touch water when there is lightning storm because water is a good conductor of electricity	I have learnt about forces	I have learnt that there are herbs that you can mix to protect yourself from lightning	I have learnt about electric charges	I learnt that lightning is science	I learnt that like charges repel	I learnt about charges
2.What have you enjoyed in this lesson?	Enjoyed working with my group	Enjoyed the manner Otata presented the lesson we were free	I enjoyed hering what my Grand father normally tells me about lightning	I enjoyed the stories Otata told us about lightning	I enjoyed speaking in the lesson	I enjoyed when we were taken photos during the lesson	I enjoyed learning what I know	I enjoyed the lesson because it was easy	It was presented in isiXhosa	I enjoyed the lesson because I used knowledge, I have from home to discuss lightning	I liked to be given a chance to speak in a science lesson	I enjoyed groups presentations

3.What have you not enjoyed in this lesson?	Community member couldn't produce evidence to backup their claim	I enjoyed everything about the lesson	There is nothing I did not enjoy	Other learners were forcefull when they were arguing	Other learners were dominating	I enjoyed the presentation	They have less time	Nothing, agained more	Science concepts	I enjoyed everthing	Asked to present	They have no evidence
4.What have you learn from the community members' presentation?	they are more knowlaegable	Don't stand under a tree when there is lightnin	Tires cannot prevent being struck because lighting is more powerful	Covering a mirror does not prevent lightning strike	Herbs that can prevent lightning I cant wait to tell my mother about it	Learnt about ancestors who are protecting us	Isixhosa made me to understand the lesson more	Not to touch water when there is lightning	Not to play outside when there is lightning	Do not stand in the house because lightning struck taller object	Do not play outside when there is lightning	Do not touch a Fence with wet hands
5. Did the presentations by the community members change (or not) your views about science?	It changed me I now like science	I now uderstand the topic better	It made me to be eager to go toscience lessons	It made me enjoy science	I wish they could come again	**I now like science**	If they include the knowlaedge fron home I will be happy	They made the topic easy to understand	They presented what we know and mixed it with science	I want to attend more lessons like this	I will not miss science classes again	I learnt a lot From them And the teacher I still believe that Witches do send Lightning but Again I believe Lectrons and Protons cause lightning