An investigation on how grade 8 learners make meaning of static electricity through exploring their cultural beliefs and experiences about lightning: A case study

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature: .... Date:..

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DEDICATION

This thesis is dedicated to my daughter Rachel Hauwanga who was born while I was busy with this course and to my son Rhobben Hauwanga who missed my attention as a mother during this course. They should be committed to education and grow academically in future.

ABSTRACT

Lightning as a natural phenomenon is shallowly presented in the Namibian curriculum documents such as the syllabus and textbooks. This gap in curriculum triggered my interest to investigate whether learners' meaning-making in static electricity was enabled or constrained by elicitation and integration of their cultural beliefs and experiences about lightning and by their practical activities. This study was conducted with my grade 8 learners at the school where I am currently teaching. The school is located in a rural area in Ohangwena region in Northern Namibia.

The study is situated within an interpretive paradigm. Within the interpretive paradigm, a qualitative case study approach was adopted. I considered this methodological orientation appropriate in this study as it allowed me to use the following data gathering methods: document analysis, brainstorming, discussions and presentations, semi-structured interview, focus group interview, observation and an assessment test. Multiple methods to gather data were used for triangulation and validation purposes. For data analysis purposes, the data sets were colour-coded to derive themes and analytical statements. Ethical considerations were also taken seriously in this study and all participants gave consent.

An analysis of data revealed that there is no learning objective or basic competence in the Namibian Physical Science syllabus for grade 8-10 that requires learners to bring in their cultural beliefs and experiences, in particular, about lightning. Yet the study revealed that learners possess a lot of prior everyday scientific and non-scientific knowledge and experiences about lightning that they had acquired from their communities. Also, mobilization of learners' everyday knowledge and experiences about lightning enabled learner engagement during the science lessons. Likewise, engaging learners in practical activities in static electricity helped them to make meaning of scientific concepts. Based on my research findings, I therefore, recommend that learners' prior everyday knowledge and experiences about lightning should be incorporated during teaching and learning of the topic on static electricity.

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LIST OF ABBREVIATIONS AND ACRONYMS

FGI:	Focus group interview
IK:	Indigenous Knowledge
IKS:	Indigenous Knowledge Systems
LoLT:	Language of learning and teaching
MoE:	Ministry of Education
MoEC:	Ministry of Education and Culture
OB:	Observation
PCK:	Pedagogical content knowledge
PEEOE:	Predict, Explain, Explore, Observe, Explain
SSI:	Semi-structured interview
SWAPO:	South West Africa People's Organisation
ZPD:	Zone of Proximal Development

Chapter One

Research Context

1.1. Introduction

This chapter introduces my study which explored the possible incorporation of learners' prior everyday knowledge and experiences about lightning with a view to enhance meaning making of static electricity. In this chapter, I therefore briefly outline the background of the study, curriculum reform in Namibia, context of my study, research goal and questions, motivation of the study, definition of key concepts as well as the organization of the thesis. I end the chapter with some concluding remarks.

1.2. Background of the study

As a learner I attended one of the disadvantaged schools in Namibia and I had very little understanding of the science content knowledge that was taught. For example, during science lessons we were merely expected to memorise information from the textbooks without carrying out any experiments or practical work ourselves. Consequently, the only way to learn was to memorise the important facts of science just in order to pass the examinations. I did not even know that the things that we were taught really existed.

Furthermore, even though as learners we had our own perspectives on how the world works, such experiences were rarely explored during classroom discussions. To mention just one example at our homes we carry out separation of mixtures like using a sieve to separate '*mahangu*' (millet) flour from grains, fermentation and simple distillation when making traditional beverages.

In the ten years I have now been teaching physical science in schools located in remote areas. I have experienced how difficult it is for learners to understand scientific concepts when they are only taught the theoretical part of the subject so that science is not made relevant to their everyday lives. It is my belief, therefore, that engaging learners in practical activities facilitates conceptual development and understanding; even more so when their prior everyday knowledge and experiences are taken into consideration. I have also realised the need for and importance of preparing learning and teaching support materials (LTSMs) that are relevant to learners' everyday lives as proposed by Czerniewicz, Murray and Probyn (2000) as tools for facilitating learners' scientific conceptual development and understanding.

1.3. Curriculum reform in Namibia

Before independence in 1990, teaching in Namibia was mostly teacher-centred. Teachers acted as the masters of all knowledge while learners were perceived as recipients of such knowledge. This resulted in learners memorising important scientific concepts without understanding. As a result, some learners became frustrated and even developed negative attitude towards science subjects.

After independence, however, the education system was transformed into education for all and was underpinned by learner-centred pedagogy which is informed by the constructivist perspective. In addition, the National Curriculum for Basic Education in Namibia puts emphasis on empowering learners for the future development of Namibia as a knowledge-based society (Namibia, Ministry of Education (MoE), 2010).

A knowledge-based society is defined as an effective involvement of society and wise use of existing knowledge which leads to the creation of new knowledge (MoE, 2010). As a consequence of its reform, the new Namibian school curriculum requires teachers to shift from the textbook and content-based education to an education in which learners refer to their everyday knowledge in order to learn new scientific concepts, principles and skills. There is a need to fully appreciate that Namibia's current school curriculum focuses on the inclusion of learners' prior everyday knowledge and insists on learners' engagement in practical activities.

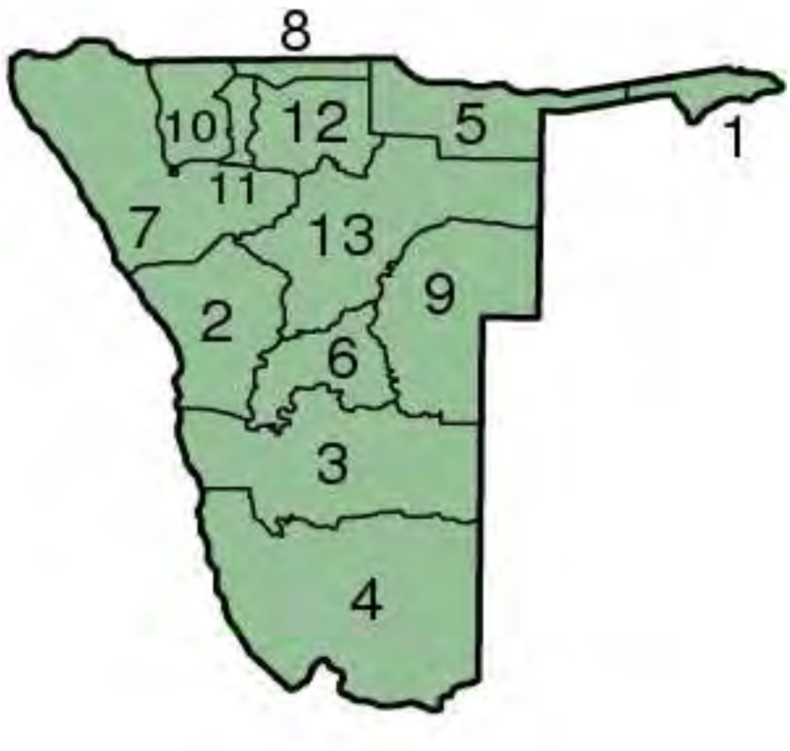
However despite these reforms, Namibia's educational statistics shows that in most schools, in particular, in rural areas learners still perform poorly in physical science national external examinations (Namibia, MoE, 2008, 2009 & 2010). This could be due to the way the subject content is approached and delivered to the learners. Everyday teaching may lack inclusion of learners' everyday knowledge and even fail to engage them in practical activities.

These contextual realities form the backdrop to my interest in finding ways to improve the understanding of science in learners and their performance in science. The investigation is thus premised on the assumption that learners' cultural beliefs and everyday experiences is a factor in the learning of science. This assumption is encouraged by the claims of a number of educational studies that one can enhance science learning by linking some science teaching to learners' everyday knowledge (Stears, Malcolm & Kowlas, 2003; Oloruntegbe & Ikpe, 2011; Rennie, 2011).

1.4. Context of the study

This research study was conducted at Ndida Combined School (pseudonym) in Ohangwena Region (see Map below).

Figure1: Namibian Map showing 13 political regions



1. Caprivi
2. Erongo
3. Hardap
4. Karas
5. Okavango
6. Khomas
7. Kunene
8. Ohangwena
9. Omaheke
10. Omusati
11. Oshana
12. Oshikoto
13. Otjozondjupa

This school has an enrolment of 986 learners with a staff complement of 29 teachers including the principal. This means that the teacher – learner ratio is 1:34. Being located in the northern Namibian region of Owambo, all learners at this school speak the same local language which is the Oshiwambo language.

Even though this study did not aim at researching learners' languages profile, it is important to take language into consideration as learners are taught and learn in English as their medium of instruction. Yet English is a second language for both the teachers and learners at this school.

Since the study was carried out with a group of a grade 8 class, all learners in this class group speak and understand Oshiwambo well. It is unfortunate that, even though the language of learning and teaching (LoLT) is English, none of these learners are exposed to English language outside the school. This is due to the fact that their parents and the community speak only the Oshiwambo language.

Therefore, learners are taught in the second language which they as well as their teachers are not exposed to and are not fluent in. As a result a lot of code-switching takes place during teaching and learning (Probyn, 2009). In addition, the fact that learners are taught in the language that their parents do not understand means that learning support from parents is hardly possible. Such learners depend only on their teachers for learning.

Some challenges that learners and teachers experience during rainy seasons in this region

The Ohangwena region is one of the northern regions that are often affected by floods. Since the school where the research was carried out is situated in this region, it also faces challenge. During rainy seasons, between February and April, from 2008 until the present, the rivers have been prone to floods. Hence, some teachers and learners have to cross wide and deep rivers to school and back home every day (see Photographs below). This situation forces schools to suspend classes for some weeks while water drops to a level where it is safer to walk through.

Figure 2: ***Teacher checking the depth of water***

Figure 3: ***This is how learners at Ndida CS struggle to reach school and home during floods***

During these floods, many houses are washed away leaving the affected families without roofs over their heads. The Namibian government and other organisations usually provide tents as temporary accommodation for those who are affected. Even though these families are provided with food by the government, this is not enough to satisfy school-going children. As a result, the affected learners may come to school hungry and this has a negative effect on their academic performance.

The school being a victim of floods also faces a challenge that many teachers are tempted to transfer to schools which are not affected by floods and to schools with easy access to basic services such as roads e.t.c. As a result, this school has six long-serving and experienced teachers who have transferred to other schools between January and May 2012. Four of the six transferred teachers are science and mathematics teachers, one is a language teacher and one is a grade one teacher. Due to the lack of qualified teachers, the school was forced to recommend unqualified teachers to teach on a temporary basis.

1.5. Research goal, objectives, question and sub-questions

The main goal of this research study was to investigate how eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning making in static electricity.

Research objectives:

1. To explore whether curriculum documents and grade 8 physical science textbooks take into consideration learners' prior everyday knowledge and experiences about the natural phenomenon of lightning in static electricity;
2. To explore and integrate learners' cultural beliefs and experiences about lightning;
3. To investigate whether mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning-making of scientific concepts;
4. To understand how engaging learners in practical activities associated with lightning can facilitate meaning-making in static electricity; and
5. To understand what scientific concepts learners acquire when their cultural beliefs and everyday experiences about lightning are considered in conjunction with practical activities in static electricity.

To achieve this goal and objectives, the following main research question and sub-questions were asked:

Research question

Does eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enable or constrain meaning making in static electricity?

Sub-questions:

1. Do the curriculum documents and textbooks consider learners' prior everyday knowledge and experiences about lightning in static electricity? I analysed a physical science syllabus for grade 8-10 and two different physical science textbooks for grade 8 to answer this sub-question.
2. What are the learners' cultural beliefs and everyday experiences about lightning? Brainstorming, discussions and presentations were used to answer this question.
3. Does the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts? I answered this question by using interviews, practical activities with worksheets, videotaped lessons and observation.
4. How can engaging learners in practical activities associated with lightning facilitate meaning-making in static electricity? This question was answered by using practical activities with worksheets, interviews, videotaped lessons and an assessment test.
5. What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated into teaching science in conjunction with practical activities in static electricity? This question was answered by using focus group interview, practical activities with worksheets, and an assessment test.

1.6. Problem statement

This research study investigated whether mobilising and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning-making in static electricity.

Lightning is a natural phenomenon which is an example of static electricity at a large scale. This phenomenon is normally presented as mere example of static electricity or defined as a form of discharge in grade 8 textbooks and Namibian school syllabus for grade 8-10. Lightning as a natural phenomenon, an example of static electricity in everyday life and a form of discharge bears quite a number of cultural beliefs and experiences of which some of them are scientific and others are non-scientific. Unfortunately, lack of reflecting such beliefs in the school syllabi leads teachers into merely naming lightning as an example of static electricity without in-depth discussion about the phenomenon and without including learners in science lessons. As a result learners end up acquiring shallow or superficial understanding or do not understand how static electricity really happens.

This study endeavoured to incorporate learners' everyday knowledge and experiences about lightning in conjunction with practical activities in static electricity with a view to engaging learners in science learning and enhancing scientific conceptual development.

1.4. Significance of the study

The study provided me with an opportunity to develop my own learning and teaching support materials (LTSMs) using various resources rather than relying only on a textbook as a source of information when teaching and learning static electricity.

During this study, I endeavoured to engage learners in practical activities in static electricity preceded by involving their cultural beliefs and experiences about lightning. This strategy was useful in improving learners' acquisition of skills to predict, manipulate equipment, observe, record, analyse data, present and draw conclusions. This approach of teaching and learning science arouses learners' interest in science.

I believed that by approaching this topic from a different angle this would lead to learners' everyday experiences being involved in science teaching and learning. In addition, the cultural beliefs and experiences about lightning of Namibian people, especially Oshiwambo speaking community, would be documented. The findings of this study and comments might inform the curriculum reform in Namibia and other countries.

1.7. Definition of key concepts

Prior knowledge is the knowledge acquired from different subjects or previous lessons.

Prior everyday knowledge is the knowledge acquired from home which can be both indigenous and scientific knowledge.

Indigenous knowledge is the local knowledge acquired through social interaction in a community or families. Indigenous knowledge is specific to the particular community.

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

Experience is knowledge or skill from doing, seeing or feeling things.

Conceptual development refers to gradually increasing or expanding the content of particular concepts in order to create more understanding of them. For example, teaching electricity in each of the grades 6-10, better and more understanding is created as the content keeps on increasing. Learners could be assisted to develop new concepts through using a variety of teaching approaches or strategies.

Meaning-making is when learners are able to make sense of the new concepts emerging in the topic being taught. It deals with the issue of whether learners are able to relate a particular situation to what they know or experience.

Mediating learning is the quality of interacting between a learner and a teacher as a mediator. The teacher develops her own repertoire of methods depending on the size of the class, the apparent ability of the learners, the subject matter and availability of resources. The process of such interaction enables a learner to create a mental representation of the mediator' intentions. This can be done through various ways for example, language, analogy, pictures, practical activities, field work and many more.

Practical activities as opposed to practical work refers to the activities that enable the learners to put into practice the theory and skills they are studying, often in a practical setting. Practical activities engage learners in field work, presentations and working in laboratories. It is influenced by a range of activities that requires careful planning and clear identification of the purpose of the activities. Practical work is any teaching and learning activity which at some point involves learners in observing or manipulating real objects.

PEEOE (Predict, Explain, Explore, Observe, Explain) **approach** is the learning process that allows learners to bring in the lesson their prior understanding about an idea or theory (predict), they explain such idea/theory and carry out an experiment in order to find out about the idea or a theory whereby they make comparisons between experiment results with their own prior understanding and then draw conclusions based the outcome of an experiment.

Learner-centeredness refers to the approach to teaching and learning which regards learners as central in the learning process. Teaching is planned in such a way that new knowledge is based on refining the prior knowledge of learners to create new understanding. A learner can construct meaningful and coherent representation of knowledge when supported and given instructional guidance as time goes on. A learner is allowed to link information with existing knowledge in meaningful ways. Learners talk and act more than being 'sit and listen'.

1.7. Thesis outline

This thesis documents the findings of my research study whose focus was on investigating how eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning making in static electricity. It consists of seven chapters.

In **Chapter One**, I presented the background of the study, curriculum reform, context of the study, research goal, main question and sub-questions, problem statement, significance of the study, definition of concepts, thesis outline and concluding remarks

Chapter Two is a discussion of the literature informing this study which looked at curriculum issues and the conceptual framework which explains about indigenous knowledge, static electricity, lightning and practical activities. I also discuss the theoretical framework underpinning the study which encompasses constructivism, in particular, the socio-cultural perspective and pedagogical content knowledge.

Chapter Three discusses the methodology whereby I give the insight of how the study was approached and the paradigm that underpins the research project. First, the research goal, main question and sub-questions are given. The chapter also illuminates the data generation techniques, describes with reasons, how each method was used to generate data and indicates the research question answered by each method. I also explain how the data were analysed, give the ethical considerations, limitation of the study and I then draw some concluding remarks.

Chapter Four presents the data generated using brainstorming, group discussions and presentation, as well as data gathered from the community, followed by concluding remarks.

Chapter Five presents the data generated using various methods which are: document analysis (Physical Science for grade 8-10 and two Physical Science textbooks for grade 8), practical activities using worksheets, observation, interviews and assessment test.

Chapter Six documents the analysis, interpretation and discussion of the data as presented in Chapters Four and Five, drawing on the literature discussed in Chapter Two. In this chapter, I tried to make sense of research outcomes as they answer the research question and sub-questions outlined in Chapters One and Three.

Chapter Seven is a conclusion of the study. Recommendations based on the findings and areas for future research are given as well as the limitations of their application.

1.8. Concluding remarks

In this chapter, I discussed the background of this study. I started by discussing my own experience as a learner and then as a teacher. I also gave the picture of the Namibian curriculum prior to independence and after independence. Then, the chapter also looked at the learners' language development. I reviewed the motivation of the study and the challenges facing the school where the study was carried out. Finally, I outlined the chapter organisation of the thesis. The next chapter discusses the literature reviewed in this study.

Chapter Two

Literature Review

2.1. Introduction

The focus of my study was on eliciting and integrating learners' cultural beliefs and everyday experiences about lightning to support meaning making in static electricity in the Namibian context. This chapter thus discusses the relevant literature reviewed for this focus.

The chapter also describes literature on conceptual frame works such as: learners' prior everyday knowledge, indigenous knowledge system (IKS), ideas about static electricity and lightning as well as practical activities. I also discuss the theoretical frameworks which informed the study, namely: the socio-cultural and social constructive perspectives and pedagogical content knowledge (PCK). Lastly, some concluding remarks are provided based on the discussions.

2.2. Curriculum issues

Before independence in Namibia, very few children went to school. That resulted in most children not studying far. Furthermore, the type of education that was given to black Namibians was vocational utility which was intended to prepare learners for a specific job to justify the requirements for German and South African education system (Namibia. Ministry of Education and Culture [MoEC], 1993, p. 2). It could be argued that the education system was underpinned by acute disparities, inequality and tensions. Policies of racial discrimination have also left a legacy of differential allocation of resources to different racial groups.

At independence in 1990, however, the education system was reformed. The inequality in education led the South West Africa People's Organisation (SWAPO) leaders to reform the educational curriculum. The goals of education were formulated as: *access*, *equity*, *quality* and *democracy* (MoE, 1993) and the education system was underpinned by the learner-centred philosophy. Therefore teachers as implementers of the curriculum are required to value themselves as active participants who can implement the curriculum successfully.

Teachers must also have sufficient autonomy in order to be able to implement the curriculum materials successfully (Namibia: MoEC, 1993).

Thus, the curriculum aims at providing a coherent and concise framework in order to ensure that there is a consistent delivery of relevant knowledge in schools (Namibia: Ministry of Education [MoE], 2010). For this to happen, however, the curriculum needs to incorporate the indigenous knowledge of the immediate society (where possible) where learners come from and use that local knowledge to explicate the nature of science. This suggests that the curriculum should be adjusted to fit learners' different contexts in different places.

It is acknowledged, however, that not all science topics can accommodate the indigenous knowledge and not all teachers know how to incorporate or integrate such knowledge. Different teachers come from different communities with different indigenous knowledge. This might make it difficult for such teachers to integrate learners' indigenous knowledge that the teachers do not necessarily understand themselves.

Barab and Luehmmann (2002) assert that teachers are responsible for adopting the curriculum for their local use. They further challenge the curriculum designers to develop curricula and provide support to teachers for the adaptation of curriculum content to meet the local needs and goals. However, in my view, teachers should not wait for the curriculum to explicitly explain everything for them. A committed and knowledgeable teacher who is innovative may find her own way of adjusting the curriculum to fit the learners' context.

The National Curriculum for Basic Education of Namibian schools (MoE, 2010) indicates that teaching should embrace what the learners already know and can do. This will result in acquisition of new knowledge through ways of working which are relevant and meaningful for them, and show them how to apply knowledge creatively and innovatively (MoE, 2010; Oloruntegbe & Ikpe, 2011; Rennie, 2011; Kuhlane, 2011).

Oloruntegbe and Ikpe (2011) assert that teachers should teach in such a way that learners are able to connect science to their everyday experiences and be able to also realise how everyday experiences can be applied to school science. Rennie (2011) too posits that teachers deal with everyday knowledge that arises from the community.

So, teachers need support or training in teaching such knowledge. Helping learners to learn about and use science in everyday contexts requires a teacher to be well equipped in terms of both content knowledge and pedagogical content knowledge (Shulman, 1986). Shulman asserts that some of the knowledge that learners bring in the classroom are misconceptions. Therefore teachers need knowledge of the strategies on how to reorganise learners' understanding fruitfully. Using knowledge in different contexts often requires significant adaption of that knowledge by knowledgeable teacher so that it can suit new context.

It is further indicated that the implementation of the content in science should be school contextualised to fit learners' context and culture (MoE, 2010; Rogan & Grayson, 2003). However, curriculum contains themes and topics that are on a variety of scales to meet international education requirements (MoE, 2010). These learners should be taught so that they would be able to work effectively, independently in groups, build on their own learning experiences, cultural background and follow the preferred learning style.

It is suggested that learners should be active participants in the learning process in order to build a meaningful understanding of concepts which they can apply in their lives (Rogan & Grayson, 2003). Rogan and Grayson's idea is that the curriculum requires learners to be viewed as active knowledge constructors instead of being passive recipients of knowledge. They should be allowed to bring in or use their everyday experiences rather than receive knowledge transmitted by the teachers. It should be emphasised though that a teacher's role is very important in ensuring that learners' misconceptions are cleared up and correct concepts are learnt.

It is pointed out that the curriculum structure must not treat knowledge as a load (Namibia: MoEC, 1993). Teachers are therefore urged where possible, to use local examples to illustrate scientific issues, concepts and processes that are relevant to facilitate learners' understanding. This means that learners need to be taught in such a way that their everyday experiences are taken into consideration during teaching and learning repertoires. By so doing they might be able to share their knowledge in developing their communities and maintaining their environments. They might be able to analyse, synthesise, imagine, explore, criticise, create, understand and to use the knowledge they have gained in science classrooms (MoE, 2010). Yet, a closer look at the Namibian curriculum shows that it fails to state clearly how teachers should incorporate the use of indigenous knowledge in science lessons.

2.3. Conceptual framework

2.3.1. What do we understand about IKS and IK?

Indigenous refers to the root, something natural (Odora-Hoppers, 2001). Van Wyk (2002) refers to indigenous as a sense of belonging in a certain environment. Furthermore, he argues that indigenous knowledge (IK) stands for an idea or system of thought peculiar to the so-called natives of a particular geographical location or socio-cultural environment.

To Ogunniyi and Ogawa (2008, p. 177-178), by Indigenous Knowledge Systems (IKS) is meant the combination of knowledge systems encompassing technology, philosophy, social, economic, learning or education, legal and governance systems. Van Wyk (2002) infers that indigenous knowledge system is a brand framework thinking about context, seeking to problematise the insufficient integrations of the cultural, social and the canonical – academic dimensions of natural science and technology.

Kibirige and Van Rooyen (2006) too argue that indigenous knowledge is a "legacy of knowledge and skills unique to a particular indigenous culture and involving wisdom that has been developed and passed on over generations". According to Hewson, Javu and Holtman (2009, p.5), "IK enables learners to learn science within their cultural context", affording learners an opportunity to work with the materials that are familiar to them. This facilitates their understanding so that they can find the science subject enjoyable.

2.3.2. Learners' prior everyday knowledge

Prior everyday knowledge is the knowledge that learners bring to the class from home which can be both cultural and western knowledge. For example, learners may be warned by parents to switch off the radio when it is thundering, which is western knowledge. At the same time, learners culturally believe that, when it is raining and thundering 'twins and twins' mother then should chew charcoal. Such knowledge needs to be elicited and misconceptions cleared.
However, I would like to caution that elicitation of prior everyday knowledge does not guarantee that learning will take place. Instead, it enhances learners' engagement rather than providing a learning opportunity as such. Moreover, once learners are engaged then learning

opportunities for learning are great provided the teacher is clear about the key scientific concepts to be developed.

Van Wyk (2002) asserts that learners' everyday experiences form a basis of learners' science and technology. Learners have knowledge about science that they acquire from home through interaction with people in their communities. Herein lies the importance of elicitation and integration of learners' everyday knowledge.

Lending support, Hewson, et al. (2009) argues that IK is part of the learners' prior knowledge which directly impacts their ability to accept new ideas. Based on their argument, it means that learners' new scientific ideas would be built on everyday experiences. Since both teachers and learners engage in knowledge construction, indigenous knowledge (IK) seeks to include knowledge of the full diversity of cultural, racial, ethnic and religious practices of all people so it brings about common understanding (Odora-Hoppers, 2001). Thus, it is vital to provide learners with an opportunity to use their prior everyday knowledge and experiences.

It is therefore important for the teacher to start with what learners already know to move towards what they do not know so that they build new knowledge on prior knowledge. During this process any misconceptions brought by prior everyday knowledge need to be cleared up. For example, the belief needs to be cleared up that putting a small branch of '*omulavi*'/Xinemia caffra (indigenous tree without a tree ring) tree on top of the roof of the hut prevents it from being struck by lightning. The teacher needs to be knowledgeable about the key scientific concepts to be developed that may help learners to understand the natural phenomenon of lightning.

Van Wyk (2002), Kibirige and van Rooyen (2006) and Cimi (2009) indicate that inclusion of everyday experiences enables the community members to participate in education and pass on their knowledge to the learners. The problem with intergenerational knowledge, though, is that it is not documented and it is possible that the community members and learners may pass on distorted information. Nevertheless, working with community members might result in learners valuing their cultural heritage as well as enjoying the process of linking new knowledge to old.

O’Donoghue, Lotz-Sisitka, Asafo-Adjei, Kota and Hanisi (2007) argue that IK strengthens the community and cultural identity and promotes moral values of the indigenous people. With this reason, when community members participate in the education discourse, it makes curriculum relevant to the livelihood of the learners. For example, O’Dononghue, et al.’s (2007) research revealed that involving learners in researching the food preferred by indigenous people aroused learners’ interest in valuing those foods.

While IK contextualises learning, it could be difficult for a teacher who belongs to a different culture to integrate the local knowledge with in-depth understanding. On the other hand, in a multicultural classroom IK may advantage some learners and disadvantage others. In this situation, it might be convenient for the teacher to stick to scientific knowledge which is universal.

Stears, Malcolm and Kowlas (2003) emphasise that learners’ best construct knowledge when they are actively involved in the community which they call a ‘community of practice’. This helps learners to realise that science is found within community practices. Consequently, they will enjoy learning from one-another and they can easily capture new knowledge as well as ideas.

On the other hand, Stears, et al.’s (2003) research findings indicate that even though inclusion of learners’ everyday knowledge increased learning engagement, teachers and learners still experience difficulty in making the connection between everyday knowledge and the nature of science. This difficult might be caused by the following reasons:

- Learners are not aware of the extent to which they bring in their everyday knowledge
- Teachers perceive science as different from learners’ cultural lives
- Teachers lack the knowledge of handling diversity in classroom especially in one with learners of different cultures or everyday experiences.

Thus, Stears, et al. (2003) recommend that when planning a lesson that aims to incorporate learners’ everyday knowledge, teachers should put more effort and apply careful planning to connect the activities to learners’ everyday knowledge. This helps teachers and learners to make the significant link between knowledge acquired from home and school science.

Ogunniyi (2007) argues that learners are loaded with a lot of science from home and teachers should not ignore it. This argument is supported by Ogunniyi and Hewson (n.d.) and Ogunniyi (2007) that indigenous science offers what western modern science has not yet prepared to offer. Hence, Ogunniyi and Hewson (n.d.) for example, reveal how scientists also value IK as a useful method for environmental sustainability in non-western society.

In spite of the value of indigenous knowledge, in most science classrooms some teachers do not put much emphasis on learners' prior everyday knowledge and experiences but rather they stick only to what is written in the textbooks. It is a necessity that teachers help learners to make use of their prior experiences so that they use it to construct scientific knowledge as young scientists.

Roschelle (1995) points out that scientist reuse metaphors and ideas drawn from prior knowledge. She explains that when learning, learners assimilate additional experience to their current theories and practices. New knowledge that learners gain from science classroom adds value to the existing knowledge. Lack of including learners' prior everyday knowledge in science teaching causes learners to have difficulties in learning science. Kibirige and Van Rooyen (2006) identified problems that might arise as a result of ignoring learners' cultural knowledge and value system. These are:

- Learners' enthusiasm and motivation get lost
- Teaching task is made more difficult by not starting where the learner is, and build on what she already knows.

These points suggest that in order to facilitate learners' understanding of scientific concepts teachers should divert from textbooks' recipes. Kibirige and Van Rooyen advise that teachers should design classroom tasks that bring in elements of IK that connect with science. In other words, the use of indigenous knowledge serves as a strategic point for exploring scientific concepts and inquiry procedures.

2.3.3. Criticism of indigenous knowledge

There are direct or indirect criticisms about inclusion of indigenous knowledge (IK) in science lessons. The research conducted by Ogunniyi (2007) with South African teachers revealed the feeling that IK was perceived as being primitive by some science teachers and could not be granted a place in science teaching. Even after conducting the practical argumentation course (PAC); their study revealed that not all teachers were convinced that IK was worth including in science teaching.

Roschelle (1995) argues that prior everyday knowledge might mislead learners to unconventional interpretations of concepts. Learners bring in some misconceptions to class that they will tend to stick to which teachers might not able to clear precisely. In view of this, Oguniyi (2007) asserts that IK brings cognitive conflicts as learners may adhere to their beliefs even if they are not scientifically correct. The incorrectness could be due to the fact that IK belongs to a specific group which is only transferred from one generation to another but cannot be transformed from one culture to another (Ogunniyi, 2007).

This argument is congruent with Kibirige and Van Rooyen's (2006) assertion that IK is not easily shared with members of another community. So, teachers need to learn different cultures in order to be able to give feedback to the learners when some experiences or ideas arise unexpectedly. However, the challenge is whether teachers are knowledgeable enough about the various cultural backgrounds of the learners that they teach.

It is for these reasons that Ogunniyi (2007) cautions that there are no models of implementation to which teachers can build their teaching approaches on. This could by and large be exacerbated by the fact that IK is not documented as has been reiterated by Kibirige and Van Rooyen (2006). Similarly, Agea, Lugangwa, Obua and Kambugu (2008) share the same sentiments adding that IK lacks scientific explanations. As a result, it depends on the willingness of those who have knowledge to share it with others. Lack of documentation causes valuable IK to be lost. Kibirige and Van Rooyen (2006) indicate special features of IK of which some are that, oral transmission causes codifying to the loss of some of its properties. This is an indication that learners might possibly bring in distorted information to the classroom.

2.3.4. Some suggestions on how to incorporate IK during teaching and learning

Learners' everyday experiences can best be valued if the teachers know the direction to proceed in. Stears, Malcolm and Kowlas (2003) suggest that teachers and curriculum designers should work together to write materials that are culturally relevant. Their research findings also suggest that teachers should plan the activities carefully to link activities to learners' everyday experiences.

A teacher needs to be knowledgeable if she is to start a lesson by referring to learners' context. Oloruntegbe and Ikpe's (2011) research findings reveal that learners cannot connect certain knowledge taught at school to life outside the school nor can they connect everyday knowledge to school science. It is recognised, however, that it is also possible that some of the activities do not clearly connect to life outside classroom. For instance, learners are taught that the building blocks of matter are atoms and molecules. Yet, learners cannot see or touch the atoms or molecules either in the classroom or at home. In this case, learners' understanding can only be facilitated by making atomic models accompanied by explanations.

Maselwa (2004, p. 56) suggests that teachers need to be knowledgeable about the subject content and mindful of the elicitation and incorporation of learners' experiences into their teaching and learning practices. This enables the teacher to help learners develop scientific concepts and even clear up misconceptions that may arise from indigenous knowledge.

2.4. Static electricity and lightning

The Namibian science textbooks give lightning as an example of static electricity in nature without referring to learners' cultural beliefs and experiences about this natural phenomenon. Pabale (2006) also argues that science textbooks do not provide integration of the nature of science and cultural beliefs. She however acknowledges that in one of the textbooks she read, learners were allowed to investigate cultural belief about lightning held by the community. She indicates that this is not enough as integration means acknowledging learners' prior everyday knowledge and doing something about it.

Scientific background

Static electricity happens when insulators are rubbed against each other (Maselwa, 2004). According to Maselwa (2004), lightning is static electricity at a large scale. The clouds become charged through friction with air and other clouds. In the clouds, the negative charges move towards the bottom of the cloud inducing a positive charge on earth (since the negative charges on earth are repelled by the negative charges on the clouds). When the potential difference is large enough a spark will be formed between these opposite charges – and that is lightning.

The Namibia's curriculum for the junior secondary phase (grades 8-10) requires that learners should be able to describe how the objects get charged by friction and explain how objects with unlike charges will attract each other and how those with like charges will repel each other (MoE, 2010). But some science teachers tend to teach static electricity theoretically. Thus, learners are forced to memorise explanations given in the textbooks and summaries.

Some cultural beliefs about lightning

According to Pabale (2006), her research study which she conducted in the Limpopo province in South Africa revealed some of the following cultural beliefs about lightning: Lightning is caused by God; it occurs when it is raining, it can be prevented by using motor car tyres

Maselwa and Ngcoza's (2003) research study revealed the following preventive measures about lightning: no standing under a tree, cover mirrors with blankets, no eating, no sitting, no touching metal things, not using water, not answering phone calls, switching off TV and radios and do not play with fire. In his study, Maselwa (2004, p. 39) classifies these beliefs into groups based on the findings of his research such as those that deal with: electrical appliances, consumption, social issues and general issues.

These authors' findings show that learners do come with prior everyday knowledge into the science classroom. Looking at the above beliefs about lightning it seems there are some scientific concepts that emerged from them. It can be seen then that science does exist within community's cultural beliefs even though scientific explanations might not be known. For example, warning children against standing under a tall tree protects them from a danger of lightning since scientifically; trees are prone to being struck by lightning.

According to scientific and cultural ideas about lightning, it is clear that a teacher needs to have deep understanding of the subject content knowledge (Shulman, 1986). Such knowledge enables the teacher to clear up misconceptions from cultural beliefs by using scientific explanations and to explain scientific concepts. It is recognised, however, that it might be a challenge to change deeply ingrained beliefs of learners.

Aikenhead and Jegede (1999, p. 269) researched on the transition between learners' everyday-world and school science. Such transition is termed as cultural border crossing. They identified the factors on which success to move between two cultures as: The degree of cultural difference that learners perceive between their life-world and their science classroom, how effectively learners move between their life-world culture and the culture of science or school science, and the assistance learners receive in making those transitions easier (p. 270). Aikenhead and Jegede (1999) indicate that learners can hold both an indigenous knowledge and scientific knowledge concurrently. This is termed collateral learning. They assert that effective collateral learning in science classrooms will rely on successful cultural border crossing into school science as collateral learning and cultural border crossing are basically interconnected.

2. 5. Practical activities

2.5.1. Purpose of practical activities

When studying science one can make sense of the subject matter by discovering things through experimentation and explorations. Johnstone (2010) suggests that teachers should start where learners are. He believes that learners' interests and experiences would lead them into discovering new ideas among the familiar. Hence, practical activities could be seen as catalysts for discovering new ideas. However, during practical activities the focus should be on the development of key scientific concepts since doing practical activities for the sake of doing them does not necessarily promote learning.

From my teaching experience, practical activities have proved to be good teaching methods Learners become active, happy and seem to enjoy the lesson. Despite enjoyment, however, I have realised that some of them still do not understand the reasons for doing practical activities. They still cannot draw conclusions from the activities nor apply their observations in real life situations.

Millar (2004) too sees practical activities as a means of providing learners with opportunities to acquire manipulative and observation skills. Practical activities also stimulate learners' interests along with understanding of scientific concepts. He further argues that practical activities afford learners an opportunity to acquire practical work skills of handling apparatus such as setting up experiments, measuring, predicting, observing, concluding and presentation.

There are many reasons why practical activities are regarded as the preferred teaching approach in science classroom. For example, Hodson (1990, p. 34) identifies the purpose of practical work as:

- To motivate by stimulating interest and enjoyment;
- To enhance the leaning of scientific knowledge;
- To teach laboratory skills; and
- To give insight into scientific method, and develop expertise in using it.

Based on my own experience, the purposes identified above by Hodson are observable in science teaching. Learners look bored when they are not engaged in any activity and they become active when they are manipulating materials as they are able to talk with one another instead of only listening to the teacher. However, there may be no guarantee that learning does take place during practical activities. So, teachers should be careful to equate activity with learning.

Ramsden (1994) highlights that, some practical activities such as investigations and projects are believed to provide learners with an autonomous engagement in the activities. He believes that such activities allow them to follow their own ideas and structure their own practical activities freely. Lending support, Millar (2004) points out that this strategy enables learners to conduct scientific inquiry as well as build explicit declarative understanding of the logic of scientific inquiry and of the nature of scientific knowledge.

Through practical activities learners will gain insight of being able to apply their own understanding and draw conclusions based on evidence. In order to achieve all these, teachers are identified as important driving factors. Teachers play a major role in helping learners make sense of scientific ways of knowing based on their prior-knowledge. Practical activities further give learners a framework for distinguishing between scientific knowledge and everyday knowledge.

2.5.2. Proposed ways of carrying out practical activities

The success of practical activities does not come automatically. Leach and Scott (1995, p. 48) claim that scientific knowledge is a social construct. They further indicate that learners cannot develop an understanding of the theories of science through their own observations only. This is due to the fact that the theoretical entities of science are not simply there to be seen.

Gott and Duggan (1996) stress that in order for the learners to be able to understand and apply concepts; they need to be engaged with the sense of the whole task. Teachers need to be committed to preparing practical activities that promote meaningful learning. Thus, during practical activities science, teachers should be careful to equate activities with learning so that it measures what it is intended to. This is because teachers' greater knowledge and skills enable them to assist learners in applying common knowledge in unfamiliar contexts and employing new knowledge in known contexts (Hodson & Hodson, 1998, p. 18).

The textbooks are valuable teaching resources (Czerniewicz, Murray & Probyn, 2000). They give the designed instructions for practical work but sometimes the content is far from learners' context. Thus, the teachers need to be able to adapt the practical instructions or procedures given in textbooks in ways that suits learners' contexts.
This follows the idea that the nature of classroom activities contributes to acquisition of practical skills.

The classroom environment that promotes learning is one that has exciting activities and inviting stimulus as well as adequate scaffolding by the teacher. It is also believed that this environment exposes learners to more general ideas of the subject. The nature of teachers' guidance influences learners' thought processes as well (Hodson & Hodson, 1998). These authors caution, however, that too much guidance might disturb learners' engagement in problem solving and could lead to premature conclusions. While on the other hand, too little guidance could leave learners unable to make satisfactory progress and could subsequently lead to feelings of frustration and even alienation.

Hodson and Hodson's argument shows how challenging the implementation of practical activities can be. In most cases, at the end of a practical activity, a teacher might not be sure whether the intended objectives have been successfully achieved by learners. It is proposed, therefore, that at the end of the practical activities teachers should discuss and exchange understanding through conversations to ensure that learners have received and understood the objectives of the activity (Johnstone, 2010). The discussions and consolidation would provide an opportunity to clear learners' misconceptions and reinforce meaningful learning.

In order to be able to clear misconceptions, teachers need to be experts of knowledge and skills. According to Hodson and Hodson (1998), the knowledgeable teacher should devise learning experiences that are scientifically significant, meaningful and interesting. The teacher should criticise and advise learners and ask as well as answering critical questions. In addition, teachers should have a deep understanding of both scientific knowledge and scientific methods. Language based-activities are seen as the best approach.

Hodson and Hodson (1998) further suggest that language based-activities can be used to explore, develop, extend, enrich and reorganise learners' personal framework of understanding. Moreover, the practical activities should allow learners to predict, explain, explore, observe and explain (PEEOE) as proposed by Maselwa and Ngcoza (2003) in their research study conducted in South Africa. This type of approach enables involving both group discussions and whole class discussions. Predictions and explanations might enhance learners' critical thinking skills while observations might enable them to examine closely every aspect of the experiment. Also, their writing skills might be reinforced during this process.

2.5.3. Critiques about practical activities

Gott and Duggan (1996) alert us to the mismatch between practical activities and acquisition of scientific concepts. Their criticism is that illustrative work such as, instructional worksheets severely limit the decisions that learners may take with regard to design instruments and data handling. On the other hand, however, my argument is that, worksheets are beneficial to learners with learning difficulties. Learners can be asked to make predictions too. Conversely, it does not always mean that carrying out practical activities guarantees that learners will acquire necessary scientific concepts and practical skills.

Even though Leach and Scott (1995) indicate that learners enjoy the kind of practical activities that teachers give them in class, their counter argument is that not all learners enjoy the given practical activities. This adverse experience mostly happens when classes are overcrowded or learning and teaching resources are inadequate. They also claim that the teachers' expectations of practical activities and learners' satisfaction with them are opposite as it sometimes happens that learners are not satisfied by the activity. The greatest critique is that when the amount of practical activity increases so the learners' interest decreases. This is a warning that learners should not be overloaded with practical activities at one time.

Thus, Hodson (1990) says that even after carrying out several practical activities in science class, many learners may not be able to carry even simple laboratory skills successfully. Hodson's argument is supported by observations in my class. As a result, the teacher needs to ensure that each learner has access to practical instruments needed for scientific concepts and understanding.

2.5.4. Code-switching

Code-switching is changing from the language of teaching and learning to the language that learners understand well which mostly their mother language is. Probyn (2004, p. 50) asserts that the English proficiency of many learners often does not meet the demands of learning through the mediation of English. Learners' poor English proficiency lowers their level of understanding and knowledge construction.

Probyn (2004) offers various reasons why teachers use code-switching in their science classroom. These are: for classroom management, to encourage learners participate in the classroom activities. Probyn (2009) argues that code-switching is not recognised as a legitimate strategy. According to Probyn's (2009) research findings, code-switching might be useful in helping learners understand concepts but it also damages their English language. Probyn (2004 & 2009) propose that code switching could be used to teach content and also for language development.

2.6. Theoretical framework

2.6.1. Constructivist perspective

Moll (2002, p. 9) indicates that "learning is active process involving learners constructing knowledge for themselves". Learning results when learners interact with a problem context where the learners construct their own knowledge. According to Hodson and Hodson (1998), constructivism provides some ideas for teaching strategies that might help learners to co-construct knowledge. My focus in this study will be on constructivism, in particular, the socio-cultural perspective and social constructivism as well as pedagogical content knowledge (PCK).

2.6.1.1. Socio-cultural perspective

According to Boran (2008), culture refers to a program of shared rules that govern the behaviour of members of community or society and values, beliefs, and attitudes shared by most members of that community (p. 367). The literature suggests that the cultural experiences of learners need to be revealed and represented in their subjective perspective (Li, 2010, p. 122). Li further suggests that learners acquire culture through complex process of human interaction.

Lemke (2001, p. 301) too suggests that "learners and teachers need to understand that science and science education are always part of large communities and their culture". Such acquisition of culture and extending science beyond classroom may help learners to make use of what they know in order to be able to overcome any obstacles hindering them from giving attention to the learning task.

2.6.1.2. Social constructivism

Social constructivism is a sociological theory of knowledge that applies the general principle of philosophical construction. Social constructivism includes two types of knowledge construction, personal and social aspects of learning. In its personal aspect, knowledge is constructed by individual and in its social aspect; knowledge is socially mediated through cultural experiences and interaction with others (McRobbie & Tobin, 1997, p.194).

McRobbie and Tobin (1997) assert that the social constructivist perspective on learning suggests that learners should have control over their own learning and be able to construct meanings from their experiences in terms of what they know at the time of learning (p. 199). This suggests that learners should understand the purpose of learning. A teacher as a facilitator of learning should create a conducive learning environment which may stimulate learning interest. A conducive learning environment needs to have visible and manipulative learning materials which are relevant to facilitate the learning at hand.

Social constructivism deals with knowledge that is constructed by human beings in working with one another. This study thus aimed at creating a learning environment that could enable my learners to socially construct knowledge. Hodson and Hodson (1998) point out that the Vygotskian (1978) perspective requires teachers to concentrate their efforts in the zone of proximal development (ZPD) and create opportunities for learners to use them. They also indicate that learners can guide fellow learners through the ZPD.

According to Vygotsky (1978), the ZPD is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with a more capable peer. This distance influences the extension of the learners' understanding of the subject beyond their prior understanding as an individual.

2.6.2. Pedagogical Content Knowledge (PCK)

According to Shulman (1986, p. 9), pedagogical content knowledge (PCK) includes "the most useful forms of representation of topics, the most powerful analogies, illustrations, examples, explanations and demonstrations in a word, the ways of representing and formulating the subject that makes the learning of specific topics easy or difficult: the conceptions and preconceptions that student ages and background bring with them to the learning of those most frequently taught topics and lessons". Shulman (1987) further explains that teachers need to understand what they teach in several ways. In order to accommodate all learners in learning, teachers need to consider learners' various learning abilities and the backgrounds of different learners.

According to Van Driel, Verloop and de Vos (1998), pedagogical content knowledge (PCK) is a specific category of knowledge which goes beyond knowledge of subject matter *per se* to the dimension of subject matter knowledge (p. 675). It implies a transformation of subject matter knowledge so that it can be used effectively and flexibly in the communication process between teachers and learners. So, teachers need a strong PCK to be as good teachers as they can be (Loughran, Mulhall & Berry, 2004).

Loughran, et al. (2004) identify the development of the big ideas for a topic as an important aspect of articulating one's PCK, since it offers access to the way the science teacher structures the topic. PCK may also be regarded as the main ideas that teachers see as valuable in helping to conceptualise the topic as a whole and present the key concepts to the learners in the way that they best understand

Loughran, Mulhall and Berry (2008) claim that lack of deep conceptual understanding among teachers, results in subject matter knowledge being fragmented, compartmentalised and inadequately organised. This makes it difficult for teachers to access such knowledge efficiently when teaching. Rennie (2011, p. 23) too argues that "helping learners to learn about and use science in everyday context requires a high level of pedagogical content knowledge". In support of his argument, Rennie (2011) explains that using knowledge in different contexts often requires considerable reworking of it so that the knowledge can be used in new situations. In other words, teachers should be able to adjust the content to fit learners' contexts and this is a huge task for some science teachers.

Van Driel, Verloop and De Vos (1998) argue that experienced teachers appear to have developed a conceptual framework in which knowledge and beliefs about science subject matter, teaching and learning and learners are interrelated in a coherent manner (p. 678). Abell (2008) too emphasises that PCK is about the quality of knowledge and how it is put into action.

This study provided me with an opportunity to explore my PCK as it was stated that experienced teachers quickly learn the new content and adequate content-specific instruction strategies. PCK in this study is important as I have used it as an analytical tool.

2.7. Concluding remarks

In this chapter I have reviewed the literature relevant to my research project. The discussions covered the literature on curriculum issues and the conceptual framework. The latter encompassed the learners' prior everyday knowledge, indigenous knowledge (IK), static electricity and lightning and practical activities. The theoretical framework on constructivism was discussed, in particular, the socio-cultural perspective and social constructivism. Lastly PCK has been discussed as an analytical tool which helped me to analyse my teaching practices.

In the next chapter I discuss the methodology underpinning the study.

Chapter Three

Research Methodology

3.1. Introduction

In this chapter, I discuss the research methodology of this study. I start by explaining the research design and the paradigm underpinning the research study. Thereafter, I discuss the research goals and questions. To be able to get responses to research questions, the following data generation techniques were used, namely, document analysis, brainstorming in groups and discussions, teaching involving practical activities with worksheets, observations using a video-tape, audio-taped semi-structured interview with a critical friend and focus group interviews with the learners as well as an assessment test. Learners also kept journals where they wrote their reflections after each lesson.

I also describe how data generated from each data gathering technique was analysed, triangulated and validated as well as how ethical issues were taken into consideration. In addition to this, factors that limited the research study are indicated as the. The chapter concludes with some remarks whereby I pull the various threads together.

3.2. Research design

3.2.1. Paradigm underpinning the research study

This research study is located within an interpretive paradigm which is intended to provide in-depth understanding of the study activities. The interpretive paradigm endeavours to understand the subjective world of human experience (Cohen, Manion & Morrison, 2007). Cohen, et al. (2007, p. 21) also indicate that the interpretive paradigm "focuses on action" and in the context of this study actions were essential since learners were able to interact and share their everyday experiences.

Essentially, in this study I wanted to understand the learners' cultural beliefs and experiences about lightning and whether these enabled or constrained meaningful learning of static electricity. It is for these reasons that I found the interpretive paradigm suitable for my research. Thus, the interpretive paradigm served to provide a framework that helped me to understand how I could assist my learners to improve meaning making, conceptual understanding and development in the topic of static electricity.

I also saw it fitting to assign learners to generate information in groups in the form of discussions; whereby they interacted with one another. Group discussions bring about social interactions with one another and enhance learners' participation in the classroom discourses (O'Dononghue, Lotz-Sisitka, Asafo-Adjei, Kota & Hanisi, 2007). This study engaged learners in social interactions as they were expected to participate in their groups and classroom discussions with a view to co-constructing knowledge.

However, I was mindful of the fact that this did not mean that every learner would maximally participate as there may be some learners who are passive. Therefore, in order to activate learners' interaction with one another, I designed activities which brought about social interactions and sharing of experiences among them, so that they could acquire scientific concepts in static electricity, which is a focus of this study.

3.2.2. Case study as an approach to the research study

Flyvbjerg (2004, p. 420) defines a case study as a "detailed examination of a single example". According to Creswell (2003), Payne and Payne (2004) and Yin (2012), a case study is a qualitative approach in which the researcher explores a particular unit or phenomenon bounded by time and activity. Since this research study focused on a single classroom and the various activities performed by my learners it constituted a unit of analysis. Furthermore, since a case study is an in-depth investigation of a given social unit, Leedy and Ormrod (2010) assert that the purpose of a case study is to study the background, current status and environmental interaction of a given social unit. In the context of my study, a group of grade 8D learners that I teach constituted such a social unit.

During my research case study, I actively engaged learners in the practical activities in static electricity. In selecting this topic, I had hoped that learners would be given an opportunity to explore their cultural beliefs and share their experiences and ideas about lightning in their own context or situation.

Furthermore, a case study is context -specific (Flyvbjerg, 2004, p. 421) and it enables learners to construct knowledge and experience that is based on their perspective. Thus, it could be argued that a case study provides concrete context-dependent knowledge. As a result, in order for the learners to understand the phenomenon of lightning in this study, they needed to comprehend the connection between lightning and static electricity. For them to comprehend this link, practical activities as well as use of prior everyday knowledge and experiences were used as a catalyst for realization and knowledge construction. In essence, this case study approach provided me with an opportunity to study the selected grade in some depth within a limited period of time.

Cohen, et al. (2007) further argue that a case study can be taken by a single researcher without needing a full research team. They, however, argue that some of the weaknesses such as the results may not be generalized and that it is prone to problems of observer bias, despite attempts made to address reflexivity. In my case, however, the intention was not to generalize but to get some insights on meaningful learning with a view to ultimately improve my practice. In addition, observer bias was addressed through reflexivity and methodological triangulation (Cohen, et al., 2007; Leedy & Ormrod, 2010). Cohen, et al. (2007, p. 23) refer to reflexivity as the way in which all accounts of social settings-descriptions, analyses, criticism and the social settings occasioning them are mutually interdependent.

3.3. Research site and participants

3.3.1. Research site

This research study was conducted at my school called Ndida (pseudonym) Combined School in Engela Cluster in Ohangwena Circuit, in Ohangwena Education Region in Northern Namibia. A pseudonym was used to protect the identity of the school where the research study was conducted. Ohangwena is just few kilometers from the Angola border and is one of the poorest regions where most of the schools lack teaching and learning resources resulting in most teaching of science in some schools being theoretically based.

My school is no exception and it accommodates approximately 986 learners from the same community. At this school there are 29 teachers including the school principal making the ratio of teacher-learner ratio 1:34.

3.3.2. Research participants

My research participants were my grade 8 learners. They were all from the same ethnic group ('the Oshiwambo speaking community') and thus their vernacular language 'Oshiwambo' This made it easier for me to use code-switching during my lesson presentations and interviews. Using learners' vernacular language helped them to understand what was expected of them as well as helping them to express themselves clearly especially during the interviews (see Table 5.4). However, the translation proved to be a tedious process.

I chose this grade 8 class because I teach them and they are used to my teaching style. For the purposes of this study, I used different teaching and learning strategies which took into particular consideration, the learners' prior everyday knowledge and experiences. In adopting this strategy, I assumed that these learners would be responsive to my teaching and learning strategies and they were.

My grade 8 class consisted of 30 learners of which 10 were boys and 20 girls. Generally, there are more girls than boys in grade 8 at my school. Because the research study was carried out after school hours, three males and two female learners could not participate as they had to go and look after animals or assist their parents with household chores in the afternoon. Even though these learners wanted to participate, they had to accept the situation in which they found themselves. I thus ended up working with 25 learners only of which seven were boys and 18 girls.

Despite the fact that some learners could not participate in the study, they still had time to be taught as the static electricity topic is normally taught in the second term. Unfortunately then, they were disadvantaged in that they did not have a chance to learn socially with those involved in the study, apart from their normal classes.

During the research process, learners kept journals too in which they recorded what they had learnt in each lesson. However, I could not use the information from the learners' journals since they simply summarized the lessons instead of giving their feelings or evaluation of the teaching and learning approaches used. Anyway, journal writing helped them to improve spelling skills and some sentence construction. If I were to do this research again, I would encourage learners to reflect properly by guiding them with some questions.

I initially approached a Life Science teacher to observe my lessons and be my critical friend during this research process. This is because I could not observe my own teaching practice during lesson presentations. His role was to observe and to give me feedback at the end of each lesson. Due to unforeseen circumstances, however, my critical friend was not available most of the time to observe my lessons. Another science teacher was approached to video-tape my lessons. Instead, the camera-man turned into being my critical friend and I had to approach another teacher who was not busy to help with taking the videos of my lessons. This affected the quality of my video. However, the videotaped lessons helped me to revisit my teaching practices after the lessons.

3.4. Research goal

The main goal of this research study was to investigate whether eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning making in static electricity.

Research objectives:

1. To explore whether curriculum documents and grade 8 Physical Science textbooks consider learners' prior everyday knowledge and experiences about lightning in static electricity;
2. To explore and integrate learners' cultural beliefs and experiences about lightning;
3. To investigate whether the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts;
4. To understand how engaging learners in practical activities associated with lightning can facilitate meaning making in static electricity; and
5. To understand what scientific concepts learners acquire when their cultural beliefs and everyday experiences about lightning are considered in conjunction with practical activities in static electricity.

To achieve this goal and objectives, the following main research question and sub-questions were asked:

Research question

Does exploring and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enable or constrain meaning making in static electricity?

Sub-questions:

1. Do the curriculum documents and textbooks consider learners' prior everyday knowledge and experiences about lightning in static electricity? I analysed a Physical Science syllabus for grade 8-10 and two different physical science textbooks for grade 8.
2. What are the learners' cultural beliefs and everyday experiences about lightning? Brainstorming, discussion and presentation was used to answer this question.
3. Does the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts? I answered this question by using interview, practical activities with worksheets, videotaped lessons, and observation.
4. How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity? This question was answered by using practical activities with worksheets, interviews, videotaped lessons and assessment test.
5. What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated into teaching science in conjunction with practical activities in static electricity? This question was answered by using focus group interview, practical activities with worksheets, and assessment test.

In the following section I discuss the methods which I used to generate data in this study.

3.5. Data generation methods

The qualitative researcher is able to use a variety of techniques for generating information. Bell (1987, p. 8) suggests that "method of collecting information are selected which are appropriate for the task". Cohen, Manion and Morrison (2007) give examples of various data gathering techniques to be used in qualitative research, such as interviews, observations and video recording. This part of the chapter is a discussion of the techniques that were used to generate data in this study as shown in the table below.

Table 3.1: Shows the methods used to gather data, data gathered and purpose of gathering data

	Methods used to gather data	**Data gathered**	**Purpose**
Stage 1	Document analysis	How static electricity is approached and how lightning is presented.	To get some insights on what is expected from the learners, so that I could develop my own approach on these daily teaching guidelines.
Stage 2	Brain storming, discussions and presentation	Various learners' cultural beliefs about lightning. Initial learners' thoughts about whether cultural beliefs are scientific or non-scientific.	To explore learners' cultural beliefs about lightning as their prior everyday knowledge and experiences that they bring in science classroom in order to move from context to content. Learners sit in groups of five to share and write down their cultural beliefs about lightning in worksheets. Then later they classified them as scientific and non-scientific in worksheets and then present it on a flip chart so that they construct own knowledge.
Stage 3	Teaching: Practical activities-worksheets	Learners' engagement with the practical materials. Development of scientific concepts through practical activities	Draw learners' attention into science. For them to understand how lightning is formed, its damage and how it is prevented from scientific perspective. Test

			the quality of the designed unit of work.
Stage 4	Observation and video-taped lessons	How learners used materials to do practical activities on static electricity. Teacher-learner interactions during lessons. How teacher elicits learners' prior everyday knowledge. How teacher scaffolds learners to understand the concepts. How the critical friend feels about the approaches used during the lesson as well as the usefulness of practical activities with worksheets.	To research and reflect on my own teaching practice. Gain an insight how practical activities enable/constrain learners' meaning making of science concepts in static electricity.
Stage 5	Semi-structured interview with a critical friend who observed my lessons.	Follow up on the data generated from observation. Questions were asked depending on the generated data from the video tape and it might include teacher-learner relations during teaching and learning repertoires.	To gain insights from a critical friend on the integration of learners' prior everyday knowledge and experiences; advantages and disadvantages of practical activities in enhancing meaning making in static electricity.
Stage 6	Focus group interview with learners	Questions to complement the data already generated to gain learners' views on the inclusion of their cultural beliefs in science lessons, engagement in practical activities and how it helped them to understand static electricity.	Triangulate the data gathered from other techniques. To get insights on my teaching and learning approaches.
stage 7	Assessment test	Learners' performance as a result of a different approach to the topic static electricity.	To evaluate the quality and usefulness of a new teaching strategy used.

Stage 1: Document analysis

The documents analyzed in this research study were the grade 8 syllabus and two Physical Science textbooks. As supported by Shear and Knobel (2004); Payne and Payne (2004), and Hopkins (2008), these documents are written data which include a wide range of pre-existing texts that I gathered as part of this study. Hopkins (2008, p.122) states that documents can provide back-ground information and understanding of issues that would not otherwise be available. Coleman (1999, p. 134) defines document analysis as a tool to be used as a supplementary to either interview or questionnaires or both, often within a case study approach.

The document analysis formed the baseline data for this study. This provided me with a picture on how static electricity and lightning as a natural phenomenon was presented. I was able to get a picture of what is expected from the learners after teaching this topic. This understanding enabled me to design my teaching and learning unit of work and worksheets (Appendix 3) in a different way while following the same objectives except that I had to incorporate learners' prior everyday knowledge and experiences about lightning. This too helped to answer the first sub-question which asks: Do the curriculum documents and textbooks consider learners' prior everyday knowledge and experiences about lightning in static electricity?

Stage 2: Brainstorming and focus group discussions and presentations

Brainstorming is a useful and popular technique that can be used to develop highly creative solutions to a problem (Cimi, 2009, p.38). Rawlinson (1981. p. 35) refers to brainstorming as wide-ranging, far reaching activities, seeking to generate ideas. It is a means of getting a large number of ideas from a group of people in a short time. In view of this, this method was suitable in this study as it allowed me to gather ideas from different learners in grade 8 at the school where I teach.

The learners were organized to sit in five groups of five learners per group and were asked to discuss their cultural beliefs and experiences about lightning. I explained the task to the learners using both languages which were English as a language of teaching and learning and

Oshiwambo, the learners’ mother language or vernacular. The use of vernacular helped learners’ to understand the activity better. But I was mindful of the fact that they would be tested in English hence I asked them to do the translations. In hindsight, this proved to be a worthwhile validation process (see Section 3.7).

The learners brainstormed their cultural beliefs and their preconceptions about lightning in groups in order to get data about their prior everyday experiences. During the brainstorming and discussions they wrote down their cultural beliefs and experiences about lightning in worksheets and then later on the news prints.

After brainstorming and discussing in groups, a learner from each group presented their work in front of the class while I was writing learners’ cultural beliefs and experiences on the chalkboard. At the end of each presentation of their findings, there was class discussion in which learners shared their experiences, observations, interpretation and explanations. Anyway class discussions were at the centre of each lesson. As a result, this session was longer than I expected but the discussions were worthwhile.

I also sent learners to gather data from the community members about their cultural beliefs and experiences about lightning. In addition I invited four elders from the community to come and share their knowledge with the learners at school. This phase was carried out seven months after I had gathered classroom data. The aim was to strengthen my data in terms of the information from the community where the learners who participated in this study come from.

This method helped in answering sub-questions two, three and five. What are the learners’ cultural beliefs and experiences about lightning? Does the mobilization of learners’ cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts? What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated in teaching science with static electricity practical activities?

Stage 3: Practical activities using worksheets

Learners remained in the same groups they had been in during the brainstorming sessions. As a teacher and facilitator, I provided each group with a worksheet and the materials to be used during the practical activities. I explained to them the instructions for the activities to ensure that learners understood what they had to do. Due to the fact that learners struggled with the English language, I read through the instructions and explained to them what they were supposed to do in Oshiwambo as well. I also had to walk around to facilitate the practical activities and give assistance to each group.

The practical activities performed in groups served as a means of social learning. Since social learning is the process of social change in which people learn from each other (Reed et al 2010), the practical activities enabled the learners to learn in a social setting as proposed by Vygotsky (1978).

During the practical activities too, learners used the worksheets in which they were expected to predict, explain, explore, observe and explain (PEEOE) (Maselwa & Ngcoza, 2003; Maselwa, 2004). Unfamiliar terms such as 'predict' and 'explore' were explained to them.

This method answered sub-question four and five: How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity? And what scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated in teaching science with static electricity practical activities?

Stage 4: Observation and videotaped lessons

According to Merriam (2001, p. 111), observation is a major means of gathering data in qualitative research. It offers an actual account of the situation under study and, when combined with interviewing and document analysis, allows for a holistic interpretation of the phenomenon being investigated. Bell (1987) suggests that in researching your own institution, you should be familiar with the personalities, strengths, and weakness of the people you are working with. Familiarity with the institution and participants equip the researcher for adaptations in response to unexpected interference with the study or the participants.

The observation was done by a critical friend as well as by me as a researcher. A fellow physical science teacher and another teacher on request were responsible for observing and video-taping the implementation of practical activities with worksheets. His role was to observe and record (Bell, 1987), so that I could analyze the data later. This method gave me an opportunity to gather 'live' data from a natural occurring situation as proposed by Cohen, et al. (2007).

Cohen, et al. (2007) emphasize useful characteristics of observation such as: physical setting, the human setting, interactional setting and the programme setting. I found these to be useful in my research. These settings deal with organization of the class, composition of the groups, interaction between learners, resources used as well as pedagogical approaches. I felt that the critical friend's use of the observation sheet as a guide (see Appendix 2) was a reliable source since he had to complete it while he was observing my lessons. Nonetheless, he was encouraged to document other aspects that were not included in the guideline.

In addition to this, the whole teaching processes was captured using a video-tape. Leedy and Ormrod (2010, p. 147) argue that a video recorder captures only the event happening in small, focused area. They further argue that video recorder and voice recorder might make participants uncomfortable. However, discomfort was not observed among my participants. And also, accepting Maselwa's (2004) view, the videotaping enabled me to have closer observation of the interaction between the learners in groups and my involvement in the whole exercise. Thus, this provided an opportunity to observe my own teaching practices and interaction with the learners.
Overall, the observation helped to answer all the four research questions as all the sessions were videotaped.

Stage 5: Interviews

Semi-structured interview

A semi-structured interview which is a flexible method of gathering information was used to allow new questions to be brought up during the conversation (Shear & Knobel, 2004; Cohen, et al., 2007; Leedy & Ormrod, 2010). Leedy and Ormrod (2010) assert that it is possible to probe for clarification and reasoning during semi-structured interviews. In order to get more insight in this study, I probed on emerged responses for clarification. This method helped to answer questions three, four and five which are: Does the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts?

How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity?

What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated in teaching science in conjunction with practical activities in static electricity?

Stimulated recall interview

Since the lessons were video-taped, I also watched the video with my critical friend. Stimulated recall semi-structured interviews with the critical friend thus conducted were used as a form of member check. They provided detailed information on how engaging learners in practical activities helped to construct new knowledge, develop scientific knowledge and understanding. This method answered question three and four as it helped me to get the overview of the study from the observer side. Does the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts? How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity?

Focus group interviews

Focus group is a form of group interviews (Cohen, et al., 2007). A focus group interview was conducted with a group of six learners of whom three were boys and three were girls as I took gender balance into consideration.

The focus group interview provided me with the opportunity to ask for clarifications because I was able to ask learners to say more on the given answers. Thus, the focus group interview enabled me to get information and insights in a collective fashion (Shank & Brown, 2007) which led to a deeper exploration of learners' understanding of scientific concepts in the static electricity topic. In other words, the focus group aimed at providing me with an overall picture of the whole proceedings. During this interview, learners socially constructed the answers arising rather being individually created (Maselwa, 2004). In the context of this study, the use of focus group interviews created a relaxed environment because learners expressed themselves freely and supported one another's ideas.

Since the learners could not express themselves well in English, interviews were done in both English and Oshiwambo languages in which they expressed themselves well. The main purpose was to facilitate the verbal communication process by the learners as it is suggested by Shilongo (2007). Moreover, scientific terms were pronounced in English so that learners could be acquainted with scientific concepts that they had developed during the learning process.

For validation purposes (see Section.4.7, Table 4.7.2), the Oshiwambo interview version was translated into English by the learners themselves and thereafter by me. I found this strategy useful in reinforcing the learners' language skills and this could be an area for future research. This method answered research questions two, three, four and five of this study which are:
What are the learners' cultural beliefs and everyday experiences about lightning? Does the mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts? How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity? What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated in teaching science in conjunction with practical activities in static electricity?

Stage 7: Assessment test

The test was set to determine whether learners had gained better understanding of scientific concepts (Pabale, 2006) of static electricity and lightning after a teaching and learning process that took into account learners' everyday knowledge and experiences about lightning. The test consisted of two sections. Section A, consisted of multiple choice questions and Section B, consisted of structured questions which required learners to define, explain, reason and also to complete the given statements. In my view, multiple choice questions are vulnerable to guessing on one hand and might help learners to recall easily what they have learned on the other hand. Some learners did well in the multiple choice sections and performed poorly in the structured questions section in this study. Such poor performance could be caused by poor language proficiency.

3.6. Analysis of data

This part describes the process of data analysis, which encompassed organizing, analysing and interpretation of data.

The data was analysed inductively by colour coding my gathered raw data. The data sets generated through brainstorming and discussions were analysed to discover patterns and trends in learners' cultural beliefs and experiences about lightning. I used colour code as follows: green for scientific concepts, red for non-scientific concepts, yellow for learner engagement, blue for misconceptions and pink for conceptual attainment.

The data gathered through engaging learners in practical activities with worksheets, interviews and observation schedules and videotaped lessons were analysed to discover trends, contradictions, differences and similarities (Cohen, et al., 2007) on learners' beliefs and experiences about lightning in comparison to the scientific knowledge. Data gathered through assessment were analysed by looking at whether learners' responses provided evidence of new understanding and development about lightning and static electricity as a result of the new approach that I used to teach this topic. Thereafter, the common themes were combined into analytical statements and these were also aligned to the research questions of this study. The following analytical statements were developed:

1. Consideration of cultural beliefs and experiences about lightning in curriculum documents and textbooks;
2. Mobilization of learners' cultural beliefs and experiences about lightning enable or constrain learner engagement and co-construction of knowledge;
3. Facilitating meaning making in static electricity through engaging learners in practical activities; and
4. Scientific concepts that learners acquire through consideration of cultural beliefs and experiences about lightning with practical activities in static electricity.

3.7. Ethical considerations

Burton, Brundret and Jones (2008) propose that taking ethical consideration seriously increases the chances of maintaining positive relationship between the researcher and participants. According to Cohen, et al. (2007, p.51), a major ethical dilemma is that which requires researchers to strike a balance between the demands placed on them as professional scientists in pursuit of truth, and their subjects' right and values potentially threatened by the research.

Consequently, it was a necessity that I took into consideration the ethical issues before I embarked upon this research study. These were: informed consent, confidentiality and the consequences of interviews (Cohen, et al., 2007, p. 382). Thus, pseudonyms were used to protect the identities of the site as well as of the participants. I sent consent letters to the Circuit Office, Cluster Centre, School Principal, participant teachers and parents of the learners who participated in this study. Parents had to sign in the permission letters (Leedy & Ormrod, 2010) written in Oshiwambo and which were returned to me as proof that learners were permitted to participate in the study. I wrote these in Oshiwambo so that parents could understand the contents of the letters.

According to Anderson (1994) and (Bassey, 1995), an explanation should be given to the participants about the purposes and procedures of the research, describing the arrangements for protecting their privacy, and indicating who has access to raw data that was taken from participants. For this reason, before I embarked upon the interviews, an explanation was given to the research participants about the purpose and procedures of this study. I made sure that I described the arrangements for protecting their privacy, and I indicated who could have access to the raw data that was taken from participants as suggested by Anderson (1994) and Bassey (1995).

Furthermore, in order to protect participants' personal identities, the names of learners, teachers and the school are not mentioned in the data presentation to protect their identities. Even though the research includes pictures and video recording during lesson presentation as well as audio tape during interview, these would be kept safe by the researcher to ensure that they would not be exposed to the public without the permission of the research participants.

3.8. Validation

Anderson (1994, p.13) defines validity as the complement to reliability. Gay (1987, p. 128), Anderson (1994, p. 13); Lankshear and Knobel (2004, p.167) refer to validity as the extent to which what we measure reflects what we expected to measure. “Validity is an important key to effective research” (Cohen, et al., 2007, p.133; Cohen, et al., 2011, p. 179).

In this study, multiple methods (Roberts-Holmes, 2005; Leedy & Ormrod, 2010) were used as a triangulation strategy to ensure validity. Cohen, et al. (2007) define triangulation as the use of two or more methods of data gathering in the study of some aspect of human behaviour. As Cohen, et al. (2007) suggest, the data was triangulated by looking at different theories in order to avoid using one viewpoint only.

In order to validate my practical activities also, the instruments were piloted last year (2011) in grade 8 but with a different group apart from the group that participated in the study but in the same school and in the same grade. The purpose was to gain feedback on the validity of the instruments used to gather data, to eliminate ambiguities or difficulties in wording, to check the time taken to complete the practical activities and interviews (Cohen, et al., 2007). This helped me to revisit some of my data generation tools such as worksheets, and interviews.

Methodological triangulation (Cohen, et al., 2007) was also used since different methods as explained earlier were used to gather data from the same unit of analysis which were activities carried out with the grade 8 learners at Ndida Combined School. The outcomes provided by different data gathering techniques used were analyzed in order to look for insights between them, hence, reducing false conclusions.

I also validated my data by giving back the transcripts to the critical friend to read through so that he could confirm whether what I wrote was what he had said exactly. This is called member checking (Cohen, et al., 2007). Since I interviewed learners in English and in Oshiwambo (learners' mother tongue), I gave the transcripts written in Oshiwambo to the learners so that they could translate them to English and thereafter I checked their translations. This proved to be another worthwhile member checking process. Since the lessons were captured in the video, I also did some stimulated recall interviewing by watching the video together with a critical friend. The critical friend made some useful comments accompanied with constructive feedback.

3.9. Limitations

Since the approached critical friend who was something of an expert could not observe my lessons, I was observed by a different teacher. The quality of the video was also not as good as the cameraman was not an expert. As a result, the first part of the first lesson was not captured in video.

3.10. Concluding remarks

This chapter started by providing the outline of the research case study. I discussed the paradigm that informed the research study and the research methodology which I selected to approach the research study. The chapter also provided the outline of the methods that were used to approach the study as well as techniques used to generate data. I also explained that multiple data gathering techniques were used to triangulate data. The motives for choosing the methods used were explained. The chapter also gives the research site and research participants. Finally, I indicated how the ethical considerations were addressed and discussed the limitations to the study.

The next chapter presents and analyses the data gathered using, brainstorming, group discussions and presentation, as well as data gathered from the community.

Chapter Four

Data presentation: Phase One

4.1. Introduction

In Chapter 3, I described the methods used to gather data in this study. In this chapter I present the findings obtained from data generation techniques I used in the first phase of this study, namely, brainstorming, discussions and presentations. Brainstorming forms the foundation or baseline in this study. I then present the findings from each data generation technique in a sequence.

4.2. The extraction of examples from each data set

The data that is presented in this chapter was selected according to the following aspects:

- Cultural beliefs and experiences were presented exactly as they were presented by the learners and community members;
- I extracted the classification of cultural beliefs as scientific, non-scientific or not sure and
- I also present the cultural beliefs and experiences which are popular in the community where this study was carried out.

These data sets provided answers to questions two and three and this shows how learners understand their cultural beliefs and experiences about lightning in relation to science.

Data presented were selected based on how these answered the research questions in this study.

4.3. Lesson 1. Day1: Brainstorming, group discussion and presentation session

As stated in Chapter 3, the brainstorming session was the starting point of the teaching and learning strategies used in this research study. This session aimed at answering sub-questions two and three which are:

> What are the learners' cultural beliefs and experiences about lightning?
> Does mobilization of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of scientific concepts?

I worked with twenty-five learners and they were divided into five groups of five learners per group. No specific criteria were followed to put learners in groups except ensuring that each group was gender balanced. That is, groups had more or less the same number of boys and girls. I had to do this because I knew that if I told the learners to arrange themselves in groups, the groups would be composed of learners of the same gender because in most cases girls do not like to sit and work with boys. This is due to the fact that sometimes boys are dominant over the girls.

Also, learners were seated in such a way that they faced each other but in such a way that they could read from the chalkboard without turning around. Each group was given a worksheet with a set of instructions as a guide.

Firstly, I wanted learners to discuss and write down their cultural beliefs and experiences about lightning as an attempt to answer sub-question questions two and three. Furthermore, learners had to classify their beliefs and experiences as scientific, non-scientific or not sure. Before they embarked upon the activity, I asked them if they understood what was meant by the terms scientific, non-scientific and not sure. Some learners said 'yes' and some said 'no'. Their responses encouraged me to assign one learner to explain to others what 'scientific', 'non-scientific' and 'not sure' meant in their mother tongue instead of giving them the explanation myself.

L1's explanation was: *Nge takutiwa scientific oyeyi to dulu nokwiilongwa kofikola, hoi udu, hoimono yashangwa nomomambo (Freely translated: Scientific is something that can be taught at school what you know in your everyday life from home, something you can hear, see* *or experience and is written in the school textbooks). Non-Scientific osheshi ushishi ashike okudja keumbo, ndee kashili momambo (Freely translated: non-scientific are the ideas that you acquire from home but are not written in the school textbooks). Not sure osheshi uheshishi ngee oscientific ile onon-scientific (Freely translated: it is when you do not know whether it is scientific or non-scientific).*

This session was thus concerned with the elicitation of learners' prior everyday knowledge and experiences which would later be incorporated in teaching science. I started the lesson by asking learners if they knew what lightning is, if they have ever experienced or seen lightning, what lightning looks like.

One learner said lightning looks like a fire. Learners shared their cultural beliefs and experiences about lightning in groups, wrote them on worksheets and then on the news prints. The groups were tasked to select a presenter who presented what they discussed in their various groups.

Table: 4.3.1. The following table shows learners' cultural beliefs and experiences about lightning

Group 1	Group 2	Group 3	Group 4	Group 5
Lightning kills animals and people. Destroy buildings and plants. Okashelu ohaka etifa omundilo (It causes fire). Ohaka etifwa kounona tava danauka modula (It happens when children are playing). Kake hole oikwamalusheno (It does like electrical appliances)	Lightning is dangerous it kills animals. The lightning can break houses. The lightning can burn the environment. If you wear a red cloth, the lightning will strike you. If you leave your mouth open and the lightning sees your teeth it will strike you. If you make noise during the rain the lightning will strike	It can strike people and trees. The lightning can also break down buildings. Lightning can strike radio and television or it can strike the electricity off. Lightning may burn your house if you are using electricity. Human can also be strike by lightning if they are under the tree while lightning	Is anything that is dangerous and it can destroy buildings? It kills people and animals. It destroys plants. It is caused by the rain. Put tyres on the roof of a hut to prevent it from lightning strike Do not touch seeds during lightning	When rain is raining we are not supposed to play around. We cannot dress red clothes. When you look after animals then rain comes, do not go under the trees. When also the rain is raining you shall not take your teeth out. Do not sleep on your back when the rain is raining.

It can throw a person away		are happening Twins mother should ululate	You should hang a panga/bush knife through the roof centre of the hut or room	Twins and twins' mother should chew charcoal

4.4. Summary of learners' cultural beliefs and experiences about lightning generated by learners

- It is dangerous;
- it kills animals and people;
- it destroys plants;
- it does not like teeth;
- it does not like noise;
- it does not like red clothes;
- Do not move too much when it is raining and thunders;
- it strikes electricity off;
- it can strike radios and TV;
- it occurs when it rains;
- do not stand under the tree;
- do not lie on your back;
- do not play when it is raining and thunders;
- stay far from animals during thunderstorm;
- lightning causes fire;
- it does not like electrical appliances;
- it can throw a person away;

- put tyres on top of the roof of a hut to prevent it from lightning strike;
- do not touch seeds during lightning;
- twins and twins mother should chew charcoal;
- twins mother should ululate; and
- You should hang a panga/bush knife through the roof centre of the hut or room.

From this activity, groups had to further classify their cultural beliefs and experiences as ‘scientific’, ‘non-scientific’ or ‘not sure’. Some learners in some group did not understand what they were expected to do. Learners who understood explained to others what to do. One learner explained to others and said *'shanga ashike ove (just write), apa oto shange po oscientific, apa onon-scientifi, apa onot-sure'* (*You should write scientific here and here you should write non-scientific and here you should write not sure)* (learner pointing on the Table while she was explaining to others). They did the classification as shown in Table 4.3.2, with translations into English as made by learners.

Table 4.3.2. Classification of cultural beliefs and experiences about lightning

Group	Scientific	Non-scientific	Not sure
1	Lightning kills animals. Destroy buildings and plants. Ohaka etifa omundilo (It causes fire). It does not like people behind animals.	Kake hole ounona tava danauka modula (It does not like learners playing when it is raining and thundering).	
2	The lightning is dangerous if you leave your mouth open and the lightning sees your teeth it will strike you.	The lightning can break houses. The lightning can burn the environment. If you make noise during the rain, the lightning will strike you.	If you wear a red cloth, the lightning will strike you.

3	It kills people and animals. It burns tress. It throws you out.	It can destroy buildings.	It can destroy properties
4	It strikes people It breaks down buildings It also strikes electricity off	When lightning happens, you do not need too much movement. Human can also be strike if they are under the tree Lightning may burn your house if you are using electricity	Lightning can strike radios and televisions.
5	It destroy buildings It kills people It kills animals Do not play when it is raining	Do not dress red clothing Do not stand in a tree when the raining is raining	Do not take your teeth out when the rain is raining Do not sleep on your back when it is raining

The lesson continued by asking learners to discuss and write down about things that they should do or should not do during thunderstorms. They wrote down as follows:

- keep quiet when it is raining;
- do not stay under the tree when it is raining; and
- Do not run around when it is raining and thunders.

They wrote things they should do to protect themselves and their houses. In order to get learners' views about lightning, I asked them to write down the definition of lightning and its causes.

4.5. Definition of lightning from learners' perspectives

- Lightning is something that looks like a fire which happens when clouds make friction;
- Lightning is caused by thunderstorms and it is like an electric shock that comes from the atmosphere;
- It is when the clouds crash with each other and make light;
- It is when the clouds attract each other and cause the fire; and

- It is when a stream of negative charges pouring down. It is caused when charges attract each other.

During the group discussions, I had to move around to give individual group further explanations. This activity was expected to be short and simple but it took much time than I expected. I believe this was due to the fact that this lesson was dealing with learners' prior everyday knowledge and each learner had his/her own knowledge so there were lots of arguments among some of the groups before they reached an agreement. I explained to them that there was no wrong idea since they had different knowledge and experiences. Thereafter, each group had to display their news prints and presented what they had discussed in their groups as said in Section 4.3.

Presentations by learners increased learner talk since they were making comments and even corrected where others went wrong but they were reluctant to ask questions. I had also to intervene when incorrect terms were used or to re-construct some sentences. I also asked learners to give correct terms where they could. For example, when a scientific concept was classified as non-scientific or not sure and vice versa, other learners were making sure that they put it under the correct classification. Thus, critical thinking was promoted during the presentations and discussions. For example, group 4 classified the idea that ‘a person can be struck by lightning when standing under a tree’ under the non-scientific category. Other learners corrected this and suggested that the idea should be under scientific instead.

During group discussions, I wrote learners' responses/discussions on the chalkboard so that learners could comment on others' work and made corrections whenever it was necessary. This writing while I was explaining helped learners to follow what was being said. In other words, they were able to follow my explanations. In the following section I present the findings from the community.

4.5. Learners' and parents' discussions

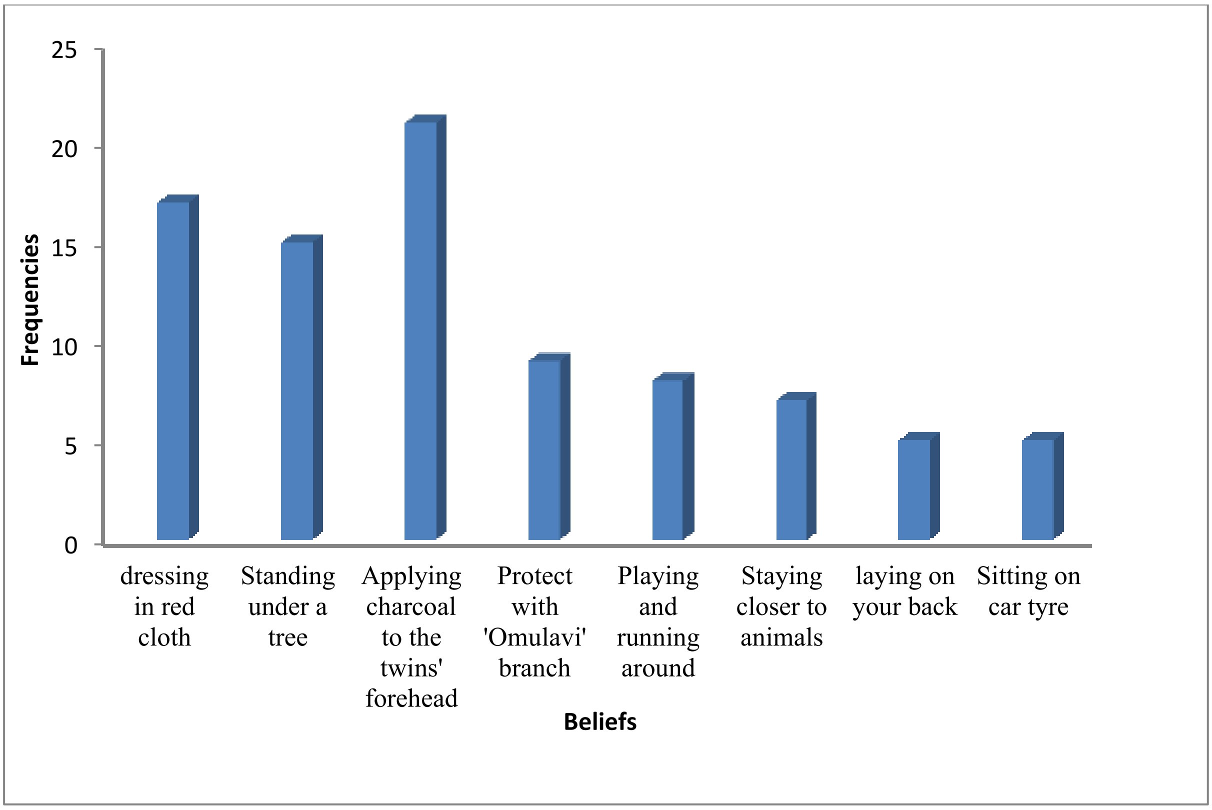
I assigned learners to interview community members about their cultural beliefs and experiences about lightning. Thereafter, they had to discuss their findings in the classroom. I also invited four parents (three males and one female) to share with learners their cultural beliefs and experiences about lightning in order to strengthen my data sets on this aspect.

Table: 4.5. The following table summarises learners' and community members' cultural beliefs and experiences about lightning

Cultural beliefs	**Frequency**
1. Do not dress in red clothes	17
2. Do not stand under a tree	15
3. Chew and apply charcoal on the forehead and teeth twins	21
4. Do not make noise	4
5. Put a small stick from '*omulavi'* (white gardenia) on top of hut	9
6. Do not play or run around when lightning flashes	8
7. Do not stay closer to animals	7
8. Do not lay on your back	5
9. Do not make noise	3
10. If lightning strikes a place, is should be treated by an expert	2
11. Sitting on a car tyre protects against lightning strike	5
12. When you speak in a phone you can be struck by lightning	1
13. Lightning can strike you when you play in water	2
14. Lightning can strike you when you lay on your back	2
15. Peels of jackal berries or palm fruits causes lightning strike	2
16. Do not switch on a radio	3
17. Cover mirrors	1
18. Do not switch on electricity	2
19. Touching a person who was struck by lightning you can also be struck by lightning	2
20. Do not pound or cultivate when it rains and thunders	1
21. A house is likely to be struck by lightning if there is a non-perennial river passing through the field where houses are built.	2
22. Do not smile or open your mouth	2

Form the table above it is clearly seen that there are some cultural beliefs and experiences which are more strongly believed in than others. This is also shown in the graph below.

Graph 4.6. Shows the popular cultural beliefs and experiences about lightning among community members from Ouhongo village in Ohangwena region



The table and graph show that it is strongly believed that chewing charcoal and applying charcoal on twins' forehead can protect them from being struck by lightning. It also emerged that dressing in red clothes and standing under a tree causes one to be struck by lightning.

How the elders defined lightning

- Lightning is a warning or beating by God, when God wants to beat people because of sins;
- Lightning causes fire that can be seen with naked eyes and if you come closer it burns you; and
- Lightning occurs during rainy season, when it is raining. The intensity of lightning flashes symbolise whether rain is male or female.

Lightning occurs when:

- Temperature is high;
- There is a lot of clouds;
- It is windy which causes clouds to collide with each other
- Clouds are too white; and
- When there is *oluudi* (black clouds)

A person can cause lightning to strike when:

According to the parents a person can cause lightning strike when sowing seeds in the fields as she moves to and fro. Lightning can see you when you are moving.

Preventive measures against lightning:

- Hiding under baobab tree or *'omulavi*' tree (white gardenia) quietly;
- Put a small branch from *'omulavi'* tree(white gardenia) on top of thatched roof;
- Twins' mother chew coals and ululate;
- Stay away from red seeds and peels of palm fruit;
- Pray for protection from God; and
- Carry with you a small branch from '*omulavi'* tree (white gardenia) to protect yourself against lightning strike.

What should not be done?

- Do not stand under the tree;
- Do not reveal your teeth;
- Do not pound;
- Do not move around;
- Do not touch hairs;

Figure 4: Omulavi branch

It is prohibited to eat certain wild fruits when it is raining and thundering as they are believed to cause lightning strikes:

- *'eenyandi'* (jackal berries),
- *'eempyu*' (Xinemia caffra); and
- *'eendunga'* (palm fruits)

Children are warned not to play with:

- *'eeni deenyandi* '(jackal berries seeds)
- *'ookena*' (kena's seeds); and are
- *'oipeta yeendunga'* (peels from palm fruits)

Figure 5: Oshimbyu branch

Views about cultural beliefs about lightning: Are they true or myth?

Excerpt 1: According to the parents,

P1: O*inima oyo ndishi oya kala ko ngoo nale eshi kwali ku hena Kalunga. Paife ngeenge odula tai shela oha tu indile ashike. Kaina eameno lasha* (Freely translated: *those beliefs have been there when there was no God. These were Gods of our fore parents. Now we pray when it is raining and thunders. They do not really protect).*

P3: *Ame ohai shi koleke ashike. Modula tai loko, okashelu taka shela ndee omunhu ota kala eli mepoya takunhu ndee teli mwenenene ita mono oshiponga kokashelu. Ndee shoshili ou a hagika ta kunu ohai mu vakula po (Freely translated: I confirm it. When it is raining and a woman in the field stops sowing and remains stand still, she won't be struck by lightning. But truly speaking, lightning strikes a person who is sowing).*

These parents had different opinions about the cultural beliefs and experiences about lightning. One parent felt that these beliefs are myths while others felt that they are true and if one does not adhere to them they can be struck by lightning. These parents also strongly believe that their beliefs protect people from being struck by lightning.

Views about inclusion of cultural beliefs and experiences about lightning:

Excerpt 2:

Parents felt that cultural beliefs about lightning should be included in teaching science: one said:

P3: *Omadilaadilo aa okwa wana oku longwa mofikola shaashi omadilaadilo aa efimbo linya twa dja lootatekulu nomeekulu, omadilaadilo mahapu omawa, natango otaa longifwa, oo mahapu ngeenge hatu a diinine ota etu amene (Freely translated: In those years of our fore parents these ideas were good and they are still being used. When we adhere to them they will protect us).*

P2: *Oshawana oku shangwa shaashi ope na ounongononi tau li longwa. Nena ngeenge oto lilongo to nongonona oshiima ndee kushii efina, etameko lasho, ita shi ku mangulukile oku u dako (Freely translated: these ideas should be written in the books because of the science which is being learnt. When you are teaching about science and learners do not know the indigenous knowledge of the topic being taught they will not easily understand what is being taught).*

These parents felt that cultural ways of knowing is wealth to be included in teaching science since they have been useful in the past and they are still useful and can protect us from lightning strike if adhered to. Cultural beliefs can serve as a base where the learning of science can be built.

Some misconceptions that emerged from the discussions

- Twins have magnets which attract lightning;
- Twins have more magnetism in their bodies than ordinary people because a twin is a leader;
- Hairs have magnets which attract lightning;
- Lightning does not like teeth and nails;
- 'Kena's seeds (red seeds), peels of jackal berries and palm fruits causes lightning strike;
- Red colour/die has magnet that attracts the magnet of lightning; and

- Standing under a tree when it is raining and thundering protects from lightning strike.

From the data sets collected by learners from the community and from the discussion with the community members in class, the common misconception that emerged was that human beings have magnets in their bodies.

Learners tried to clear some misconceptions

One learner tried to clear misconceptions when one learner presented that twins have magnets which attract lightning. He stood up and said: *Do human beings have magnets? Human beings do not have magnets in their bodies* (Appendix 4B).

Learners also tried to clear some misconceptions that emerged from the discussions held with learners and with parents in the science class (Appendix 4C). One learner cleared up misconceptions raised by one parent that 'you can hide under a tree when it is raining and thundering.

The learner commented as follows:

L: *Oto hange taku ti: odula ngee tai loko ngaashi unene fyee ava hatu kala koufita, vati ino pumbwa nana oku kala wa ya momuti odula tai shela. Oto kala ashike opo fiyo odula otai sheka* (Freely translated: *sometimes you are told, especially us boys who look after animals, not to stay under a tree when it is thundering, but we should stay at a bare place until rain stops falling).*

P: *Ehee! naasho oshoshili. Opena omiti edi dayoololwa (Freely translated: Yes, it is true. There are specified trees).*

L: *Epulo lange onde li pulila molwaashi nee ta ku tiwa omunhu oto dulu ngoo okuyaama pefina lomuti ngee odula tai loko* (*Freely translated*: *I asked because it was said that you can hide under a tree when it is raining and thundering).*

P: *Ayee, opo ouli mondjila, epulo opo oku li mweenena shike. Okukala pefina lomuti opena miti edi dayoololwa ndishi! Doo odo ohadi keelele okashelu, inai tonga nawa. Epulo loye oli li mondjila. Hamuti keshe ngaashi omufyaati oo nde to kal pefina lao. Omumati penya okwa tonga nawa kutya li mwenenena uli poluhaela. Ngeenge opena omulavi inda momulavi ile momukwa itai uya mo (Freely translated: No, you are right, what is important is to be silent. Staying under a tree, there are specified trees and they protect against lightning strike. I did not make it clear. Your question is valid. You cannot stand under a tree* *such as mopane tree. The learner is correct. You should stay at a bare space quietly. If there is 'Omulavi' tree* (white gardenia) *or baobab tree you can stand under there. Lightning will not come in).*

- The reason why some trees are prone to lightning strike was that the tree rings (growth rings) are red and hence they like lightning. Interestingly, there was no reason connected to the height of trees as a major cause of lightning strike.

4.6. Concluding remarks

This chapter presented and analysed the findings from the brainstorming, discussion and presentation session during the first lesson as well as findings from the community members. It is clear from the presentations that learners possess a lot of knowledge. It is also clear that there is a lot of knowledge that exists in the community, albeit some being misconceptions.

This data revealed that there are some beliefs which are strongly adhered to compared to others. Inclusion of parents in the science discussions made lessons enjoyable for the learners. When the indigenous ways of knowing are incorporated in science lessons, some misconceptions can emerge and such misconceptions were cleared up by the learners using their scientific understanding.

The next chapter presents the second phase of data presentation.

Chapter Five

Data presentation: Phase Two

5.1 Introduction

In the previous chapter, I presented the data generated from the brainstorming session and data gathered from the community. In this chapter, I present the data from document analysis, practical activities with worksheets, whole class discussions, observation, focus group interviews with learners as well as semi-structured interviews with a critical friend who observed my lessons. Essentially, the practical activities with worksheets, discussions, and interviews formed the main data gathering techniques of this research study.

5.2. The extraction of examples from each data set

The examples of data presented in this chapter were selected according to the following aspects:

- Document analysis which informed the research study; and
- Extracted data from worksheets used during practical activities as well as observation captured in a video. These data sets answered sub-questions three and four as well as five which pulled all the research questions together. Quotes from the video were used to illuminate learners' engagement during the lessons; and
- Quotes from both the semi-structured interviews and focus group interviews were used to highlight, in particular, the voices of the research participants.

5.3. Document analysis

5.3.1. The Namibian syllabus for grade 8, 9 and 10

The syllabus is the ministerial document which guides teaching and learning. The Physical Science syllabus for grade 8-10 was developed so that it describes the intended learning outcomes and assessment practices within the science mainstream. The learning and subsequent outcomes are tailored towards promoting the learners' knowledge of the physical world of which they are part of (Namibia: MoE, 2006).

The syllabus further states that learning experiences in the natural science area are focused upon promoting the teaching and learning for understanding. Learners need to acquire relevant knowledge and skills which are a prerequisite for progressive national and economic goals and the improved standard of life for our people. Thus, learners need to acquire knowledge and skills which foster their understanding of the interaction of human beings and the environment in order to satisfy human beings.

The syllabus indicates the learning objective and basic competences about static electricity (which is a focus of this study) as follows:

Learning objectives state that learners will:

- know existence of charge;
- understand charge;
- know how to charge objects; and
- know how an electroscope works.

The basic competences state that learners will be able to:

- Explain the existence of electrons, protons as introduced in the chemistry section;
- Explain the existence of charge by imbalance of electrons (negative) and protons (positive) (e.g. the separation of charges by rubbing objects against one another);
- Investigate and describe how objects can be charged by friction and explain examples in everyday life; and
- Investigate and explain how charges on a charged electroscope are able to discharge by flowing to the Earth through the process called 'earthing'.

The themes of this topic are: charges, static electricity and electroscope.

The syllabus also suggests some practical activities, approaches or demonstrations such as:

Topic: Charge and static electricity

Learners should investigate:

- the effects of charged objects on one another;
- how different objects attract or repel each other depending on their charges;
- charge objects by friction, e.g. combs, pens, glass and Perspex rod, plastic straws and pens rubbed on wool, silk and hair;
- Identify examples of everyday life where charging takes place by friction as in; and
    - walking on carpet
    - pulling off a jersey
    - pulling blanket and sheets apart
- Optional demonstration of the use of the use of the van de Graaff generator to show sparking, electric wind, glowing of a neon lamp, repulsion and attraction.

Topic: Electroscope

- learners should use an electroscope to:
    - demonstrate how an electroscope can be charged;
    - test if objects are charged; and
    - Demonstrate how charges on a charged electroscope are able to discharge by flowing to the Earth.

The syllabus also makes some provision for learners to use examples from everyday life. For example, the third basic competence requires learners to explore and describe how objects can be charged by friction and requires them to explain examples in everyday life. It also outlines specific examples of everyday experiences whereby charging takes place by friction. Unfortunately, among these examples there is no example about lightning as example of charging by friction in nature. Instead of presenting lightning as an example of static electricity in nature, it is only defined as a form of discharge under electric current topic (see Appendix 9). This could lead to teachers presenting it to the learners without considering their prior everyday knowledge and experiences of such natural phenomenon. Also, examples of static electricity such as pulling off a jersey and pulling blanket and sheets apart are familiar to the learners but learners in the village do not know what a carpet is.

5.3.2. The textbooks

Two textbooks were analysed to look at how static electricity is approached and how lightning, in particular, is presented. The first textbook analysed was Go for Physical Science grade 8. This textbook is written by Helene van Niekerk and published by Macmillan, Namibia in 2007.

The second textbook analysed was New Physical Science grade 8, Namibia Junior Secondary Certificate, written by Ivan Britz and Nevison Mutasa and the publisher is Zebra, publishing year 2007. Even though both textbooks are in line with the syllabus, the second textbook is used by the learners in most schools in Namibia in Ohangwena Region while the first one is just used by teachers at some schools as a reference. This book is commonly used because it is in the government catalogue so it is accessible. It is learner-user friendly as the language used is simple. It also gives clear and easy explanations and has diagrams that are useful in facilitating learners' understanding.

Go for Physical Science textbook highlights examples of static electricity as follows:

- You try to clean a TV screen or window by rubbing it with a cloth, more and more dust particles are attracted to the screen;
- You try to comb your hair and static electricity causes it to stand on end;
- You get a shock after walking on a carpet and then touching a metal door handle;
- Clothes cling to your body and crackle when you put them on or take them off; and
- Blankets and sheets crackle and cling together when you pull them apart.

This textbook describes lightning as the situation (sic) in which static electricity can kill a person or animal or cause fire. Large static charges build up when air and water particles in a cloud rub against one another. When there is a sudden discharge of this build up, the lightning strikes the highest place on the ground.

Looking at how lightning is explained in this book it is a bit questionable especially, describing it as '*the situation...'* instead of saying an example of static electricity in nature or static electricity at large scale. This is how teachers will pass the knowledge to the learners and learners will take it as the correct explanation. Therefore, instead of defining lightning as a situation, it should be given as an example of static electricity in nature and its dangers such as; it kills people, animals and it causes fire.

New Physical Science gives lightning as an example of charges in everyday lives this is presented under static electricity. The explanation about the formation and occurrence of lightning is the same as the one given in the **Go for Physical Science textbook**. There are no other examples of static electricity in everyday lives given in this textbook. Therefore it is recommended that teachers should not stick only to one textbook as a source of information. Instead, should use the syllabus as a teaching guide and consult variety of references textbooks as a source of information.

5.4 Practical activities with worksheets

Practical activities were carried out and worksheets were used to record the learners' observations. The worksheets were numbered according to the lessons in which they were used.

Lesson 2: Day 2 Charges

Each group was given a worksheet with instructions which they had to follow. This lesson only lasted for about 40 minutes. It aimed at revising and reminding learners about the structure of an atom and the composition of atom (protons, electrons and neutrons) because I wanted to establish whether they knew about charges as these were not as yet introduced to the topic 'matter'. The basic competence indicated in the syllabi also indicates that learners should be able to recall the types of charges as they were supposed to be taught in the topic 'matter' (see Section 4.2.1).

These learners were able to use the prior knowledge they had gained from grade 7 about the structure and compositions of an atom. Thus, all the groups knew that the two types of charges are negative charges and positive charges. They also knew that negative charges are electrons and positive charges are protons (see Appendix 3B). All of the groups except one completed the table successfully.

Table 5.1. The sample of the table which was completed by the learners prior to practical activities to test learners' prior knowledge

Particle	Charge	Position on the atom
(a) Electron	Negative	In the shell of an atom
(b) Proton	Positive	In the nucleus at the centre of an atom
(c) Neutron	Zero	In the nucleus at the centre of an atom

As stated earlier on, this activity was designed to help learners recall the types of charges since static electricity is caused by charged particles. They had to complete the sentences in a worksheet (see Appendix 3B), which they all did very well. This aimed to test whether they knew when the object is negatively charged, positively charged or neutral.

Thereafter they proceeded to the third activity which dealt with forces between charged objects and neutral objects. In this activity, learners had to predict first before they did the experiment. I read the instructions aloud together with them (learners), so that they were able to do the activity according to the instructions. But not all groups followed the instructions properly. Instead of predicting, they started with charging the pen (rubbing it into their heads). This might be because they did it in the previous grade or they were excited to have the materials in front of them. Therefore, instead of writing their predictions, they wrote down their observations. I had to intervene so that they did not make the same mistake in the next activity.

Some groups followed the instructions as they were. All the groups understood the difference between a charged and neutral object. They also understood that objects get charged by rubbing materials/objects against each other but all groups failed to reason why charged objects attract a neutral object. Some gave reasons such as:

- Because the charged object needs more negative and positive charges;
- Maybe the object has a lot of charges; and
- Because the pen is rubbed and it has positive charges and pieces of papers have negative charges and they have to attract each other. Learners understood that unlike charges repel each other but they failed to pay attention to the concept 'neutral'.

Other two groups did not give reasons. Since learners had to present their findings, at this time I explained with the help of diagrams drawn on the chalkboard.

Lesson 3: Day 3 Forces between charged objects

This lesson was a practical activity that focused on the forces between charged materials referred to as insulators. Before the lesson started, I started the lesson by recapping on what we did on the previous lesson. I did this to test whether learners had the necessary prior knowledge for the current activity.

Each group was given a worksheet and materials to be used (see Appendix 3C). I asked learners to read through the instructions aloud. Even though the instructions were emphasised, learners in some groups started doing the practical activities without predicting, the same problem they had in the second lesson. I had to intervene and told them to read and work according to the instructions given.

I demonstrated to them how they should hold the drinking straws that they were using. Since not all learners could understand what they were required to do, I had to walk around and give individual assistance to the groups. Learners were intent on doing the right observations. They even assisted one another with the spelling of words.

Based on their activities, not all groups used the correct terms when the objects were repelling or attracting each other. They used words such as: *spinning, move away, move around.* These terms were corrected during explanations when learners were presenting their findings. Some groups managed to use the correct scientific terms such as: ' repel' and 'attract'. These were the concepts that I reinforced during explanations.

All four groups understood that when two objects are repelling each other the force between them is a repulsive force and when two objects are attracting each other the force between them is an attractive force.

In order to be able to assess learners' understanding as a result of practical activities, I gave them a class task to work individually (see Appendix 6A). In doing this I was trying to address the misconceptions that LCE has to do with learners working in groups all the time. Furthermore, I believed that the class work would provide me with a chance to assess the effectiveness of engaging learners in practical activities.

Lesson 4: Day 4 Electroscope

This lesson was started by revising the class work which was given in the previous lesson. All learners defined static electricity correctly. But some of them struggled to write correct explanations on the open ended questions. For instance, they could not reason that a balloon became positively charged because it has more protons than electrons.

The lesson was aimed at showing how to charge and discharge an electroscope and further explored the uses of an electroscope. Since there was only one electroscope to be used, I did the practical activity as a demonstration by the teacher and individual observations by each learner. At the beginning each learner was given a worksheet to record predictions and observations as individually. This activity helped learners to concentrate on observation and recording of findings as individuals. Passive learners were also relieved from dominance by dominant fellow learners.

I introduced an electroscope and other materials to be used by the learners. This was activity six and seven. I charged objects by friction and charged an electroscope by bringing a charged material close to the metal cap of an electroscope. Some learners also had a chance to charge the electroscope.

During the practical activities, some learners developed some observation skills even though they lacked the right concepts at first. There were still those who did not develop observation skills nor develop the right concepts. This was evidenced by the fact that they could not use the right terms when writing down their observations. Some did the correct observations but could not give reasons. For example, they could not reason that a gold leaf opens because like charges repel each other.

Some of the learners predicted that if a negatively charged plastic strip was brought closer to the metal cap of electroscope, the leaves would come closer. One of the learners used the term ‘attract’. None of the learners stated that electroscope would become neutral. Some of them predicted that the leaf would remain open. One of them used the concept 'electroscope remains charged'. Reasoning was different from learner to learner.

Nonetheless, all learners gained some understanding on how electroscope works from the activity as they all stated that an electroscope was used to test whether the object has a positive or negative charge or to detect electric charges. This is one of the learning objectives in the syllabus which was achieved well (see Section 5.3).

The next activity had to do with the materials that could discharge an electroscope. The activity was done step by step. First, after charging an electroscope, take an object and touch the electroscope with an object. Learners had to observe and complete a table about whether the electroscope became neutralised or remained charged. This activity helped my learners to understand the difference between a conductor and insulator.

At the end of the activity, each learner was given an opportunity to read out one of his/her predictions or observations. By doing this I wanted each learner to participate in the activity. When a learner did not use the correct concept, other learners were asked to give the correct scientific terms. This lesson disadvantaged learners on the one hand, by not having access to touch the materials and do experiment on their own but on the other hand it advantaged them by allowing each learner to observe independently, do his own recording and participate in the lesson by reading out his outcomes. This lesson was concluded by giving learners some homework (Appendix 6B) which they had to do individually.

Lesson 5: Day 5 Lightning in pocket format

Since learners were given some homework in the previous lesson, the revision was a starting point, whereby the answers were discussed and corrections were made according to learners' responses of the homework. This was the platform where the misconceptions that emerged from the learners' answers were cleared up through explanation and by drawing diagrams on the chalkboard.

This activity was designed to lead learners to scientific explanations of lightning and examples of static electricity in everyday life. To capture the learner's interest, the title of the practical activities worksheet was 'lightning in pocket format'.

In this activity, learners had to charge a plastic ruler and then bring it closer to a finger. It took some of the learners some time before they observed electrical shock from the charged ruler on their fingers. Learners in some groups observed that the ruler felt hot. I told them to repeat the experiment until they eventually got the correct observation.

Finally, each group got the correct observation. Their observation was: 'you feel electric shock', except one group whereby they stated that 'you hear sparkling sound'. In the worksheet, they were asked to give reasons for what they felt.

They gave reasons such as:

- a person has charges;
- there are different charges between ruler and finger;
- the extra charges try to escape;
- the charges move from the ruler and shock the body; and
- the extra charges on the ruler move form ruler through your finger to the earth.

These learners were aware of the existence of charges but still they did not have in-depth understanding of what was happening and why it happened the way they observed it. The last three reasons given (that was from the last three groups) were making sense. The last group also managed to give more clear explanations.

As said earlier, the activity proceeded so that learners could give examples of static electricity in everyday life. They came up with a lot of examples as they had experienced it in their daily lives.

Examples were summarised and presented as follows:

- When you remove a jersey you hear sparkling sound;
- When you touch a door handle you feel electric shock;
- When you touch a plastic chair you feel electric shock;
- When you remove a jersey you feel electric shock;
- When you sit on a plastic chair you feel electric shock;
- When you pull the blanket off you see sparks; and
- When you comb your hair with a plastic comb you hear small sparkling sound.

The first two examples of static electricity were generated from the diagrams on the worksheets whereby learners had to look at what was shown in the picture (Appendix 3E) and write it down. Then they used the activity to think of other examples where they experienced static electricity in their everyday lives. Learners did not write anything about cleaning a TV screen or walking on a carpet as described in the syllabus and textbooks (see Section 5.3).

This activity allowed learners to use the understanding they gained from static electricity practical activities to generate examples of static electricity as given above and to define what lightning is and what they thought causes it. Despite the practical activity, some misconceptions still persisted as some of the groups failed to give sensible definitions. For example, some gave a definition such as: electricity occurs when clouds collide with each other. Only one group could give the scientific explanation, others still stuck to their cultural beliefs about lightning. One group did not give a definition of what lightning is. This is an indication that practical activities help learners become engaged with learning materials but it does not mean that all learners will learn.

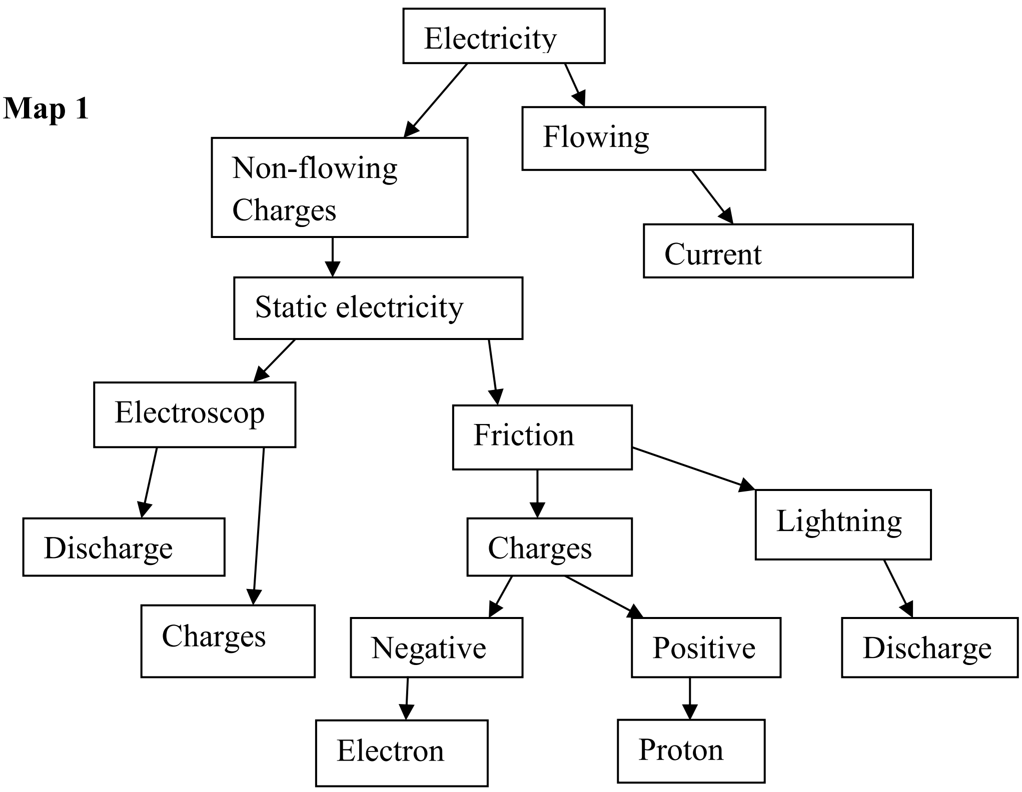
Day 6: Lesson 6 Consolidation

This lesson was a consolidation of the lessons presented for this study. It was the time things were pulled together. This lesson, unlike other lessons, was taught in the morning. Unfortunately, it was not recorded in a video machine because all the teachers who worked with me had attended a workshop on that day.

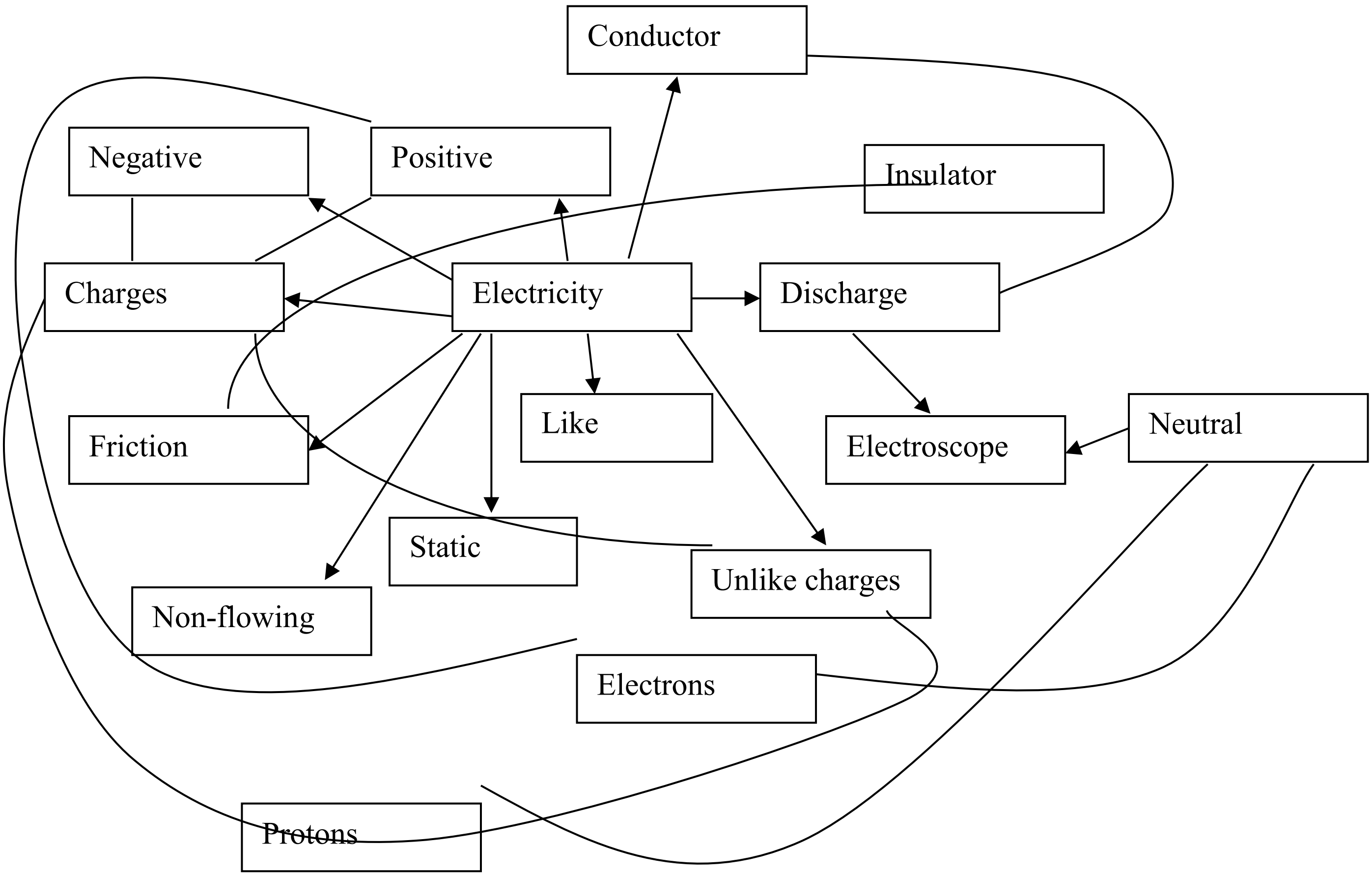
Learners had to summarise the lessons by drawing mind maps and concept maps in their groups. These maps were aimed at enabling learners to indicate the scientific concepts they had gained during practical activities and show how such concepts were linked to one another. This is one of the answers to questions four and five which had to do with whether learners could make meaning of scientific concepts and if they understood and developed scientific concepts as a result of engaging them in their cultural beliefs and experiences about lightning and practical activities in static electricity.

The outcome shows that there was still confusion among some learners. Some learners still stuck to their cultural beliefs as being real as they did with the meaning and causes of lightning (see Section 4.5). The following are samples of mind maps and concept maps of two groups.

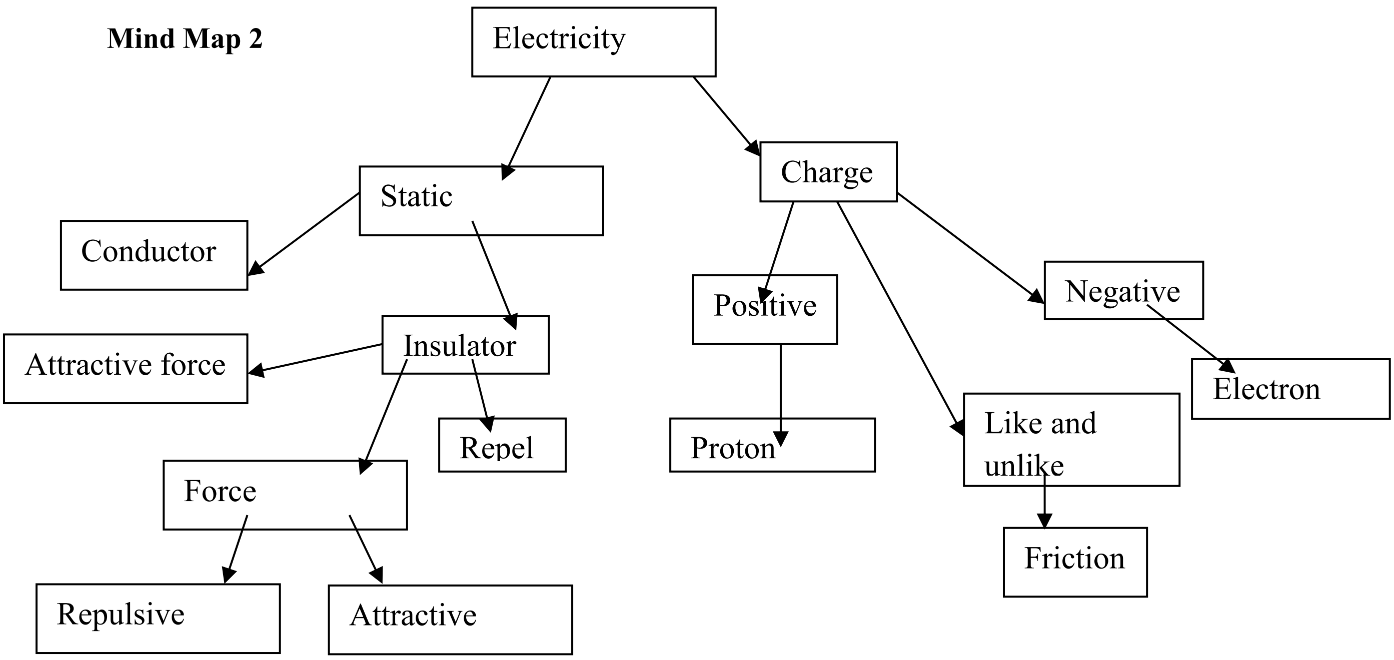
Mind Map 1



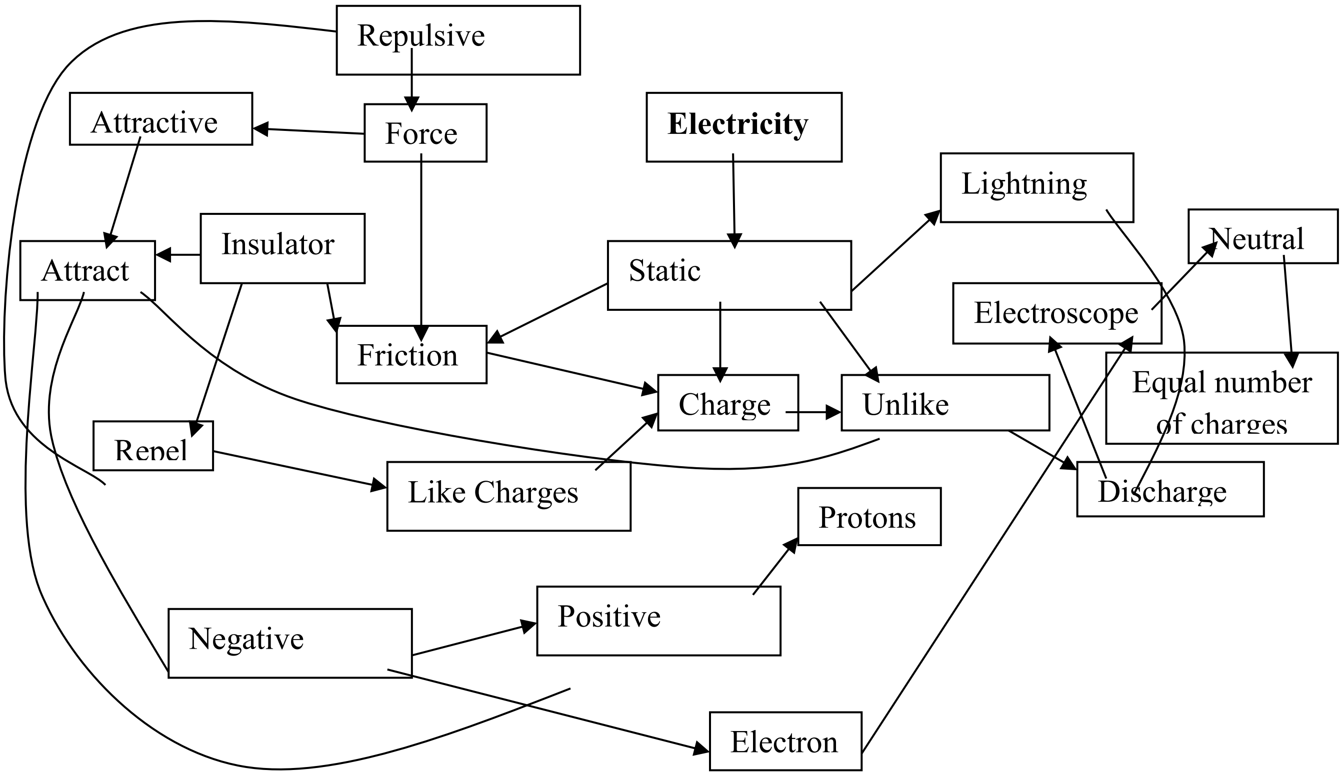
Concept map 1



Mind Map 2



Concept map 2



Learners were also tasked to classify the cultural beliefs as they did in lesson one, as scientific or myths. They were expected to use the understanding they gained from doing the practical activities.

Table 5.4. Shows the sample of learners' classification of cultural beliefs and experiences as scientific or myth

Scientific concepts	**Myths**
Lightning is dangerous	It does not like teeth
It kills animals	It does not like noise
It destroys houses	Do not put on red clothes during lightning
It can burn plants	Lightning occurs when it rains
Do not walk or run around when there is thunderstorm	Do not lay flat on your back
It can strike electricity off	Do not play
Switch off TV, radio and cell phone when it thunders	Put tyres on top of the roof of a hut to protect it
Do not stand under the trees	Do not touch seeds during lightning
Lightning can cause fire	Hang a bush knife through the roof centre of the hut
It does not like electrical appliances	A person can make lightning strike
It can throw a person away	

5.5. Data extracted from the video tapped lessons

This section presents the data gathered through videotaped lessons. Observation played a major role since all except the last lesson presentation was captured in a video (lesson 6). From the video, I could extract the information about lightning I elicited learners' prior knowledge, how the learning was mediated, how the learning was facilitated towards acquisition of scientific concepts, how learners were engaged in the lesson, and how misconceptions were cleared.

The following is an example of some of the conversation I made with learners as an evidence of their engagement during the lessons.

T: Balloon X is positively charged. What type of charges is on balloon Y? Remember they are moving away from each other. (Here I was supposed to use the concept "repel each other" to reinforce the development of scientific concepts.)

L: Balloon Y is also positively charged.

T: Balloon Y is also positively charged. How do you know? How do you know it has the same charges as balloon X?

L: Like charges repel each other.

T: How does balloon X become charged in terms of protons and electrons?

L: Because it has more positive charges.

T: More positive charges than what ...?

L: than negative charges

T: Yes, it has more positive charges than negative charges. (I wrote learners' responses on the chalkboard and explained with the aid of the diagram.)

When learners were presenting, I wrote their observations on the chalkboard so that learners could read others' observations from the chalkboard. I kept on asking leading questions to direct learners to the correct answers or reasoning. In my explanations when learners read out their observations, I intervened to help learners to use the correct terms/concepts when they presented their observations of the activities.

The disappointing part during the lessons was that in most cases learners did not ask or initiate questions. Even if I asked/told them to ask questions, none of the learners asked questions. I was supposed to ask them to come up with questions in their groups, have them raised and discussed by the whole class to stimulate their thinking.

5.6 Focus group interview

This interview was conducted with the learners in English. However, when I realised that they could not express themselves in English well I then interviewed them again in Oshiwambo when they were able to articulate themselves very well. Interviews were also conducted after I had finished conducting the practical activities. As stated earlier in Chapter 3, the focus group was aimed at enabling me to gain some insights into benefits and values of this study from the learners' perspectives.

Since the lessons started by looking at the learners' cultural beliefs and experiences, their answers were mainly about lightning. Therefore, I only presented responses which made sense and in line with my research questions.

Table 5.6.1. Showing interview responses with a focus group in English

Question	Learners' responses in English
1. Do you think teachers should consider learners' prior knowledge or not?	**L1**: I think it is important it is learning us about static electricity and lightning to know the danger of lightning. **L2**: To consider because when you are asked everyday knowledge someone can be participate and when we are asked knowledge of everyday life we learn also it in science. Science is the study of everything around us. That is why our everyday knowledge should be considered.
2. How do you feel that I started the lessons on static electricity with exploring your cultural beliefs and experiences about lightning?	**L4**: We start with the lesson with what we know very well and left with what we do not know. **L6**: I feel very good because it is important to start with the thing that you know and that can be asked from the parents who know more about our culture.
3. Do you think it is important to do practical activities in science or not? Explain Teacher: (follow-up question): Can you give examples of something that you learned which you did not know before?	**L1**: It is important because in those practical activities we use to learn a lot of things that we did not know before and now we know them. **L1**: I did not know how lightning is formed but when we learnt at school I know. Practical activities helped me to understand how lightning is formed. **L2**: It is important because when you do the practical activities you can be learn things that

T: How do you compare the learning when you did practical activities and when there were no practical activities?	you will not know when you can do in the group. Like the group help you the mind to be added together and do the correct things. We learn from one another. **L1**: You do not understand very well because if there is practical activities you understand better then when a teacher is just writing on the chalkboard.
4. Which scientific concepts did you learn during the practical activities in static electricity? Can you give some specific examples of the concepts that you learnt? What did you learn about conductors? What do the conductors do? Apart from lightning, what else did you learn under static electricity during the practical activities? What else?	**L1**: We learn examples of static electricity, lightning and dangerous things of lightning. **L1**: If rain is raining and may be you are in the building and lightning strike the building, you can also be struck by lightning because you are inside there and lightning strike you and kill you. **L3**: We learn about the danger of lightning, conductor, how to protect when there is a raining. **L2**: We learnt that when there is like charges they repel each other, when there is unlike charges they attract each other.
5. Do you think that the inclusion of your cultural beliefs and experiences about lightning has helped you or not to understand the scientific concepts on static electricity? Explain. Can you give an example of something you understand as a result of inclusion of your cultural beliefs and experiences about lightning in the lessons? Can you give an example of what did you understand specifically?	**L1**: It helped because things that we did not know in cultural way we learn them in scientific way. Like may be if you are using electrical appliances you can be shocked but in cultural way there is no such a thing. **L3**: Example of cultural belief, you cannot lay when the rain is raining. **L4**: Put a lightning conductor on top of the room.
6. Did you enjoy or not doing practical activities on static electricity in groups? Explain.	**L1:** I enjoy because, we were told things we did not know. L5: I am enjoy because we learn about the information that we did not know and we learn the meaning of static electricity.
7. Did you like or not the way the lessons on static electricity were taught? Explain. Teacher: What else did you enjoy?	**L1**: I like the way they were taught because we were also demonstrating how static electricity happens apart from our cultural beliefs and demonstrating things that are in scientific ways/ideas.
8. What else do you feel needed to be done to facilitate your understanding of static electricity? Teacher: Are they not just positive and negative charges?	**L1**: I think that we should continue to learn more about static electricity because sometimes when you sit on a plastic chair you feel/hear sparks on your skin you did not know what they are. When you learn about it you understand better than before. **L1**: And also how does the charges positive or negative charges get to electroscope to make the gold leaf to get open, how does the charges get inside there? **L2**: When the lightning is occurring why people say: do not be near by the plants? **L1**: And what type of charges is in the plants?

Looking at the conversation in the table above, L1 dominated the interview. This was due to the fact that this learner's English proficiency is good compared to the others'. This was a methodological dilemma in terms of focus group interview since the learner who can express himself well is most likely to dominate the interview.

Table 5.6.2: The following table shows the data from the focus group interview in Oshiwambo (learners' home language) version.

Questions	learners' responses	learners' translation	my translation
1. Owu udite ku tya omuhongi na kwatele mo ile i na kwatela mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? (Do you think that the teacher should include or exclude your prior every day experiences, when teaching scientific subjects?	.L2: Nali kwatelwe mo opo omunhu a shiive oku shiiva nawa kudja koinima yokeumbo koo keshiivo ta ku wedwa nee kwaai ta longwa yoscientific opo shikale shipu kuye oku lilonga oinima shaashi okuna okukala ena po okashiivo kamwe nale. L3: Nashi shiivike shaashi ionima imwe ohai kala ishiivike okudja keumbo.	L2: Will be include so that person can know well from things from home to knowledge will be add for things that will be learn for scientific to be easy learn things because will have a knowledge already. L3: Will be known because something will know already from home.	L2: The pre-knowledge should be included because we also acquired knowledge from home on which we build the scientific ideas in order to facilitate our learning. L3: Shoud be known because some things are pre-knowledge from home
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everyday knowledge and experiences about lightning?)	L3: Onduudite nawa shaashi ka kwali ndishii kutya oinima imwe otai dulu oku ku kwaatifa kokashelu. Ngaashi ngoo u li meumbo u li mo noinamwenyo oto dulu oku kwatwa kokashelu. .	L3: I feel good because I were not know something that can make you striked by lightning. Like you are in home with animal it can cause you to be striked by lightning.	L3: I feel good because I did not know that some of the things can cause lightning strike. For example when you are in the house with animals, at the same place with them, it is likely for you to be struck by lightning.
3. Owu udite kutya opractical activity oya fimana ile inai fimana	L4: Oha tu lilongo mo ngo kuvakwetu oinima oyo tuheshi nale. Oinima	L4: We learn from our collicks things that we don't know and also we	L4: We learn from the fellow learners things that we did not

nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?)	ngaashi oustrip oyo, oinima oyo kakwa li twei mona nale. L1: Ngeenge ka pena oelectoscope ndee opena omafano oelectroscope ove toi longwa nee otoi shiiva nawa nokui uda ko.	use strip, that we haven't show them ever. L1: If there is no electroscope you will know it even there are photos for really electroscope and will learn it and know it.	know before. Things like strips we have never seen them before. L1: If there is no an electroscope, you could understand it if there is its diagram. Then you will just study about it from there you will know it better.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?)	L3: Otwe li longa mo ngoo oinima oyo yatyatywa, needischarge. Otwe li longa mo kutyaa oelectroscope ohai uli ke ocharge ile odischarge. L5: Ondeli longa mo kutya unlike charges oyeyi inai lifa, ngeenge owe yi eehenifa pamwe otai likwata. Ame onde li longa mo ku tya negative ohai u fanwa electon nopositive ohai u fanwa positive charge.	L3: we learn things that are charged and discharge. We learn that electroscope showed when something if it has charge or not. L5: I learn that if they are unlike charges it means they are positive charges and negative things that are not the same they attract each other and I learned that that unlike charge are the ones that are different. If you bring them to together they will attract. I also learn that negative are called electrons and positive are called protons.	L3: We learn about charged objects and discharges. We learned that electroscope detects charges and discharges. L5: I have learned that unlike charges is when there are positive and negative charges. Objects with unlike charges attract each other. I have also learned that like charges are same charge and when brought close to each other they repel. I have also learned that negative charge is called electron and protons are called positive charges.

5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa moku longa ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knowledge and experience about lightning when teaching static electricity helped you to understand scientific concepts or not? Explain.	L1: Odakwafela nge shaashi oto longifa oinima ei yopamufyuululwakalo ei wa hangika nale ushi ove to longifa nee ei yopascientific ku tya okashelu oha ka etwa po ngaha, to longifa ei yopamufyuululwakaloove toweda ko oscientiffic opo wu u deeko nawa.	L1: It help me because we using things that in traditional that we know already used from scientific that from traditional and add from scientific to understand.	L1: It helped me because; first we used our prior knowledge and then moved onto the scientific ideas about how lightning is formed so that we understand better.
Q6: Owa tyapula ile inotyapula okuu ninga opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?) T: ndee ngeno okwali tolongo oove auke? (What if you were working alone?)	L1 Ondei enjoy shaashi okwali hatu pukulafana apa u he udite ove to pula mukweni yee te ku lombwele. Apa u wete ku tya mukweni keu dite ko ove to mu pukulula, ta mu tula nee omadilaadilo kumwe. L5: Ondei enjoy shashi otashidulika kwali ndi heshi na nde oshitya shimwe moshingilisha ndee handi ilongele ngaho ku vakwetu shaashi navo okwali ngaho veshiisha.	L1: I have enjoy because we were helping one another and you ask your partner and he will tell you where you don't understand. If your partner does not understand and you will tell her and you put idea together. L5:I have enjoyed because if may be I was not know any word in English than I will learn from other learner because they know they will know	L1: I enjoyed it because we have been helping one another, where you did not understand you ask others. If you realised something that the fellow learner does not understand then you help him/her. We were sharing ideas. L5: I enjoyed since there were things that I did not know that I have learned from my fellow learners.
7. Ou hole ile ku hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the	L3: Ondi u hole shaashi ngaashi mostatic electricity otwe li honga mo nana oinima ihapu ngaashi insulator no conductor, kutya oinima ei yeeinsulator luhapu i hai dulu naana oku kwatwa kokashelu. Ngaashi naana taku tiwa kutya vati ngeenge wa tungu etungo loye ndee to	.L3: I like it because like in static electricity we have learn more things like insulator and conductor, like the things of insulator they may be strike by the lightning, of the conductor they can conduct with the lightning. Like it been sayed that if you build	L3: I liked it because like in static electricity, we learn a lot such as, insulators and conductors that in most cases insulators are not most likely struck by lightning. Apparently, if you construct your building and you fit it

lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?)	li tula naana okaima, omaretial ngoo imwe hai longifwa hai dulu oku taataa okashelu, oinsulator ihai kwatwa naana kokashelu vati ngeenge ndee etungo ta li kwatwa hanaana vati etungo hali hanaunwa po vati alishe. L5: Ondi ilonga mo shaashi potete omunhu oho longifa tete omadilaadilo oye opo mu ka pewe eeinstrument opo u mone nee ku tya oshiima ohashi longifwa ngahelipi.	your building than you put a thing, the material that has been used to prevent lightning, the insulator can be strike by the lightning if the building been strike by the lightning will not be very destroyed. L5: I like because first you use your idea so that you be given the instrument to see that the thing are use for when.	with a certain material which repels the lightning, an insulator it will not be struck by the lighting. If the building happens to be struck by lightning, it is unlikely for the building to be destroyed by the lightning. L5: I like it because at first you use your ideas before you will be given the instrument to learn how to use it.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricity? (What else do think if was supposed to be done in order to help you understand static electricity topic well?)	L5: Okwa li twa wana oku li longwa mo shashi ohandi udu ku tya vati ngee to danene omeva oto kwatwa kokashelu. Okwali nee nda hala oku uda ku tya moo momeva omuna nee opositive ile onegative?	L5: We were enough to learn because I heard that if you play in water you will strike by the lightning. I was want to hear that in water there is positive or negative?	L5: We had to learn more, because I was told that if you play in water you can be struck by lightning. I wanted to know the types of the charges in water whether they are positive or negative.

It appears from the tables of interviews above that it was a long conversation. From these findings learners raised crucial points. They indicated that incorporation of their cultural beliefs and experiences about lightning helped them to bring in their knowledge and they moved onto new knowledge. They indicated that they liked the practical activities because they worked in groups whereby they assisted one another, and they also touched the objects. They also felt that they needed to be given homework that required them to work with parents.

Their replies to question 8 shows that they had some aspects that they wanted to know which were worth rising during the lesson. For example, L5 wanted to know the types of charges in water because she was warned not to play in water because she can be struck by lightning. As a teacher, I was supposed to elaborate more on this. The following is the interview with a critical friend. I interviewed him to gain insights on the success and weaknesses in my approach to my lessons. This interview was held after I had completed all my lessons.

5.7. Semi-structured interview with critical friend

In this interview there were five focus questions but follow up questions were raised. It was held a few days after I had finished teaching my lessons and focus group interview with the learners. It was held in the evening at the school where I teach when my critical friend was free from school work. The following is the data from the semi-structured interviews.

When responding to the question whether learners' cultural beliefs and experiences should be incorporated in teaching static electricity, he said:

T: *I think it is needed to be included because culturally learners have beliefs about lightning and some of their beliefs are corresponding to the really meanings of static electricity and the lightning. So, it is really needed to help their understanding and the way to protect them from the danger of lightning.*

He also indicated the challenge of incorporating cultural beliefs and everyday experiences that:

The challenges are these, some learners get confused, and some they just stick to their cultural beliefs and try not to understand what the really meaning of static electricity. Some they just look at what they got from their parents as real and try not to understand what the teacher is teaching them.

When I asked him about how sticking to cultural beliefs and experiences affect learners' learning and he replied that:

T: *The effect is that, it can lead to the failure and they cannot understand because what is in their head is just that what their parents told them is real and what is written in their text books is like they cannot really get it even if they will get that one after sometimes.*

From the semi-structured interviews, I picked up some different factors. Firstly, that learners' prior everyday knowledge is important to be included in teaching science because learners already know something about lightning some of which match with the nature of science. Secondly, culture and nature of science are intertwined. Third, inclusion of learners' prior everyday knowledge in science teaching causes confusion as learners adhere to the knowledge that they acquired from their parents.

In other words, border crossing between culture and science is hard to achieve. Fourthly, he pointed out the advantage of practical activities as learners are able to manipulate materials, able to observe, learners are able to link their findings from the practical activities with their existing theory. Fifthly, the challenges of doing practical activities were that learners wanted to see the sparks between the charged object since lightning is a spark (see Appendix 7A). When working in groups some learners tended to be dominant thus they wanted to do the practical activities alone. Language was also identified as a barrier to learners' understanding of new concepts. Even though he commended the lessons as good, diagrams were an important factor to accompany the explanations. He also felt that learners should be given some hand-outs with summaries.

5.8. Data from the assessment test

The test (see Appendix 6C) was based on the static electricity topic. It was set out of twenty marks and consisted of two sections. Section A was multiple choice questions which contributed five marks and Section B was structured open-ended questions which contributed fifteen marks. The main aim of the test was to assess learners' understanding of static electricity as it was taught along with practical activities. When I gave this test, I assumed that if the majority of the learners passed it that would indicate that learners understood the lessons especially that they wrote it six months after the topic was taught.

Even though the multiple choice questions are not very reliable as it is vulnerable to guessing, the structured open-ended questions provided me with an adequate picture on how learners understood the issues.

In the first section (multiple choice questions), thirteen learners (57%) did well while ten learners (43%) performed poorly. In the second section (structured questions open-ended), the learners had to differentiate between the concepts, state, explain, give examples and fill in the missing words.

Seventeen learners (74%) obtained between 50% and 87%, six learners obtained between 13% and 47%. None of the learners got between 90% and 100% of this test. The highest score was thirteen marks (87%) out of fifteen and the lowest was two marks (13%) out of fifteen. Even though 74% performed well in this section, I was still not happy how others answered the questions.

Although many learners gave correct explanations in some questions; the explanation on how lightning was formed was not pleasing. This was because the majority of the learners (this was 17 learners (74%) did not write understandable explanations. Three of these learners still adhered to their cultural beliefs (myths) about lightning. Six learners gave the correct explanations. The last question was well answered by the majority of the learners (16 learners (70%).

In general, I was satisfied with my learners' performance especially that it was written some months after the topic was taught. I believe that my new approach to the topic helped learners to understand the topic since they could still remember some of the things.

However, there were still concerns to be paid attention to. If given another chance with the same group of learners I would definitely go through the test together with them so that I could clarify using their language (not area of focus) and clear up some of their misconceptions/misunderstanding including spelling of words. For example, in a test learners were asked to explain how lightning occurs. Some learners' explanations were (direct quotes as written by the learners):

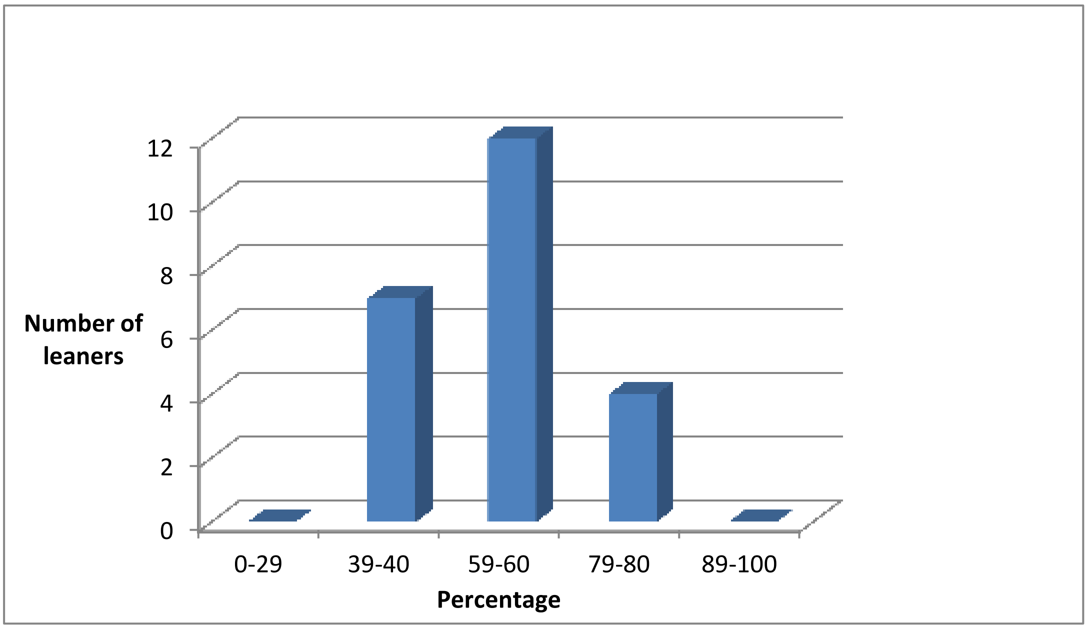
L1: *Is the friction between cloud and soil when the changs (referred to charges) close other they repel and they form lightning;*

L2: *Is when positively joined together with a negatively charged*; and

L3: *The lightning will happen when the cloud make friction with air charge will refilex (referred to reflect) and into the soil there is diferent (referred to different) charge from cloud with the other one which is in the cloud the charge from cloud will frow (meant flow) into the soil and it is cause of lightning.*

But if these learners had written the test immediately after teaching this topic, I believe that they could have done better than this. If teachers could allow learners to bring in their everyday knowledge and experiences in the lessons and engage them in practical activities focusing on conceptual development, they could perform better in their examinations.

Graph 5. 8. Analysis of test outcomes



5.9. Observation and member checking

This section is a combination of observation during teaching and member checking after the lessons. The critical friend had to observe my lessons, watch videos together with me and make comments.

Learner engagement:

- Learners were writing their beliefs on a flip chart and presenting them to the whole class;
- They were discussing and they were free to ask questions;
- Learners' were discussing and sharing ideas on how to charge objects; and
- Organisation of the lesson allowed learners to do something and discuss.

Benefits of the practical activities:

- They draw learners' attention;
- Learners make sense of the learned content;
- Learners learn more from teacher's explanations;
- Learners acquire more skills and knowledge;
- They allow learners to debate;
- They encourage critical thinking through asking critical requiring questions;
- They expose learners to some new concepts thus enrich learners' vocabulary;
- They arouse learners' interest during the lessons;
- Learners become interested when the lesson is successful;
- Learners construct own meaning;
- Learners learn from each other through explanations; and
- They promote independent learning.

The challenge of practical activities observed was that some learners were just passive in their groups and when they saw me coming to their groups they pretended that they were also discussing the answers to the questions in their groups.

Teaching methods observed:

- Asking questions;
- Demonstration and experimentation;
- Group work;
- Discussions;
- Chalk and talk;
- Demonstration; and
- Explanation.

Mediation of learning

The teacher observed that I walked around to give groups assistance and gave further explanations where learners did not understand. According to him, the use of group work supports learner-centred approaches, though it is not the only method that was used. Some other methods were used that also supported learners-centred approaches. I asked questions to dig deep into learners' prior knowledge. Learners were given short summaries on the chalkboard and also in the hand-outs.

Working in groups made it easier for the learners to help each other when answering questions posed to them. Walking from one group to another drew learners' attention into the lesson and they were forced not to do as they liked. Learners were allowed to give their prior everyday knowledge about the topic which helped them to develop scientific concepts of, for example, the composition of atoms. I also used the diagrams which helped learners to visualise the location of particles on the atom and reduced memorization of facts and concepts.

5.10. Concluding remarks

This chapter presented the findings from the various data gathering techniques used in this phase of the study, namely, document analysis, practical activities with a worksheet, focus group interview consisting of two language versions and semi-structured interview. The chapter also indicated what the critical friend found out during his observation and watching a video.

Practical activities enhanced learners' engagement with learning materials. The learners and the critical friend acknowledged the strengths of using practical activities such as drawing learners' attentions, acquisition of knowledge and skills, stimulating learners' interest. However, this does not always mean that practical activities result in meaningful learning as some learners still did not understand some of the scientific concepts well. Similarly, irrespective to the teaching and learning strategies used, some learners still adhered to their cultural ways of knowing.

In the following chapter I will analyse, interpret and discuss the findings from this study.

Chapter 6

Data analysis, interpretation and discussion

6.1. Introduction

The main goal of this study was to investigate how eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning making in static electricity. This chapter, therefore, deals with the analysis, interpretation and discussion of the data that was gathered and presented in Chapters 4 and 5 in this thesis.

In my analysis, I first coded my data to form themes. Thereafter, from the themes I developed analytical statements in relation to the data sources as well as the research sub-questions of this research study as described in Chapter 3. In my discussion, I also linked the findings of this study to the literature reviewed Chapter 2. The analytical statements that emerged from my analysed data are summarized in the table below.

Table 6.1: The Analytical Statements

Data sources	Themes	Analytical statements	Research questions
Document analysis	Curriculum issues	Consideration of cultural beliefs and experiences in curriculum documents and textbooks	1. Do the curriculum documents and textbooks consider learners' prior everyday knowledge and experiences about lightning in the topic of static electricity?
Brainstorming, discussion and presentation	Learners' cultural beliefs and experiences about lightning	Learners' everyday knowledge and experiences they bring in science classroom	What are the learners' cultural beliefs and experiences about lightning?
Brainstorming, videotaped lessons, focus	Learner's engagement, co-construction of	Mobilization of learners' cultural beliefs and experiences about	Does the mobilization of learners' cultural beliefs and

group interview, semi-structured interview	knowledge, Misconceptions that emerged when learners are engaged with cultural beliefs and experiences about lightning	lightning enable or constrain learner engagement and co-construction of knowledge.	experiences about lightning enable or constrain meaning making of scientific concepts?
Practical activities with worksheets, videotaped lessons, interviews, assessment test	Learner participation, positive aspects of practical activities, meaning making, mediating learning	Facilitating meaning making in static electricity through engaging learners in practical activities	How can engaging learners in practical activities associated with lightning facilitate meaning making in static electricity?
Practical activities with worksheets including concept and mind maps, and assessment test.	Conceptual attainment, Integrating cultural beliefs and practical activities enables or constrain learning	Scientific concepts learners acquire through consideration of cultural beliefs and experiences about lightning with practical activities in static electricity.	What scientific concepts do learners acquire when their cultural beliefs and everyday experiences about lightning are incorporated in teaching science in conjunction with practical activities in static electricity?

The analytical statements that emerged from the analysed data were also developed by looking at the research sub-questions to be answered in this study. The following section discusses the analytical statements that emerged from the analysed data.

6.2. Analytical Statement 1:

Consideration of learners' cultural beliefs and experiences about lightning in the curriculum documents and textbooks

The documents reviewed in this study were Physical Science syllabus for grade 8-10 and the two Physical Science textbooks for grade 8 which are in line with the revised curriculum. The syllabus further outlined the practical activities that learners should carry out in the classroom about static electricity. Both the syllabus and the two textbooks analysed indicated the scientific concepts that learners are required to learn in grade 8.

Some of the concepts about lightning such as *'lightning kills animals and people'*, and '*it causes fire'* are commonly known by the learners. But some of the examples about static electricity in everyday life such as *'walking on carpets'* and '*cleaning television (TV)*' are unfamiliar to them (see Section 4.3.1.). Furthermore, among the objectives of what to teach about static electricity, there is no learning objective or basic competence (see Section 4.3.1) which requires teachers to include learners' cultural beliefs and experiences about lightning.

The textbooks also do not contain any activities which embrace cultural aspects about natural phenomena, in particular, lightning in the context of this study. In view of this, Hewson, Javu and Holtman (2009) propose that there is need for professional development programmes for science teachers that include curriculum design and materials development. Such programmes should help teachers develop teaching strategies to enable them to elicit diverse learners' cultural beliefs and experiences. Stears, Malcolm and Kowlas (2003) too propose that teachers and learners should be involved in curriculum designing. They believe that this would enable teaching and learning to be built on science understanding through learners' everyday knowledge and experiences.

In this study, for instance, some of the scientific concepts which learners brought up during the brainstorming session were not found in the prescribed learners' textbooks (see Section 4.3.2 and 4.4). This could be due to the fact that the curriculum documents and textbooks are nationally based. So, they tend to present the content which suits the Namibian's national context. This suggests that rural contexts are compromised. For instance, cultural beliefs and experiences such as putting tyres on top of the hut, not wearing red clothes and twins must be applied with charcoal on their foreheads and so forth are not indicated in the curriculum documents and science text-books. Yet, this could be an opportunity to clear some misconceptions associated with these cultural beliefs and experiences.

Building on Ogunniyi’s (2007), Kibirige and Van Rooyen’s (2006); Stears, et al.’s (2003) arguments that everyday knowledge and experiences (which some of these scholar call indigenous knowledge) is context specific, and it cannot be shared between cultures or different communities. This could be the reason why such local knowledge is excluded from the curriculum documents and textbooks. For example, dry wood is an insulator that when it is put on a top of a hut could not carry electric charges to the Earth as does the lightning conductors. Therefore, it could be valuable if such documents may motivate teachers to relate lightning as a natural phenomenon to learners' prior everyday knowledge and experiences.

Ogunniyi's (2007) findings from his study revealed that there is no model of implementation to which teachers can base their teaching approaches which incorporate learners' prior every day knowledge and experiences. Therefore, if teachers rely on textbooks as sources of information, they would transmit knowledge to the learners as it is presented in the textbooks as well as in the syllabus. As a result, learners would not make an effort to relate knowledge acquired from the classroom to everyday knowledge and experiences as it is proposed by Oloruntegbe and Ikpe (2011) in their study they conducted in Nigeria.

In my view, in order to avoid such perceptions, the findings of this study would suggest that, irrespective of teaching guidelines which exclude learners' prior everyday knowledge, teachers should not ignore such knowledge in their science classrooms. My argument is that such knowledge could form the foundation upon which new knowledge could be built on as I did in this study.

6.3. Analytical Statement 2:

Learners' prior everyday knowledge and experiences they bring to science classrooms

This part of the study engaged learners in their cultural beliefs and experiences about lightning. Learners' cultural beliefs and experiences that they generated during this study illuminated that they are not empty vessels. Rather, they have a lot of cultural capital from their homes. In addition to this, their ideas were complemented and triangulated with the everyday knowledge and experiences that were brought up from the community members (see Section 4.5). The inclusion of community members in science teaching was based on Lemke's (2001) view that it enables learners and teachers to understand that science and science education are always part of large communities and their culture.

Thus, in this study, learners' ideas were evidence to justify that they do come to science classroom with some prior everyday knowledge and experiences (Maselwa & Ngcoza, 2003; Maselwa, 2004; Pabale, 2006; Rennie, 2011) about natural phenomena in particular, lightning in the context of this study, which they acquired from their community. Pabale's (2006) findings accentuates that the inclusion of learners' cultural beliefs and experiences as examples when teaching science has an advantage of drawing learners' attitudes into the learning of science topics. Notwithstanding, Rennie's (2011) recent study revealed that teachers need to be scientifically literate in order to be able to deal with learners' everyday knowledge that they acquire from their communities. I concur with Rennie. It is recognised also that for teachers to be able to incorporate cultural issues in their classrooms, they need to be knowledgeable in their subject content knowledge.

6.4. Analytical Statement 3:

Mobilisation of learners' cultural beliefs and experiences about lightning enables or constrains learner engagement

Learner engagement

In this study, learners had to brainstorm and discuss their cultural beliefs and experiences about lightning in their groups, and they were discussing freely in their home language which is Oshiwambo. They generated a long list of what they knew or had heard about lightning (see Section 4.5). The activity also provided learners with the opportunity to write their everyday knowledge and experiences on news prints. Thereafter, learners had to present their findings to the entire class. The findings of this study indicated that mobilizing learners' cultural beliefs and experiences promoted active participation of learners (Goos, 2004; Pabale, 2006).

Pabale's (2006) study explored integration of indigenous knowledge with science topics. She asserts that incorporation of everyday knowledge and experiences could be one way to draw learners into active attitude to the learning of science topics. Such ideals resonate with my study whereby an opportunity for meaningful learning environment was created (Dlamini, 2009), through group discussions, writing and presenting. In order to ensure a balanced participation by learners, I appointed each learner to read out predictions, observations, explanations or conclusions from their worksheets. Teachers need to be equipped with skills to make sure that each learner in each group participates actively.

When learners collected information from the community members and when the community members were invited to the science classroom, I observed that the lesson was livelier than before. During this lesson learners' participation was enhanced as the discussions were in Oshiwambo. The findings of this study revealed that involvement of community members during the science lesson whereby learners discussed in their mother tongue; learning became an interesting experience for the learners. They became enthusiastic and wanted to know more which was evidenced by the questions they asked. For example, learners asked questions such as: *Momalutu eehamba omuna nee shike osho hashi etifa okashelu? (Freely translated: What is in the twins' bodies that cause lightning srtike?). Ohamba oya pumbwa* *okulikalela ngee kuna oushelu? (Freely translated: Does the twin child need to stay in isolation when it is raining and thundering?)*. It became evident also that a lot of everyday knowledge existed in the community where the learners come from.

The findings of this study from both focus group interview (FGI) and semi-structured interview (SSI) revealed that engaging learners in their cultural beliefs and experiences enhanced participation and facilitated learners' understanding of the natural phenomenon of lightning. The feedback given by a critical friend was that some learners' cultural beliefs and experiences about lightning corresponded with the textbook meaning of static electricity (Appendix 7A, question 1). From the SSI and FGI it also emerged that learners build scientific knowledge on the everyday knowledge and experiences and thus the strategy facilitated their understanding when they are engaged with it. The community members also confirmed that inclusion of learners' everyday knowledge and experiences when teaching science is vital as it helps to facilitate learners' participation.

The findings of this study further revealed that inclusion of learners' everyday knowledge and experiences about lightning in teaching science is valuable but some teachers tend to ignore it. Thus, according to the learners' responses to question 7 in the interview schedule (see Appendix 7C, L1, Q7), it was the first time their prior everyday knowledge and experiences was being incorporated in the lesson. For example, one learner said, "*I have never taught in this way, it is the first time I am being taught in this way"*. Another learner commented that he preferred this teaching and learning strategy because they were allowed to predict first before they did the practical activities. Then after the practical activities, they were given an opportunity to compare their results with actual outcomes of the practical activities (see Appendix 7C, L2, Q7).

From these learners' responses it could be argued that in the past my teaching style was examination-driven (Oloruntegbe & Ikpe, 2011). Instead of engaging learners in knowledge construction, I followed the textbook as a recipe thus denying learners access to the knowledge that they already hold. As Rennie (2011) explained, this could be due to the pressure of time and the need to cover the curriculum for examination purposes, hence hindering bridging the boundary between the school science and everyday knowledge and experiences from the community.

Co-construction of knowledge

Through social interactions in the various groups, the findings from this study revealed that learners were able to construct new knowledge through categorising cultural beliefs and experiences as ‘scientific’, ‘non-scientific’ and ‘not sure’ (see Table 4.1.). Thus, I was able to clear some misconceptions. This is evidence that learners' prior everyday knowledge does not need to be ignored. As social constructivism (McRobbie & Tobin, 1997) proposes, the findings of this study revealed that it is a necessity to provide learners with autonomy to reconstruct their extant knowledge. Learners use such knowledge to make sense of experience and when applicable to reconstruct their understanding of, for example, lightning as a natural phenomenon.

Looking at how learners classified their cultural beliefs and everyday experiences as scientific and non-scientific, it emerged that they had some understanding of the difference between these. This enabled them to learn new scientific concepts whereby prior knowledge was used as starting point (Roschelle, 1995). Learners were also able to make some links between everyday knowledge and experiences and nature of science. This means that learners were co-constructing their knowledge and at the same time making sense of lessons in relation to their own contexts. This resonates with what Oloruntegbe and Ikpe (2011) say in their study that, if teachers could relate school science to home activities, learners would benefit in learning these examples.

During the focus group interview, learners' responses were congruent with Maselwa and Ngcoza's (2003) findings of their study that, working collaboratively in small groups provided them with an opportunity to share ideas. It gave them an opportunity to reflect on what their parents used to tell them about lightning. They were thus able to think intuitively and synthesise their cultural beliefs and experiences from their own context. Van Wyk (2002) argues that learners' everyday knowledge and nature of science supplement one another. According to Hewson, et al. (2009), such prior everyday knowledge directly impacts the learners' ability to accept new ideas. Notwithstanding, I agree with Rennie's (2011) findings that teachers need help on how to integrate cultural issues in science lessons.

From the semi-structured interview (SSI) with the teacher who was my critical friend, it also became evident that eliciting and mobilising learners' prior everyday knowledge and experiences during science teaching and learning provides an opportunity for the learners to be taught the real things which are relevant to the nature of science (NOS). According to the critical friend, indigenous ways of knowing go hand in hand with scientific knowledge (see Appendix 7A, question 2).

For example, in this study learners stated that they are warned not to run around when it is raining and thundering. But culturally, as learners and community members indicated, there is no explanation as to why they are warned not to run or play around when it is raining and thundering. Herein lies an opportunity for science teachers to explore and explain the science behind such cultural beliefs and everyday experiences.

In the context of this study, since it emerged that knowledge exists in the community where these learners come from, this could be an opportunity whereby learners are encouraged to reason why they are warned not to do some of the things when it is raining and thundering. Such strategy could enable scientific ideas which learners know from home to be valued (Ogunniyi, 2007).

Learners also indicated that when their everyday knowledge and experiences are included in the lesson, every learner participates in the classroom discussions. In addition to that, they also revealed that indigenous knowledge (IK) is mainly learnt from home but not at school. The findings of this study also suggest that involving parents to share their prior everyday knowledge and experiences during science teaching and learning could provide an opportunity for parents to pass on their knowledge to the learners. This might help learners to realise that scientific ideas are not abstract ideas but are embedded in their communities. But misconceptions embedded in such prior everyday knowledge need to be cleared. So, parents should know that when their children ask questions are not being disrespectful as it is often the case in some communities.

Some misconceptions that emerged when learner were engaged with cultural beliefs and experiences

Kocyigit (2003) refers to misconceptions as learners' ideas that are incompatible with currently accepted scientific knowledge. For example, in this study learners and community members strongly believe that people wearing red clothes are vulnerable to being struck by lightning.

An attempt was made to clear such misconceptions by giving practical examples. For instance, by asking learners whether they could be struck by the lightning because of the red bag (which was in the class that time and it was raining and thundering). Learners shared that if they carried or dressed in red clothes but they had never heard of any person who was struck by lightning. Thus, their response was *'no'* but from their responses during focus group interviews it became apparent that my explanation did not help as such because the same misconception mentioned above emerged. One learner (L5) answered that she learned that she never knew that she could be struck by lightning when she holds seeds form '*kena*' (red seeds from a certain local plant) and '*eenyandi'* (jackal berry seeds).

There were also some learners who tried to use their scientific understanding to clear some misconceptions that were raised (see Section 4.5). Even though not all misconceptions were precisely cleared, learners' involvement was evidence that they had captured some scientific knowledge from the first part of the activity (lesson 1). I realised, however, that I should have started with the community members' perceptions about lightning and then proceed with learners' views on lightning so that I could clear many of the misconceptions that emerged.

After learners had collected information from the community members and thereafter when they held discussions with community members, they came to believe that human beings have magnets that attract lightning (see Section 4.4.). This belief could hardly be rooted out of some of the learners' minds. Pabale (2006) argues that it is difficult to modify cultural beliefs that are strongly held by learners. Therefore, teachers should refine learners' prior everyday knowledge and experiences but should not attempt to replace them with scientific knowledge. Aikeinhead and Jegede (1999) too suggest that teachers should assist all learners to acquire some scientific interest, skills and knowledge without distracting learners' particular cultural beliefs and experiences.

The misconceptions that emerged from this study as a result of engaging learners with their prior everyday knowledge and experiences, confirmed that, the inclusion of prior everyday knowledge when teaching science may mislead learners to alternative interpretations of concepts (Roschelle, 1995) if they are not properly explained. Perhaps, this also suggests that science teachers should understand what their learners already know about the topic they want to teach. In other words, teachers need to be well-versed with the content knowledge that they teach (Shulman, 1987). Broad knowledge may enable them to decide on an effective and appropriate teaching strategy that could result in meaningful conceptual development. Then, they might be able to or ready to clear emerging misconceptions.

Roschelle (1995) perceives prior everyday knowledge and experiences in two ways. She asserts that prior everyday knowledge and experiences serve as a raw material of scientific ideas but challenging. Nevertheless, the study revealed that the inclusion of learners' prior everyday knowledge in the science teaching could cause confusion among the learners as shown by a critical friend during SSI as learners just held on to their cultural beliefs and failed to understand the real meaning of scientific concepts.

This argument was confirmed through brainstorming and FGI, whereby learners and some of the community members strongly felt that some of their cultural beliefs were real. However, the purpose of this study was not to bring confusion but it was to provide learners with an opportunity to interact with everyday knowledge and experiences they brought to my science classroom. Teachers should thus use scientific explanations to clear misconceptions.

6.5. Analytical Statement 4:

Facilitating meaning making in static electricity through engaging learners in practical activities

Learner participation

During the practical activities using easily accessible resources and worksheets, learners were engaged with various teaching and learning materials throughout the research process. Practical activities are perceived as an important aspect in facilitating meaning making and conceptual development (Maselwa & Ngcoza). In order to make practical activities productive, however, Maselwa and Ngcoza (2003) used the PEEOE approach (see Section 2.5.2) in which learners were encouraged to make predictions and give explanations.

After the practical activities learners were engaged in the lesson through question-and-answer method which was a means of follow-up on their experimental findings as they presented from the worksheets that they were using to record their findings. Such leading questioning strategy enabled learners to construct knowledge with minimal influence from me.

When learners did not use the proper scientific term, the scientific one was reinforced through explanations. For example, when a learner said "*object repel because they have the same charges"*, in order to reinforce the scientific concept I said, *"yes, they have like charges...."*. This also helped learners to develop the scientific concepts and this was evidenced by the summaries they constructed (see Appendix 9). But it is apparent that even though the activity allowed learner talk (Lemke, 2001), learners did not ask questions as it was suggested by Maselwa and Ngcoza (2003). In my view, learners need to be encouraged to ask questions during teaching learning in order to bring about meaningful learning and this could be an area of future research.

Positive aspects about practical activities as a science teaching strategy

The syllabus and textbooks (see Section 4.3) indicated the investigations that learners are expected to carry out in the static electricity topic. This study thus engaged learners in practical activities which were designed according to the syllabus (see Section 4.3) but with a focus on the PEEOE approach as proposed by Maselwa and Ngcoza (2003). This was certainly an innovation on the part of this study.

The findings from the interviews revealed common feelings towards practical activities from the side of learners as well as the teachers who observed my lessons. The same findings were also revealed from the observation, video and member checking. From the learners' perspectives during the focus group interviews, their views on the need of practical activities were as follows:

- learn things that they cannot learn in the absence of practical activities;
- provides them with a chance to work in groups;
- exposure to new scientific terms and learn new words;
- learn from one another;
- exposure to real world materials, thus they understand well;
- facilitates understanding and reduces memorization of facts;
- remember things in the examinations;
- enable them to assist one another;
- learn from one another on how to spell words;
- use of materials facilitate understanding compared to being theoretically on the chalkboard;
- open for prediction (predict first and experiment later);
- enable learners to learn some scientific terms from other learners in vernacular language; and

- Increases learner meaningful talk (when presenting in front of the classroom, discuss in groups/class and ask questions).

Gott and Duggan (1990) views the purpose of practical activities as a means to motivate by stimulating interest and enjoyment, enhance the learning of scientific knowledge, teach laboratory skills, give insight into scientific method and develop expertise (see Section 2.5.1).

The teacher that I interviewed also revealed that practical activities enable learners to manipulate materials/equipment, observe and link with their theoretical knowledge (see also Section 4.5). These findings resonate with what Gott and Dugan (1996), Maselwa and Ngcoza (2003), Millar (2004) and Pabale (2006) found in their studies. It could thus be argued that it is important to engage learners in various kinds of practical activities. Without engaging learners on 'hands-on', 'minds-on' and 'words-on' practical activities with a focus on the development of key scientific concepts (Maselwa & Ngcoza, 2003), little or no learning will take place. Maselwa and Ngcoza also caution that science teachers should be careful to equate activity with learning.

In this study too, learners worked in groups of five learners per group (see Section 4.4) and I am mindful that not all learners benefited from the practical activities. This could have been compounded by the fact that as the learners were working in groups, not every learner had an opportunity to touch every learning material which was used. Taking an example given by Gott and Duggan (1996) about acquisition of skills, a learner should know how to use equipment or materials to set up experiments. Hence, Hodson's (1990) critique is that learners can do practical activities for several years but still it could be found that they cannot carry out simple laboratory procedures acceptably. Another criticism by Hodson (1990) is that practical activities as conducted in various schools are ill-conceived, confused and fruitless. Perhaps, Maselwa and Ngcoza's (2003) PEEOE approach could be useful in minimizing such a cookbook approach as criticized by Hodson above.

Nonetheless, learners in this study indicated that practical activities enabled them to learn from one another. This is consistent with the socio-cultural perspective and that practical activities are important for social learning (see Section 3.5).

What came out of this study in relation to meaning making of scientific concepts?

This section of the study thus analysed whether learners were able to make sense of scientific concepts as a result of the practical activities or not. Evidence to answer this was extracted from the worksheets and videotaped lessons (Section 4. 3). Since learners were engaged in different activities with worksheets, most of the groups were able to set up experiments, observations and complete the worksheets but some could not use the correct terms.

During the second lesson (see Section 4.3.1) after revising the topic on charges, the practical activities started with investigating the forces between charged and neutral objects. All the groups understood the difference between a charged and neutral object. They also understood that objects get charged by rubbing materials/objects (and these objects must be insulators and not conductors) against each other but all groups failed to reason why a charged object attracts a neutral object (see Section 4.3.1). Even if they did the correct observation, the critical reasoning was still lacking as they failed to reason why a charged object attracted a neutral one. This difficulty was facilitated during group presentations and discussions when some explanations were given.

The third lesson was more on the forces between charged objects, assistance with spelling of words was observed. Learners observed what was happening but some lacked the scientific terms. They used words such as: *spinning, move away, move around.* But there were some groups which used the correct terms such as repel each other and attract each other. They could not explain further about the forces between repelling and attracting objects, that is repulsive force and attractive force respectively. This is an indication that these concepts were not well emphasised.

During explanations, the English words used by learners were reframed into science language. For example, spinning, move away, move around means repel each other, same charges means like charges and different charges means unlike charges. Hodson and Hodson (1998) posit that proper use of language contributes to meaningful learning. When trying to convert partly formed ideas into articulated speech or coherent written language helps to develop scientific concepts.

The next practical activities in the fourth lesson were about charging and discharging an electroscope (see Section 4.3.3) whereby the PEEOE approach (Maselwa & Ngcoza, 2003) was used. Learners were able to do observations but they were still struggling with coming up with the correct concepts. For example, when an oppositely charged object was brought closer to a charged electroscope, some learners predicted and wrote that the gold leaves would come closer but they could not give an explanation why. Also, learners used the term gold leaves become open or the leaves remained open instead of saying, the electroscope became or remained charged. Even though learners were able to state the uses of an electroscope correctly in the worksheet (see Appendix 3D), they were still struggling with descriptions, explanations and reasoning when they did the homework (see Appendix 6B).

The lesson in day five looked at lightning in pocket format (see Section 4.3.4). This activity gave learners a lot of challenges. It took some of the learners several minutes before they observed electric shock and crackling sound on their fingers. One group wrote some meaningful explanation on what they observed; three groups wrote reasons that were almost correct but needed elaboration. One group's reasoning was that *"a person has charge"* (see Section 4.3.4). At the end of the lesson, the answers/findings from each group were discussed to help learners' understanding of the objective of the activity.

Mediating learning

This study revealed that the different teaching methods applied during the lessons (see Section 4.11) use of experiments, presentations explanations, questions and use of diagrams as meditational tools used in this study facilitated learning. For the learners to be able to learn they should be taught in such a way that their interest and understanding of scientific concepts is stimulated. Oroluntegbe and Ikpe (2011) argue that if knowledge is transmitted to the learners then they will not be able to apply the knowledge to everyday problems. So, they suggest that teachers should be trained on how to incorporate learners' everyday knowledge in science classroom.

The findings from the videotaped lessons revealed that learners learnt through the scaffolding process. This suggests that the teaching was located in Vygotsky’s (1978) zone of proximal development (ZPD). The zone of proximal development is defined as the difference between the child's ability to solve problems on his own, and his ability to solve them with the support of a knowledgeable person (Vygotsky, 1978). For example, I showed learners how to hold the straws and charge them and thereafter they were given an opportunity to work on their own. According to (Vygotsky, 1978), this gave learners an opportunity to do activities that they could perform on their own and independently without the help of anyone.

Building on the Vygotskian theory, Hodson and Hodson (1998) assert that the teacher is at the centre of leading learners to new level of understanding by interacting and talking to them. Goos (2004) too claims that teachers should create meditational tools by structuring learning as social interactions to make learning of scientific concepts meaningful. In this study, learners were taught in such a way that they were able to recognise the relevance of science, in particular, lightning in everyday life as a result of carefully scaffolding learning about prior everyday knowledge and experiences about lightning in conjunction with practical activities in static electricity.

In other words, the strategies used in this study helped learners to be aware of the science, provided them with multiple experiences of scientific concepts in relation to static electricity. Thus, they acquired multiple experiences which enabled them to see and understand the key ideas in static electricity. As a result, they were able to generate a long list of examples of static electricity in everyday life as well as constructing mind and concept maps independently (see Chapter 5, lessons 5 and 6).

During the practical activities I was mindful of the need to be closer to the groups. So, I moved from one group to another, giving further explanations where it was necessary. I also elicited learners' answers by constantly asking questions that helped them to develop scientific concepts. In order to help them to gain broad understanding I had to make some follow up questions for instance: What is another meaning of 'gold leaves come closer'? Their understanding further was also facilitated by explaining with the aid of using the diagrams. A critical friend indicated the necessity of drawing diagrams on the chalk board to facilitate explanations.

Learners also indicated that working in groups enabled them to understand science concepts since they had an opportunity to share ideas and learned from one another (Maselwa & Ngcoza, 2003). It could be argued that starting with what learners already now and lead them to the new side of learning is appropriate (see Johnstone, 2010). Sharing of ideas meant that learners were afforded an opportunity to co-construct knowledge in this study. Kibirige and

Van Rooyen (2006) believe that all learners should be involved in science believing that it is a responsibility of a teacher to make science interesting to all learners.

Despite the endeavours of mediating learning in this study, there were however some challenges that were experienced during the practical activities. For instance, analysing of data from interviews and observations indicated some challenges experienced during practical activities. Since lightning is a flow of charges, learners wanted to see the flashing light from the ruler, for example, to the finger. In my view, this finding suggests that in order to facilitate learners' understanding teachers should prepare teaching materials so that learners will be able to see and assimilate the visible concepts. This could have been made clear by using a van de Graaff generator so that learners could observe the sparks. Unfortunately, I could not use this instrument as it is not available at my school. Nonetheless, I suggested that learners should try this when it is dark at their homes.

6.6. Analytical Statement 5:

Scientific concepts learners acquired through consideration of cultural beliefs and experiences about lightning in conjunction with practical activities in static electricity

This analytical statement aimed at pulling the findings of the study together since the goal of this study was twofold. First, I started with engaging learners in their cultural beliefs and experiences about lightning. Lastly, I engaged them in practical activities in static electricity. Therefore, it is vital to look at what differences did the two strategies result in.

Conceptual attainment

The last activity in the worksheet was designed in such a way that it enabled learners to generate knowledge without the interference of the teacher. Learners were able to come up with a lot of examples on static electricity in everyday life based on their daily experiences (see Section 4.3.4). Instead of following the textbook as a recipe, this study enabled me to carefully adopt the curriculum to suit the learners' context (Barab & Luehmman, 2002) in which they could construct their own knowledge independent of the teacher.

Therefore, the findings from this study indicate that a carefully designed activity with a focus on key scientific concepts to be developed and how such concepts are linked has a great potential to result in meaningful learning. This resonates with what Maselwa and Ngcoza (2003) propose in their study. Through eliciting learners' prior everyday knowledge in conjunction with practical activities facilitated learners' understanding and they were able to generate their own summaries that they could easily understand.

Furthermore, learners concluded the practical activities by drawing the mind maps and concept maps in their respective groups (see Section 4.4). The two sample maps showed some understanding and conceptual development attained by learners during the research process.

For example, mind map 1 indicated that learners understood that electricity is divided into two components which are: *flowing charges is current electricity and a non-flowing charged is static electricity.* Their concept maps further indicated the links between the concepts. For example, *lightning* (which was a starting point of this study) *is a form of discharge and the two types of charges are negative and positive charges.* They also indicated that *negative charges are electrons and positive charges are protons*.

Consolidation of such key scientific concepts plays a vital role in the enhancement of conceptual understanding and development by the learners. However, these concept maps are no easy to assess (Maselwa & Ngcoza, 2003), but the important part is that they show that learners learn in different ways. This was evidenced by the fact that the learners' maps looked differently.

From the focus group interviews learners indicated that they acquired some scientific concepts. For instance, question 8 asked learners about the scientific concepts they acquired during the learning process (practical activities). One learner answered that, they had learnt the forces that exist between the like charges which is repulsive force and charges between unlike charges unlike charges which are called attractive forces. The learner further explained that unlike charges attract each other and like charges repel each other. Concepts like attractive force and repulsive force were emphasised. What learners failed to get right in their worksheets was explained during discussions.

Another learner indicated that the inclusion of their cultural beliefs and experiences about lightning in teaching science has helped him to understand how buildings could be protected from lightning strike.

Similarly, the test results justified that the teaching and learning approaches used enabled learning. Learners could still remember some scientific concepts in a test which was written many days after the topic was taught. Such good performance may have resulted since learners were actively involved in the learning process (Rogan & Grayson, 2003) and this could be attributed to the elicitation of their prior everyday knowledge and experiences upon which they built a meaningful understanding.

Integrating of cultural beliefs with practical activities when teaching science enables or constrains learning

Based on the constructivist perspective (see Section 2.2.1.2), learning is a process of individual construction which needs new concepts to be comprehensible, reasonable and productive. The practical activities carried out in this study helped learners to acquire some new scientific concepts through their social interactions in groups but did not necessarily replace their existing knowledge.

Therefore, the findings from this study illuminated that learners understood and acquired some new scientific concepts but such new concepts did not replace the old ones. For example, before learners were engaged in practical activities, some of them explained that lightning occurs when clouds collide/crush/attract with each other and make fire. From the learners' practical activities with a worksheet, interviews and assessment test, some learners developed scientific explanation about how lightning occurs while some of them still held the same explanation. Leach and Scott (1995) argue that in many instances, the theoretical explanations of natural phenomena resonate with everyday experiences and everyday explanation is similar to scientific explanations. These learners seem to have had everyday ideas about lightning even though some of them did not use the correct scientific explanations, but their explanations were congruent to the scientific ones.

Despite the practical activities, some learners still held strong cultural belief and experiences. For example, they still strongly believed that a small branch of '*omulavi*' tree protects the house/hut from being struck by lightning. One learner (L2) misinterpreted a conductor as he said that this branch may protect against lightning strike as it will transport the charges to the ground because the wood is a conductor.

This resulted in a cognitive conflict (Aikeihead & Jegede, 1999) as a result of learners' preconceptions about everyday experiences about protecting houses against lightning strike. These findings correspond with Pabale's (2006) findings which show that border crossing between everyday knowledge that learners brought in the science class and nature of science (NOS) is not easily achieved. Fakuze and Ogunniyi (2003) too indicate that border crossing is when transition occurred from one culture to another.

In this study, despite the fact that learners had been exposed to science lessons in which their prior everyday knowledge and experiences were incorporated and explained, the assessment test results and FGI revealed that learners still held such cultural beliefs about lightning. These findings are also in line with Aikenhead and Jegede's (1999, p. 122) argument that "it is possible to hold simultaneously an indigenous knowledge and scientific view of the world" process known as collateral learning. It is obvious that border crossing by the learners is not easy. Therefore, teachers should help learners to acquire scientific knowledge, interest, skills, attitudes and ways of thinking without replacing their cultural beliefs and experiences (ibid.).

On the other hand, these learners also understood that the building is protected by fitting it with a lightning conductor which conducts charges to the ground. For instance, learner (L5) stated that she was going to tell her parents about the scientific way of protecting houses from being struck by lightning.

The findings of this study were also in agreement with that of Pabale's (2006) study which she conducted in South Africa. Her study indicated that conceptual transformation is not easily achievable. According to Ogunniyi (2007), inclusion of indigenous knowledge brings in cognitive conflicts which were evident in this study since learners adhered to their cultural beliefs even though they were not scientifically correct.

6.7. Concluding remarks

In this Chapter, I discussed how static electricity under the electricity theme was presented in curriculum documents such as syllabus and grade 8 physical science textbooks. Through this study I was able to compare my findings with other researchers' findings which indicated some commonalities in terms of learners' perceptions of their world in terms of the natural phenomenon 'lightning', acquisition of new scientific concepts, challenges of integrating prior everyday knowledge with science, border crossing between cultural and scientific way of knowing.

The findings of this study also gave me an insight on how the elicitation and integration of learners' prior everyday knowledge and experiences in conjunction with practical activities when teaching science is important as well as interesting. Such approach is just not only vital to the static electricity topic as such, but it could be relevant to any other topic in the science subjects.

The next chapter will summarise the research study by means of recommendations, limitations and conclusion.

Chapter 7

Summary of findings, recommendations and conclusion

7.1. Introduction

In the previous chapter I analysed, interpreted and discussed the data presented in Chapters 4 and 5 in this thesis. In this chapter, I provide the summary of the findings, significance of the study, recommendations, limitations and conclusion.

7.2. Summary of the research findings

The findings from this study indicated that the curriculum documents in the form of the syllabus and textbooks contain less scientific concepts which are familiar to the learners' everyday lives specifically in the context of this study, lightning as an example of static electricity. Yet, learners have experiences of this natural phenomenon in their daily lives. Based on the findings as described above, I suggest that the curriculum documents and textbooks should make the provision whereby teachers use learners' everyday life experiences as a starting point (Johstone, 2010).

The findings from this study revealed that the mobilization and incorporation of learners' cultural beliefs and experiences about lightning enhanced learners' participation and engagement during the lessons. When learners were engaged and discussing about their cultural beliefs and everyday experiences, they were able to talk freely in their mother tongue (*Oshiwambo)* especially when community members were present in the classroom. Even though Lemke (2001) recommends that teachers should give learners sufficient opportunities to talk using science language, mother tongue used during this study served as a tool in enhancing dialogue and hence meaning making.

It also became apparent that the approach used in this study reinforced learning of science as learners were able to attain some scientific concepts. For instance, the classification of their everyday knowledge and experiences into scientific and non-scientific confirmed that learners can co-construct own knowledge if they are given an autonomy to do so. The list of beliefs and experiences generated by the learners is an indication that science and scientific ideas do exist in the local community in which learners come from. It is an indication that learners are not empty vessels and such knowledge needs to be tapped into. They just need to be given an opportunity to bring in the science lessons what they already know and use it as a foundation to build new knowledge on.

Regarding practical activities, the findings of this study indicated that practical activities maximise learner participation and engagement too. As it was revealed in the previous chapter, the practical activities gave learners an opportunity to co-construct knowledge, manipulate equipment, acquire some scientific skills, facilitate understanding and reduce memorisation of important factors.

It emerged, however, that learners learn in different ways. This was evidenced by the mind maps and concept maps drawn by learners in Chapter 5. If learners are given the chance to bring in their ideas about science and engaged in 'hands-on', 'words-on' and 'minds-on' activities (Maselwa & Ngcoza 2003), they are likely to learn in their own styles.

The use of worksheets in groups during teaching and learning promoted social interactions (see Section 3.5) through discussions and improved the learners' writing skills. The use of worksheets was also useful in exposing learners to new written scientific terms. For example, in this study learners indicated that they did not know the term 'predict'. But as they experienced this term in the worksheets they understood what they were expected to do. Furthermore, presentation of learners' findings from their observations maximised learner talk (Lemke, 2001) as well as their reading skills. The PEEOE approach which was used as it was adopted from Maselwa and Ngcoza's (2003) work helped to facilitate meaning making of scientific concepts. The use of worksheets during practical activities and the PEEOE approach enabled learners to acquire some new scientific terms.

Practical activities further enabled scaffolding (Vygotsky, 1978) of learners. This happened when I walked from one group to another to give learners individual assistance. In the context of this study, learners were also able to assist one another when working in their groups. On the other hand, however, this study revealed that some learners dominated in some groups. As a result some learners became passive observers and not manipulated the materials as it was required. This was exacerbated by the shortage of learning and teaching materials (LTSMs). In a situation where there are no enough materials for learners to work in groups, a teacher is likely to demonstrate to the learners while learners observe and record.

However, it also emerged in this study that the inclusion of learners' prior everyday knowledge and experiences in conjunction with practical activities during teaching and learning of science does not necessarily lead to border crossing between everyday knowledge and school science. It was found that learners in this study still held onto their cultural beliefs and everyday experiences even though scientific explanations about lightning during the practical activities were given.

Notwithstanding, this finding does not imply that consideration of learners' cultural beliefs and everyday experiences about lightning has no value in science classroom. But it proposes that teachers need to be empowered and be equipped with knowledge on how to integrate such knowledge during teaching and learning.

7.3. The significance of the study

The aim of this research study was to investigate whether eliciting and integrating learners' cultural beliefs and experiences about lightning in conjunction with practical activities enabled or constrained meaning making in static electricity. A study of this nature is the first to be conducted in Namibia since I did not come across any journal articles in this area of focus. Instead, similar studies were conducted in the South Africa. Thus, carrying out this study would inform the Namibian curriculum designers to revisit the syllabus content of science subjects in terms of recognition and inclusion of learners' prior everyday knowledge (which could constitute indigenous knowledge) in science teaching about natural phenomena in general.

Another important aspect about this study is that, it informed me about the benefits and challenges of including learners' and community members' cultural beliefs and everyday experiences about lightning when teaching static electricity. So, other teachers could certainly learn from these experiences.

Above all, this study provided me with an opportunity to develop my own learning and teaching support materials (LTSMs) which take into consideration contextualisation of content knowledge rather than relying solely on science textbooks.

7.4. Limitations

This case study concentrated on a single area in Namibia. Thus, the findings presented in this study do not represent the large number of the learners in the Namibian schools since it was limited to a small group of learners in a specific class and it was context specific. Cohen, et al. (2007) too, indicate that it is difficult to generalize findings in such circumstances. Nonetheless, my aim was not to generalise but I was trying to understand the situation and hence the approach adopted was a case study.

The language proficiency of the learners who participated in this study was also limited. Due to their poor language proficiency, their participation in practical activities was limited. They could not ask questions or comment adequately in the results of their experiments. This resonates with Probyn's (2004) arguments that English proficiency of the majority of learners frequently does not meet the demands of learning through the mediation of English. Therefore, learners' poor English proficiency lowers their level of understanding and knowledge construction. As a remedy to this challenge, I used some code-switching to help learners understand what I was teaching even though Probyn (2009) suggests that code-switching is not a legitimate teaching strategy.

The language proficiency also forced me to hold two focus group interviews. The first one was done in English but I could not get adequate information. I thus did a second focus-group interview in the learners' home language which is Oshiwambo. Thereafter, I asked learners to translate their responses from Oshiwambo to English and some of them struggled. Since I had also translated learners' responses from Oshiwambo to English, some of the data might have been lost in the process of translation.

Finally, since my last lesson was not captured in a video due to other commitments of fellow teachers, I could not observe my whole teaching practice and I could not get a feedback on the last lesson of my research study. This methodological dilemma could have had a negative effect on my findings.

7.5. Recommendations

In this section I present the recommendations drawn from the insights I have gained from this study.

- In this study I established that learners come to the science classroom with their own everyday knowledge. In contrast, the curriculum documents do not contain much of what learners are familiar with. I therefore, recommend that curriculum documents and textbooks should include learners' everyday knowledge and experiences.
- Since science is part of learners' everyday lives, the curriculum should make a provision so that teachers start their lessons with what learners already know. Teachers also need to have broad knowledge of the learners' everyday experiences in their context. Thus, this study recommends that teachers should be trained in this area so that they could be able to use it when it is applicable and be able to clear the misconceptions that might arise during this process.
- Teachers need to find ways of involving community members during teaching and learning so that they can share their everyday knowledge and experiences in their classes in order to contextualise knowledge and clear any misconceptions that might be there in the community. This could help to enhance parental involvement.
- This study also recommends that learners should be engaged in meaningful practical activities in order to enhance meaningful learning, conceptual development and hence conceptual understanding.
- Learners should be provided with autonomy to learn through social interactions with a teacher as a facilitator of learning. This could enhance learner engagement, participation and opportunity for knowledge construction. However, teachers should be knowledgeable in their subject content knowledge and pedagogical content knowledge.
- This study recommends that when learning and teaching materials (LTSMs) are not available teacher should improvise using local available materials.
- Teachers should be empowered to teach in English second language so that they could help learners to become proficient in language of learning and teaching.

- When teaching static electricity, learners' cultural beliefs and everyday experiences about lightning should be incorporated into teaching science in conjunction with practical activities to enhancce acquisition of scientific concepts.

7.6. Areas for future research

This study investigated how eliciting and integrating learners' cultural beliefs and everyday experiences in conjunction with practical activities enabled or constrained meaning making in static electricity. From the findings of this study I propose the following areas for future research:

- Research should be done to investigate the best ways of teaching science in the second language to enhance scientific conceptual development and understanding.
- Research should be conducted to discover the possible best ways that are responsive to the development of learners' scientific literacy when science is taught in a second language.
- A similar study could be done but involving other schools to investigate how teachers could be assisted to incorporate learners' cultural beliefs and experiences about lightning as a natural phenomenon in teaching science.
- A study could be done focusing on whether grouping learners following a specific criterion influences their learning.
- A study could be conducted to investigate whether grouping learners according to gender influences learners' engagement during learning and teaching.

7.7. Conclusion

In this chapter, I provided a summary of the research findings. The significance of the study was discussed by giving an overview of the purpose of the study. The overarching findings of this research study are that learners come into classroom loaded with a variety of knowledge about science. Such knowledge should be used as a starting point during teaching and learning. Practical activities, provided that they are properly planned, are useful methods of engaging learners during science lessons and can be useful in enhancing their participation.

Based on my findings of this study, some recommendations have been made in relation to the inclusion and elicitation of learners' cultural beliefs and everyday experiences about lightning in conjunction with practical activities. Also some areas for future research have been proposed.

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APPENDICES

Appendix 1A: A letter to the principal

O.M. Nanghonga

Ndida CS

Ohangwena circuit

19 January 2012

The Principal

Ndida CS

Ohangena circuit

Dear Sir

Ref: Requesting a permission to carry out my research study after teaching hours at Ndida Comb. School

I am Ottilie M. Nanghonga a teacher at this school (Ndida C.S). I am doing my Master Degree in Education with Rhodes University. As part of my studies, I am tasked to work on a research study at my school. As a result, I planned to do it with grade 8 learnersin Physical Science subject. I also requested Mr Vaino Muvale and Mr. Gideon Nantanga as science teachers to help me during my lessons as a critical friend.

I am therefore requesting your good office to allow me to work on my research study with the aforementioned individuals as from 24 January 2012 up to 3 February 2012. I believe such research will benefit the researcher, observers and learners.

Thank you for paying attention to my request.

Yours faithfully,

....

Ottilie M. Nanghonga

Appendix 1B: A letter to the Inspector of Education

Enq: O.M. Nanghonga

Cell: 081 2695 029

The Inspector of Education
Ohangwena Circuit
Ohangwena Region

Dear Sir

Ref: **Research study on MEd Course**

I am Ottilie Nanghonga, a teacher and HOD at Gabriel Ndadi Comb School. I am doing a Master's Degree in Education with Rhodes University.

I would therefore like to inform your good office that, as part of my study, I have planned to carry out a research study at Ndida Comb School as from **24th January 2012** up to **03 February 2012**. The research study will be carried out with **grade 8D learners** and Science teachers who are: Mr **Muvale Vaino** and Mr **Nantaga Gideon** at this school.

This study will not interfere with the school activities as we will start at 14H00. I believe that you will have no objection to such study.

I thank you for your usual cooperation in this regard.

Yours faithfully

....
Ottilie M. Nanghonga

CC: Cluster Centre Principal

Appendix 1C: A letter to the parent

Gabriel Ndadi Comb School

Ohangwena Circuit

P O BOX 543

19 January 2012

Omudali omufimanekwa

Aame Ottilie M. Nanghonga omulongi wounongononi mondodo 8 no 9 pofikola Gabriel Ndadi Comb School. Ohai ku indile nefimaneko opo u pitike okanona koye ketu lombwelwa wedina Justin Mutikwa.................konima yefimbuko. Eshi oshinasho necumei nokutinga omapekapeko moshilongwa shounongononi. Ohaikalonga naye okudja 24 January 2012 fiyo 7 February 2012.

Tangi kelongelo kumwe,

Nefelo woye:

[signature]........................ 20-01-2012

Ottilie M Nanghonga Efiku

Eshaino lomudali 20-01-2012

M. Moeno..................... Efiku

Appendix 1D: Community members' invitation

Ministry of Education
Ndida Comb School **16 September 2012**

Omapulo: Ottilie M. Nanghonga
Cell: 0812695029

Omufimanekwa

Ekufombinga moudindoli

Aame Ottilie M. Nanghonga, omulongi womwaalu nounongononi pofikola Ndida Combined School. Ondili yo omulihongi nomupekaapeki moshilongwa shoudindoli okupitila noshiputudilo shopombada hashi i fanwa Rhodes University.Ohai pekaapeka owino nounongononi wovakwashiwana vo momudingonoko omu ndili, opo owino neshiivo letu lovawambo li yambukepo.

Onghe nee ohai kui ndile nefimaneko linene opo wu uye tuye meenghundafana metitatu, 19 September 2012 pofikola ya tumbulwa pombada potundi onivali yomutenya. Oku kufa ombinga kwoye ota kuti sha shihapu mehongo loshiwana shaNamibia nomounyuni yoo.

Tangi eshi to holoka pefimbo.

Neyelo woye,

....
Ottilie M. Nanghonga

Appendix 2: Observation Guideline for Science Education Research

Ndida Comb School
CLASSROOM OBSERVATION TOOL: January 2012

Physical Science Lessons

Date______________________________________ **Duration of lesson** ☐

Lesson topic_______________________________ **Grade** ☐

No of learners ☐

Name of Observer___________________________

Focus	**COMMENTS**
Lesson approach and presentation	
Is there proper lesson organisation?	
Is there any reinforcement of the previous content?	
Introduction and elicitation of learners' prior knowledge considered	
Variation of teaching methods	
Is the subject content appropriate to the Grade level?	
Is the classroom environment conducive to learning?	
Does the teacher demonstrate sufficient content knowledge and uses this knowledge successfully to create meaningful experiences for the learners	
Are the practical activities enabling learners to make sense of the learning content?	
Does the teacher ask questions that probe for understanding and concept development?	

Was the lesson presentation logic with attention paid to its transition?	
Is there enough and appropriate teaching resources?	
Is the lesson's conclusion help learner to capture the main point of the lesson?	
Are the learners given a homework/class work?	
LEARNERS' ENGAGEMENT	
Are the learners interested in the activities? Are the learners given an opportunity to ask questions?	
Are all learners having the opportunity to participate in questions and activities?	
Are the resources used enhancing learners' understanding?	
Are the learning media arising learners' curiosity?	
Are the learners interested and enthusiastic?	
Is there good communication between learners and the teacher?	
How do learners interact with each other?	
Does the teacher elicit responses from specific learners	
Are the learners given a chance for constructing own meaning?	

ANY OTHER COMMENTS

OWN REFLECTIONS

Appendix 3 A: Worksheet one

Group 2

Physical science unit of work **Date:24-01-20112**

Grade: 8

Group members:

Activity 1: Exploring cultural beliefs and experiences about lightning. For this activity learners are required to work in groups of four/five.

1. Write down your cultural beliefs and experiences about lightning.

   - *The lightning is dangerous because it killed animals.*
   - *the lightning can break houses*
   - *The lightning can burn the environment*
   - *If you wear a red cloth, the lightning will strike.*
   - *If you leave your mouth open and the lightning see your teeth it will strike you.*
   - *If you make noise during the rain the lightning will strike you.*

2. Group your cultural beliefs and experiences into categories of **scientific** and **non-scientific ideas** or **not sure**:

Scientific ideas	**Non-scientific ideas**	**Not sure**
The lightning is dangerous	The lightning can break houses	If you wear the red cloth, the lightning will strike you.
If you leave your mouth open and the lightning see your teeth it will strike you.	The lightning can burn the environment	
	If you make noise during the rain the lightning will strike you	

3. From the cultural beliefs and experiences you have listed above, write down with explanations:

a. Things you must do or not do during thunderstorm or lightning

- *do not make noise*
- *do not touch a metal*
- *do not touch the water*
- *do not open your radio*
- *if you put salt at the fire the rain will stop raining*

b. Ways of protecting yourself from lightning strike

- *you must be quiet*
- *If you put the stick of 'omulav'i at the hut the lightning will not strike you*

c. Ways of protecting your house/hut from lightning strike

- *If you put the stick of 'omulavi' at the room*

d. Any other things

→ *You must not be nearby plants and animals*
→ *ngeenge poima paandwa koluvadi vati ihapa endwa*

3. Use your own understanding to explain what lightning is and what causes it

Is when the clouds attract each other and cause the fire that we called lightning, it is caused by the cloud attract each other

Appendix 3B: Worksheet two

Worksheet 2

Activity 2: Charges

The two types of charges are: positive charges (+) and negative charges (-). The positive charges are **protons** and negative charges are **electrons.**

Purposes: To revise on the existence of electrons, protons and neutrons as they were introduced in the chemistry section.

What to do:

1.1. Write down two types of charges

......Negative charges..

......Positive charges..

1.2. Complete the following table

Particle	Charge	Position on the atom
(a) Electrons	Negative	In the shell of electron an atom
(b) Protons	Positive	In the nucleus at the centre of an atom
(d) Neutrons	Zero	in the Nucleus at the centre of an atom

1.3. Use the following words to complete the following statements: positively, neutral, negatively.

a. When an object has more protons than electrons, then it is..Positively..........charged.

b. When object has more electrons than protons, then it is ....Negatively charged.

c. A ...Neutral...object has equal number of protons and electrons.

Activity 3

Charges and static electricity

Purpose: To investigate the forces between charged object and a neutral object.

Materials needed:

3

- Pieces of papers
- An ink pen or plastic ruler or drinking straw.

What to do:

a. Cut pieces of papers into tiny pieces and place them on a table. Predict what will happen when you bring a pen/ruler close to the pieces of papers

pieces of papers attract by ruler

b. Bring a pen close to the pieces of papers. Write down your observation

piece of papers attract by a pen

c. Predict what happens when you rub the pen vigorously and then bring it close to the pieces of papers.

pieces of papa attract by a pen

d. Now, rub the pen onto your hair vigorously, and then bring a pen or any material you use close to the pieces of paper. Write down your observation

pieces of paper is attract by a pen

e. Between a pen (or any material that you have rubbed) and pieces of papers, identify the neutral object and a charged object.

piece of paper ~~will be attracted by a rubbed/charged pen~~

A neutral object is ~~equal number of - and +~~ and

~~Pen~~ pen

a charged object ~~is unequal number of - and +~~

f. Explain why you think a charged object attracts a neutral object.

is attract a neutral object because make an object having lot of ~~charged~~ charges

The unlike charges e.g negative charges on a neutral object aligns themselves is the surface of the object, so they attract each other by induction

4

Appendix 3C: Worksheet three

Worksheet 3

Activity 4: Forces between charged materials

Material needed:

- Two plastic straws
- Pins
- Eraser
- Pieces of toilet paper
- Plastic ruler or plastic rod

What to do:

1. Push the pin through the middle of a straw. Turn the pin around to make the hole bigger so that the straw can move easily.

2. Remove the pin and now hold both straws together in your hands

3. Wipe both straws at one end with the toilet paper. Wipe a few times to charge both straws. Do not touch the ends you have wiped.

4. Put the pin into the straw and fix it to the eraser.

Predict what happens if you bring the wiped end of the straws close together

They will repel each othere..

....

5. Bring the wiped ends of the straws close together.

5

(a) Write down your observation

One wiped is speenning

(b) What types of charges are on the straws (**like** charges or **unlike** charges)?

~~Unlike charges~~ like Charges

(c) **Complete:** Objects that have the like charges...repel.............each other.

6. Now rub a plastic ruler or a black strip on one end. Bring a rubbed end of a ruler or a black strip close to rubbed end of a straw.

(a) Write down your observation

It will ~~speen~~ repel

(b) What type of charge is on the ruler or black strip and a straw (like charge or unlike charges)?

Unlike charge

(c) **Complete:** Object with different charges.......attract.........each other.

(d)Choose from the give words and complete the following statements

There is ....~~[illegible]~~....................force between the objects which are repelling each other (**attractive/ repulsive**) and there is ~~[illegible]~~.............................force between attracting objects (**attractive/ repulsive**).

(e) **Summarise:**

Like charges......repel each other Unlike charges...attract each othere

A charged object......attract.................. a neutral object

6

Appendix 3D: Worksheet four

Worksheet 4

Activity 6

Purpose: To investigate the uses of an electroscope

What you need:

- An electroscope
- Cotton cloth
- A straw/red plastic strip and black plastic strip

What to do:

1. Rub the straw or red plastic strip with a cloth in order to charge it positively.

2. Touch the top of the electroscope with the positively charged end of the straw or red plastic strip.

(a) Write down your observation gold leaves repell ^open each other

(b) What types of charges are on the electroscope?

positively Charged

(c) Give a reason for your answer in (b) It is positively Charged because a red plastic having positive Charge

3. Rub the straw or red plastic strip again and bring it closer to the top of the electroscope again without touching the top. Write down your observation.

gold leaves there are also repell upean wide

4 Predict what will happen if you bring the negatively charged plastic strip closer to the top of electroscope.

attractively/close each other a leaves open

10

Explain your prediction

is attractively because a black plastic having negatively charges

5. Now, rub the black plastic strip with a cotton cloth in order to charge it negatively.

6. Bring the charged black plastic strip closer (without touching it) to the top of the electroscope

Write down your observation of gold leaves there are repell/open each other

6. Touch the top of an electroscope to discharge it.

7. Rub the plastic ruler in order to charge it negatively.

8. Touch the top of the electroscope with the negatively charged end of the plastic ruler in order to charge it negatively.

Write down your observation.

there are repell/open

it become charged

9. Charge any object and approach the top of a charged electroscope.

(a) Write down your observation Leaves there are repell open or it remains charged

(c) Write down the function of an electroscope. Function of electroscope is to use to make sure which charge in the any object / It is used to detect electric charger

Activity 7

11

Appendix 3E: Worksheet five

Worksheet 5

Activity 8

Lightning in pocket format

What you need:

- Plastic ruler
- Cloth or wool (e.g. jersey)

What to do:

1. Rub one end of the plastic ruler vigorously (very much and strong) to make it strongly electrically charged.

2. Move a finger close to the ruler. Listen carefully!

(a) Observation......You will feel sparklings on your finger.

....

(b) Explanation...The extra charges will tray to escape.............

Examples of static electricity

3. Lightning is an example of static electricity in nature. Apart from lightning we experience static electricity in our everyday lives. Identify the examples of static electricity given in the following diagrams below.

A B

Example A...Removing the jersy you will hear sparks..

Example B ...Touching the door handle you can be shock

11

3.1. Give any other examples of static electricity in everyday life

Putting on a blacket when you sleep you will hear or feel sparks on your skin ~~setting on a plastic~~ chair when you sed on a plastic chair, you will feel sparks on your skin.

3.2. Use the scientific ideas that you have gained from the practical activities to define what lightning is and what causes it.

Lightning is formed when charge are btan the surface of the earth or to the neighbouring clud.

Activity 9

Draw a mind map and then concept map to indicate the concepts you have learnt in part of this chapter.

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Appendix 4A: Smple of learners' data from the community

Learners' interview guide (Learner 1)

Investigating about cultural beliefs and experiences about lightning of a community in Ohangwena Region in Namibia

07 September 2012

Instructions to the learner:

Interview five people about their cultural beliefs and experiences about lightning. Ask them to give you reasons as well. Record their responses in the table. Use extra paper if the answers cannot fit in the table.

NB: These data were exactly copied as they were written by the learners.

	Beliefs and experiences about lightning	Reasons
1	If you touch person who been strike by a lightning you will also been striked by a lightning	Because the strong of the lightning have left in that person
2	If a lightning strike at a place, it will still strike at that place anless you call the sangoma to came and make that place very nice	Because the lightning have been left its urine look like a diamond
3	If you are nearby a seed of jackal berry you will strike by a lightning	Because the seeds are from the tree and the lightning does not like tree
4	Do not switch on the bulb	because the electricity it look like a lightning
5	Apply charcoal at the teeth of the baby it will not strike by lightning	because they have like charge

Learners' interview guide contiues (Learner 2)

Investigating about cultural beliefs and experiences about lightning of a community in Ohangwena Region in Namibia

07 September 2012

Instructions to the learner:

Interview five people about their cultural beliefs and experiences about lightning. Ask them to give you reasons as well. Record their responses in the table. Use extra paper if the answers cannot fit in the table.

	Beliefs and experiences about lightning	Reasons
1	You don't dress red clothes	because there is a charge
2	don't stand under the tree it the rain is raining	Because between trees there is exuku there having magnet that attract lightning
3	Apply charcoal on the forehead of twins	Because the twins is having magnet on their body
4	You don't make noise	Because in sound there is magnet that attract lightning
5	You put omulavi on the top of your hut head Don't stay with animals	Because to prevent the hut to do not touch by lightning because animals having red blood

Appendix 4B: Data generated by learners from the community

Learners shared their information in groups that they have collected from the community as it was instructed. They were discussing in Oshiwambo (their mother language) but wrote in English. I move between the groups to give further explanation. I made it clear that there is no wrong idea.

Commends to the first group

A learner from the **first group presented** and learners asked questions as well as comments; the discussion was as follows:

L: (Stood up) you said apply twins with charcoal on their foreheads because they have magnets in their bodies. Do human beings have magnets? Where is that magnet?

L: (stood) in sound because human being speaks.

L: We all have sounds but we do not have magnet.

ON: We do not have magnet in our bodies. Is it not so? Haufiku has got a question listen. Haufiku

L: (Stood up) do not wearing a red cloth....what ...what..(he got stuck)

I: Say it in Oshiwambo

L: Vati ino djala oshikutu shitilyana(apparently we are worn not to wear in red clothes) , moshikutu shitilyana omuna shike ngeengge oye lifa ashike naashi (what is in a red cloth if it is just the same as this one? referring to his shirt)?

L: (Stood up) because they look like blood.

I: What does it look like? Looks like blood? Ooo! Ok, outilyane oo ounasha nashike? (What does rednesness has to do with?) What is there, paife onda hala u shi dilaadile muule ku tya (I would like you to think critically that): Shaashi otwe li longa ku tya, okashelu oha ka eta koshike (because we learn how lighting occurs). We talked about attraction between opposite charges. Mbela moshikutu shitilyana omuna shike shiheli moshikutu shitoka, shi heli mo shikutu shishunga? (What really is there in a red cloth which is missing in a white or yellow cloth? yes (pointing at learner to give the answer).

L: Because lightning ....because that red cloth look like ...look like...it looks like a fire.

I: Ok, ondahala u lombwele nge to ti (I want you to tell me that): eshinee Hamalwa a li eya nombidja itilyanakofikola ndee ta kwatwa kokashelu (for example, Hamalwa was struck by lightning when he was dressed a red cloth), (referring to learners in a class) owe shi mona (have you ever seen it)?

L: aaye (no).

ON: Does it happen?

L: aaye, no

ON: (explain and draw on a chalkboard) we talk about what causes lightning. We said, the opposite charges,.... this one is a ground. When it has.... this one is induced with positive charges. Since there are a lot of negative charges here (pointing to the diagram on a chalkboard) this charges have to flow down to the region of opposite charges so that this cloud becomes neutral. Now I want you to think critically, be realistic, and be concrete. If you are thinking of a fire, keshe fiku oha tu shakala omundilo, ndee momaumbo omo, ovanhu vangapi kwali va kwatwa kokashelu shaashi kwali va shakala? (We set fire every day but how many people were struck by lightning as a result of setting fire)?

Ls: No

ON: Otwe li longa kutya (we also learned that) all the materials are made up of atoms. An atom has positive and negative charges, which means this (touching a learner's cloth) is a neutral cloth. This cloth is red and neutral and it is a matter, it is a material which is made up of atoms that consists of protons and electrons. What differs is only the colour. You just need to understand that lightning happens because of opposite charges. Nothing has to do with colour. That is what you believe in but it is what? It is a myth. Is there any other question?

L: No

ON: Any other question

L: No query

Discussion, questions and comments to the second group

L: Omunu oto kwatwa kokashelu to yolo, tolimemesha ashike ngahenya? (Is it possible for a person to be struck by lightning when laughing or smiling)?

ON: Omwe shi uda? (Have you ever heard about it?) Omwe muu da kwali ta yolo ndee okwa kwatwa kokashelu osho? (Have you ever heard a person who was struck by lightning when he/she was laughing?)

L: When we were younger our parents told us not to smile when it was raining and thunders.

ON: Ok, now think in scientific term, connect it to science, you should apply your science now. It is true; can you be struck by lightning when you are smiling?

L: But culturally we believe in it but in scientific we do not believe in it

ON: Think in terms of scientific now, because we want to move from culture to scientific. Will it ever be possible? Yes, Nelly,

L: It is not possible

L: Maala ngeenge omunhu to yolo shili, oha ku kala ngoo omingungumo noushelu (But when you are loughing there use to be thunderstorms and lightning flashes)

ON: Ngeenge i to yolo iha ku ngunguma nandenande? (Do the lightning flashes and thunders not occur when you are not laughing?)

L: Otaa ku ngunguma ngoo ndee haunene (They do occur but not much).

L: Mom is, ngeenge ota ku ngunguma ngoo mutu, oto ti ai, kaimba aame haikongwa. ouna ngaho oku ngugnumana (When there are thunders and lightning flashes you may thing that: it is looking for me! then you remain silent)

Discussions, questions and comments to the third group

L: Omolwa shike nee taku tiwa ino nangala ongali? (Why is it prohibited to lay on your back?

ON: Think scientifically, you are scientists now. I explained referring to charges and how objects get charged. Is that true? wa nangala ongali?

L: No

ON: Omunhu oto dulu oku kwatwa kokashelu nande ouli omutumba ile wanangela kombinga keshe ngeenge apa uli okashelu opo ta ka striking opo uli (You can be struck by lightning even if you are sitting or lying on any side provided that the lightning may strike that site).

L: Let me ask Ms. what if I put charcoal around all the trees, do you mean they will not be struck by lightning?

A lot of arguments and questions were arising. Learners wanted to know more. They were thinking deep, thus they asked questions, but some failed to relate to science, they felt what they know already is real. Some learners strongly believe that applying charcoal on forehead of twins protected them from lightning strike.

L: (Female) explained that, twins' parents and twins are treated or washed (traditional initiation), eehamba oha dikala dina oinima tai dulu oku etifa okashelu. Ngeenge owahu okaana ekala oha mu di oiunima opo kaha kwatwe kokashelu (twins' bodies contain things that can cause lightning. Applying a charcoal helps to remove those things).

Questions, comments and criticism to the fourth group

There was interesting beliefs emerged from this group that when lightning strikes at a certain site, it remains there because it leaves urine behind. This urine looks like gold. If it is not removed by an expert traditional doctor, lightning will keep on striking the same site over and over.

L: (argues) onda monene omuti uli naana peumbo wa kwatwa kokashelu, ndee tau lidenge po, ndee inai mona nande omunhu ile ondudu yeya oku hakula po, oinima yafa opo (there was a tree stuck by lightning in our court yard but I did not see any traditional healer came to treat that tree, but the lighting did not repeat striking that site). Maala ina ka alukila po, onale nee maala ina ka a lukila po (But it happened long time, but it did not strike again).

ON: Ndee i na ka kwata nande opomudingonoko wopopepi? (Did it not strike the nearby trees?)

L: Ahawe inaka kwata po asha (No it did not strike ant tree)

L: Ngahenya okaima i na ka kwata oka pita po ashike kena ashike apa ka kakwata (It did not really strike, but it was just passed by and struck somewhere else) .

ON: Apa pa ka fudama oshiima osho? (Where the thing got under the ground)

L: Ehee (yes).

I: Shaashi ngeenge oshiima kashipo opo, oshiima osho (it that thing is not there) what they call urine shaa shadi po eitavelo oleli kutya okashelu ita ka alulikile po (when it is removed the belief is that lightning will not strike the same site anymore), because according to her (an expert) that thing attracts lightning, thus it keeps striking at that site or at the surrounding. Once it is not there, there is nothing that attracts lightning.

L: (Asked) Ndishi omunhu oha fe nee ta dingilile omuti aushe oo? (Does the person dig around the tree?)

ON: ina ndi shimona (drawing learner's attention). Listen here, Nathan

L: (Explained) Ngeenge ka kwata oho mono ashike patenda omufya apa ka ningina (When it strikes you can see where it enters the ground because the soil craks). Noho ondudu shaa yakwata omuti ota imono po apa ka ningina (Again, the traditional healer can see where it penetrates the soil). Ovanhu ova fa pomunghulo wo muti (People dig next to the tree).

Appendix 4C: Discussion with the community members: Section where learners were actively engaged

Epulo (question) 4. Ope na ne peembinga dimwe oha ku tiwa vati; omunu ota dulu okuetifa okashelu. Oshoshili? (Some people say that a person can cause lightining. Is it true?)

P3: Ehee, ohashi shiiva, oha shishiiva nomukalo uli ngaha taa: shama wa mono odula ya didimika, oha ku tiwa na tu limwenenene. Ngeenge oto lifa oto kala pefina lomuti ndee inoli nyenga. Ngeenge oweli nyenge okashelu oke ku wete. Iyaa, na unene ngeenge omepya, odula sha ngoo yadidimika ovakulukadi ita vadulu okukuna. Ngeenge te linyenge ngaha, ota eta okashelu. To kunu ngoo ngaha ove wa ile kwinya ove to a luka ko vati okashelu oke kuwete. **(**Yes, it can happen in this way: When it is about to rain, one need to sit still. If you are herding livestocks then you must sit under the tree and don't make unnecessary movements. If you are sowing, then it is also dangerous as you are making lots of movements.)

L: Oto hange taku ti: odula ngee tai loko ngashi unene fyee ava ha tu kala koufita, vati ino pumbwa nana oku kala oku kala wa ya momuti odula tai shela, oto kala ashike opo fiyo odula otai sheka. (You hear people saying that, when it is raining, especially for us herders, it is not good to stay close to trees. So I should just stand there until the rain stops.)

P3: Ehee, naasho oshili. Opena omiti edi da yoololwa. (That's also true. There are some trees that are more prone to lightining strike).

L: Epulo lange onde li pulila molwaashi nee ta ku tiwa omunhu oto dulu ngoo oku yaama pefina lomuti ngee odula tailoko. (I am only asking in reference to what you said earlier that I should stay under the tree when it's rainning).

P3: Ayee, opo ouli mondjila, epulo opo oku li mwenenena ashike. Oku kala pefina lomuti opena nee omiti edi da yoolowa ndishi? Doo oha di kelele okashelu. Oku kala pefina lomuti inai tonga nawa. Omumati okwa pula nawa. Hamuti keshe ngaashi omufyaati ngaha ile omuhongo ndee tokala pefina lao.

Ashike omumati penya okwa tonga nawa kutya limwenenena uli poluhaela. Ngeenge ope na omulavi, omulavi. Mumati omulavi owu ushi? (Yes, you are right. I think I did not make myself clear there. There are trees that are prone to lightning strike and some are not. Some trees like mopane trees are very prone to lightning. But the boy asked a good question. Boy, do you know *'omulavi'* tree?)

L: Ehee. (Yes)

P3: (Continued explaining), ngeenge ope na omulavi, inda momulavi. Osho tuu wani? (asking parent 2). So if there is omulavi tree then go there. Isn't that so? (asking parent 2)

P2: Ile momukwa ita yi uyamo. (You are right. Also under a baobab tree it won't get in).

P3: Ile momukwa (repeating after parent 2) (Yes. Or in a baobab tree)

L: Momulavi omuna ne shike eshi okashelu ita kee ya mom? (So what is special about *'omulavi'* tree that lightning can strike it?)

P3: Odina eameno ngoo. Shoo vene ita tu ti .... ito ti naana kutya oshike shili mo. Ndishi eshi ha tu tongo osheshi twa lombwelwa kova kulunhu. Iyaa, omiti dinya oda talika ko dina eameno edi twa tonga apa, itoti naana eameno lado... (There is just protection. We can't really tell of what is there. You know we only got the information from our forefathers....so we can't really tell.)

P2: Ota shiiva otuneni omangenete, fyeni otuna oivela, ndee hakeshe oshivela hashi kwa twa kengenete, pamwe noiti oyo osho ya shitwa i li ngaho. (We also have magnets and metals, but not all metals are magnetic, so I think this might apply in the case of trees.)

P1: Omunhu umwe okwa shitwa ena omangenete eshi hatu udu kovakulunhu. Shoo osho ngaho ha tu hanyenwa nopaife nande ngenono odula otai shela ovanhu ngaashhi hatu lipandaapanda, ino kwata eexwiki, shaashi eexwiki odina omangenete a shitilwa mo. Noipanyala kaiholike vati kodula eshi twa dja hatu lombwelawa kovakulunhu.Oipanyala nomayoo, kaiholike kokashelu. Shoo osho ngaho to hanyenwa ngee odula tailoko, mwene ni utale ina mu yola! Omayoo nao iha eli kwata nodula. Onghenee oha ku tiwa opo uha kwatwe koupyakadi ngee oumumbada, luhapu oha ku tiwa inonangala ongali nangala eombe. (Some people are born with magnets, so our elders say. That is why parent caution their kids especially when they are plaiting hairs because hair is magnetic too. Nails and teeth are also magnetic, that is why parents always tell us not to laugh when it is raining. So one should lie on his/her stomach instead of his/her back.)

ON: Oshima oshiwa nee. Ounona ova hala oku pula. (It is getting interesting. The children want to ask.)

L: Ame onda hala oku nyamukula epulo laOlvia. Vati omiti edi nee iha di kwatwa kokashelu, iha di kwatwa vati shaashi kadina olute ngaashi omifyaati nomihongo. Vati ngeenge owa kala momufyaati oto kwatwa shasahi owuna olute lafa oshiima vati eshi hashi hangika medu (omaxu okashelu). (I just want to answer Olivia's question. Apparently, the trees that are not prone to lightning strike, it is because they don't have tree rings like mopane and 'omuhongo' tree. If you are under a mopane tree then lightning can strike you because it has tree rings which look like lightning leftovers/urine.)

Appendix 5: Member check, discussions and recommendations

The lesson presentation was well organised and planned, teaching aids are correct and can improve the understanding of the learners. The lesson well introduced to the learners as the teacher tried to get the learners pre-knowledge by asking them few questions. The whole lesson was conducted in the learners-cantered approach indicated by the fact that teacher was not just feed the learners while they are quite but she always give the floor to the learners to give their ideas and the role of the teacher was just to scaffold them.

The notes she wrote on chalkboard were real a good short summary. The classroom well arranged as learners were sitting in groups which makes it easier for them to help each others when answering questions posed to them. Some learners were just mute in the group and just pretend as they ate also discussing the answers to the questions. Teacher was walking between groups for the reason of drawing the attention of the learners into the lesson and not just to do their own things there. She made use of flip- charts for short summarised notes as her teaching aids.

When it comes to practical activities each group were given materials in order to carry out the practical activities and this was quite interesting to the learners and they all participated. Teacher helped them as required. Learners followed instruction from the teacher. Oshiwambo was not really discouraged as most were discussing in Oshiwambo. Most groups fail to get the correct result of the experiment and they were just so reluctant to ask for help. Assessment of the learners understanding was properly done through activities. Lessons were well conducted.

Learners got a chance to differentiate between reality and myth about lightning. Teacher taught them really things which might be relevant to nature of science eg. Teaching them about not standing under the tree some of cultural beliefs are related to the nature of science. They gain reasons why they are warned not to do some of the thongs during thunders.
About learners' engagement: learners were motivated to participate. They brought in their ideas/knowledge they acquire from their parents

Benefits of presentation

Learners become self-confident, share ideas and improve communication skills and develop language development and language proficient as the teacher tried to correct the spelling of words, translation of sentences and words from vernacular to English and construction of sentences.

Facilitation of learning

Teacher allowed learners to give their prior knowledge about the topic e.g. atoms, probe to help learners develop scientific concepts of the composition of atoms. She also used the diagrams which helped learners visualise the location of particles on the atom and reduces memorisation of fact and concepts.

Appendix 6A: Classwork

PO Box 534, Ohangwena Tel; 065 – 260191 Ohangwena Circuit

PHYSICAL SCIENCE
GRADE 8D
INDIVIDUAL CLASS WORK
NAME:

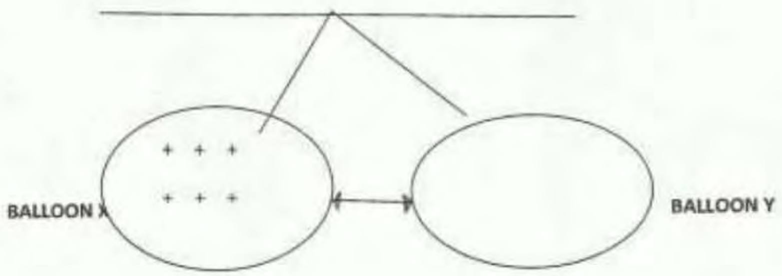
INSTRUCTION: WRITE YOUR NAME ON THE SPACE PROVIDED.

ANSWER ALL THE QUESTIONS.

1. DEFINE WHAT STATIC ELECTRICITY IS

is electRicity that Does not move.

2. THE TWO BALLONS WERE ELECTRICALLY CHARGED AND SUSPENDED AS SHOWN IN THE DIAGRAM BELOW.



(a)State what should be done for an object to become electrically charged?

When you rubbed an object become electrically Charged

(b)Balloon X is positively charged, what is the charge on balloon Y?

positively Charged

© Describe how balloon X become positively charged in terms of protons and electrons

because balloon x having lot of positive than and less Negative charges

6 Marks

Appendix 6B: Homework

PHYSICAL SCIENCE GRADE: 8D

HOMEWORK

NAME:______________________________

THEME: STATIC ELECTRICITY

INSTRUCTION:*Write your name on the space provided

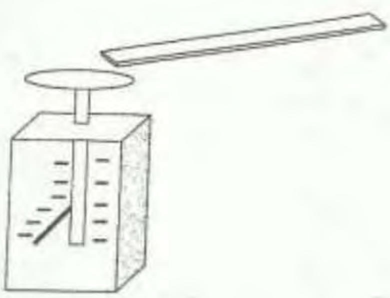
- Answer all the question

1. After combing his hair with a plastic comb, Tangeni renamed with negatively charges on his hair.

What charges will be on the plastic comb?

is the ~~negatively~~ positive charges

2. The diagram shows a negative charged electroscope and a plastic strip is placed near the cap.



(a) Predict the nature of charges in a plastic strip.

is negativety charge ✓

(b) Explain your answer in (a)

because when you put a plastic stip have negative charge on the electroscope the leave will open

3. Describe how an electroscope can be discharged?

when you put a the electroscope a uncharge thing. ✗

Appendix 6C: PHYSICAL SCIENCE TEST

Topic: Static electricity July 2012

Grade: 8D

Marks: 20

Time: 40 minutes

Instruction to candidates

1. Answer all the questions in the space provided in the question paper.
2. Write answers clearly and neatly.
3. This question paper consists of two Sections, Section A, multiple choice questions and Section B, structured questions.

Section A: Multiple questions. Choose the correct answer. For each question, there are four possible answers A, B, C and D. Circle the letter of the answer of your choice.

1. A positively charged red polythene strip is brought close to the charged plastic ruler, the learners observe that they are repelling each other. What types of charges are on the plastic ruler?

A. negative

B. neutral

C. no charge

D. positive

2. Which of the following would probably be the safest place during a thunderstorm?

A. Standing under umbrella

B. Standing under a tree

C. Sting inside a car

D. Lying next to a fence in a large open space

3. Two metal spheres, P and Q are mounted on insulated stands. Sphere P is negativelyy charged while sphere Q is neutral.

Sphere P is brought closer to Q so that the spheres touch each other. They then moved back to their original positions. Which ONE of the following pairs of statements is TRUE about the static electricity force of sphere P on sphere Q, before and after touching?

	Before	After

A	P has no effect on Q	P repels Q
B	P has no effect on Q	P attracts Q
C	P attracts Q	P repels Q
D	P attracts Q	P attracts Q

4. Objects become negatively charged with static electricity because of:

A. The movement of electrons onto the object

B. The movement of electrons off the object

C. The movement of protons onto the object

D. The movement of protons off the object

5. Which of the following is an example of insulator?

A. Aluminium

B. Carbon graphite

C. Dry ice

D. Copper wire

SECTION B: Structured questions, answer all the questions. Write your answers in the spaces provided.

1.1. Differentiate between static electricity and electric current

....

....(2)

1.2. Explain why charge exists

....

....(1)

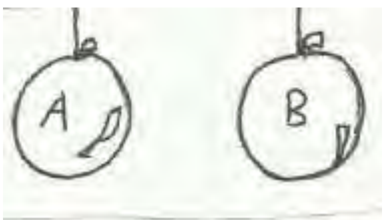
2. Objects can be charged by friction.

a. Give one example of everyday life where charging takes place by friction.

....

....(1)

b. Two balloons are hung as shown below. Vaino rubbed the two balloons on the sides facing each other with a dry **woollen jersey.**



(i) Explain what happens to the two balloons when they are rubbed?

....

....(1)

(ii) State the force that balloon B exerts on balloon A after they have been rubbed and give its direction (left or right).

....

....(2)

3.1. A positively charged electroscope was approach with a charged glass rod. The gold leaves open further.

a. State the type of charges on the glass rod. Give a reason.

....

....(2)

b. Give the use of electroscope

....

....(1)

3.2. Lightning is an example of static electricity in nature.

a. Explain how lightning occurs

....

....(2)

b. Give one example of the danger of lightning

....

....(1)

4. Complete the following

Like charge ....each other and unlike charges ....each other. (2)

Appendix 7A: Semi-structured interview edited version

Q1: Do you think learners' cultural beliefs and experiences about lightning need to be incorporated in teaching static electricity topic or not? Why?

T: I think it is needed to be included because culturally learners they have beliefs about lightning and some of their beliefs they are corresponding to the really meanings of static electricity and the lightning. So, it is really needed to help their understanding and the way to protect them from the danger of lightning.

Q2: How did the inclusion of learners' cultural beliefs and experiences about lightning enable or constrain meaning making of static electricity?

T: So, culturally learners they also believe that lightning is from the clouds and lightning is the flow of the charges from the cloud to the ground or from cloud to another cloud. So the interactions between culturally and really knowledge scientific knowledge it is going hand in hand, in that case so it is really needed, so it is really helping.

Q 3: What are the challenges of including learners' prior everyday knowledge about lightning when teaching static electricity?

T: The challenges are these, some learners get confused, and some they just stick to their cultural beliefs and try not to understand what the really meaning of static electricity. Some they just look at what they got from their parents as real and try not to understand what the teacher is teaching them.

ON: What effect does it have when they stick to what their parents told them? What effect does it have on their learning?

T: The effect is that, it can lead to the failure and they cannot understand because what is in their head is just that what their parents told them is real and what is written in their textbooks is like they cannot really get it even if they will get that one after sometimes.

Q4: In which ways did engaging learners in practical activities benefit the learners?

T: When learners carried out practical activities they manipulated the equipment and observed clearly how things happened and made a link with their theoretical knowledge. So, in that way it really helps or benefits the learners.

Q5: What were the challenges of doing practical activities on static electricity did you observe?

T: The challenges of doing practical activities that I observed is that some learners wanted to see things happening exactly as the teacher told them. For example, some learners wanted to see the flashing light since we say when it comes to lightning, we see the light flashing from the cloud to the ground. Now when they carry out the activities, they wanted to see the light flashing coming from the charged ruler for example to a certain object. So, this causes a little bit confusion to the learners and some they just wanted to carry out the practical alone. That is the challenge.

ON: any other challenge?

T: no

ON: Do you think their language development did it real help them to understand what they were doing?

T: So, ya, language is also contributing to their misunderstanding of this, because some of the words used, they are like new words to them. They do not understand them very well; it is also a contributing factor to their slow catching up.

Q6: What were the challenges of doing practical activities on static electricity did you observe?

T: So, you engaged learners very well, you did it very well, all the learners participated and the activity was well organised accordingly.

ON: Imagine, you were to do the same practical activities, what would you do differently?

T: apart from.....

ON: what I did

T: What you did?

ON: yes

T: So, there was nothing much new that I could do but what I could may be do is just to draw some pictures on the chalkboard, which shows exactly how the lightning happens and to give may be hand-outs with diagrams how the building up of charges on the cloud and how the charges can flow from one cloud to another. But I think most of the things you have done them very well.

Appendix 7B: Interview with a focus group - English version

Question	Learners' responses in English
1. Do you think teachers should consider or not learners' prior knowledge?	Learner 1: I think it is important it is learning us about static electricity and lightning to know the danger of lightning. L2: to consider because when you are asked everyday knowledge someone can be participate and when we are asked knowledge of everyday life we also in science. Science is the study of everything around us. That's our everyday knowledge should be considered. L3: need to consider because some of them they cannot be teaching from school but you know in the home. L4: I think because there is a thing that is not learn only by teacher that we called a culture. L5: Cultural beliefs something, sometimes you was do not know something and then that day you will know danger and how you will help yourself. L6: yes teacher should consider because you will know more about science and you will pass very well in some subjects like physical science and life science.
2. Do you feel that we started the lessons on static electricity with exploring your cultural beliefs and experiences about lightning?	Learner 1: I feel that in cultural belief we should also add other things that are not in cultural beliefs so that we can add other ideas in cultural beliefs. Learner 4: we start with the lesson that we know very well and left with what we do not know. Learner 6: I feel very good because it is important to start with the thing that you know and that can be asked from the parents who know more about our culture.
3. Do you think it is important or not to do practical in science? explain Teacher: can you give example, something you learned that you did not know before. T: how do you compare the learning when you do practical activities and when there is no practical activities? How do you compare thee understanding when you do practical activities and when there is no practical activities? T: what do you do with the materials?	Learner 1: It is important because in those practical activities we use to learner a lot of things that we did not know before and now we know them. Learner 1: I did not know how lightning is formed but when we learnt at school I know. Practical activities helped me to understand how lightning is formed. Learner 2: it is important because when you do the practical you can be learn things that you will not know when you can do in the group. Like the group help you the mind to be added together and do the correct things. We learn from one another. Learner3: I think it is good because it help you to know how to learn about it and know the new words, for example, you can see a word that you do not know before. Learner 4: it is important to help you know activities in science. Learner 5: yes, because it is important you know different ideas in our traditional a long time and to know where lightning come from Learner 6: it is important to do practical activities because you learnt the subject that is learnt by your teacher and when your teacher is going to learnt you, You know more about what she/he learnt you. Learners 1: You do not understand very well because if there is practical activities you understand better then when a teacher is just writing on the chalkboard. Learner 2: because there are materials

	Learner1: you use to understand your knowledge. You touch the materials.
4. Which scientific concepts did you learn during the practical activities in static electricity? Teacher: can you give a specific example? Teacher: what did we learn about conductors? What do the conductors do?	Learner 1: we learn examples of static electricity, lightning and dangerous things of lightning. Learners 1: if rain is raining and may be you are in the building and lightning strike the building, you can also be struck by lightning because you are inside there and lightning strike you and kill you. Learner 2: we learn about danger of lightning, how to prevent the danger of lightning, how lightning occur and what we can do or not do when lightning occur. Learner 3: We learn about the danger of lightning, conductor, how to protect when there is a raining. Learners2: conductor is when the charges flow out the body to the earth. Learners 1: conductors are things that allow electrical charges to pass through. Learner 4: We learn about how to protect our houses from the lightning and we learn about danger of lightning. Teacher: apart from lightning, what else did we learn under static electricity during practical activities? What else? Learner2: we learn about positively, negatively, lightning, positive and negative charges, protons, electrons, neutral, conductor objects, charging objects, repulsive, attractive, repel and attract and insulator. Teacher: For example, what did we learn about neutral object? Learner 2: neutral? Teacher: Yes Teacher: yes, something is neutral? Learner 2: Is when something has equal number of protons and electrons. Teacher: what did we learn about charges? Learner 2: Like charges or unlike charges? Teacher: yes, what did we learn about them? Learner 2: We learnt that when there is like charges they repel each other, when there is unlike charges they attract each other. Learner 5: It is important because we learn about how lightning come from and what danger of lightning is. Teacher: what else did you learn apart from lightning? Because lightning is static electricity, what else did you learn under static electricity? Learner5: electroscope Teacher: what does electroscope do? What did you learn about electroscope? Learner 2: we learn about discharging electroscope by Earthing and how to charge electroscope.
5. Do you think that the inclusion of your cultural beliefs and experiences about lightning has helped you or not to understand the scientific concepts on static electricity? Explain	Learner 1: I helped because things that we did not know in cultural way we learn them in scientific way. Like may be if you are using electrical appliances you can be shocked but in cultural way there is no such a thing. Learner 2: there is help because we learn what we can do and what we cannot do during lightning. Teacher 3: I think they help you to understand about scientific concept because they cannot help you to

Teacher: Can you give an example of something you understand as a result of...? Teacher: Can you give an example of what did you understand specific.	understand the scientific. Learner 3: Example of cultural belief, you cannot lay when the rain is raining. Learner4: It helps us to understand what to mean about static electricity Learner 4: Put a lightning conductor on top of the room.
6. Did you enjoy or not doing practical activities on static electricity in group? Explain Teacher: Did you doing it in groups? Teacher: And what else, put ideas together you...? Teacher: did you talk together during practical activities? Teacher: in which way? Like what? Teacher: Ok, now, think now, you are given a worksheet to do the practical activity alone and then when you work with someone, how do you compare it?	Learner 1: I enjoy because, we were told things we did not know. Learner 1: yes, we enjoyed because we were adding ideas together to understand things. Learner 1: understand things Learners 1: yes Learner 1: may be like if you are given something and you did not know to do, you colleague will tell you what to do then you do. Learner 2: I enjoy it because when we were in groups we can add ideas together to get our ideas and to control what is wrong. Teacher: For example? Learners 2: like cultural beliefs and scientific ideas. Teacher: What else did you enjoy? Learner 2: To be learn the something that we did not know like cultural beliefs. Learner 4: I enjoy because when we work in groups we put ideas together. Teacher: And what else did you? How did you put ideas together? Learners 4: We do some activities. Teacher: Did you talk? Learner 4: yes Teacher: to whom did you talk during group activities? Learner: We talk with people in our group Learner 5: I am enjoy because we learn about the information that we did not know and we learn the meaning of static electricity. Teacher: And what else? Learner 5: New ideas Teacher: new Ideas from where? Learner 5: from others when we discuss. Learner 6: We enjoy because I learn more about static electricity. Like, I learn that when you put on your jersey you hear sparks or feel shock. Learner 2: it is easy to work because you ca bee put ideas together, and to correct what is correct or wrong. Learner 1: I think that when you do it together you understand it better then when you are doing it alone, because sometimes things that you do not know the person who is sitting next to you will tell you that this one is wrong, this one is correct, because what you know is not what the other person knows.

7. Did you like or not the way the lessons on static electricity were taught? Explain Teacher: What else did you enjoy?	Learner 1: I like the way they were taught because we were also demonstrating how static electricity happens apart from our cultural beliefs and demonstrating things that are in scientific ways/ideas. Learner 2: It is good because we learn how static electricity is becoming. What causes it and how to be

	look like. Learners 2: I enjoy what electroscope can do and what like charges they will be do and learn how to discharge and charging electroscope.
8. What else do you feel needed to be done to facilitate your understanding of static electricity? Teacher: What else? Just give your ideas	Learner 1: I think that we should continue to learn more about static electricity because sometimes when you sit on a plastic chair you feel/hear sparks on your skin you did not know what they are. When you learn about it you understand better than before. Learner 2: When we were using the electroscope, we want to be know what is caused the electroscope to open or repel when there are like charges Learner 1: And also how does the charges positive or negative charges get to electroscope to make the gold leaf to get open, how does the charges get inside there? Learner 3: because they were make to know many different things about static electricity. Learner 2: we need to be know what the charge in the plant because.... Teacher: are they not just positive and negative charges? Learner 2: when the lightning is occur what people say do not be near by the plants? Learner 1: And what type of charges are in the plants? Learner 3: I like because the learn many things about static electricity and to know it.

Appendix 7c: Focus group interview: learners 1

Questions	Learners' response	Learners' translation	my translation
1. Owu udite kutya omuhongi nakwatele mo ile i na kwatele mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why?	L1: Nali kwatelelwe mo opo ngaho ava kwali vehe shishi kombinga yomufyuululwakalo kutya ngeegne odula tai loko nava ninge ngaha nongaha navo veshshiive.	L1: Will include so that some who cannot know about traditional that when rein raining the can do that for them to know.	L1: Pre-knowledge should be used to help those who are not aware about it for instance the safety to be taken during lightning flashes so that everyone knows it.
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo	L1: Okwa li shili nawa shaashi ka kwali tushi kutya oka shelu oha ka e twa po koshike ove toli	L1: It was good because we were not know that cause of lightning what is the cause of lightning and	L1: It was good, because we were not aware about the causes of lightning, then now you will

neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everyday knowledge and experiences about lightning?)	longele ko nee kutya okashelu okafaafana noshiima eshi ngaha.	you learn what lightning look like.	compile your understand basic to that.
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?) T: kakele nee ko kulihonga mo sha, omuna vali ouwa washike? (Apart from learning, what other benefit will you gain then?)	L1: Oshafimana opo u lihonge mo shihapu shidulife pwaashi kwali ushi nale. L1: omuna ngaho vali ouwa umwe opo uli longe mopractical activities opo eshi to ka ya moshilongwa shoovene pamwe oto mu kaya po topic yafa osho, oto kala nee ushi nale oinima imwe toi piti nee. L1: Ngeenge ka pena oelectoscope ndee opena omafano oelectroscope ove toi longwa nee otoi shiiva nawa nokui uda ko.	L1:Its important to for you to learn more so that you can know already L1: there is good again for you to learn the practical activities so that when you come to the subject at that topic like that one you learn already you know something and you can pass. L1: If there is no electroscope you will know it even there is photos for real electroscope and will learn it and know it.	L1: It's important for you to learn a lot more than you know before. L1: The other good things about it is that for you to learn more on practical activity, so that by the moment you will be dealing with the subject itself and came across a related topic to that, so it will be already familiar to you then definitely you will pass it. L1: If there is no an electroscope, you could understand it if there is its diagram. Then you will just study about it from there you will know it better.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?)	L1: Otwe li longa mo ngaho oitya imwe kwali tu heishi moscientific. Ondeli longa mo oelectroscope ku tya oili ngahelipi, ohaicharging no ku discharge ngaheli pi.	L1: we learn words that we didn't know in scientific. i also learn how an electroscope look like how it charge or discharge	L1:We have learned different concepts that we never came across before. For example I learned electroscope about it is charged and discharged and how it looks like as I never came across it before.
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knowledge and experience about lightning when teaching static electricity helped you understand scientific concepts or not? Explain	L1: Odakwafela nge shaashi oto longifa oinima ei yopamufyuululwakalo ei wa hangika nale ushi ove to longifa nee ei yopascientific ku tya okashelu oha ka etwa po ngaha, to longifa ei yopamufyuululwakaloove toweda ko oscientiffic opo wu u deeko nawa.	L1: It help me because we using things that in traditional that we know oready used from scientific that from traditional and edd from scientific to understand.	L1: It helped me because we started with our cultural beliefs that we knew before, our prior everyday experiences from home and then we moved on to the scientific knowledge how lightning is formed so that we understand well.
Q6: Owa tyapula ile	L1 ondei enjoy shaashi	L1:I have enjoy because	L1: I enjoyed it because

inotyapula okuu ninga opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?) T: ndee ngeno okwali tolongo oove auke? (What if you were working alone?)	okwali hatu pukulafana apa u heudite ove to pula mukweni yee te ku lombwele. Apa u wete ku tya mukweni keudite ko ove to mu pukulula, ta mu tula nee omadilaadilo kumwe. L1: otashi kala shi djuu kwoove opo wu udeko nawa shaashi kushi ngee omadilaadilo oye okwa puka ile okuli mondjila. Otodulu ku tula po aa apuka mboli aa kwali to dilaadila oo eli mondjila.	we where helping one another and you ask your partner and he will tell you where you don't understand. if you partner does not understand and you will tell her and you put idea together. L1:It will be difficult to you to understand very well because you don't know if your idea are wrong or correct. You can maybe put the wrong are but the one you are thinking are correct.	we were helping with one another, where you did not understand you ask others. If you realised something that the fellow learner does not understand then you help him/her. We were sharing ideas. L1: It will be absolutely difficult for you to understand when working alone as you may not aware of whether your idea is right or wrong. It is possible to write down the wrong one and leave the correct one.
7. Ou hole ile ku hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?) Ove owe u longifile tuu nale kaanave una eematerial?(Have you ever used it before?)	L1: Omukalo oo kwali hatu longwa nao okwali ndiu hole shaashi oinima oyo kwali ha tu longwa okwali ha tu pewa eematerials do ku longifa ngashi electroscope opo wu u dee ko nawa filufilu ponele yo ku longwa membo ngahenya nyee i ta mu peewa eematerial dasha. L1: Aye, ina ndiu longifa nale opo ashike nde u eshi kwali hatu longwa. L1: Omulongi okwali he tu longo nawa shaashi okwali he tu pe efimbbo lawana lo ku dilaadila omapulo ngaho aa e tu pa hatu dilaadila omanyamukulo.	L1: The way we where using with I was like it because the things that we where learned we where given the material to use like the electroscope so that you can hear very well the way of been learned from the book like that with out given materials. L1: No I have ever not use it is the first time I am using it, when we were I been teached. L1: The teacher was good because she was give us the enough time to think the question that she give us think the answer.	L1: I prefer the method that was being used because we were provided with learning materials such as electroscope to facilitate our understanding rather than being tough t using the chalkboard only and there are no learning materials. L1: The teacher taught us very well because we were given enough time for us to thing about the answer to the given questions.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricity? (What else do think if was suppose to be done in order to help you understand static electricity topic well?)	L1: Ngeno okwali pena eematerial dawana ngeno keshe umwe ukuna yaye ekeilongife keu mbo oku charging electrosope.	L1: If there enough material every material at home to used the electroscope that it charge or it discharge or it does not charge.	L1: If there were enough materials, then everybody could be given a material or instrument to go with it home. Then she/ he will use the electroscope at home, whereby she/he will use different material at home to test whether they can charge an electroscope or not.

Appendix 7C: Focus group interview: learners 2

Question	Responses (oshiwambo)	Learners' translation	My translation
1. Owu udite kutya omuhongi nakwatele mo ile i na kwatele mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why?	L2: Nali kwatelwe mo opo omunhu a shiive oku shiiva nawa kutja koinima yokeumbo koo keshiivo ta ku wedwa nee kwaai ta longwa yoscientific opo shikale shipu kuye oku lilonga oinima shaashi okuna okukala ena po okashiivo kamwe nale.	L2: Will be include so that person can know well from things from home to knowledge will be add for things that will be learn for scientific to be easy learn things because will have a knowledge already.	L2: The prior-knowledge should be included since we also acquired some knowledge from home on which we build the scientific ideas in order to facilitate our learning as we also have our prior knowledge.
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everyday knowledge and experiences about lightning?)	L2: Ame ondiu dite ku tya otashi kwafele shaashi omunu oto lombwelwa ku tya ino enda pondje ngee odula tai shela ndee ku shii nee kutya ota shi ningi nana shike, ile na nde oto lombwelwa kutya ino djala oikutu itilyana modula ndee kushii nee kutya otashi eta shike ngee wa djala oikutu itilyana, ndee kushii nee ku tya oshike tashi ku kwatifa kokashelu ngee wa djala oikutu i tilyana. Oo omaitavelo nee amwe, oshiima ohdulu okukala ushiishi ashike moshiwambo ku tya okashelu oha keya po ashike nesiivo olo ku tya, vati oilemo yelidenga mumwe. Paife moscience otwa longwa mo ku tya, okashelu oha key a po ngeenge eecharge edi dili koilemo da dja ko deya pedu tadi attracting nee kumwe naadi dili pedu tadi kongo dikwao opo nee tapa holoka okashelu.	L2: I feel that it help because a person you can told that do not go outside the rain it's strike and you do not know what causes of it or if you told that do not dress red clothes during rain raining and you do not know what causes of it when you dress red clothe and you do not know that what make you striked by lightning if you dress red clothe. Some believed you know things but in vamboland lightning it happen of that knowledge that, that cloud crusher each other. Know in science we learn that lightning it caused when charge from cloud react with which one is in ground with other and it causes lightning to be happen.	L2: I think that it really helps us, because in tradition you are being told not to move around when lightning flushes. But you still do not know what is the cause? Or you will be told not to put on/ wear reddish clothes when it thunders. But you do not know what will be the outcome if you put reddish clothes. Then you won't understand what will make you to be struck by lightning when you are wear red clothes. Now some believes you may know about it, as to mention in 'Oshiwambo' they say the lightning happen when clouds collide with each other but by science we are told that the lightning happens when the clouds get charged up than the charges will attract those on the earth ground eventually when the attraction become so strong the cloud charges

			move down to ground so called the lightning.
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?) T: hano ngeenge taku ningwa opractical activities oha mu kala ta mu ningi shike? Opractical activity oshike nana? Ovanhu ohava kala tava ningi shikee nana? (When you are doing practical activities, what is actually being done? What is practical activity? What did you usually do?) T: teshi lilongo hashi tiwa ngaha, opractical activities ohamukala ashike muli omutumba ta mu popi?(When doind practical activites, did you only discuss?) T: Tamu longifa shike, eepeena ashike? (What did you use, was it only pens?) T: Oshina nee ouwa washike ngee to longifa eematerials? (What is the advantage of using learning materials/apparatus?) T: Ngeenge nee ngeno owa longwa uhena opractica activities nongee wa longwa una opractical activities onaini houdu ko nawa?(When do you understand better, is it when you are taught by doing practical activities or is it when you are taught without doing	L2: ongee ovanhu tava tula omadilaadilo kumwe opo muete po oshiima shonumba. Ile ngeenge mwa pulwa nande omapulo opena ngaho ou eshishi nau eheshishi ye eta dip o nee elilonga kutya hambaa, eshi ohashitiwa ngaha! L2: Aye, ohatu kala hatu shange oactivities, oha tu kala nee hatu dilaadila, hatu tula omadilaadilo kumwe shee hatu shange nee. L2: ohatu longifa eematerial dimwe edi ina tu longifa nale ngashi electroscope, no....no....noilongifo nee ikwao ihapu. L2: Oshina ouwa opo tokala u shi nandde electroscope tai tongwa oui sshi ngo kutya electroscope oshiima hashilongo ngaali, oha shi dulika ashike ta mu longwa komulongi ngahaenya poo ka pen a oilongifo. Ku shi ku tya electroscope oshiima shili ngahelipi, ohashi longo ngaheelipi. Opo nee ho dipo wiilonga ku tya: mboli electroscope oshiima shili ngahelipi ohashi longo ngahelipi opo shi holoke po. L2: ongeenge tuna practical activities shaashi otashidulika ashike tamu longwa koshipelende, oshiima eshi ta mu longwa naashi hashi longifwa ku shishi. Onghenee mopractical activities oha mu pewa oinima eeinstrument ei ta mu longifa oku konga oshiima shonumba, ndee koshipeleende kwinya ngee ita mu ningi practical activities ohokopele ashike oshiima ndee kushi kutya oshiima	L2: No we use to write activities, and we use to think, putting the idea together and write. L2: We use some material like electroscope and the ones we haven't used them ever and other material. L2:It is good when to know an elctroscope when people are talking about it you know how to use it, you might be learned by a teacher without an materials. But you don't know what electroscope is, how it is used. Then from there you learn, if there is materials you learn that: electroscope is something that is used what it does for something to happen.	L2: This is when people bring up their ideas, to brought up something or for example when you are given a question, there are those who do not know and those who know the right answer, then those who do not know will know the things by experimental being done by other fellow learners. L2: No!, we usual writes activities and bring up our ideas, eventually we compiled the ideas, then we wrote as a main idea. L2: We used different materials and apparatus that we did not used before such as electroscope and other different apparatus. L2: It is really vital because even your teacher is talking to you about electroscope you know how the electroscope works, as some moment the teacher could be talking about electroscope but there is no electroscope to show you. Then but you won't know what or how the electroscope look like, how it works. So if it's there, from there you know how it works, look like, and will be easier for you to cope with it in detail. L2: When we are doing our practical activities, because sometimes you could be taught on the chalkboard, but you do not know the thing you are being taught and its usage. But in the practical activities you are given instruments to find out about something. In addition to the chalkboard issues, if you are not doing practical activities

practical activities?) T: Ngee nee tashiya nande opomakonaakonn opo ile peetest opo, ota shi kukwafele ngahelipi ile kashina ekwafo lasha?(When it comes To examination or tests, how will it help you or does it not help?)	osha folomwa nana ngahelipi, ohashi longifwa ngahelipi. L2: ota shi tu kwafele opo nande owa pulwa oshiima ndee owa fa weshi dimbwa oto dulu oku dimbuluka ku tya oelectroscope ohai discharging noearthing. Okuninga nee oearthign opo nee hoka dimbuluka ku tya ohai ningwa ngah opo udischarging no earthing.		you only memorise the things, but you do not understand how it works and how to use it, L2: it really helps you, for instance you are asked about something but you might forget about it, you will definitely recall for instance that electroscope is discharged by Earthing. Then if you did Earthing you will remember what you did to discharge with Earthing at least.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?)	L2: Otwe li longa mo kombinga yocharges, neenghono odo dili pokati keecharge odo delifa oha di ufanwa repulsive force, pwaadi ina dilifa oha pakala oattractive forces. Ngeenge eecharge inadi lifa ohadi likwata kumwe, ngee eecharge ode lifa ohadi liundula. Ohatu longwa vali kutya ngeenge oshiima owe shi rubbing ngaho oto charging. Ota shidulika pa kale oshima inashi charging ndee to charging, eshi toshi tula popepi nasho ngaha otashi dulu oku kwatwa shaashi shinya inashi charging oinina eecharge difike pamwe shili neutral, doo dinya in a difa edi dili kopena ohadi ya kombada doo dinya dafa edi dili kopena tadi i kooshi.	L2: We learn about charges and a trongness is between charge and the one that are similar are called repulsive force the one that are not similar are called attractive force. If charges are the same they don't attract. we learn that if you rub something you charge than u charge it this if you bring it close to other it will attract it because the other one is not charge and charge that are the same still neutral , the other one are not the same as the pen they came above.	L2: We have learned a lot about charges. The forces that exist between the like charges which are called repulsive force and those that exist between like charges are called attractive force. When the charges are the same they build up a repulsive force and repel each other. While if the charges are differ from each other, they build an attractive force and attract each other. We also learned that when you are rubbing things together, you are building charges within it and it get charged up. If you bring a charged object closer to a neutral object, a charged object attract a neutral object because a neutral object has equal number of positive and negative charges, so the unlike charges are pushed/ align themselves to the surface while like charges are pushed down to the bottom of the object.
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of	L2: Ngaashi eitavelo linya kutya ion lotauka pondje ngeenge odula taishela. Hasheshi ngeno ngee tolotoka to ningi eecharge dihapu ndee mboli osheshi kushi ku tya okashelu otaka ende peni. Pamwe apa to ende nako opo taka ende		

your everyday knowledge and experience about lightning when teaching static electricity helped you to understand scientific concepts or not? Explain	onghee oto kwatwa. L2: otashidulika ngaho pamwe haka a mene shaashi oshiti oconductor L2: okanon-conductor, okainsulator. Kaimba ngee pamwe onduda oya kwatwa ota ka transport ngoo eecharges diye medu pamwe ngoo!!!		
L6: Owa tyapula ile inotyapula okuu ninga opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?) T: ndee ngeno okwali tolongo oove auke? (What if you were working alone?)	L2: Ondei enjoy shashi otwa shiiva mo shihapu eshi kwali tu heshi nale, ngaashi eebilief dimwe ka kwali nana oinima imwe tuishi nale. Eshi nee oinima imwe twe keininga eshi ha tu longo meegroup, otw ka mona ngaho kutya oinima imwe hayo nana, kaishi yoscintific lelalela. Ndee ei yoscientific otassi dulika keumbo hodulu oku shininga ndee mboli oshili moscientificsho oshounongononi. L2: Ngeno okwali oove auke ngeno otashi ke ku pula oudjuu shaashi otashi dulika nee efimbo limwe ot dulu oku dilaadila oshiima mboli osha puka. Ndee nge omuli mogroup umwe ota mu dulu ngoo oku tala omadilaadilo kumwe opo mu shi konge.	L2: it learn me because in science we be learned that if you are even maybe you are in under the tree will been strike and change that on the ground like the one from the lightning they are going under if the tree it will may be strike it also maybe you will be strike because you are nearby that tree. L2: Because the tree it was neutral but exactly the charge that are down they are not the same with the one that come from the cloud that is for the lightning it goes down and up under than the tree will be strike and you will be also be strike because you are nearby that tree that have some roots.	L2: I enjoyed it because we gained a lot about what we did not now before, especially, we did not know some of the beliefs. As we have been working in groups, we have realised that some of the things are not scientific and there are some of the scientific things we usually do at home. L2: If you were working alone it could cause tremendous problem because it is possible as you are thinking, you could be absolutely wrong. But if you are working in the groups you share the ideas to get what is right.
7. Ou hole ile ku hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?)	L2: ondeu tyapula shaashi omukalo ou kwali ha tu longwa nao ouwa shaashi oha tu ningi nomeegroup, ha tu tula omadilaadilo kumwe, shoo okwali noho eshi ha tu longwa ope na eematerial edi ha tu longifa. Kutya oshiima ngaashi outrip venya kwali ta va tanauka, oha va tanauka naana koshike. Nokulongwa ngaha nee kutya oka strip okaima naana keli ngahelipi, omufolomo wako eshi uli. otashi dulika kwali ndi he ushi nokuli.	L2: I have enjoyed because the way that we were teach it also good because we are doing in groups, and we put ideas . it was also when we were be teach there were material that we used like strip that were turn around, they been turn around for what and what brings the strips to turn around is what. And to be teach that the strip is like what and how the shape look like, it may be I was do not know it. L2: I was like the way we been learned because you can get a chance to think	L2: I have enjoyed it because the teaching method that was being used is real good. We were working in groups, sharing ideas and there were teaching materials that we were using such as using strips that were rotating, what causes them to rotate. Even the shape of such strip I did not know it before. l2: I really appreciate the teaching method that we used, because we were given enough time to think/predict and write down about something so that you will be able to

	L2: Okwali ndi hole omukalo oo twa longwa nao shaashi oho dulu oku mona omhito yo ku dilaadila nawa ndee shama oshiima shoye we shi dilaadila nee toshi shange manga u tale ngee mgela owa longifa eeinstrument ohas hi dulu ngaho oku holoka ngaashi wa tonga kwali? Ove to longifa nee eeinstrument u mone kutya, ohoo, hamba oha shi ningi ngah ngee weshi ti ngaha! Opo nee to di wa koneka kutya mboli ngeenge oshiima shonumba oweshi ti ngaha ota shi dulu oku yta ngaha.	nice and if your thing you have think it nice and you write it if you use the instrument it can be like you were say? And if you use the instrument to see that ahaaa! It do like this when you do it like this and is from that you will know that if an else thing you do it can do like this.	compare with the results when you use the instruments to see if it is the same as your prediction. Then you set up an experiment to find out about something so that you understand as to what will happen if you do that or you use it in the other way round.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricuty? (What else do think if was suppose to be done in order to help you understand static electricitty topic well?) T: Ndee ngeenge okwa longo nee aeke paumwene, ngee keuditelo?(If one works alone, what would happen if she/he does not understand?)	L2: Natango ngeno okwali eematerial dawana ngeno keshe umwe okuna eematerial daye aye nado keumbo shaashi keumbo nako okuna oinima imwe iliko eishi iliko maala keshi nee kutya ei oscientific ile onon-scienmtific. Ta ka faafanifa nee ku tya, ndee mboli oshiima eshi hai shi ti ngaha ota shiningi ngaha. Okwali pena oku kala ngeno pena okukala omukalo ou kutya ngeno keshe umwe ta shange shaye manga oye aeke, ndee ta mu uya nee mutule kumwe opo mu controle kutya ou okwa eta po eshi ou okwa eta po eshi. Ta mu shitula nee kumwe opo mu tale ngee ta mu shi faafanifa nee kumwe naashi shounongononi naashi shihefi shounongononi. Okwali yo pa pumbwa eematerial dawana lela, ngeno keshe omunhu a kale ta longifa yaye oye aeke nyee ta mu tula kumwe omanyamukulo eni aa ta mu mono. L2: oto dulu ngoovokuya pu mukweni ou wa	L2: If there were the way that everyone have to be alone to write alone, than you came control that this one he bring this or this one he bring this for scientific and non-scientific we will all so need enough material so that everyone to have is own material and you put your answer together L2: you can go to your partner who is near to you so that she can help you.	L2: There was suppose to be the kind of method, whereby everybody have to write his or her own thing first individually. Thereafter you will form up a group to see what each one have brought up as an individual. Then you could be trying to match it if it's scientific and not scientific. There was suppose to be enough materials so that every individual learner may use his/her instrument alone, then, you bring your final results together that you have found. L2: If you don't understand you can ask help from the learners who is sitting next to you.

	shaama naye opo e ku kwafele.		

Appendix 7C: Focus group interview: learners 3

Question	response	learners' translation	my translation
1. Owu udite kutya omuhongi nakwatele mo ile i na kwatele mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why? Mhhh!.... nashike vali? (What else?)	L3: Nashi shiivike shaashi ionima imwe ohai kala ishiivike okudja keumbo. L3: Otai tu kwafa ngaho opo naashi kwali u heshii u shishiive.	L3: will be known because some things will know already from home. L3: Will help us to know what we cannot know.	L3: Should be known because some things are prior-knowledge from home L3: It will help us as we will be up-dated with what we were not aware or know about.
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everday knowledge and experiences about lightning?) Nashike vali? (What else?) Haka etifwa koshike ngaashi? (It is caused by factors like....?)	L3: Onduudite nawa shaashi ka kwali ndishii kutya oinima imwe otai dulu oku ku kwaatifa kokashelu L3: Ondi udite yoo ngoo vali ku tya mostatic electricity otwa lombwelwa ku tya okashelu efimbo limwe oha ka e tifwa koshike. L3: Ngaashi ngoo u li meumbo u li mo noinamwenyo oto dulu oku kwatwa kokashelu.	L3: I feel good because I were not know something that can make you striked by lightning. L3: I feel also that static electricity we were told that what causes of lightning sometimes. L3: Like you in home with animal it can cause you to be striked by lightning.	L3: I'm also feeling that in static electricity, we are told what the causes of lightning in some occasion are. L3: I am also feeling that in static electricity we are told about the causes of lightning. L3: For instance when you are in the house with animals, at the same place with them, its definitely high for you to be struck

			by lightning.
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?) T: meloongo nee lefiku keshe, meetopic dikwao opractical activities inai pumbiwa? (In everyday teaching, is practical activity neededd or not?) T: shaashi? (why?)	L3: Oshafiman ngoo peemito dimwe shaashi ngaashi twe li honga mostatic electricity, oshafimana ngaho eshi ha tu kaya kwinya otwa uda nale kutya okashelu oha ka etwa koshike. L3: Oya pumbiwa L3: shaashi otai tu longo vali oinima ikwao ihapu ya wedwa po, shaashi oinima imwe ina tui longwa moilongwa ikwao, opo ngaho tu wede ko oinima imwe tu kale tu ishi.	L3: Its important so that sometimes because that we learn in static electricity its important because when you go there you already know already what causes of lightning. L3: It is needed L3: Because it learn us and also more things added, because some things that we are not learned other subject to	L3: It's so important at some occasion for instance what we have learnt on static electricity, so it's vital that by the time we go there, we already heard about the causes of the lightning. L3: It is needed L3: Because it will up-date us with something we have never taught in other subject, then we will add to what we know.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?)	L3: Otwe li longa mo ngoo oinima oyo yatyatywa, needischarge. Otwe li longa mo kutyaa oelectroscope ohai uli ke ocharge ile odischarge.	L3: We learned things that are charged and discharge. We learn that electroscope showed something it if has charge or not.	L3: We learn about charged objects and discharges. We learned that electroscope detects charges and discharges.
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knowledge and experience about lightning when teaching static electricity helped you to understand scientific concepts or not? Explain	L3: osha kwafa nge ngoo shaashi vati ngeenge owa tula okamuti Kenya komulavi kombada yonduda... L3: Opo onduda iha kwatwe		L3: it helped me because I learned from others that if you put a small branch from omulavi tree on top of the hut it is possible that... ahooo.. L3: So that the hut will not be struck by lightning.
L6: Owa tyapula ile inotyapula okuu ninga	L3: Ondeityapula shaashi eshi twali meegroup otwa	L3: I have enjoyed because when you stay in	L3: I have enjoyed it, as we were in groups we put

opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?)	kala a tu tula omadilaadilo kumwe, fyee ha tu hoola po nee eshi shili mondjila kutya eshi oscientific. Oscientific oyeyi ishiivike kovanhu a veshe. Eshi tu li meegroup oha tu lilombwele ku tya oscientific ile ononscientific. Non-scientific ihai kwatwa ko nana ngashi takutiwa oikutu itilyana ihai djalwa modula oto kwatwa kokashelu.	group we where put idea together we choose the one which is correct even is for scientific. The scientific know be all people we tell each other that is scientific or non-scientific. Some time non-scientific we don't know it; like they say red clothes they cause you to be strike by lightning. we will know that non-scientific it may brings maybe parent when thy stay long maybe to know that they be strike by the lightning when they wear a red cloth.	our ideas together, then we selected the ideas which was scientific. The scientific knowledge is known universally. As we were in groups we stated whether that is scientific or no-scientific. The non-scientific things sometimes, we do not really get it. For example, when you put on reddish clothes, it is a fact that the clothes is not a conductor, but they say it will make you to be struck by the lightning.
7. Ou hole ile ku hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?) yandja nee oshiholelwa shaashimwe kwali u heshishi ndee paife oushishi. (Can you give na example of something you have learned that you did not know before).	L3: Ondiuhole shaashi ngaashi mostatic electricity otwe li honga mo nana oinima ihapu ngaashi insulator no conductor, kutya oinima ei yeeinsulator luhapu i hai dulu naana oku kwatwa kokashelu. Ngaashi naana taku tiwa kutya vati ngeenge wa tungu etungo loye ndee to li tula naana okaima, omaretial ngoo imwe hai longifw hai dulu oku taataa okashelu, oinsulator ihai kwatwa naana kokashelu vati ngeenge ndee etungo ta li kwatwa hanaana vati etungo hali hanaunwa po vati alishe.	L3: I like it because like in static electricity we have learn more things like insulator and conductor, like the things of insulator they may be strike by the lightning, of the conductor they can conduct with the lightning. like it been sayed that if you build your building your building your building than you put a thing the material that has been used to prevent lightning, the insulator can be strike by the lightning if the building been strike by the lightning will not be very destroyed. L3: I was exactly like the day we been learned that in the electroscope those thing that f or charge is the thing that can cost the thing to be charged. if you take a ruler and you rub it with a cloth you are charge when you put it at a electroscope the leave open and you put it to the metal plate the leave of the electroscope it will close.	L3: I like it because like in static electricity, we learn a lot such as, insulators and conductors, which in most cases insulators are not most likely struck by lightning, while the conductors mostly conduct electricity. Apparently, if you construct your building and you fit it with a certain material which repel the lightning, an insulator it will not be struck by the lighting. if the building happens to be struck by lightning, it is unlikely for the building to be destroyed by the lightning. L3: I mostly liked those things that we were being taught about electroscope. Those things of charges like charging an object , to charge you take a ruler and rub it with a ruler, charging it when you bring it closer to the metal cap of an electroscope, the leafs will open then you will be able to tell that the object got charged. to discharge, when you put it on the electroscope the leaf closes.

8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricuty? (What else do think if was suppose to be done in order to help you understand static electricitty topic well?)	L3: Natango ngeno okwali eematerial dawana ngeno keshe umwe okuna eematerial daye aye nado keumbo shaashi keumbo nako okuna oinima imwe iliko eishi iliko maala keshi nee kutya ei oscientific ile onon-scienmtific. Ta ka faafanifa nee ku tya, ndee mboli oshiima eshi hai shi ti ngaha ota shiningi ngaha.	L3: Again if the material where enough maybe every one he or she have own material because at home there is something but you do know that this are scientific. and classify that this thing also like which do like this	L3: Again If there were enough materials, then everyone I could be given materials to go with them home, because at home there are some materials that he/she knows but he/she does not know whether they are scientific or non-scientific. He/she can go and compare.

Appendix 7C: Focus group interview: Learner 4

Question	response (oshiwambo)	learners' translation	my translation
1. Owu udite kutya omuhongi nakwatele mo ile i na kwatela mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day knowledge and experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why?	L4: Ota shi ku longo nande oshiima ka kwali u shishi oto shi shiiva.	L4: Will be teach you because if things that e cannot know to be know it.	L4: it will teach us a lot, regarding to what we did not know before.
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static elctricity based on your prior everday knowledge and experiences about lightning?) Ndee mboli?(But then?)	L4: Omunhu oho kala ngoo na nde wa hala oku shiiva ku tya kashelu kutya oka dja peni ndee... L4: Ndee omaitavelo nee amwe omunhu ote ku ombwele ku tya ngee owa	L4: A person you want to know what cause of lightning but.... L4: But some beliefs person told you say that if you wear red clothes	L4: Sometimes you got a strong desire to know where the lightning comes from but...... L4: You know some beliefs say for instance when you put on a

Opo shike vati? (Why should you pinch it?)	djala oshikutu shitilyana modula shitilyana modula shi nyota. L4: Vati opo ito shelulwa po	when rain is raining must be......mhhhh... L4: For you to be not striken.	reddish clothes, you are told to pinch it. L4: apparently for you not to be struck by lightning.
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?) T: meloongo nee lefiku keshe, meetopic dikwao opractical activities inai pumbiwa? (In everyday teaching, is practical activity neededd or not?) T: shaashi? (why?)	L3: Oshafiman ngoo peemito dimwe shaashi ngaashi twe li honga mostatic electricity, oshafimana ngaho eshi ha tu kaya kwinya otwa uda nale kutya okashelu oha ka etwa koshike. L3: Oya pumbiwa L3: Shaashi otai tu longo vali oinima ikwao ihapu ya wedwa po, shaashi oinima imwe ina tui longwa moilongwa ikwao, opo ngaho tu wede ko oinima imwe tu kale tu ishi.	L3: Its important so that sometimes because that we learn in static electricity its important because when you go there you already know already what causes of lightning. L3: It is needed L3: Because it learn us and also more things added, because something that we are not learned other subject to	L3: It's so important at some occasion for instance what we have learnt on static electricity, so it's vital that by the time we go there, we already heard about the causes of the lightning. L3: It is needed L3: Because it enriches our knowledge since there are things that we have never been taught in other subjects, then we will add to what we know already.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?)	L4: Onde li longa mo unlike charge and like charge, oinima oyo yo discharge and charge.	L4: I learned things that like charges and unlike charges things like discharge.	L4: I have learned about unlike charges and like charges, discharge and charges.
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a kwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knowledge and experience about lightning when teaching static electricity helped you to understand scientific concepts or not? Explain	L4: Oha yiamenwa kokaima kokaconductor haka tulwa kohulo yetungo ile yoipeleki ka finda medu, opo nande ngeno etungo ola kwatwa kokashelu okaima oko oha kaendelele oku pona eecharge okuya medu dihadestroying etungo.		L4: It is protected by a conductor which is fitted on top of the building down to the ground, so that when the building is struck by the building, the lightning conductor carries the charges to the ground without destroying the building.
Q6: Owa tyapula ile inotyapula okuu ninga		L4: I have enjoyed because if you where	L4: I have enjoyed it because when you write

opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?)		writing than you write a wrong answer and your partner he/she will be tell you that you are wrong put the correct one	or spell something wrongly, others can provide the correct answer.
7. Ou hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?)	L4: Amee onde lilonga mo ngaashi nee electroscope L4: Ngaashi ngoo totula ko okamunwe koo okaima ta keli tonyo kushi naana ku tya ookaima oko oha ka etwa naana koshike. L4: Okwali ndi hole mo ngashi ngoo static electricity oinima ihapu kandali ndi ishi. L4: Paife oinima ihapu ondei shiiva ngaho nee eshi twa hongwa moscientific. L4; ngasshi ngo kutya okashelu oha ka etwa koshike. Nale okwali ha tu lombwelwa kutya okashelu oha ke yapo ngeenge oilemo yeli denga mumwe. L4: oha keya po vati ngenge okashelu okena nande mhhh....positive ile negative shoo oshilemo shimwe oshina negative, kwinya ota kuka dja okashelu shaashi ooooo....eeunlike charge ohadi attracting.	L4: I have been learn like electroscope L4: Like you put you finger and the thing close you not know what cause by what. L4: I was like, like static electricity lot of thing I was don't know them. L4: Know many things I know them that we been the teached in scientific L4: Like what cause the lightning long we been told that it cause when the cloud crash other cloud and but..... L4: It cause when the lightning have even mhhhhh.. positive or negative and one cloud have a negative and one cause a lightning because ooooooo.... the unlike charge they attract.	L4: I have learn about electroscope L4: like when you put your finger on the on the electroscope and the leaf closes, you do not know what causes it to close. L4: There were a lot of things that I did not know about static electricity. L4: I now acquired a lot from this science lessons. L4: Like what causes lightning in the past, we were told that lightning occurs when clouds collides with one another. L4: Lightning occurs when the lightning even has mhhhhh positive or negative and one cloud has negative charges, there lightning will occur because oooooo..unlike charges attract each other.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricuty? (What else do think if was suppose to be done in order to help you understand static electricitty topic well?)	L4: Okwali ndi shiive, nande keshe umwe a pewe oshilongifo shasha, opo ngoo uye nasho keumbo,ku tya kwa li ta mu nyengwa mogroup opo u ka pukululwe komukulunhu keumbo.	L4: I was want to know everyone to be given his own instrument so that you can with it at home. If you were wrong in group and be correct to the parent at home.	L4: I also wanted at least everyone to be given a material to in order to take it home so that you get assistance from the parents.

Appendix 7C: Focus group interview: learner 5

Question	Response (Oshiwambo)	Learner's translation	my translation
1. Owu udite kutya omuhongi nakwatele mo ile i na kwatele mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why?	L5: Oto shi shiiva shaashi ota shidulika oinima ei kwali holongwa moscience oyo holongwa moilongwa ikwao kovalongi	L5: Will be know that may be things that will be learn from science is the one which you learn from teacher from other subjects.	L5: You will become familiar to it because it could be that, what you used to be taught in science is also what other teacher teach you about.
Ngaho oshina nee ouwa washike? ngee oinima nee pamwe ei ho longwa mofisca oyo naho holongwa moilingwa ikwao, oshina ouwa washike? (What is the advantage of that? Provided the item that you are tauhgt in physical science is similar to what you are taught in other subjects, what kind of benefit is there?)	L5: Oshina ouwa shaashi ota shi ku pitifa anwa.		L5: It's so effective, as it will make you definitely pass your exam.
Tashi ende ngahelipi opo shi ku pitife nawa? (How will it help you to pass?)	L5: Shaashi otwiilongo mo shihapu	L5: Because you will be learn more things about science	L5: Because you will know a lot about science.
2. Owu udite ngahelipi eshi twa tameka eendundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everyday knowledge and experiences about lightning?)	L5: Oshiwa shaashi ovakulunhu navo oveshii ngoo oinima yomufyuululwakalo ngaashi taku tiwa ounona vouhamba ngee kuna okashelu nava huwe omakala komayoo opo vaha shelulwe po kokashelu. Otashi dulika nee naave ngeenge wakulu pamwe oto dala ounona vouhamba, ove kushiishi nee ove ngeenge ino va xwa	L5: It's good because parent it is know also for traditional like they say twins if there is a lightning will be smear coal in their teeth for them to be not striked by lightning. It would be you also you will be hear it, you learn about that when you see you twins you should be smear it.	L5: It's really good because, the older people know a lot about cultural things. For example, they say that the twins should be smeared with charcoal on their teeth, so that they will not be struck by the lightning. So it may be you were not aware about that, then you will learn so that if you happen to get twins you will smear them.

	komayoo ota va shelulwa po kokashelu, kaimba ka kwa li nee we shiuda, oto li hongo mo nee ngeenge wa mono ounona voye vouhamba ove tova xu nee		
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?)	L5: Oshiwa shaashi oinima imwe ka tu ishi, shaashi ovahongi oha vetu longo kutya electroscope oshiima hashi charging ndee ove ku shiishii nee. Paife eshi twe ya moscience oelectroscope otu ishi nashi hai longifwa.	L5: It is good because some of the things we don't know them. Like electroscope, and teacher they use to learn us how electroscope change and we don't it. When we came in science we know electroscope it used and what it do.	L5: It's good because some of the things we do not know it, for instance, electroscope The teacher used to tell us that, electroscope is something that charges up, but we did not know it Now when we learnt in science, we .are familiar with it and know how to use it.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activites on static electricity lessons?)	L5: Onde lilonga mo kutya unlike charges oyeyi inai lifa, ngeenge owe yi eehenifa pamwe otai likwata. Ame onde li longa mo ku tya negative ohai u fanwa electon noproton ohai u fanwa positive charge.		
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knowledge and experience about lightning when teaching static electricity helped you to understand scientific concepts or not? Explain	L5: Osha kwafela nge shaashi ngaashi oshiima shinya shoku tya okamuti komulavi ohaka tulwa kombada yonduda ka kwali ndishishi, paife ondishishi ohai ka lombwelela ovakulunhu shaashi ondeli honga moscience.	L5: It help me because I was no know that in culture a room is protected when put a small stick fro omulavi tree. Now I know it and I will tell my parents.	L5: It was helpful because I never knew that that culturally the hut can be protected by putting the small branch from omulavi tree on top of it. Now I know and I am going to tell the parents what I have learned in science.
L6: Owa tyapula ile inotyapula okuu ninga opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?)	L5: Ondei enjoy shashi ota shidulika kwali ndi heshi na nde oshitya shimwe moshingilisha ndee handi ilongele ngaho ku vakwetu shaashi navo okwali ngaho veshiisha.	L5: I have enjoyed because if maybe I was not know any word in English than I will learn from other learner because they know they will know	L5: I enjoyed since there were things that I did not know that I have learned from my fellow learners.
7. Ou hole ile ku hole	L5: Ondiu hole mo shashi	L5: I have learned more	L5: I have learned a lot as

omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?)	potete omunhu oho longifa tete omadiladilo oye opo mu ka pewe eeinstrument opo u mone kutya oshiima ohashi longifwa nahelipi. L5: Oha tu longele ngaho kumwe navakwetu ha tu tula omadiladilo kumwe, ha tu likwafele ngoo.	because it may be I was don't know anything like sparks I was not know it in English than you learn that spark are charges in English. L5: I like because first you use your idea so that you be given the instrument to see that the thing are use for what. L5: Wee work together with our partner and we put idea together and we help one another.	there were things that I never knew before for example I did not know what sparks means in Oshiwambo L5: We worked together and helped one another.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricuty? (What else do think if was suppose to be done in order to help you understand static electricitty topic well?)	L5: Okwa li twa wana oku li longa mo shashi ohandi udu ku tya vati ngee to danene omeva oto kwatwa kokashelu. Okwali nee ndahala oku uda ku tya moo momeva omuna nee opositive ile onegative?	We were enough to learn because I heard that if you play in water you will strike by the lightning. I was want to heard that in water there is positive or negative?	L5: We were supposed to have learned, because I was told that if you play in water you can be struck by lightning. I wanted to know the types of the charges in the tree whether they are positive or negative.

Appendix 7C: Focus group interview: learner 6

Question	responses (Oshiwambo)	Learners' translation	my translation
1. Owu u dite kutya omuhongi nakwatele mo ile i na kwatele mo eshiivo loye eli u shii okudja keumbo ngee ta longo ounongononi? Eshiivo loye linya u shii okudja keumbo nali kwatele mo moku longa ile i nali kwa telwa mo nomolwashike? (Do you feel that the teacher shall include or exclude your prior every day experiences, when teaching scientific Subjects? Should the knowledge that you acquired from be included when teaching science or not and why?	L6: Onawa omuhongi ngee eshi shhiva naave ka kwali u shishii yee nomulongi ka kwali eshishii, omadilaadilo otaafaafana nee ushi shiive nee nomongula.	L6: It is good teacher it is know because you were not know and a teacher also were not know, you thinking will be differentiate you to know it tomorrow.	L6: It's better for the teacher to know it as both of you are not familiar to it. Then you will learn from each other, for future reference.
2. Owu udite ngahelipi eshi twa tameka eetundi dostatic electricity ha tu pekaapeka omaitavelo neeshiivo kombinga	L6: Onawa shaashi opo u shishive u mone ku tya okashelu oka dja peni, nokashelu oshike nana. Otashi dulika u kale una	L6: It is good because for you to be know that lightning will come from were and what is lightning. If you have a	L6: It's good to know, where the lightning came from and really what is the lightning. I could be like you are holding the

yokashelu?(How do you feel when we started our lessons on static electricity based on your prior everyday knowledge and experiences about lightning?)	eeni dookena ile deenyandi todanauka mboli ove ka kwali ushishii koo okashelu ta ke ku shelula po, ove kwa li nee weshuuda nale. Onawa ngaho nee naau kwa li e heshishi eshishiive ove to weda ko ngoo nee.	seeds it will cause you to be struck by lightning and you were not know it. It is good if there is someone who were not know it for you to add for his/her.	seeds of 'kena' and jackal berries then you could be struck by the lightning. Because you was not aware about that before, so it is good even for these when were not aware about this before to know and add to what they know again.
3. Owu udite kutya opractical activity oya fimana ile inai fimana nomolwa shike?(Do you think that it is important to do practical activities? Is practical activity important or not and why?)	L6: Kwaame osha fimana shaashi oshiwa oku longwa ndee hai kalonga vakwetu kwali ve heshishi ndee tave shishiiva no kutya oshiima shonumba ohashi ningwa ngaha ile iha shiningwa ngaha noinima ngaho ihapu.	L6: To me is important to be touched and go learn others those who don't know and learned what something it used and what it does and more many things.	L6: To my side I feel strong that it's vital to be taught and later to pass my knowledge to others. Those that they do not know and make it clear to them also, Regarding how difficult things are being done in nowadays.
4. Oitya nee ilipi yopauningononi we lilonga eshi kwali to ningi practical activities meetundi do static electricity? (What scientific concepts did you acquire during practical activities on static electricity lessons?) T: electroscope ohai charging ngahelipi? (How can you charge an electroscope?)	L6: Onde li longa oelectroscope kutya oelectroscope oili po ngahelipi, nonghee haicharging. L6: Oto kufa okatendifo nokalapi, torubbing nee ndee okatendifo to ka eta kombada ngaha efo linya olina oku kala la yeuluka.	L6: I learned about electroscope how it look like.	L6: I have learned how electroscope look like, how it can be charged. L6: You should take a ruler and a piece of cloth, rub and bring the charged ruler closer to the top of an electroscope, the leaf will open.
5. Owu udite kutya eshi omaitavelo eni opamufyuululwakalo neeshiivo kombinga yokashelu a akwatetelwa mokulonga ostatic electricity topic oye ku kwafela ile inai ku kwa fela? Hokolola(Do you think that the inclusion of your everyday knoewldge and experience about ligthning when teaching static electricity helped you yo understand scientific concepts or not? Explain T: olo eitavelonee. Ngeenge nee oto kwatakanifa ole ku	L6: Ame ondiilonga mo shihapu oku shiiva nana kutya ngenge vati ouli nande onombwa momuti oto dulu oku kwatwa kokashelu shaashi kakehole oinamwenyo L6: oya kwafela nge oshiima kwali ndi heshishi yee umwe te shi lombwelenge nee.	L6: Me I have learn more exactly that if you under the tree with a dog you will strike by the lightning because does not like animals.	L6: I have learned a lot such as that if you stay under a tree together with a dog you can be struck by lightning, because lightning does not like animals. L6: It helped me to know what I did not know before.

kwafela ngahelipi opo wu ude ko e scientific concdepts mostatic electricity? (That one is a cultural bellief, how did it help you to understand the scientific concepts in static electricity?)			
6: Owa tyapula ile inotyapula okuu ninga opractical activities mostatic electricity moungudu? (Did you enjoy or not doing practical activities in groups?)	L6: Ondei enjoy shaashi ngeno okwali ndili aame andike ngeno itai dulu oku tya lange olili mondjila ile kalili mondjila. Eshi tuli mogroup oha tu fafanifa oinformation ove toli hongeleko ngoo ne mongula kutya eshi oshili ngaha eshi oshili ngaha.	L6: I have enjoy because if was alone I will not say my answer is correct or is wrong. When we are in group we one another information than you will learn from other that this that this is like this and like this.	L6: I have enjoyed, because if I was working alone, I could claim whether my work/answers are correct or wrong. When we were in groups, we were comparing our information and learned from one another for now and the future
7. Ou hole ile ku hole ile ku hole omukalo oo eetundi do static electricity da longwa? Omukalo ngoo oo wa kala to longwa moivike aishe oyo ili ivali, owu u hole ile ku u hole, nomolwashike? (Did you like or did you not like the way the lessons on static electricity were taught? the method that has been used during the two previous weeks, did you like it or not and why?)	**L6:**:Kwaame okwali shiwa shashi ondi ilonga mo charge, kutya types of charges ngaho negative no positive.	L6: To me it was good because I have learned charge. I have learned that the type of charge are negative and positive charges.	L6: On my side, it was quite good because i learned about charges, the types of charges which are negative and positive charges.
8. Oshike vali wu udite kwali sha pumbwa okuningwa opo wu ude ko nawa ostatic electricuty? (What else do think if was suppose to be done in order to help you understand static electricitty topic well?)	L6: Ame okwali nda hala ngoo oku longwa mo to pewa ngoo nande oshilongifo ove toi ngoo nasho na nde ngoo owe ke shi hanga opo, eshi to shi pewa oto shi konaakona tete, to dilaadila manga tete, eshi omadilaadilo oye to ka pula nande omukulunhu woye te ku lombwele kutya ongaha ongaha. Ove naave pamwe owa hangika nee nasha shafaafana naashinya kwali wa tonga tete. Ove to shi koneke nee nande omongula weshi hanga opo oto ti ohoo, hamba	L6: To me I was want to teached with a material and go with it or is there, first if you will classify it, first and thinking if you think your idea and parents tell you is this and this and you maybe you were thinking like the thing you were talked already and you memorise and if you see it tomorrow and find you will say ohoo, its this! L6: Yes to correct something that you was do not understand	L6: I was keen to be taught whereby you are given an instrument to take then at least you go with at home to study it thoroughly, so that even if you come across it in future you can remember it. L6: yes to be helped by the parents.

	osheshi. L6: Ehee, oku pukululwa ngoo ngaho, oinima ngaho ei u heu dite.		

Appendix 7D: Interview schedule with parents

1. Okashelu oshike?(Could you explain what lightning is?

....

....

2. Oha ka holoka efimbo lili pi? (When does it occur?)

....

....

3. Ohakeya po ngaheli pi/ohakaholoka po ngahelipi? (How does it formed?)

....

....

4. Omunhu ota dulu oku etifa okashelu ka kwate eumbo ile omunhu mkwao? (Do you believe that a person can cause lightning to strike a house or another person?)

....

....

....

5. Okashelu okanyika oshiponga? (Is lightning dangerous?)

....

....

....

6. Oshike omunhu ena oku ninga ngee kuna eembadi? (What should be done during thurnderstorm?)

....

....

7. Oshike omunhu ehena okuninga ngee kuna eembadi? (What should be done during thunderstorm?)

....

....

9. Oholi amene ngahelipi kokashelu? (How can you protect yourself from lightning?)

....

....

10. Osha enda ngaheli pi opo wu ude ko omadilaadilo aa? (How did you come to understand these views?)

....

11. Omadilaadilo aa ooshili ngaho? (Do you thing that these views are real?)

....

....

....

12. Omaadiladilo aa naa longwe mofikola ile inaalongwa? omolwa shike? (Do you think these beliefs should be taught at school? Explain)

....

....

Appendix 8: A section from the syllabus

4.5 Magnetism		• investigate to identify metals that are attracted by magnets and those that are not • use iron filings to show magnetic lines of force around a magnet (bar and horseshoe) • draw the shape of the indication of magnetic lines of force around a bar magnet and a horseshoe magnet (in one place only) • investigate the alignment of a freely suspended magnet with the Earth's magnetic field • make and use a compass

THEMES AND TOPICS	LEARNING OBJECTIVES Learners will:	BASIC COMPETENCIES Learners should be able to:

Topic 5 Electricity	• know how to construct simple circuits and draw the circuit symbols and
	  • (Grade 8) from **observations**
	  • (Grade 9) **measure current, resistance and potential difference at any place in a circuit**
	  • (Grade 10) measure **and calculate** current, resistance and potential difference at any place in a circuit
	• **explain effects on current and potential difference when bulbs, resistors and cells are connected in series and parallel**	

5.1 Charge	• know the existence of charge	• explain the existence of electrons, protons as introduced in the chemistry section • explain the existence of charge by imbalance of electrons (negative) and protons (positive) (e.g. the separation of charges by rubbing objects against one another)
5.2 Static electricity	• understand charge, know how to charge objects	• investigate and describe how objects can be charged by friction and explain examples in everyday life where charging takes place by friction • explain how objects with unlike charges will attract each other and those with like charges will repel each other

5.3 Electroscope	• know the working of an electroscope	• investigate and explain:
		  • the use of an electroscope to demonstrate charges (the existence of charges)
		  • how an electroscope can be charged
		• investigate and explain how charges on a charged electroscope are able to discharge by flowing to the Earth and outline the process of earthing

5.4 Electric current	• understand current as the movement of charge	• explain the term discharge as the movement of charge and discuss lightning as a form of discharge • discuss the dangers of lightning to people and properties and how to avoid the dangers of lightning

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Appendix 9: A sample of learners' summary

LESSON 2 25-01-2012

An atom (revision)

Structure of an atom

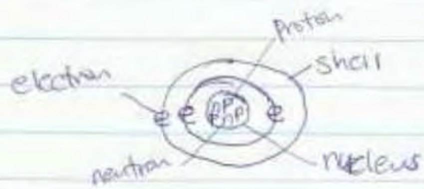
Atom consists of:

* a nucleus of protons and electrons
* Shell or energy level
* electrons located on the shell(s)

Relative charges

* Proton has a positive charge (+)
* electron has a negative charge (−)
* neutron has no charge

Example of a diagram of an atom



Two types of charges

* Negative charge (electrons)
* Positive charge (protons)

Charge

Charge exists due to imbalance of electrons (negative charge) and protons (positive charge)

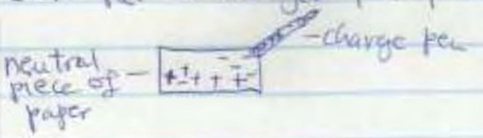
* When object has more protons than electrons, is positively charged
* When object has more electrons than protons, it is negatively charged.
* A neutral object has equal number of protons and electrons

STATIC ELECTRICITY

Static electricity is non-flow of charges

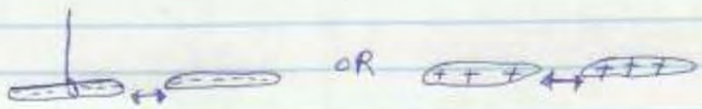
* objects become charged when they are rubbed.
* Rubbing (friction) separate charges.

example: a charged pen picks up a neutral piece of paper



26-01-2012

Forces between like charges



* objects with like charges repel each other
* The force between them is repulsion force

Forces between unlike charges

* Object with unlike charges attracts

Therefore:

- Like charges repel each other
- Unlike charges attract each other.