

**The integration of climate change in the  
Namibian senior secondary Physical Science  
syllabus through environmental education**

**WN IIPINGE**



<https://orcid.org/0000-0003-2603-9950>

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Education* at the North West University

Supervisor: Dr LO de Sousa

Graduation: May 2019

Student number: 21996938

## DECLARATION

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

Signature

A handwritten signature in black ink, appearing to be 'K. P. ...', written over a horizontal line.

2018/11/19

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## **DEDICATION**

I dedicate this dissertation to my mother, Rauha N Henok, my inspiration, who made this journey possible.

## **ABSTRACT**

This study undertook to explore how climate change could best be integrated in the Namibian senior secondary Physical Science syllabus through environmental education. Current research studies and scientific projections reflect that, if unchecked, climate change will continue to adversely impact on the livelihoods of many societies across the globe. Climate change is a global phenomenon that has gripped governments, academics, scientists, politicians, development practitioners and policymakers. Given the incessant droughts in Africa and rising temperatures in Namibia that will severely affect natural resources as well as the functioning of ecosystems and lead to socio-economic devastation, the impacts of climate change cannot be ignored.

Academics have urged the education sectors to develop alternatives in the quest for solutions to the challenges posed by climate change. In light of these challenges and the role that education is called upon to play to develop alternatives in the quest for solutions by equipping learners with relevant skills and expertise that will be useful in today's world, I deemed it necessary to explore how climate change can be integrated into the Grade 11 and 12 Physical Science syllabus in Namibia through environmental education. This involved exploring which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education and in the Namibian senior secondary Physical Science syllabus. I also looked at what climate change issues are addressed by teachers in Grade 11 and 12 in Physical Science and how environmental education can be implemented in the senior secondary Physical Science syllabus to address these issues.

This qualitative multiple case study research methodology was undertaken within the interpretivist research paradigm. The data was collected from document research and through semi-structured one-on-one interviews and a focus group interview. I used purposive sampling and the official Namibian curriculum document and senior secondary Physical Science Syllabus (Grade 11 and 12), as well as official Namibian policies on climate change and environmental education to form the sample. Six Physical Science school teachers from six senior secondary schools in the Kalahari cluster circuit, one Physical Science subject advisor and one National Institute for Educational Development official were participants. Content analysis and thematic analysis were used to inductively analyse the data and derive themes.

The conclusions were derived from the literature review, document research, data gathered from the focus group interview and one-on-one semi-structured interviews conducted with participants. The literature review demonstrates and discusses the various processes of curriculum development undertaken to ensure that a curriculum is consistent with the current challenges of society. As such, this research study promotes the integration of climate change in the Namibian Physical Science syllabus through environmental education. The study puts forward guidelines and recommendations for stakeholders involved with curriculum development and implementation regarding climate change in the Namibian education sector, as well as government policy harmonization with regard to climate change and environmental education in the Physical Science syllabus (Grade 11 and 12).

**Keywords:** climate change, education for sustainable development, environmental education, Namibia climate change education, Namibia curriculum, Physical Science syllabus.

## OPSOMMING

Hierdie studie het onderneem om ondersoek in te stel na hoe klimaatsverandering die beste in die Namibiese senior sekondêre Fisika-sillabus geïntegreer kan word deur middel van omgewingsopvoeding. Huidig navorsingstudies en wetenskaplike projeksies weerspieël dat, indien dit nie gestuit word nie, klimaatsverandering sal voortgaan om 'n nadelige impak op die lewensbestaan van baie gemeenskappe wêreldwyd uit te oefen. Klimaatsverandering is 'n globale fenomeen wat regerings, akademië, wetenskaplikes, politici, ontwikkelingspraktisyne en beleidmakers aangryp. Gegewe die aanhoudende droogtes in Afrika en stygende temperature in Namibië wat natuurlike hulpbronne sowel as die funksionering van ekosisteme erg sal affekteer en tot sosio-ekonomiese verwoesting sal lei, kan die impak van klimaatsverandering nie geïgnoreer word nie.

Akademië dring daarop aan dat die onderwyssektore alternatiewe ontwikkel in die soeke na oplossings tot die uitdagings wat deur klimaatsverandering gestel word. In die lig van hierdie uitdagings en die rol wat onderwys versook word om te speel en alternatiewe te ontwikkel in die soeke na oplossings deur leerders toe te rus met relevante vaardighede en kundigheid wat in die hedendaagse wêreld nuttig sal wees, het ek dit nodig geag om ondersoek in te stel na hoe klimaatsverandering in die Graad 11 en 12 Fisika-sillabus in Namibië deur omgewingsopvoeding geïntegreer kan word. Dit het behels om vas te stel watter doelwitte vervat in die Nasionale Beleid oor Klimaatsverandering in Namibië aangespreek word in die Namibiese Nasionale Kurrikulum vir Basiese Onderwys en in die Namibiese senior sekondêre Fisika-sillabus. Ek het ook gekyk na watter klimaatsveranderingkwesties deur onderwysers in Graad 11 en 12 aangespreek word en hoe omgewingsopvoeding in die senior sekondêre Fisika-sillabus geïmplementeer kan word om hierdie kwessies aan te spreek.

Hierdie kwalitatiewe veelvoudige gevallestudie navorsingsmetodologie is binne die interpretivistiese navorsingsparadigma onderneem. Die data is met dokumentnavorsing en deur semi-gestruktureerde een-tot-een onderhoude en 'n fokusgroep-onderhoud versamel. Ek het doelbewuste monsterneming endie amptelike Namibiese kurrikulumdokument en senior en sekondêre Fisika-sillabus (Graad 11 en 12) sowel as amptelike Namibiese beleide oor klimaatsverandering en omgewingsopvoedinggebruik om die monster te vorm. Ses Fisika-onderwysers vanuit ses senior sekondêre skole in die Kalahari trossirkel, een Fisika-vakadviseur en een beampte van die Nasionale Instituut vir Onderwysontwikkeling

het deelgeneem. Inhoud-analise en tematiese analise is gebruik om data induktief te analiseer en temas te formuleer.

Die slotsomme is afgelei uit die literatuuroorsig, dokumentnavorsing, data versamel uit fokusgroep-onderhoude en een-tot-een semigestruktureerde onderhoude wat met deelnemers gevoer is. Die literatuuroorsig demonstreer en bespreek die verskeie prosesse van kurrikulumontwikkeling wat onderneem is om te verseker dat 'n kurrikulum in voeling bly met die huidige uitdagings van die samelewing. As sodanig hierdie navorsingstudie bevorder die insluiting van klimaatsverandering in die Namibiese Fisika-sillabus deur omgewingsopvoeding. Die studie bied riglyne en aanbevelings aan vir belanghebbendes wat betrokke is by kurrikulumontwikkeling en -implementering rakende klimaatsverandering in die Namibiese onderwyssektor, sowel as die harmonisering van regeringsbeleid met betrekking tot klimaatsverandering en omgewingsopvoeding in die Fisika-sillabus (Graad 11 en 12).

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## **CHAPTER 1: INTRODUCTION AND ORIENTATION TO THE STUDY**

### **1.1 INTRODUCTION AND OVERVIEW OF THE STUDY**

The term “Curriculum” refers to “what teachers are going to teach” and “what learners are going to learn” (Su, 2012:153). A curriculum should be built upon education and around a balanced and holistic range of objectives, interdisciplinary and learner-centred learning with the emphasis on aspects of learning that enhance the transitions to sustainability. There is a need to reorient educational policies, programmes and practices in order to build concepts, skills, motivation and commitment needed for environmental learning and sustainable development (UNESCO, 2002:40, 45). Martin (2007:22-23) states that the UK curriculum is concerned with the knowledge imparted on learners and the outcomes of the learners’ learning process. In England the Education Reform Act was introduced in 1988, and aims to promote excellence in learning in a way that combines cognitive and affective aspects, and prepares the learner for a changing future (Hall & Øzerk, 2008:7).

The Oxford Committee for Famine Relief (Oxfam) (Oxfam, 2017:5) has suggested and developed a new curriculum for the UK that strives for a global citizenship education. It proposes to integrate global citizenship since teachers normally face challenges in their classroom practice regarding complexity, with reference to learners trying to make sense of a world characterised by division, conflict, environmental change, extreme inequality and poverty. The focus of global citizenship is enforcing awareness of the wider world, respect and values of diversity within all levels, both local and global, for a more sustainable world. Furthermore, knowledge, skills and values should promote globalisation and interdependence, self-awareness and reflections, as well as concern for the environment and commitment towards sustainable development. Oxfam (2017:4) believes that global citizenship education is vital, because it will ensure that learners are equipped with knowledge, skills and values pertaining to the changing world and make sense of a world faced by environmental changes. Thus, by creating links to places, people and cultures, opportunities are established to tackle environmental challenges and help create a better world.

UK teachers are reported to be dissatisfied with the national curriculum that seems to be highly prescriptive, inflexible, and disengages learners. It packs knowledge into silos, where one just passes tests rather than encouraging curiosity and interests (Oxfam 2017:1). Furthermore, UK teachers are of the opinion that learners are entitled to an education that

should be about supporting achievement and helping them to develop a range of skills, values and attitudes required for life and to take on challenges facing the uncertain world. In the same context, UK teachers have re-examined their Education Reform Act and highlight how global citizenship can help schools take ownership and control of the curriculum (Oxfam, 2017:1, 4). The added advantage in schools will be a holistic approach and promotion of environmental education and climate change-related issues, by engaging teachers as well as learners in presenting challenges and opportunities presenting themselves in the 21<sup>st</sup> century. This will be especially advantageous in developing countries like Namibia.

The world is changing and in light of the latter, education must also change by undergoing deep transformation and a call for new interventions to foster the competencies that societies and economies need, today and tomorrow. This means moving towards new approaches on environmental education for greater justice, social equity and global solidarity (UNESCO, 2015:3).

The purpose of the Namibian school curriculum is to provide a coherent and concise framework that ensures consistency in delivering of the curriculum in schools throughout the country (NIED, 2008:1). In the Namibian context, a curriculum is a broad policy document which describes the general aims, objectives and rationale of an educational programme. It contains the principles of teaching, learning and assessment, language policy, and curriculum management at school level. On the other hand, a syllabus is derived from the curriculum. A syllabus specifically outlines the learning outcomes of a particular subject. It details the content of the subject and the various topics and themes of that particular subject. Tokatli and Kesli (2009:1491) point out that a syllabus is the plan for a course which details what learners should learn in a particular subject. Teachers' schemes of work and lesson plans can be developed from the syllabus so that the aims and objectives can be put into practice in a consistent manner (NIED, 2008:1).

The Namibian curriculum has been developed to enable basic education to accomplish the objectives of Namibia's Vision 2030. The Namibian curriculum therefore is a futuristic undertaking aimed at meeting future education needs in Namibia. The goal of basic education is to empower learners with development skills that will ensure that Namibia becomes a knowledge-based society. The characteristics of a knowledge-based society are the effective and wise use of existing knowledge and the creation of new knowledge; sharing and using knowledge effectively through a dynamic information infrastructure; using high-level technology and research to create innovations and sustainable development for people and the

environment; flourishing entrepreneurship in a growing production-based economy; and equity (NIED, 2008:1, 7). A knowledge-based society takes its place in a context of globalisation where it is important to not only have knowledge and skills, but also a strong identity and values as an individual, a culture and a nation. The concept of knowledge thus embraces indigenous knowledge and local and national culture, as well as international and global culture (NIED, 2008:7). It is important for learners and the general public to have knowledge of environmental issues and risks since the biophysical environment suffers as a result of human actions (Reddy, 2008:168; Loubser, 2014:xiii).

Modern scientists are convinced that the climate is changing and will continue to do so. It is imperative for governments in Sub-Saharan Africa to come up with mitigating measures aimed at reducing the impact of climate change on vulnerable societies (Anyanwu *et al.*, 2015:1). These authors postulate that imparting knowledge about climate change in formal education is one of the effective ways of combating climate change. It is important that the national government develop a curriculum that adequately addresses climate change. In this regard, the integration of climate change concepts should be addressed first in the national curriculum and subsequently be crafted into the syllabus of Physical Science and/or other related subjects, since the syllabus is informed by the national curriculum. Thus, the Physical Science syllabus cannot address the climate change concept whilst it is not included in the Namibia National Curriculum for Basic Education. This assertion emanates from the realization that climate change has long ceased to be a supposition, but rather it is a reality that confronts us in our daily lives. Adedeji *et al.* (2014:114) state that “climate change is one of the major challenges of our time and adds considerable stress to our societies and to the environment”.

The National Policy on Climate Change for Namibia (NPCCN, 2010:8) defines climate change as the significant change in the measurements of climate, for example temperature, rainfall and wind speed over an extended period of time. The main causes of climate change include natural factors (changes in the sun's intensity or slow changes in the Earth's orbit around the sun), natural processes within the climate system (changes in ocean circulation), human activities that change the atmosphere's composition (through burning fossil fuels), and the changes of the land surface (through deforestation, reforestation, urbanization, desertification) (NPCCN, 2011:i, 39). Namibia is recognised as one of the countries in sub-Saharan Africa that is vulnerable to the impact of climate change because it is hot and dry. The recent prolonged periods of drought in Namibia bear testimony to the vulnerability and

unpreparedness towards changing patterns in climate. As a result, unpredicted increases in temperatures, evaporation and variability of rainfall result in the disruption of food production and other economic activities that are reliant on good agricultural products. The occurrence of droughts has led to economic decline, environmental degradation, food shortages and economic hardships amongst the poor sections of society (Botha, 1998:5). Developing countries such as Namibia are negatively affected by climate change because they are susceptible to economic environmental shocks. Efforts aimed at reducing poverty are drastically undermined by climate change, giving credence to the notion that climate change is not just a socio-economic issue but an environmental and geographical one as well. Poor countries rely on natural resources for a number of reasons, therefore drought and floods which may result from climate change are likely to affect the capabilities of poor countries to deal with these eventualities (Adedeji *et al.*, 2014:115). As such, it can be deduced that climate change affects the daily lives of the people in Namibia. It poses an economic risk because industries and economic activities are disrupted. The government has a duty to develop and implement education policies towards the dissemination of information on climate change (NPCCN, 2010:19).

In Namibia the National Curriculum for Basic Education that was promulgated in 2010 introduced an education system responsive to the current trends and challenges relevant to Namibian society. As such, the aim of the National Curriculum for Basic Education is to ensure that learners are taught subjects that will enable them to tackle problems and challenges that occur in society (NIED, 2008:4). A syllabus contains the aims and assessment objectives of the subject (for example, Physical Science) at a particular level of education, the sequence of the content knowledge to be taught, and the assessment procedures (Musingafi *et al.*, 2015:58). Section 20 of the Constitution of Namibia designates education as a fundamental right that should be given to every child in the country regardless of sex, race, ethnicity and social standing. According to Ninnes (2011:7), the National Curriculum for Basic Education is a policy introduced by the Namibian government to “promote the development of diversified, competent and highly productive human resources and to build a knowledge-based society”. In the same vein, the National Policy on Climate Change (NPCCN, 2010:23) for Namibia emphasises “the need and importance to raise awareness, build capacity and empower stakeholders at local, regional and national levels and at individual, institutional and systemic levels to ensure a collective and timely response to

climate change”. Therefore, it is deduced that there should be a link between the National Policy on Climate Change for Namibia and the National Curriculum for Basic Education.

It is clear that there is a call and a need for systems thinking on how to address environmental education, specifically climate change, in the senior secondary Physical Science syllabus, as recommended by the National Policy on Climate Change (NPCCN, 2010:19) for Namibia. As alluded to by Bory-Adam (2006:1), a syllabus geared towards increasing knowledge about climate change will ultimately result in a society that is well informed and involved in matters pertaining to climate change and a sustainable future. As such, it is important for teachers and learners to have a complete understanding of climate change in order to equip them with information on how to combat and address climate change in their daily lives. Without a clear curriculum directive on climate change, teachers will deal with the concept of climate change in a random manner. Moving towards systems thinking that will deconstruct a network of analytical thinking into dynamic change and development of environmental issues will integrate holistic and rational thinking (Tilbury & Cooke, 2005:28). Currently, it is difficult to measure or improve the teaching of climate change because of the absence of a clear and coordinated curriculum policy on climate change. As a result, learners and society at large may fail to understand climate change. The National Curriculum for Basic Education (NIED, 2009:4) lists the main risks and challenges prevalent in the Namibian society that will have to be faced as the following: Namibians’ indifference to caring for and managing natural resources; HIV and AIDS; health hazards caused by pollution, poor sanitation and waste; lack of democracy and social instability caused by inequity and governance that ignore rights and responsibilities; living in an information society; and globalisation. In the context of this study, issues pertaining to environmental education particularly climate change and sustainability should be considered and addressed in senior secondary Physical Science, so that Namibians can be educated to understand and deal with environmental challenges today and in the future.

## **1.2 CLARIFICATION OF CONCEPTS**

To provide a better understanding of this study, the following key concepts are clarified by means of a brief definition:

### **1.2.1 Climate change**

Climate change is a concept that refers to an apparent change in the state of the climate; the aforementioned change is usually identified by means of statistical tests carried out over a lengthy period of time ranging over decades. It is caused either by human activity (for example deforestation, over-population, and poor environmental management) or natural variability (IPCC, 2007:1). Xie *et al.* (2016:241) maintain that due to increased human activity since the onset of the industrial era, global surface temperatures are on the increase. Solomon *et al.* (2010:18354) concur that largely due to human activity, there has been an increase in the emission of greenhouse gases which has “contributed to global climate change”.

### **1.2.2 Curriculum**

According to the National Curriculum for Basic Education in Namibia, a curriculum is the official policy for teaching, learning and assessment. Furthermore, it guides the planning, organizing and implementing of teaching and learning. It is the official policy document for formal and non-formal Basic Education in Namibia which guides schools on how to organise the teaching-learning process, and provides a coherent framework to ensure that there is consistency in the delivery of the syllabi. In other words, a curriculum is a guiding policy document from which syllabi of particular subjects are developed. Namibia has only one curriculum, which is a general policy document catering for all the grades from Grade 0-12. It contains the broad aims and objectives which guide how the syllabi should integrate teaching and learning contents in the various subjects. Therefore, a curriculum is a framework for formulating syllabi, learning materials and textbooks to be used in the various subject (NIED, 2008:1). Su (2012:153) states that a curriculum contains what teachers are going to teach and what learners are going to learn.

### **1.2.3 Syllabus**

A syllabus is a product of the curriculum. It prescribes the learning materials, such as textbooks and study guides, to be used in a particular subject. A syllabus is instrumental in the designing of teachers’ schemes of work and lesson plans; it is specific to a particular subject, thus it contains the topics, themes, aims, objectives and learning outcomes of each particular subject (NIED, 2008:1). The Namibian Physical Science syllabus defines a

syllabus as a document designed to meet the requirements of the curriculum guide for formal and non-formal education for Namibia which is approved by the National Examination, Assessment and Certification Board (NIED, 2009:1). In a nutshell, a syllabus is the end product of a curriculum, it puts the broad aims and objectives of a curriculum into practice.

#### **1.2.4 Physical Science**

Physical Science is a branch of science, identified as a natural science, which encompasses the study of non-living systems, in contrast to the life sciences. It is the field of study that analyses the natural state and properties of energy paired with any non-living matter. Physics, chemistry, geology (earth science), and astronomy form part of Physical Sciences (Imperial, 2013:176). The Namibian Physical Science syllabus (NIED, 2010:3) defines Physical Science as a subject within the natural science area that places strong emphasis on the learners' understanding of the physical and biological world around them at both local, regional and international levels. It thus includes how societies use natural resources to satisfy their needs, and how the environment may be changed in ecologically sustainable ways. Consequently, it places emphasis on the application of scientific knowledge and attitudes to health and is of special relevance for the individual, the family, and society as a whole. Physical Science in the Namibian syllabus (NIED, 2009:3) is described as a subject that focuses on investigating physical and chemical phenomena through scientific inquiry by applying scientific models, theories and laws. Furthermore, it seeks to explain and predict events in the physical environment.

#### **1.2.5 Environmental education**

According to Squazzin (1998:13), there is no 'universally' agreed definition of environmental education. The IUCN (1971:7) defines environmental education as "the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings". Environmental education is an important factor in the achievement of sustainable development, because it is central to the discourse of poverty alleviation (Blum, 2008:348; Bekalo & Bangay, 2002:35). In terms of Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD), environmental education is the process of developing environmentally literate citizens who

are aware and concerned about the total environment and are empowered through knowledge, attitudes, motivation, commitment, skills and shared decision-making to individually and collectively achieve an improved quality of life through the sustainable use of and appropriate developments of Namibia's resources (Imene, 2010:1).

### **1.3 IDENTIFYING THE GAP IN THE RESEARCH**

Crucial global issues such as environmental issues that are rapidly changing the world and affecting the quality of our lives must be inculcated in the Physical Science syllabus for senior secondary learners (NIED 2009:1). It has now become imperative to ensure that concerns for climate change are introduced to senior secondary learners, as the Physical Science syllabus is currently silent on the effects and impact of climate change throughout its content. This is despite the fact that the subject deals with resources taken from the environment that cause environmental harm and degradation. The challenge with regard to climate change in Namibian schools is that there is no synergy between the National Policy on Climate Change for Namibia, the National Curriculum for Basic Education, and the senior secondary Physical Science syllabus. In terms of education, the National Policy on Climate Change for Namibia (2011:4) promotes synergies amongst sectors and stakeholders for effective and efficient mitigation and adaptation responses to climate change. In addition, prioritising climate change issues and integrating them into sectoral policies, as well as mainstreaming them into development planning to ensure that it is addressed at appropriate levels at all times are needed (NPCCN,2010:16-23). The National Curriculum for Basic Education (2010) is silent on the issue. Instead, it only refers to globalisation and management of natural resources (NIED, 2008:4). There is no specific reference to the intergration of climate change as an environmental education theme in the Physical Science Grade 11and12 syllabus (NIED, 2008:4). This implies that grade 11 and 12 Physical Science learners are deprived of gaining knowledge and understanding of the impact of climate change locally and globally.

The National Policy on Climate Change for Namibia (2010:19) and the National Curriculum for Basic Education, (2008:4) have revealed the absence of a link within the two policies with regard to the topic of climate change. The Namibian National Institute for Educational Development (NIED, 2008:13) states that the Natural Sciences are one of the main drivers of the transformation of society and the world.

The Natural Sciences area of learning contributes to the foundation of a knowledge-based society by empowering learners with the scientific knowledge, skills and attitudes necessary to formulate hypotheses, to explore, observe, make deductions and understand the physical world in a rational scientific manner. The National Curriculum for Basic Education addresses globalisation and emphasizes that learners are supposed to understand challenges and risks of globalisation through a learner-centred approach. However, the curriculum fails to specify globalisation issues that would enable learners and educators to address them at personal, local, national and global level. The National Curriculum for Basic Education highlights that since environmental learning is integrated across the syllabi it is not necessary for it to be taught as a promotional subject, but rather as a co-curricular activity. Co-curricular activities seek to enrich learner's experiences at school, making school an enjoyable place for learners after lessons (NIED, 2008:38). Co-curricular activities are organised to support important areas of teaching and learning such as science clubs, environmental clubs, debating societies, a school newspaper, and a school website (NIED, 2008:4, 38, 39).

From the discussion above it can be deduced that the National Curriculum for Basic Education and the senior secondary Physical Science syllabus should be more specific in advocating for the integration of climate change in the curriculum for basic education, as recommended by the National Policy on Climate Change for Namibia (NPCCN, 2010:19), especially if the challenges faced by Namibians are not addressed with regard to caring for and management of natural resources. The integration of environmental education in the senior secondary Physical Sciences syllabus may help to address the absence of knowledge about the interrelated nature of climate change in Namibian schools. The main challenge to the integration of climate change in Namibian schools emanates from the lack of a clear education curriculum and syllabi on climate change.

In the section above I have discussed the lack of the integration of climate change in the Namibian school education. It is clearly a result of policy inconsistency between the National Policy on Climate Change for Namibia, the National Curriculum for Basic Education, and the senior secondary Physical Science syllabus. As such, there is a gap between the climate change objectives contained in the National Policy on Climate Change for Namibia and what is contained in the National Curriculum for Basic Education. To this end, within the scope of environmental education this study aims to address the lack of integration of climate change education in the senior secondary Physical Science syllabus.

#### **1.4 Purpose of the research study**

Climate change is a global environmental phenomenon that needs to be addressed and integrated into education and the Namibian curriculum and syllabi. The absence of environmental education as a compulsory subject in the Namibian education system bears testimony to the unpreparedness of the Namibian society to understand climate change and subsequently tackle its effects on the environment (NIED, 2009:39). The purpose of this study was to explore how climate change is addressed in the Namibian senior secondary Physical Science syllabus and to further explore ways through which climate change can be integrated in the senior secondary Physical Science syllabus through environmental education. This study was necessary since the current approach and intervention to combat climate change in the Namibian curriculum do not address the impact of climate change that continues to be felt.

Namibia is regarded as the driest country in sub-Saharan Africa, and so it is vulnerable to the impacts of climate change. Severe droughts lead to poor plant growth and a decrease in livestock, and high ultraviolet rays give rise to skin cancer. These negative effects are caused by the increase in temperatures, high evaporation, as well as variability in rainfall. Thus, integrating climate change awareness in the curriculum and syllabi will help Namibians prepare themselves against the impact of climate change (NPCCN, 2011: i, 2). Effective measures to educate current and future generations need to be incorporated through the infusion of environmental education in the Physical Science senior secondary syllabus.

#### **1.5 MAIN RESEARCH QUESTION**

How do Namibian grade 11 and 12 secondary school teachers integrate climate change as an environmental education theme into the Physical Science subject?

##### **1.5.1 Secondary Questions**

- Which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education?
- Which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus?

- What climate change issues are addressed by teachers in Grade 11 and 12 in Physical Science?
- How can environmental education be integrated in the senior secondary Physical Science syllabus to address climate change?

## **1.6 AIM OF THE STUDY**

This study aims at exploring the intergration of climate change as an environmental education theme in grade 11 and 12 physical science in Namibian secondary schools.

### **1.6.1 Objectives of the study**

- To identify which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.
- To identify which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus.
- To establish what climate change issues are addressed by teachers in Grade 11 and 12 in the Physical Science syllabus.
- To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.

## **1.7 RESEARCH DESIGN AND METHODOLOGY**

A research design is the blueprint for the research and the five key elements included to unpack this research study were the methodology, paradigm, sampling methods, methods of data generation, and methods of data analysis (Punch, 2006:45). The research design aims to connect the research questions to the data. In other words, research design shows how the research questions will be connected to the data and what tools and procedures to use in answering them (Punch, 2006:47). This case study utilized an interpretivist research paradigm and relied on purposive sampling of selected participants who were the most knowledgeable about the senior secondary Physical Science syllabus. Data was generated using document research and semi-structured focus group interview and one-on-one interviews. The document research data was analysed using content analysis. Thematic

analysis of the focus group and one-on-one interviews yielded similarities and differences from the participants and their interpretation of the documents.

### **1.7.1 Research design**

Kerlinger (1986:279) defines research design as a “plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problem”. According to Punch, (2016:98), the research design is the internal logic by which the study will be able to proceed in order to answer the research questions. The research design enables a researcher to measure, select a sample and collect data that will be used to test the hypothesis or analyse the results of the research (Thyer, 1993:94). Kumar (2014:122) concludes that a research design is a roadmap which a researcher follows with the aim of seeking answers to the research questions.

According to Yin (2014:16-17), a case study is an empirical inquiry that explores a current phenomenon in depth and in its real-world context. Kothari (2004:113) states that a case study is a “form of qualitative analysis and involves a careful and complete observation of a social unit, be that unit a person, a family, an institution, a cultural group or even the entire community”. This study used a multiple case study design consisting of six schools. A multiple case study design enables a researcher to obtain information from multiple sources. A multiple case study design enables a researcher to focus on ‘two or more cases’ (Zongozzi & Wessels, 2016:221).

All the selected schools in this study are located in one education district, namely the Kalahari circuit in Namibia. A case study allows a researcher to get a deep understanding of the phenomenon under study by collecting data from a specific location. Grinnell (1981:302) states that a case study is characterized by a very flexible and open-ended technique of data generation and analysis.

### **1.7.2 Methodology**

This study adopted a qualitative research approach. A qualitative research approach enables a researcher to understand the processes and the socio-cultural contexts by exploring what climate change issues are addressed by teachers in the senior secondary Physical Science syllabus. A qualitative research methodology approach was motivated by the nature of data that was sought in this study. I sought the opinions of the participants from the six schools

about climate change in the senior secondary Physical Science syllabus. Newby (2014:53) states that research methodology refers to “the assembly of research tools and the application of appropriate research rules”. Research methodology is the ways, techniques and strategies that a researcher uses to conduct a study. Kothari (2004:8) states that it is ‘a way to systematically solve the research problem’, thus ‘it may be understood as a science of studying how research is done scientifically’. Qualitative research studies people or systems by interacting with and observing the participants in their natural environment and focusing on their meaning and interpretations (Maree, 2007:51). The authors cited above demonstrate that research methodology refers to the manner in which a researcher conducts his/her study.

### **1.7.3 Philosophical orientation**

The philosophical orientation refers to the philosophical foundation on which the study is grounded. Methodologies arise from different philosophical orientations which are connected to their theoretical perspectives, thus different interpretations of climate change are underpinned by different theoretical assumptions, for example, ontologies and epistemologies (Robottom & Hart, 1993:12). Ritzer (1975:7) states that a paradigm is a fundamental reflection or interpretation of the subject matter with science. For example, a paradigm formulates what should be studied, what questions should be asked, how they should be asked and what rules should be followed in interpreting the answers obtained. Patton (1975:15) defines a paradigm as a world view, a general perspective and a way of breaking down the complexity of the real world. He adds that paradigms are embedded in a way in which proponents and practitioners conform to them and tell what is important, what is legitimate, what is reasonable and what to do without necessary considering its implications. This study used an interpretivism research paradigm, as it supports a qualitative research approach, which seeks to understand how people make meaning of their environment (Maree, 2007:56). The interpretivist paradigm focuses on people’s subjective experiences, how they construct their social world and how they interact with each other. Moreover, interpretivists believe that reality is socially constructed. Therefore, putting people in their social contexts presents an opportunity to understand how they perceive their own activities (Maree, 2007:59). In the same vein, Kelliher (2005:1) agrees that interpretivists believe reality is not objectively determined but rather socially constructed. Interpretivism will enable this researcher to draw conclusions and deductions from the data generated in this research study.

#### **1.7.4 Sampling strategy**

The study employed an appropriate sampling strategy to scientifically select the best possible sample to generate the data relevant to this study. Sampling strategy refers to the way a researcher selects a sample from the population under study (Kumar, 2014:382). Sampling allows a researcher to choose research participants who will provide information that will be useful in investigating the research problem. A sample is “a selection from a population”; it is drawn from a sample frame also known as a population (Newby, 2014:699). Kothari (2004:152) states that sampling allows a researcher to obtain information about the whole population by investigating only a part of it. In this study, sampling enabled me, the researcher, to focus on a portion of the population to obtain the relevant data. Using purposive sampling, I requested that all Physical Science teachers who teach Grades 11 and 12 in the six schools within the Kalahari circuit be selected for the research. As such, this study used a multiple case study approach to collect information from six research participants who were located in different locations. I was inclined to use a multiple case study approach because despite the spatial location of the schools, the six Physical Science teachers would provide valuable information on the integration of climate change in the senior secondary Physical Science syllabus. Tongco (2007:147) states that purposive sampling is a “deliberate choice of an informant due to the qualities the informant possesses”. He (2007:147) further states that the apparent bias of purposive sampling promotes efficiency because a researcher knows exactly who she/he wants to take part in the study.

In this case study, only Physical Science teachers who teach Grade 11 and 12 took part in the study due to their vast knowledge of the subject and its syllabus. Due to the small number of learners most schools have only two Physical Science teachers. I focused on six schools because they belong in the Kalahari cluster circuit. One teacher from each school took part in the research study because each school has only one Physical Science teacher that teaches Grade 11-12. In addition, the Kharas region only has one Physical Science subject advisor for the region and was selected for the study. The study also included a National Institute for Education official who deals with the development of the Physical Science syllabi and resources in the Natural Sciences. Both the subject advisor and official were included in the sample because of their knowledge and experience in curriculum development in Physical Science at national level and in the Kharas Region. In total, the sample comprised eight participants.

### **1.7.5 Methods of data generation**

Methods of generating data are the various ways through which a researcher will collect data from various sources used in a study. Data generation relates to the collection of data for a particular study (Hox & Boeije, 2005:593). Roberts (2007:4) states that data generation is the manner in which a researcher collects information from his/her sample. In this study, I used document research, a focus group interview, and one-on-one interviews to collect data from the sample. The data generation methods are discussed below.

#### *1.7.5.1 Document research*

Owen (2014:10) is of the opinion that document research is carried to gather information about the phenomenon under study. Accordingly, in this study I researched documents such as Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD), the National Policy on Climate Change for Namibia, the National Curriculum for Basic Education, and the senior secondary Physical Science syllabus. A document research of these documents (see Addendum A) was supplemented by other relevant documents that I came across before the focus group and one-on-one interviews. The latter documents provided me with an in-depth knowledge about how the government of Namibia seeks to include and address climate change matters in the National Curriculum for Basic Education. In this regard, I also consulted government documents and policy documents that were relevant to answering the research question.

#### *1.7.5.2 Focus Group interview*

I used focus groups to collect information about climate change in the senior secondary Physical Science syllabus from the six teachers. I contacted the participants before embarking on data generation. Invitation letters (see Addendum E) were sent to the participants in advance, prior to the bi-annual Physical Science circuit meeting. The letter contains the objectives of the study and what would be expected from the participants. The focus group interview was conducted after the main bi-annual meeting for that specific day, whereby I utilised one classroom for the interview. I used open-ended pre-set structured questions to conduct the focus group interview in order to collect as much data as possible (Kumar, 2014:185), as the aim was to have responses that answered the specific questions being

asked. Moreover, all the responses needed to follow a specific order. From the data collected I consolidated the information by collating the data that fitted with the research questions.

A Physical Science circuit is a gathering of Physical Science teachers twice a year. Due to the fact that the six teachers were located far apart, I took advantage of the Physical Science circuit to carry out a focus group interview. Focus group interviews explore the perceptions, experiences and understanding of a group that have common experiences with regard to the subject (Kumar, 2014:193). They allow a researcher to encourage a free flow of information and ideas by observing the visual aspects, such as participants' body language and facial expressions while discussing the topic (Bowen, 2009:27). The focus group interviews gave me the opportunity to have a discussion with Physical Science teachers and is a rich method of gathering data because it allowed me and the participants to have an open discussion.

#### *1.7.5.3 One-on-one Interviews*

Bowen (2009:28) highlights that there are three types of interviews, namely structured interviews, semi-structured interviews and unstructured interviews. In this study, I used semi-structured one-on-one interviews to collect data from the Physical Science subject advisor and the National Institute for Education's official for Physical Science. DiCicco-Bloom and Crabtree (2006:315) state that semi-structured interviews are "organized around a set of predetermined open-ended questions, with other questions emerging from the dialogue between interviewer and interviewee". Therefore, using semi-structured interviews enabled me to ask questions and probe further in order to get a complete picture about how climate change can be integrated into the Namibian senior secondary Physical Science syllabus when using environmental education. According to Alsaawi (2014:151), semi-structured interviews are commonly used by Social Science researchers because they elicit information of a qualitative nature. A semi-structured interview combines the characteristics of a structured interview and an unstructured interview because "questions are pre-planned prior to the interview, but the interviewer gives the interviewee the chance to elaborate and explain particular issues through the use of open-ended questions" (Alsaawi, 2014:151). Thus, semi-structured interviews did not restrict me as the interviewer to the pre-planned questions, but rather gave me an opportunity to follow up on what the participants said.

### **1.7.6 Methods of data analysis**

After the process of collecting data, the research embarked on analysing the data collected from the documents researched and from the participants. Data analysis entails giving meaning and sense to the information obtained from the participants. Schwandt (2007:6) states that data analysis makes sense of research data. In this research study the data collected from the document research was analysed using content analysis and the data collected from the participants was analysed using thematic analysis.

## **1.8 TRUSTWORTHINESS AND CREDIBILITY**

Maree (2007:305) defines trustworthiness as the way in which a researcher is able to persuade the readers that the findings in the study are worth paying attention to and that the research is of high quality. In other words, in research trustworthiness refers to the degree of accuracy and dependability of any given study. In this regard, trustworthiness is intertwined with credibility. Credibility refers to the assurance that a researcher's conclusions emanate from the data and should be presented and discussed in an accurate manner as they are obtained from the participants. Kumar (2014: 368) adds that credibility refers to a situation where the results obtained by research through qualitative means are agreeable to the participants of the research study. Therefore, in this study, I undertook to gather and present information from the participants in an ethical manner, without altering, falsifying or making any unauthorized additions. Findings and conclusions could therefore be presented that are authentic, reliable and apt.

### **1.8.1 Triangulation**

To ensure the generation of credible, reliable and trustworthy data, this study employed a qualitative research strategy commonly known as triangulation. Triangulation entails cross-checking multiple sources of data and data generation techniques to ensure that research findings are credible (Yeasmin & Rahman, 2012:154). Data from document analysis, literature review, focus group interview, and one-on-one interviews was triangulated to ensure that it credible. The usage of several sources of information enabled this study to counter-balance and verify the credibility of the data generated. In this regard, data obtained from the research participants can be collated with information contained in government policy documents and other resources, such as the senior secondary Physical Science syllabus

and the Namibia National Curriculum for Basic Education. Babbie and Mouton (2008:275) emphasise that triangulation is one of the best ways through which researchers can promote reliability and validity in a qualitative research.

To further enhance the credibility and validity of data, member-checking was done. Member-checking implies systematically obtaining feedback about one's data, analytic categories, interpretations and conclusions from the sample members (Guba & Lincoln, 1989:47). Member-checking was important for this research as a way of guarding against research bias by eliminating misrepresentation and misinterpretation of data. More importantly, it gave me the opportunity to get clarity on misunderstandings, obtain additional information as well as to correct errors. The aim was, upon completion of this member-checking, to have accurately captured the views of the teachers.

## **1.9 ROLE OF THE RESEARCHER**

In this study, I, the researcher acted as a participant observer. The idea was to objectively gather information from the participants without influencing their contributions. The interview questions were asked objectively. No attempt was made to ask leading questions or to ask the participants questions that were beyond their scope. In this regard, the research undertook to limit the questions to topics and subject areas relevant to the phenomenon under study. For example, in the case of the focus group interview, the role of a researcher is to explain and articulate the objectives of the study. This exercise was done in a professional and ethical manner. I therefore did not approach the participants with any prejudice. Equal opportunities were afforded to all the participants in order for them to equitably participate in the research study. There was no favouritism. Each participant was afforded enough time to state his or her responses.

Furthermore, I was not biased in anyway. To this end, I harboured no personal interests in this study. Therefore, the study aimed for naturalism and avoiding any form of bias to maintain reliability and objectivity. I pledged not to alter or amend any information gathered from the participants. Data analysis was validated by the study leader leaving no room for personal objections or additions. As such, the interpretations and deductions of the findings were discussed in an empirical manner, one that aimed to represent the participants' opinions in an unadulterated way.

## 1.10 ETHICAL CONSIDERATIONS

Welman *et al.* (2012:181) state that ethical considerations play a major role during a research study, such as to avoid plagiarism and instil honesty in reporting results, as well as participants' confidentiality and anonymity. Henning *et al.* (2004:73) state that ethical behaviour refers to the awareness that participants have their privacy and sensitivity protected. In carrying out a research study, an appropriate code of ethics, such as permission letters, was adhered to. I sought approval from the North-West University's Research Ethics Committee at the Faculty of Education Sciences before commencing with this research.

In this study research participants were not coerced into taking part. Neuman (2003:124) emphasizes that participation in a study should be voluntary. Accordingly, I first sought permission from the responsible authorities in Namibia before sending out letters to teachers in the Kalahari cluster circuit to explain the aim of the research and to invite them to take part. According to Kumar (2014:285), informed consent implies that participants are made aware of the type of information a researcher wants from them, why the information is being required, what purpose it will be put to, how they are expected to participate in the study and how it will directly or indirectly affect them. Furthermore, the consent should be voluntary and without pressure of any kind. In essence the letter of consent pertaining to this study clearly stipulate their voluntary participation and it was emphasised at the beginning of each data generation encounter. The consent letter was signed by both parties before the commencement of all data generation.

The right to privacy is a way of keeping the participants' information confidential (Kumar, 2014:286). Hence, in a research study, participants should be assured of their right to privacy, for example, making sure that their identities will remain anonymous (Welman *et al.*, 2012:201). In this study, the names of participants and schools were not divulged. Moreover, to promote the anonymity of the participants I replaced their names with letters and numbers. Information of a personal nature not relevant to the study was avoided. Only the name of the circuit in which the schools are to be found were made known. According to Kumar (2014:286), the environment in which the participants work should be free from any form of discomfort, such as anxiety and harassment. Thus, participants should be given the assurance that they will be indemnified against any physical and emotional harm (Welman *et al.*, 2012:201). In addition, participants were informed that they could withdraw from the study at any stage without any fear of victimisation. Under the guidance of the supervisor I ensured that all data would be kept in a safe place as per the guidelines of the NWU.

## **1.11 SUMMARY AND CHAPTER OUTLINE**

As an introduction, this chapter gave a background of the study and defined and discussed the key terms. It also introduced the research problem, research question, and the aims of the study. In addition, I briefly described the research design and the methodology of this study. The primary objective of chapter 1 was to provide a brief and comprehensive introduction and description of the study. This chapter also highlighted the ethical considerations that were dealt with in this research by highlighting my determination to comply with North-West University's (NWU) ethical protocols and standards of conducting academic research.

Chapter 2 focuses on reviewing literature on climate change. Resources from the NWU library such as journals, textbooks, conference proceedings articles and online resources were utilised to give me an in-depth understanding of climate change in Africa and beyond. The literature review also deals with the Namibian curriculum and Physical Science syllabus, as well as environmental education. More importantly, this chapter conceptualises the key words of the study. In addition to literature, in this chapter I discuss the Namibian policy documents that relate to climate change.

Chapter 3 contains the curriculum development and theoretical framework of the study which highlights the education transformation in Namibia, the National Curriculum for Basic Education as an environmental learning tool, progressions of climate change in the Physical Science syllabus and curriculum development for environmental learning. This chapter also outlines the theory through which climate change integration in the Physical Science syllabus can be conducted.

Chapter 4 deals with the research design, methodology and paradigms applicable to the study. In this chapter, I motivate my choice for a qualitative multiple case study research design. As such, I provide an explanation for my paradigmatic choice and why it is consistent with my research study. I identify the sample used in the study. Furthermore, I discuss and explain why and how my sample of the study was chosen.

Chapter 5 deals with data analysis and presentation. Using content and thematic analysis I analyse and present the findings of the study.

Chapter 6 marks the end of the study. Therefore, in this chapter, I summarise all the chapters as well as the findings of the research and offer some recommendations.

The next chapter will deal with an explanation and discussion of climate change and environmental education within the subject of Physical Science, since it is central to this research.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 INTRODUCTION**

Chapter 1 provided the introduction and the background of this study. The chapter also contained the problem statement and the aims of the study. In an effort to fulfil the first and second research objectives, this chapter reviews the relevant literature of the phenomenon under study, i.e. literature on climate change and environmental education within the subject of Physical Science, and in particular, the integration of climate change in the Namibian National Curriculum for Basic Education and the senior secondary Physical Science syllabus through environmental education. The study advances the notion that Physical Science is a subject that deals with both environmental activities and climate change matters and their related concepts. Hence, it is important to integrate climate change in the Physical Science syllabus because it will help teachers, learners and the community to understand climate change matters, adaptation capabilities and reduction of vulnerabilities in a much clearer manner (Chang & Pascua, 2017:172).

This chapter provides definitions of the abovementioned concepts and demonstrates how they are dealt with in the existing body of knowledge. Similarly, the climate change objectives of the National Policy on Climate Change for Namibia (2011) and Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) (2017) will be discussed. The chapter also includes a comparative analysis of the different approaches through which the emerging national economies of Brazil, Russia, India, China and South Africa, also known as the BRICS member states, and other countries globally address climate change in their education curricula. In addition, a discussion on the concepts of environmental education and Education for Sustainable Development will be provided.

### **2.2 CONCEPTUALISING CLIMATE CHANGE**

Climate change poses major development challenges globally (Mesmin, 2018:147). Namibia's climate is generally hot and dry, thus a consequent impact of climate change is the continuous rise in temperature whilst the country faces low capacity to adapt to the impacts of climate change (NCCPN, 2010:13). In a nutshell, the impacts of rising temperatures in Namibia will severely affect natural resources and the functioning of ecosystems. The Intergovernmental Panel on Climate Change (2001:5) states that over the years, temperature

have risen by about 0.6°C as a result of high levels of greenhouse gases in the atmosphere. The Intergovernmental Panel on Climate Change predicted that by 2100 the near surface average temperature of the earth, over the globe, will have increased by 1.4°C to 5.8°C from 1990 levels and this increase will be two to ten times more than observed in the 20<sup>th</sup> century. Werndl (2014:3), Epstein (1982:1172) and Todorov (1986:259) caution that there is no universally accepted definition of what constitutes climate change. It is one of the topical issues in the world today (Rahman, 2013:1; Mesmin, 2018:147; Werndl, 2014:3). Climate change “amounts to different distributions over two successive time periods” (Frigget *al.*, 2015:954). It is commonly agreed that climate change results from increased concentrations of carbon dioxide in the atmosphere (Frigg *et al.*, 2015:960). Recent scientific findings indicate that climate change has a significant impact on the planet, therefore it is extremely important for school learners to study climate change in order to understand it and find ways of mitigating it (Dolapo, 2013:21). Chang (2012:283) states that compulsory subjects like Physical Science should educate learners on how to respond to and live in a dynamic environment such as the prevailing change in the global climate. As such, as a point of departure it is the researcher view that, school curriculum should equip learners with skills to help them to holistically address pertinent matters such as climate change.

Climate change refers to the change in climate which is mainly attributed to human activities (Rahman, 2013:2). According to the United Nations Framework Convention on Climate Change (2006:5), climate change can be directly or indirectly attributed to human activities that alter the composition of the global atmosphere. Rahman (2013:4) points out that human activities due mainly to the age of industrialisation are the main contributors to climate change. It is stated that climate change is caused by natural climate variability which happens over a lengthy period of time. Climate change can either be concentrated in a geographical location or it can extend over a large area, hence it is commonly regarded as a global phenomenon (Seetharam, 2012:5).

The Intergovernmental Panel on Climate Change (IPCC, 2007:1) also believes that human beings are the major contributors to greenhouse gas emissions that causes global warming, which contributes significantly to the change in climate. Climate change manifests through rising temperatures, droughts and desertification; heavy precipitation, flooding and rising sea levels; and extreme weather events such as cyclones. These conditions, in particular droughts and cyclones, have the potential to affect diminishing water resources, causing increased malnutrition, waterborne diseases such as diarrhoea, and vector-borne diseases such as

malaria (IPCC, 2013: 1217). Floods and rising sea levels will lead to drowning, injuries, and severe mental and physical trauma, particularly for marginalised communities, a characteristic in developing countries (Andrew *et al.*, 2017:412; Rahman, 2012:4). According to Mesmin (2018:147), climate change is the overall change in climate over a given period of time, mainly caused by human activities that increase the concentration of gases in the air. Sitchet *al.* (2007:791) agree that apart from greenhouse gas concentration, climate change also results from human activities.

Amanchukwu (2015:72) asserts that climate change is a “considerable and lasting alteration in the numerical distribution of weather patterns over a long period”. Amanchukwu further emphasises that developing countries, due to weak economies, struggle to cope with the effects of climate change; as a result, they are likely to suffer most from its effects. Therefore, educating learners about the effects of climate change will equip them with skills that will help them to cope with the ever-changing climate. The integration of climate change learning concepts in the curriculum underpinned by this study is one way of ensuring that current and future generations understand and possess knowledge about climate change (IPCC, 2013: 1217).

### **2.2.1 The Intergovernmental Panel on Climate Change projections of climate change globally and in Namibia.**

Wehner *et al.* (2011:1359) note that the Palmer Drought Severity Index (PDSI), a model used by the Intergovernmental Panel on Climate Change, has measured incidents of droughts in North America over long periods of time. This confirms that the phenomenon of climate change is not only limited to certain areas of the world, rather it is a global scourge. Climate change is a “long term change in the statistical distribution of weather patterns” (Rahman, 2013:3) which is difficult to “detect or measure” because “climate is inherently variable on all time scales” (Epstein, 1982:1172). Speaking at the Climate Summit in 2014, United Nations Former Secretary General Ban Ki Moon called climate change “the defining issue of our time” (Frigg *et al.*, 2015:953). This speaks to the importance of addressing the gradual rise in global temperatures that has begun to adversely affect the livelihoods of millions of people globally. Findings generated by the World Meteorological Organisation and reports compiled by the Intergovernmental Panel on Climate Change reveal that the African continent warmed up by 0.7°C during the twentieth century (Mesmin, 2018:148). In the Intergovernmental Panel on Climate Change’s fifth assessment report it was projected that

“global mean temperatures will continue to rise over the 21st century if greenhouse gas emissions continue unmitigated” (Angula & Kaundjua, 2016:1). Despite sub-Saharan countries’ vulnerability to changing climate, “there have been few studies about climate change focusing on temperature that consider the whole of Africa” because of the scarcity of readily available data (Collins, 2011:3650). In this regard, it is the researcher’s view that more resources should be deployed towards collecting data about climate change especially in Africa where such information is scanty. Moreover, climate change remains a challenge especially in sub-Saharan Africa if innovative ideas are not shared to bring about sustainable climate system nationally and globally for economic growth and development. Therefore, education should be one of the sectors that should be the driving force on the awareness of climate change. Timm and Diaz (2009:4261) argue that the Intergovernmental Panel on Climate Change’s fourth assessment report leaves no doubt that the increase in atmospheric CO<sub>2</sub> concentration will lead to significant environmental changes in all regions of the globe. Van Garderen (2011:249) states that due to climate change, the projections for climate change in the SADC region (Southern African Development Community) indicate “higher average, minimum, and maximum temperatures for most months and seasons”. The Intergovernmental Panel on Climate Change’s projections for Africa suggest that in sub-Saharan Africa there will be a 3-4°C average increase in temperatures between 1900-2100 (Collins, 2011:3652). Data from the Intergovernmental Panel on Climate Change shows gradual changes in the African climate (Shongwe *et al.*, 2009:3819). On the basis of the information discussed above, the researcher strongly believes that Namibia is currently experiencing the effects of climate change. The recent erratic rainfall, floods, drought bear testament to the changing nature of climate in Namibia. As such, the researcher undertook this study to contribute towards the mitigation of the effects of climate change in Namibia because climate change in Namibia ceased to be a myth but rather it is a reality that citizens have to grapple with.

Namibia, like other SADC countries, has recently fallen victim to “climate-related extremes” that triggered natural disasters (Shongwe *et al.*, 2009:3820). This was characterised by droughts and floods which negatively affected the region’s food security and economic activities. As such, as stated in the first chapter, this study sought to find ways of incorporating climate change in the Physical Science syllabus in order to equip learners with special skills to tackle and mitigate climate change, particularly in Namibia.

### **2.3 HISTORICAL PERSPECTIVES ON CLIMATE CHANGE**

An appreciation of the history of climate change is key to understanding the current trends of climate change. Authors such as McCormick *et al.* (2012:170-174) postulate that climate change was present as early as the era of the Roman Empire because the climate varied throughout the existence of that civilization. The Romans deforested huge areas of arable land, creating high levels of pollution which led to climate change, particularly in the entire ecological cycle because forests act as a carbon sink by using up carbon dioxide and offsetting its effect on the atmosphere (Archana, 2013:24).

A wave of international environmental activity culminating in the 1972 Stockholm Conference and the establishment of the United Nations Environment Programme (UNEP) was declared as a tool to address global environmental problems (Loubser, 2014:48-49). The focus was on the serious reversible local forms of pollution, deforestation and depletion of natural resources, for example, oil spills and dumping of hazardous wastes at sea by regulating particular pollutants. In addition, effects of irreversible global threats, such as the depletion of the stratospheric ozone layer, loss of biological diversity, global warming and environmental protection to achieve sustainable development were also addressed. The discovery of the stratospheric “ozone hole” and the publication of the Brundtland Commission report in 1987 titled *Our Common Future* (WECD, 1987), and the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 (Earth Summit) (UNCED, 1992) concentrated on the goal of achieving sustainable development. It is against this background that increasing anthropogenic influences on climate change from human impacts have continued to evolve over recent decades (Bodansky, 2001:24).

Poudyal (2012:49) remarks that climate change occurs gradually over a prolonged period of time. This means that the impact and the effects of climate change might take long to be realised and felt. Therefore, the fact that there may seem to be no signs of climate change is not evidence of the absence of climate change. The concept of climate change first appeared in the mid-19th century. During this era, climate change was attributed to deforestation and ‘the strenuous clearing of marshlands’ (Barry, 2013:1318). The science of climate change before the pre-industrial period was driven mainly by the concepts of natural forces which are beyond human control. These include the earth’s daily and seasonal movement; forces associated with the sun’s activities; interactions of solar systems; the earth’s magnetic forces and volcanic eruptions. The degradation of land, water and atmosphere by humans was at its

minimal (Okoth-Ogendo & Ojwang, 1995:50). Thus, due to increased human economic activity, climate change has altered drastically in recent years. Moser (2010:43) concurs that the increase in atmospheric concentrations of greenhouse gases through the burning of fossil fuels, high energy consumptions and the relative increase in human population all exert pressure on the land, water and atmosphere due to the demand for more food, energy, settlement and many other basic necessities needed to sustain human life. Ramirez (2012:257) states that the over-utilization of natural resources and environmental degradation by human activities have induced ecological imbalances on the environment and nature generally. The latter has resulted in a situation whereby the rate of utilisation of the natural resources exceeds the rate of natural resources regeneration (Okoth-Ogendo & Ojwang, 1995:51). In simple terms, it means that as time unfolds, planet Earth will not be able to meet the needs of an ever-increasing and more sophisticated human race. The Intergovernmental Panel on Climate Change, alludes that climate change poses risks for humans and the natural environment, because human greenhouse gas emissions continue to cause global warming. Climate change over the 21st century is projected to increase due to displacement of people facing a lack the resources for planned migration, experiencing higher exposure to extreme weather events, in both rural and urban areas, particularly in developing countries with low income. Expanding opportunities for mobility can reduce vulnerability for such populations (IPCC, 2014:4, 20). In conclusion, the post-industrial era witnessed an accelerated rate of climate change, generally attributed to the rapid industrial and demographic growth witnessed in the last century.

It can be stated that it is difficult for contemporary scientists to accurately pin-point the actual onset of climate change. Barry (2013) argues that in 1873 there were no sufficient thermometric records to sufficiently render evidence that supported the notion of a change in climate. In the same vein, Fleming (1998:50-53) states that 19th century climatologists, for example Abbe (1889), were of the view that the prevailing climate was stable. “Climate change looms as the biggest threat to human civilization” (Wen, 2009:1). However, it can be stated with a higher degree of confidence that climate change started receiving solemn attention in the late 20th century due to rapidity.

### **2.3.1 Modern perspectives of climate change**

The earth’s climatic system consists of the atmosphere, oceans, sea ice, the land and its features (Trenberth *et al.*, 2000:4). Currently debates are raging about the relationship

between climate change and global warming. Scientists and scholars are adamant and continue to separate global warming from climate change. This school of thought argues that global warming is a long-term trend caused by a rise in average global surface temperatures over one or two centuries, whereas climate change refers to the changes in climate that result from an increase in average global temperatures (Okonoth-Ogendo & Ojwang, 1995:16; Mann,2009:193). Okonoth-Ogendo and Ojwang (1995:16) allude that climate change and global warming are related because both concepts carry the same connotation, namely “increasing average in global temperatures”. Climate change not only refers to the changes in global average surface temperatures but also to changes in atmospheric circulation, such as size and patterns of natural climate variations and local weather (Andrew *et al.*, 2017:412). According to Andrew *et al.* (2017:412), atmospheric and ocean circulation leads to the earth warming and influences storm tracks and many aspects of the daily weather. Thus, climate change will continue to affect the strengths and frequency of floods, droughts, hurricanes and tornados as the earth’s lower atmosphere (troposphere) becomes warmer because of human-emitted greenhouse gases. According to Choptiany *et al.* (2015:166), “climate change is a continuous process”. Seetharam (2012:5) believes that the frequent occurrence of cyclones, the increase in sea levels, a hotter atmosphere, droughts, the frequency of more intense rainfall and the melting of icecaps are all indications of climate change.

Michigan (2009:1) defines climate change as a long-term continuous change in weather that results in increasing or decreasing of the average weather. He further states that climate change occurs because of changes to the earth’s environment, for example, change in the earth’s orbits around the sun and human modifications of the atmosphere. In other words, he argues that climate change will always vary over seasons and years. As such, there will always be more instances of changes in temperatures and more precipitation from year to year, thus climate change is a normal occurrence. Michigan’s definition adds to the controversy surrounding the phenomenon of climate change. To date some scientists, such as Choptiany *et al.* (2015:166), are convinced that climate change is a natural phenomenon that is not caused by human activities. Amongst other factors, it is this conviction that climate change occurs irrespective of human activity which influenced the United States of America, under the presidency of Donald Trump, to withdraw from the Paris agreement (IUGG, 2017:1), citing that there is need for further research and empirical evidence on climate change and its impact globally (IUGG, 2017: 1). As such the International Union of Geodesy

and Geophysics (2017: 2) expressed its dismay about such a decision, because climate change is a global problem that needs a broad participation of all multilateral stakeholders.

It can be argued that for the United States of America to show no interest in climate change will have a negative impact on the implementation of Agenda 2030 for Sustainable Development's Goal 13 (Climate Action). Moreover, individual countries that normally benefit from the green climate change fund will be negatively affected due to lack of recognition of climate change by the United States of America, who is the biggest funder of the battle against global problems. Factors like the latter will have a negative impact for funding support to world experts with scientific excellence solutions and scientific knowledge. The negative impact will affect decision-making and international mediation to reduce atmospheric emissions.

Most members of the public are still unaware of the causes of climate change. Despite an almost unanimous agreement among climate scientists that the earth's climate is warming due to fossil fuels burning and other anthropogenic causes, there is no agreement about whether global warming is happening (Leiserowitz *et al.*, 2013:1). The Royal Society (2010:2) states that climate change is inevitable and mostly caused by humans changing Earth's climate; as a result, the atmosphere and oceans continue to become warmer, accompanied by a rise in sea level, with a strong decline in Arctic sea ice and other climate-related changes. Human activity, thus, carbon dioxide emissions, are responsible for the current change in global climate (Scott *et al.*, 1990:63; Scafetta, 2010:1; Trenberth *et al.*, 2000:14; Galvani *et al.*, 2016:14502). If the current levels of emissions of greenhouse gases persist, it is likely that the climate will continue to change in the near to far future (Scott *et al.*, 1990:73). Jameel (2016:8) believes that a change in human activity is needed to halt and/or limit the extent of global climate change. Jameel (2016:8-9) proposes the usage of wind power, the construction of green buildings and also addressing methane as solutions that can be implemented to deter global climate change. Developing countries are the largest source of greenhouse gas emissions (Trenberth *et al.*, 2000:21). As such, human activities in the developed world continue to impact on global temperatures. Increases in the extremes of climate can adversely affect natural ecosystems and human activities (Royal Society, 2010:2). In conclusion, the threat of large-scale climate change is one of the current global challenges. It is feared that increased climate change will not only affect agricultural output but will also adversely impact on the environment, global business and day-to-day human existence in the 21st century (Henderson *et al.*, 2017:1).

### 2.3.2 Climate Change in Africa

Toulmin (2009:1) states that climate change leads to unpredictable rain patterns, floods, prolonged droughts, subsequent crop failures and rapid desertification. Toulmin further states that climate change results in global warming and is a product of adverse human environmental activities worldwide and particularly in Africa.

The Intergovernmental Panel on Climate Change (2014:3) recognises Africa as the most vulnerable continent to climate variability, due to low adaptive capacity and because of multiple political and economic problems. Thus, climate change is likely to exacerbate dry conditions, especially in southern Africa. As a result, this will affect the poor mostly, due to constraints on employment opportunities and declining wages. Niang *et al.* (2014: 8) are of the opinion that the consequences of climate change will be felt in various ways throughout both natural and human systems in Sub-Saharan Africa. As such, climate change projections for the southern Africa region point to a warming trend, particularly in the inland subtropics; frequent occurrence of extreme heat events; increasing aridity; and changes in rainfall with a particularly pronounced decline in southern Africa and an increase in East Africa. However, the region could also experience a rise of as much as one metre in sea level by the end of the 21<sup>st</sup> century under a 4°C warming scenario. Particularly vulnerable to these climatic changes are the rain-fed agricultural systems on which the livelihoods of a large proportion of the region's population currently depends (IPCC, 2017:3). As agricultural livelihoods become more precarious, the rate of rural–urban migration may be expected to grow, adding to the already significant urbanization trend in the region. The movement of people into informal settlements may expose them to a variety of risks different but no less serious than those faced in their place of origin, including outbreaks of infectious disease, flash flooding and price increases in food.

Reid *et al.* (2008:50) suggest that the only way to raise climate change concerns is for policymakers to advance their green economic skills and environmental solutions to climate change on their agendas. In addition, they can provide figures that clearly highlight messages about the expected impact of climate change on the environment, so that they act as powerful motivators for policymakers in developing countries to start considering climate change as a part of their national development policies. The Intergovernmental Panel on Climate Change (IPCC, 2001:9; IPCC, 2014:5) has highlighted specific impacts of climate change in Africa, namely water resources, agriculture and food security, human health, ecosystems and

biodiversity, forestry, coastal zones and the attaining of the Sustainable Development Goals if the global mean temperatures continue to rise over the 21st century.2.3.3 Climate Change in Namibia

Namibia is one of the driest countries in southern Africa (Amadhila *et al.*, 2013:3), and about one-third of all years can be described as drought-prone (Zeidler, 2010:2). Namibia is more vulnerable to the effects of climate change and variability in the country is characterised by high temperatures and low rainfall, leading to a socio-economic crisis. Collective effects of environmental degradation, social vulnerability to poverty and a changing climate compromise both subsistence and commercial farming in Namibia. In addition, the country faces considerable socio-economic dynamics related to food insecurity and high food imports, ongoing population growth and further urbanization. According to Angula *et al.* (2014:225), it is estimated that the country relies more on irrigated crop production and irrigated subsistence farming, besides water scarcity facing the country. Thus, climate change together with an increase in water demand is expected to adversely affect livelihoods, economies and environmental resources. Rurinda *et al.* (2014:78) state that in order to secure the livelihood of people and food security, there is a need to reduce current vulnerability in southern Africa. Moreover, Namibia needs to work on suitable adaptation options essential for agriculture, fisheries and the groundwater sector, in relation to climate change variability, in order to help the people, cope with future problems. Hence, Namibia is no exception in integrating climate change in their education system by educating more on possible measures that increase the resilience of the community to a changing climate while working on adaptation options.

Addressing the challenges of climate change in the education sector will create a better understanding of the concept climate change. Furthermore, by addressing climate change in the education sector the government can promote an awareness of the impact of climate change at a regional and local level, thereby allowing policymakers to develop climate change-conscious education systems to help school communities be better prepared in the event of weather-related disasters. Preliminary estimates show that Namibia could lose between one and six percent of its Gross Domestic Product annually if no action is taken to adapt to the climate change impact on natural resources, specifically agriculture and fisheries. Such a situation could affect the poor most because they are more dependent on natural resources (Wilhelm, 2012:4).

## 2.4 BACKGROUND OF THE PHYSICAL SCIENCE SYLLABUS (GRADE 11-12)

This study focuses on the integration of climate change in the Namibian senior secondary Physical science syllabus and how climate change is dealt within the syllabus. To this end, the researcher focused chiefly on the senior secondary Physical Science syllabus developed in 2010 by the Ministry of Education in collaboration with the University of Cambridge International Examinations. The Physical Science syllabus is modelled around the Namibia National Curriculum Guidelines (NIED, 2009:2). Table 1 below summarises essentials aims, skills and guidelines relevant to Physical Science as a subject, which the Namibia National Curriculum Guidelines seek to instil in Namibian learners within the Physical Science syllabus as stated in the Namibia National Curriculum Guidelines (NIED, 2009:2).

Table 1 Physical Science syllabus aims, skills and the Namibia National Curriculum Guidelines

Physical Science Syllabus		Namibia National Curriculum Guidelines
Aims	Skills	
1. Develop an appreciation of the contribution of Physical Science to the needs of society.	1. Communication skills.	1. Encourage respect for human rights and freedom of speech.
2. Stimulate interest in, and care for, living organisms and their environment; and realise the interdependency between the biophysical, economic, social and political environment.	2. Critical and creative thinking skills.	2. Provide insight and understanding of crucial “global” issues in a rapidly changing world which affect quality of life: the AIDS pandemic, global warming, environmental degradation, distribution of wealth, expanding and increasing conflicts, the technological explosion and increased connectivity.
3. Develop an awareness that the study of science, including Physical Science, is subject to social, economic, technological, ethnic and cultural influences and that the applications of Physical Science may be both beneficial and detrimental to the individual, the community and the	3. Numeracy skills.	3. Recognise that as information in its various forms becomes more accessible, learners need to develop higher cognitive skills of analysis, interpretation and evaluation to use information effectively.

environment.		
4. Appreciate that Physical Science transcends national boundaries and that the language of science, correctly and vigorously applied, is universal.	4. Problem-solving and information skills.	4. Recognise that learning involves developing values and attitudes as well as knowledge and skills.
	5. Self-management and competitive skills.	5. Seek to challenge and to motivate learners to reach their full potential and to contribute positively to the environment, economy and society.
	6. Work and study skills.	6. Promote self-awareness and an understanding of the attitudes, values and beliefs of others in a multilingual and multicultural society.

Tokatli and Kelsi (2009:1491) state that a syllabus is pivotal in the imparting of knowledge from the teacher to the learner. The Namibian senior secondary Physical Science syllabus for Grades 11 and 12 (hereafter referred to as the Physical Science syllabus) serves as a contract between the learners and the teachers. It stipulates the duties and responsibilities of both the learners and the teachers. Furthermore, the syllabus contains the specific aims of the subject and the skills required by learners to successfully complete the Physical Science course (NIED, 2009:1-3), as seen in Table 1. Ludy *et al.* (2016:1-2) elaborate by stating that, as a contract, a syllabus spells out in detail the relationship between the learners and the teacher. As such, a syllabus highlights the expected outcomes of the learning process and the respective duties, obligations and privileges of both the learners and the teachers.

Tokatli and Kesli (2009:1491) agree with the above-stated opinions by pointing out that a syllabus is a plan for a course, module or subject that ‘states exactly what learners at a school or college should learn in a particular subject’. UNESCO (2013:2) states that introducing climate change in the subject syllabi enables teaching and learning about climate change that will focus on present and future examination of practical considerations of climate change through reflective and projection methods of the future secondary school curriculum. Tokatli and Kesli furthermore explain that a syllabus helps the learners to meet the desired expectations which make them feel secure, whilst Johnson (2006:139) defines a syllabus as an instrument used to improve the learners’ learning process, and serves as a tool to monitor the process of imparting knowledge to them. Hence, the syllabus encapsulates the aims and

objectives of Physical Science and serves as a reference point for both the learners and the teachers. Suter (2001:3) reports that ‘the success of the course is determined by how well the objectives and the outline are designed’. In this regard, the Physical Science syllabus clearly states what the learners are expected to learn. In the same vein, it illustrates the duties and responsibilities of the teachers.

It can be deduced that the syllabus is a roadmap of Physical Science in Namibia because it is “designed to meet the requirements of the Curriculum Guide for Formal Senior Secondary Education for Namibia and has been approved by the National Examination, Assessment and Certification Board” (NIED, 2009:1). Parkes and Harris (2002:55) state that a syllabus serves three functions, namely being a contract, a permanent record and a learning tool. The Physical Science syllabus gives effect to the guidelines stated in the Namibian National Curriculum, therefore, it can be stated that the syllabus is the implementation phase of the National Curriculum because it gives teachers clear aims and objectives that should be accomplished in order to equip the learners with the required skills, aptitudes and competencies. In this case Namibia’s Physical Science syllabus has shown how environmental learning is important, but there is no direct reference to climate change. For example, the Physics section of the syllabus aims for learners to be taught “*relevant concepts which are linking to their everyday life and to the natural and human-made world as well as considerations in the industry, such as the availability of research to produce new ways of using energy and the impact on the environment (e.g. nuclear power stations)*”. In the Chemistry section, the syllabus directs teachers to teach learners in a “*finite life of the world’s resources and the need for recycling and conservation, economic considerations in the chemical industry, such as the availability and cost of raw materials and energy*”. In addition, it demonstrates the importance of chemicals in industry and in everyday life (NIED, 2009:6, 23).

The absence of words related to climate change, such as *global warming, greenhouse gases emission, human induced processes, burning fossil fuels, increased carbon dioxide in the atmosphere, industrialization, emissions of carbon dioxide, energy, water, acid rain, earth’s energy budget* can be regarded to suggest that these concepts are not addressed in the Physical Science syllabus. To this end, the syllabus should contain and address at length these concepts owing to their centrality to contemporary Namibian society. In line with the above, Alsubaie (2016:107) remarks that a syllabus allows teachers to implement the curriculum to meet the needs of the learners. To this end, it can thus be emphasised that a syllabus is an

end-product of a curriculum. A curriculum is a policy framework document that broadly articulates the aims and objectives of an educational program.

It is important to note that the Namibia National Curriculum Guidelines is a generic policy document that holistically dictates the nature and content of basic education syllabi in Namibia. The main purpose of this section is to demonstrate that with regards to Namibia, the Physical Science syllabus emanates from the Namibia National Curriculum Guidelines. In other words, the syllabus seeks to operationalise the aims of the Namibia National Curriculum Guidelines by broadly stating the pertinent areas, subjects and themes that should be addressed in the Physical Science syllabus.

#### **2.4.1 The integration of Climate Change in the Physical Science syllabus**

In line with the primary aim of this study, the researcher is of the opinion that climate change education should be actively integrated in basic education. In this study it is the researcher's view that, the syllabus should integrate climate change as a theme in all three sections of the Physical Science, namely General Science, Physical section and Chemistry section. Climate change is not highlighted directly in the Namibian Senior Physical Science syllabus, hence there is a need for a more direct focus on climate change. One of the objectives of the Namibia National Curriculum Guidelines stated within the Physical Science syllabus is to provide insight and understanding of crucial "global" issues such as global warming, environmental degradation and others that affect quality of life in the rapidly changing world (NIED, 2009:1), but these are not elaborated on in the General Science, Physics and Chemistry sections of the syllabus. The entire syllabus content teaches about utilisation and production of resources without considering a critical approach to balanced contents with sustainability and green economic solutions to improve climate change factors. In fact, the entire syllabus highlights neither global warming nor climate change as a topic, theme, learning objective or competence content. In the Chemistry section (NIED, 2009:23-37) there is reference to teaching about the finite life of the world's resources by considering the need for recycling, conservation and chemical industry availability and the cost of raw materials and energy.

As mentioned previously, the syllabus does not directly address the concept of climate change or global warming. It is the researcher's view that the syllabus should integrate climate change as a theme in all three sections of Physical Science namely; General Science, Physics Section and Chemistry Section. This is because (as discussed in the next paragraph)

these sections can impart knowledge related to climate change. For example, topics such as drawing graphs and tables in the General Science section (NIED, 2009:4); energy, measurement of temperature, radiation, radioactivity in the Physics section (NIED, 2009:9, 11, 12, 21); and chemical reactions, industrial uses and application chemistry and environmental chemistry in the Chemistry section (NIED, 2009:26, 34, 37) are all related to the greater study of climate change, but no reference is made to climate change. Literatures sources (Toulmin, 2009:1; Leiserowitz *et al.*, 2013:1) posit that climate change results from *human induced processes, anthropogenic causes, human activities, or human modification*. Therefore, to address climate change, Physical Science teachers should be equipped with climate change knowledge and climate change should be an obligatory integration in the syllabus which teachers will subsequently impart to learners.

Keinone *et al.* (2016:6) stress that climate change remains a challenge that demands new ways of thinking. Similarly, the researcher strongly believes that given the importance of climate change knowledge in contemporary societies it is incumbent upon governments world over to ensure that citizens, learners and other stakeholders are constantly exposed to up to date information of climate change. The Namibian Physical Science syllabus should be focused on new ways of teaching that should include climate change contents, particularly that of global warming to climate change, greenhouse gases, ozone depletion, energy budget, significance of oceans in climate control and effects on people and the environment and management strategies. According to Keinone *et al.*, it is against this background that education sectors need to develop alternatives in the quest for solutions to the challenges posed by climate change to equip learners with relevant skills and expertise that will be useful in today's world. This research study asserts that the integration and integration of climate change in the Namibian Senior Secondary Physical Science Syllabus is important to finding local solutions to the problems posed by climate change.

The rationale of the Physical Science syllabus is 'to equip learners with the necessary knowledge, skills and attitudes that will enable them to enter tertiary education, or the world of work' (NIED, 2009:1). This can be achieved by fostering a learning environment that elevates the learners' understanding and equips them with the necessary knowledge of the biological and physical world in which they exist.

The Namibian Senior Physical Science syllabus is divided into three sections, namely:

- **General Science Section:** The syllabus emphasises the teaching of general science concepts (NIED, 2009:4). For example, themes such as drawing graphs and tables in

this section should require teachers to include related climate change topics. In this way learners will have knowledge about gathering and analysing data related to climate change. This skill is important in the day-to-day collection of data that shows temperature increases over time, which is one of the indications of global warming. Hence, through such learning activities learners will know about the existence of climate change. In addition, they will acquire skills and knowledge about how to collect data that is necessary when researching climate change.

- **Physics Section:** Shows the relevance of concepts to the learner's everyday life and to the natural and human-made world considerations in the industry, such as the availability of research to produce new ways of using energy and the impact on the environment (for example, nuclear power stations) (NIED, 2009:6). As mentioned, in the concept about energy, the section needs to bring in references about green energy sources as there is no reference to sustainability and education for sustainable development.
- **Chemistry Section:** Teaches about the finite life of the world's resources and hence the need for recycling and conservation. Economic considerations in the chemical industry, such as the availability and cost of raw materials and energy and the importance of chemicals in industry and in everyday life need to be included (NIED, 2009:23). As such, concepts like the chemical industry focus more on the availability and cost of raw materials and energy. There is no reference to concepts like climate change as a result of industrialization, burning of fossil fuels, greenhouse gases emission, global warming and carbon dioxide emissions, amongst others, in this section. In order to systematically address global issues, both the National Curriculum for Basic Education and the Physical Science syllabus need to directly and clearly outline contemporary concepts, such as climate change, in order to effectively teach for sustainable development.

Therefore, I am of the opinion that climate change should be included more prominently under the Physics and Chemistry sections. Furthermore, these sections of the syllabus contain topics such as environmental chemistry, radioactivity, measuring temperature, energy, chemical reactions, and industrial uses and applications chemistry that should refer to climate change. Climate change can be taught in these three sections because they focus on issues that relate to climate change, such as pollution, the burning of energy and atmospheric gases. As dealt with earlier in this chapter, climate change is a broad subject that touches on various

areas and themes in the National Basic Education Curriculum. As such, the subject sections and teaching content mentioned above contain some of the concepts that either directly or indirectly deal with climate change. Therefore, the researcher is of the opinion that it is practically possible to teach about climate change under these subjects so as to enrich their content and make them more relevant to current societal challenges.

The Namibian Senior Physical Science syllabus neither highlights nor integrates aspects of climate change as either a topic, theme, learning objective or competence content. The syllabus does not fully align itself with the Sustainable Development Goals 2015-2030, hence this is contrary to the effective implementation of climate change as stressed in the National Policy on Climate Change for Namibia (cf.2.5). Osborn *et al.* (2015: 3) state that the 2030 Sustainable Development Goals aim for development that will improve the living conditions in the present without compromising the resources of the future by respecting the environment through quality education. Therefore, learners need to be taught more about a green skills approach by critically discussing crucial global problems and solutions, for example global warming, greenhouse gas emissions, green economy, reductions and solutions of radioactive materials, industrial productions and pollutions (Ockwell *et al.*, 2009:305). In the current context of limited understanding of climate change, education sectors need to communicate climate change through innovative teaching and research to promote initiatives and strategies towards a better understanding of the multidimensional nature and effects of climate change (Islam & Winkel, 2017:4).

UNESCO (2013:5) has developed new approaches that introduce climate change by emphasising a course framework that reinforces climate change learning for sustainable development for learners and teachers to gain understanding, perceptions and personal experiences of present and future climate change of basic science. UNESCO further elaborates that such a new approach should be acquired through interactive, participatory and experiential learning processes that call for Climate Change Education for Sustainable Development (CCESD). Hence, the researcher is of the opinion that climate change teaching should focus on the local community by exploring how schools and communities can work to build a culture of safety and resilience by cross-cutting with complex global perspective and teaching learners about the future and climate change empowerment and actions.

The researcher observes that Physical Science syllabus is not consistent with the contemporary trends of climate change, sustainability and the green movement. In other words, the syllabus does not comprehensively focus on climate change and its related themes

and concepts, such as innovative solutions for the Namibian society to adapt and/or minimise the effects of climate change. For example, the syllabus aims to increase the “learners' knowledge and understanding of the physical and biological world of which they are part” (NIED, 2009: 2). Parkes and Harris (2002:58) state that a syllabus helps learners to develop an assortment of skills necessary in their cognitive development, for example learners' ability to study, learn, to prioritise and multitask, social skills and to make use of the available technology. In this regard, among other mechanisms and implements obtaining in society such as traditional media and social media, basic education particularly Physical Science is a learning initiative designed by the Ministry of Education to impart knowledge in learners for the betterment of society. This resonates with Fink (2012:3), who states that a syllabus is a teaching tool that helps a teacher to impart knowledge. Chang and Pascua (2017:172) point out that climate change is necessary in the education system in order to address the current response to the change of climate issues and to achieve the Sustainable Development Goals by 2030. An explicit integration of climate change in the Physical Science syllabus would be a milestone towards the integration of climate change in Namibian schools.

In line with the discussion in the first and second chapters of this study, the researcher maintains that climate change poses serious and far-reaching risks on modern societies. Therefore, the integration of climate change in the aims of the syllabus will enable the dissemination of critical information and communications about climate change, such as the causes, impacts, dangers and ways to eradicate and or minimise climate change. This study advocates for the integration of climate change in the Namibian senior secondary Physical Science syllabus because such an integration will promote the flow of climate change information on an academic, social and economic level, especially for a more informed green skills economy. Climate change can no longer be ignored as it negatively impacts on our social and economic life (Tshiningayamwe, 2016:29).

## **2.5 THE NATIONAL POLICY ON CLIMATE CHANGE (NPCCN) FOR NAMIBIA**

The world over, governments have come up with strategies to deal with climate change as it “poses risks to human health, ecosystems, social and cultural systems, and economic development” (Scheraga *et al.*, 2003:237). The National Policy on Climate Change for Namibia encapsulates the current information about climate change in Namibia. It seeks to devise practical ways through which the people of Namibia can adapt and hence mitigate the effects of climate change (NPCCN, 2011:1) as it continues to affect the daily lives of people,

either negatively or positively (Kristie *et al.*, 2008:501). Examples of African governments' response to climate change includes the National Climate Change Response Strategy (2014), the National Climate Change Response Strategy (2010) and the National Climate Change Response White Paper (2014) from Zimbabwe, Kenya and South Africa, respectively. The National Climate Change Policy for Namibia is, to date, the Namibian government's official response to the challenges posed by climate change. The policy was promulgated in 2011 by the Ministry of Environment and Tourism. It is a product of local studies carried out on the impact and extent of climate change on Namibian society. It defines climate change as a considerable change in climate measurement over a long period of time. Natural factors and human activities are identified as the outstanding causes of climate change (NPCCN, 2011:38).

The National Policy on Climate Change for Namibia identifies education as a major role-player in the dissemination of climate change information. Learners who are aware of climate change matters therefore are an asset to society because they can teach others and share that information in their neighbourhoods (Amanchukwu *et al.*, 2015:71). In this regard, teaching learners about climate change is not only an academic milestone but also a social development and environmental matter because it promotes a widespread flow of climate change information in a society that may not be aware of the problem.

As discussed earlier in this chapter, Namibia is one of the driest countries in Africa, most vulnerable to the impacts of climate change (NPCCN, 2011: i). As such, Mfuno and Ndombo (2005:10) emphasise that education, training, and capacity-building are necessary so as to strengthen the involvement of well-trained scientific and technical educationists who understand climate change adaptation processes. Such a support system will require institutional structures that are adequately equipped to provide facilities and finances to support the programmes and other activities of climate change adaptation and mitigation. To this end, the National Policy on Climate Change for Namibia (2011:18) imposed education, training and capacity-building for climate change to develop and strengthen individual skills, expertise and increase the capacities of relevant institutions and organisations to reduce greenhouse gas emissions and reduce vulnerability to climate-related impacts (adaptation).

The integration of awareness generation, education, training and capacity-building demonstrates the importance of climate change in the Namibian education system. Nevertheless, these objectives as included in the National Policy on Climate Change for Namibia still lack effective implementation in the curricula for basic education, specifically

in the senior Secondary Physical Science syllabus for Grades 11 and 12. Therefore, the government and curriculum developers need to find effective approaches on how to “integrate climate change into the education system in order to generate awareness and capacities at an early age” with the objective of securing long-term capacity to deal with climate change (NPCCN, 2011:10-11.). The Policy affirms that climate change education in Namibia is modelled on Article 6 and Article 9 of the United Nations Framework Convention on Climate Change (UNFCCC). Mfuno and Ndombo (2005:6) emphasise that “it is useful to promote, facilitate, develop and implement education and training programmes that focus on climate change”. Therefore, with this Policy the Namibian government aims to promote climate change education in schools and universities, but its implementation is lacking. The following objectives of the Policy can, for example, be mastered through, amongst others, General Science skills:

***Objective 1:** To develop and implement appropriate adaptation strategies and actions that will lower the vulnerability of Namibians and various sectors to the impacts of climate change.*

***Objective 2:** To develop action and strategies for climate change mitigation.*

***Objective 3:** To integrate climate change effectively into policies, institutional and development frameworks in recognition of the cross-cutting nature of climate change.*

***Objective 4:** To enhance capacities and synergies at local, regional and national levels and at individual, institutional and systemic levels to ensure successful implementation of climate change response activities.*

***Objective 5:** To provide secure and adequate funding resources for effective adaptation and mitigation investments on climate change and associated activities (e.g. capacity building, awareness and dissemination of information) (NPCCN, 2011:10).*

As demonstrated above, the Policy’s (2011:8) objectives are important because they direct and assist Namibia to address climate change. Therefore, Namibia needs comprehensive strategies and plans to either combat or mitigate the effects of climate change. To this end, Namibia should be in a position to adequately deal with the challenges of climate change and also to advocate for remedial activities aimed at reducing the effects of climate change nationally and globally. The National Institute for Educational Development (2011:19)

suggests that more should be done in order to reduce greenhouse gases emission and lessen the impact of the effects of climate change in Namibia. With regard to the senior secondary Physical Science syllabus (Grades 11 and 12) and the National Curriculum for Basic Education (2010), climate change does not feature as a topic or theme although environmental education is present. Thus, as shared previously in this study, the researcher strongly believe, that the integration of climate change education is of paramount importance because it will assist Namibia in addressing and mitigating the global challenge of climate change.

## **2.6 NAMIBIA'S DRAFT POLICY FOR ENVIRONMENTAL EDUCATION (EE)/ EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)**

Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) (EE/ESD, 2017:1) presents the national guiding principles and frameworks for mainstreaming environmental issues. The mainstreaming of environmental issues through education will help Namibians to appreciate, understand and support ecosystems and to embrace sustainable development. The draft policy states that the education programmes should be designed to enhance knowledge, skills, attitudes and values as well as actions necessary for sound environmental decision-making (EE/ESD, 2017: iv).

Since independence in 1990, education in Namibia has undergone major changes. Curriculum reform was part of the changing process that aims to teach content through environmental education. Environmental education was not considered as a formal subject but rather an extra co-curricular activity (Imene, 2010:1). Namibia attempted to incorporate extra-curricular activities through Environmental Education Clubs (NIED, 2009:39) to supplement the work of subject departments in delivering environmental education. Co-curricular activities were designed to encourage active learning and are supposed to supplement areas of learning with little curriculum time available (NIED, 2009:39). However, without clear policy directives on how to implement the activities, such initiatives do not fulfil their intended purposes. Lam Wai (2011:iii) points out that because of the lack of a formal position of environmental education in the education system, schools have great autonomy to decide on the ways of delivering environmental education.

It is therefore suggested that Namibian secondary schools need to establish different collaboration practices of environmental education in their own contexts, such as environmental clubs and networking locally, nationally and internationally (Wilhelm,

2012:6). Against this backdrop, Namibia can move away from the generalized patterns of practising environmental education and provide an angle for understanding environmental education in a more in-depth structural way. Thus, the environmental education policy for Namibia together with the Curriculum for Basic Education of Namibia need to understand the extent of current practices and import new effective measures in the delivery of environmental education.

## **2.7 THE INCORPORATION OF CLIMATE CHANGE INTERNATIONALLY**

UNESCO (2013:3) pointed out that a curriculum is vital with regard to Climate Change Education. According to Chang and Pascua (2017:172), a curriculum should be designed to enable teachers at secondary level from diverse subject areas to introduce Climate Change Education for Sustainable Development (CCESD) across the curriculum. The aim is for teachers to understand what and how to teach about the complex forces driving climate change as well as its impacts on culture, security, well-being and economic development for a sustainable use of resources for both societal dependency and industrial processes. By so doing, learners will understand how they and their communities can respond to the threat of climate change and play a leading role in reducing the severity of climate change.

David and Fumiyo (2013:4-5) define climate change education as an integration of climate change topics in the curriculum of school subjects as a key strategy to respond to climate change. The United Nations (UNESCO, 2016:30) also reiterate the critical role of education in building climate change awareness, adaption capabilities and reduction of vulnerabilities related to climate change disasters. According to Moser and Dilling (2011:15,) the education sectors should promote communication on climate change for a more holistic understanding for capacity building actions such as climate change literacy for teachers, learners and communities to take place. In an effort to motivate the integration of climate change in the Namibia senior secondary Physical Science syllabus, this section briefly focuses on how the BRICS members have dealt with climate change in their syllabi and curricula, compared to a developing country like Namibia.

### **2.7.1 Brazil**

Brazil, like China, is on the frontline of climate change policy-making, as well as strengthening climate change governance within the domestic political arena (Held *et al.*,

2012:9), while at the same time broadly maintaining its foreign policies and approaches to global climate governance, which contributed to the deadlock in the UNFCCC negotiations. Brazil is widely regarded an international leader in environmental education (UNICEF, 2012). A policy review of Climate Change Education in Brazil was developed to offer useful insights on how to enhance climate response through education because of the unique position Brazil holds in relation to the global governance of climate change (Trajber & Mochizuki 2015:45). The Ministry of Education aims to build successful climate change education in terms of reaching a significant number of schools, educators, learners and communities. Challenges remain in terms of enhancing the impact of the existing environmental education frameworks and programmes. Particularly, the school-based environmental education policies do not reach all schools as engagement is voluntary and dependent on the will and capacity of each state, municipality and school.

It is difficult to assess and measure the depth of the programmes developed in Brazil to understand the gaps between what public policies propose and actual practice of climate change education and environmental education in schools (Jacobi *et al.*, 2011). Thus, teachers should be inspired through a progressive capacity building to teach about climate change because, even though climate change is a topic “on everyone’s lips” (Wamsler *et al.*, 2012), more needs to be done to ensure that learners are taught about it in classrooms. Climate change education is deterred by teacher’s turnover rates, excessive centralization and the lack of autonomy of teachers and school, parents’ disinterest and low participation in school life (Camboim & Barbosa, 2012; Garcia, 2010; Mohedano, 2010).

### **2.7.2 Russia**

Russia is the third-largest emitter of greenhouse gases and supplier of fossil fuels globally, behind the USA and China. According to Sharmina *et al.* (2013:1), the Russian government aims to position the country as one of the leaders in the global process for addressing climate change mitigation. Russia also ratified the Kyoto Protocol and is a signatory to the Paris Agreement (Sabintsev, 2017:1). Safonov (2013:154) states that “climate change in Russia has been more dramatic than elsewhere”, recording a 1.29°C increase over the 100-year period from 1907 to 2006. According to the National Intelligence Council for Russia (NICR, 2009:33), the country plans to strengthen climate change, reforming adaptive strategies through a high level of integration in the education curriculum, so that people can change livelihoods through institutions that provide knowledge and assistance in times of change.

Limited initiatives or strategies have been designed to educate people about climate change and how to mitigate and adapt to it (NICR, 2009:32, 33, 38).

### **2.7.3 India**

Traditionally, India has been highly vulnerable to climate-related events like floods, droughts and cyclones. India has many publicly funded programmes to address the direct impacts, prevention and control of climate risks. In addition, the main objective of major anti-poverty and rural development programmes is the reduction of vulnerability to climate risks. Although India has committed itself to the international community's global goal of stabilizing emissions generally believed to cause global warming to safe limits, the country contributes more than any other country to the rise in global energy demand which continues to have serious implications such as local air pollution, freshwater availability, and greenhouse gas emissions, among others. Yet, at the same time, the country does not have an explicit policy in place for its education curriculum (Ebinger, 2016:28). According to Pandve (2009:1), India's climate change-related educational objectives encompasses a range of measures including the use of solar energy to reduce dependence on fossil-based energy sources. India plans to establish a new Climate Science Research Fund to improve climate modelling. The country also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

### **2.7.4 China**

Due to rapid economic activity emanating from its recent economic growth, China has "overtaken the United States (US) as the world's largest carbon dioxide emitter" (Wen, 2009:2). Economic growth in China has resulted in the upsurge in energy and natural resources consumption. This has seen China becoming one of the world's biggest markets. However, China's economic boom came with a stiff price on both the environment and the climate. To tackle this challenge, the Chinese government has made bold strides aimed at introducing climate change education in Chinese society. Han (2015:66) remarks that in China, education is regarded as "an indispensable component and contributor in achieving climate change plans". In China, climate change education falls under education for sustainable development. The Chinese government emphasises that climate change education should be included at "different levels of education, with the focus on fostering awareness of

climate change and sustainable development among students and the public” (Han, 2015:65). China has in recent times therefore made great strides, officially incorporating climate change in its national development plan, making China the “first developing country with a national climate change mitigation programme” (Zhu, 2014:66).

In Hong Kong, an autonomous territory of China, the education system, just like in Namibia, regards environmental education as a non-compulsory learning subject in secondary schools and it is also not assessed as an independent subject in any public examination. This is mainly due to lack of a specific and formal role for environmental education in secondary schools. Hence, educators tend to make use of various subjects, such as Physical Science and other science subjects to deliver the content, themes and issues related to environmental education (Lam Wai, 2011: ii).

### **2.7.5 South Africa**

Climate change is a key concern within South Africa (Ziervogel *et al.*, 2014:605). The Physical Science Curriculum and Assessment Policy Statement Grade 10-12 (CAPS) (SA.DBE, 2011:97) teaches about global warming. This shows that South Africa’s curriculum takes climate change matters seriously as it motivates critical thinking about the concept that people are actors and agents in the earth system.

Fundisa for Change is a collaborative programme that aims to enhance transformative environmental learning in South Africa through teacher education (Songqwaru & Shava, 2016:1). The structured approach emphasises active learning in the curriculum and commitment to environmental content, particularly in that of incorporating climate change in subjects. Through Fundisa for Change (2016) the South African school system has a support system for teachers to include climate change training in all appropriate school subjects through the requirements of the curriculum so as to teach about climate change.

In 2011 South Africa launched the National Climate Change Response Plan White Paper before hosting the Conference of Parties (COP17) for the United Nations Framework Convention on Climate Change in Durban (Garland, 2014:584). The White Paper (SA. NCCR, 2011:44) states that “climate change is a relatively new issue that has cross-disciplinary and cross-sectoral implications in South Africa”. It acknowledges that knowledge and information about climate change is key to finding ways to mitigate and address the challenges posed by climate change. To achieve this, the White Paper proposes a

holistic integration of climate change education (and its related aspects) in learning and training institutions. The infusion of climate change education will translate into a South African society that is conscious about the plight of climate change and possesses the required skills and knowledge necessary to combat and mitigate the effects of an ever-changing climate.

Garland (2014:585) argues that there is insufficient knowledge about the dangers posed by climate change in South Africa. This assertion underscores the urgent need for a nationwide, multi-sectoral incorporation of climate change matters with South African society. Currently there is no explicit policy pertaining to the integration of climate change education in the South African education system. South Africa's school curriculum is supported by the Fundisa for Change courses on climate change to teaching about climate change in subjects such as Geography and Natural Sciences.

## **2.8 ENVIRONMENTAL EDUCATION AND EDUCATION FOR SUSTAINABLE DEVELOPMENT**

This section provides a discussion of environmental education and the Education for Sustainable Development project that was necessitated by the realisation that sustainable development is heavily reliant on the environment and its capacity to sustain human daily needs (Hak *et al.*, 2016:565). Pavlova (2013:656) adds that both environmental education and Education for Sustainable Development share a common vision of quality education and a society that lives in balance with the earth's carrying capacity, though they differ in expectations of the realities of such a vision, in terms of a transformative balance and interdisciplinary approach in the education system. The UN Decade of Education for Sustainable Development (UN-DESD) called for educators to be key agents in developing and securing sustainable life aspirations for the future generation (UN-DESD,2014:16).

### **2.8.1 Environmental Education**

Environmental education is closely linked to climate change. As such, in this section I explain the nature and scope of environmental education and demonstrate how it relates to climate change, since climate forms part of a complex system.

In 1972 environmental education gained recognition internationally at the United Nations Stockholm conference on Human Environment as a tool to address global environmental problems. The IUCN (1971:7) defines environmental education as “the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings”. Pavlova (2013:656) defines “environmental education as a process that deals with the human interrelationships with the environment and that utilizes an interdisciplinary problem-solving approach with value clarification”. In addition, environmental education is concerned with education progress of knowledge, understanding, attitudes, skills and commitment for environmental problems and considerations. Environmental education gained prominence in the 20th century when it was realised that natural resources are not unlimited.

The Namibian draft policy for Environmental Education (EE)/Education for Sustainable Development (ESD), defines environmental education as “the process of developing environmentally literate citizens who are aware and concerned about the total environment, empowered through knowledge, attitudes, motivation, commitment, skills and shared decision-making to individually and collectively achieve an improved quality of life through the sustainable use of and appropriate developments of Namibia’s resources” (Imene, 2010:1). I am in agreement that environmental education is an important factor in the achievement of sustainable development, because it is central to the discourse of poverty alleviation (Blum, 2008:348; Bekalo & Bangay, 2002:35). In other words, it can be deduced that environmental education is the teaching of Education for Sustainable Development (ESD) by disseminating knowledge about understanding how to conserve the environment and its natural resources. Lieflander *et al.* (2013:371) remark that teaching about climate change is a critical tool to counter environmental problems with the goal of protecting and conserving the environment and therefore the syllabi should integrate climate change into teaching and learning through environmental education.

### **2.8.2 The aims of environmental education resulting from the Tbilisi declaration**

This section highlights the impact of international declarations on environmental education. Although the Tbilisi declaration is the bedrock of this declaration it is important to mention the Thessaloniki declaration which occurred 20 years after Tbilisi declaration. The aim of environmental education is to educate citizens about environmental issues in order to make them knowledgeable and equip them with the necessary skills to address contemporary environmental challenges (Marcinkowski *et al.*, 1990:1; Valderrama-Hernandez *et al.*, 2017:969). Therefore, teachers have a duty of conducting environmental education to give learners the necessary knowledge that will enable them to be skilled in tackling modern problems of an environmental nature.

The first intergovernmental conference held at Tbilisi in the USSR (1977) and the Belgrade Charter (1977) resulted in the twelve Tbilisi principles. The Tbilisi Declaration contains the framework, objectives and principles for environmental education at local, national, regional, and international levels for all citizens, both inside and outside of the formal school system, to help individuals with the objectives of environmental education in order to:

*Acquire an awareness of and sensitivity to the total environment and its related problems; gain knowledge and experience in, and an understanding of, the environment and all its related problems; acquire an attitude founded on a set of values with feelings of concern for the environment, thus motivating active participation in environmental improvement and protection; acquire the skills for identifying and solving environmental problems; and participate actively at all levels so as to work toward resolving environmental problems* UNESCO-UNEP (1978: 24-29).

Below are some of the guiding principles for environmental education that relate to this research study. These guidelines are included because of their insistence on environmental education and learning which help address climate change.

- Be interdisciplinary in its approach and use a holistic and balanced perspective.
- Examine major environmental issues from local, national, regional and international points of view.
- Focus on current and potential environmental situations, and the historical perspective; promote the value and necessity of local, national and international co-operation in the prevention and solution of environmental problems; enable learners

to have a role in planning their learning experiences, and provide an opportunity for making decisions and accepting their consequences.

- Relate environmental sensitivity, knowledge, problem-solving skills and values clarification to the learner's own community in early years and every age.
- Help learners discover the symptoms and real causes of environmental problems; emphasize the complexity of environmental problems, thus developing critical thinking and problem-solving skills.
- Use diverse learning environments as well as different educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experience.

The discourse on environmental education prioritizes the dissemination of environmental information to ensure that the general population is able to contribute towards addressing environmental challenges (De Sousa, 2013:73). The Belgrade Charter (UNESCO-UNEP, 1976) and Norris (2016:1) suggest that environmental education encourages humanity to care about the environment and to possess skills and knowledge which are relevant in addressing modern environmental challenges. The latter can be addressed by integrating climate change into a syllabus through environmental education.

### **2.8.3 Education for Sustainable Development**

Although this research study's main focus was on the integration of climate change in the Physical Science Syllabus Grades 11 and 12 through environmental education, Education for Sustainable Development is a crucial link between climate change and environmental education. As such, this section highlights some of the major relationships of Education for Sustainable Development in relation to climate change and environmental education.

Environmental education creates awareness of and assists in finding solutions to contemporary environmental challenges faced by society (Norris, 2016:3). Sustainable development ensures that human development is not at the expense of the environment and future needs. Strange and Bayley (2008:24) recognise the reciprocal relationship between human beings and the environment. As such, human beings have a duty to nurture and protect the environment (Raga, 2013:144). It is reciprocal in the sense that if humans sustainably conserve and care for the environment, the environment will sustain human life and cater for its needs (Galvani *et al.*, 2016:14504).

Education for Sustainable Development is learning how to make decisions that consider the long-term future of the economy, ecology and the equitable development for society. It is driven by a vision for the world to benefit from quality education and learn the values, behaviours and lifestyles required for a sustainable future for a positive societal transformation (Pavlova, 2013:656). Education for Sustainable Development requires a radical transformative pedagogy which focuses on the process of learning to live within ecological limits without human suffering (Stevenson, 2006:287). Anderson (2012:194) suggests that sustainable development should be based on a comprehensive and multidisciplinary approach which focuses on relevant content about the environment, particularly that of climate change impact. Education for Sustainable Development therefore is an important societal undertaking (Lambrechts & Hindson, 2016:6) and schools should continuously educate for sustainable development in order to contribute towards a society that is knowledgeable and conscious about the impact of human development on the environment. UNESCO (2009:1) maintains that the core values for Education for Sustainable development are respect for others, respect in the present and for future generation, respect for the planet and what natural resources (fauna and flora) provide for us.

Education for Sustainable Development forms part of this study because it is crucial that society directs human development to be subject to sustainability and the wellbeing of the environment. As such, environmental protection and preservation should be part and parcel of the education curriculum because it guides human economic and development goals (Kasimov *et al.*, 2002:25) in as far as the wellbeing of the environment is concerned.

## **2.9 CONCLUSION**

The objective of this chapter was to conduct a literature review on the integration of climate change in the Namibian Senior Secondary School Physical Science syllabus. As such, the chapter conceptualised the phenomenon of climate change. In this regard, the various definitions of the concept were discussed and explained in accordance with recent scholarly contributions. Climate change in the Namibian context and in Africa at large was emphasised. However, international perspectives, such as those of BRICS nations, were also discussed. The chapter demonstrated that climate change is not an isolated concept. There are related concepts of climate change, such as environmental education and Education for Sustainable Development because of the role they play in the discourse of climate change. This chapter carefully focused on the current state of climate change in Namibia. Given this

background, the subsequent chapter discusses curriculum development for environmental learning and its related theories employed in this study.

## **CHAPTER 3: CURRICULUM DEVELOPMENT AND THEORETICAL FRAMEWORK OF THE STUDY**

### **3.1 INTRODUCTION**

This chapter focuses on the aspect of curriculum development and what theories are relevant to this research study. The aim of this chapter is to give a comprehensive background of curriculum development in Namibia. This is crucial because it helps to position this study in a broader perspective of curriculum development initiatives in Namibia. Furthermore, knowledge of the antecedent curriculum developments in Namibia assists the study in advocating for the incorporation of climate change in the existing senior secondary Physical Science syllabus. The objective of the chapter is to foster an understanding of the phases and policies pertaining to the historical progression of Namibian educational curriculum development since the advent of independence in 1990 to date. Therefore, the chapter will discuss at length the phases highlighted above, focusing on their strategies, achievements and their shortfalls.

### **3.2 EDUCATION TRANSFORMATION IN NAMIBIA**

In recent times there have been numerous calls globally for transforming the education system especially, in the field of science subjects (Turpen, 2004:1; Picciano *et al.*, 2010:18). Education transformation relates to the deliberate change of an existing system of education to suit current trends or to meet future societal requirements (Cook-Sather, 2010:571). Katjivivi (2016:2) believes that “quality education is essential for creating a sustainable human resource in order to build a country’s development”. Thus, education that meets national and international standards is imperative because it contributes positively to the socio-economic development of a nation. Kanyimba (2009:7) asserts that environmental education is a cross-curricular subject in the Namibian education system but the challenge is that the present scientific and philosophies frameworks are not adequate to address the environmental crisis, particularly climate change. This research study aims to contribute towards the development of a Physical Science syllabus that is contemporary and responds to the climate change needs of society.

As stated in Chapter 1, climate change in Namibia and Africa as a whole can no longer be ignored because it poses a threat to human and animal life and also to the environment and

the natural ecosystem. Thus, the study seeks to empower Namibian curriculum developers and other stakeholders to incorporate climate change in a holistic manner within the Namibian formal education system. Below is the historical progression of Namibia educational curriculum development since 1990 to date.

### **3.2.1 Bantu Education system (Pre-1990)**

Before Namibia's independence in 1990, the country's education system was designed to reinforce the South African apartheid system rather than providing the necessary human resources that aim to promote equitable social and economic development. As such, at that time not much was done to include pertinent issues such as climate change education. To this end, the Namibian education inherited a deficient education that was not in line with the needs of society. Angula and Lewis (1997:31) postulate that during that time the education system was too fragmented by racial and ethnic lines, known as 'the Bantu Education system'. Such a system had a negative impact on the quality of Namibia's education system (MEC, 1993:2). Due to the apartheid ideology and policies this led to dramatic inequalities and disparities in the quality of education services rendered to the various ethnic groups. Moreover, the content, pedagogy, assessment practices and ethos of the colonial education as applied were irrelevant and unsuitable to the needs and aspirations of the Namibian people (MoE, 1993:3).

### **3.2.2 Towards Education for All: A Development Brief (1993)**

Since gaining independence in 1990, one of the biggest challenges was to build a new education system which attributes to the cornerstone of quality education for all. Hence, the Namibian educational reform was first and foremost guided by the policy statement called "Toward Education for All" (MEC, 1993), which was a government education strategy introduced to bring education to all corners of society without the racial prejudice that had characterised the pre-independence period. The first president of Namibia, his Excellency Dr Sam Nujoma, initiated a reform in education relevant to the Namibian people and substituted the apartheid education and training programme (MEC, 1993: ii). Iiping and Likando (2012:2) postulate that the four primary aims to achieve such reform were: access, equity, quality and democracy in education. This led to the replacement of the philosophy and practices of the apartheid education system to a new philosophy and practices appropriate to educating all citizens by rethinking "what we do in schools and how we should integrate it". The aforementioned change has led the Namibian government to compel itself

to address inequities and disparities inherited from the South African apartheid education system. Through the redistribution and reallocation of education, resources to previous disadvantaged underserved regions or communities and remote schools have materialised and expanded access to schooling for all primary and secondary school children (Njabili, 2004: 31).

### **3.2.3 Pilot Curriculum Guide for Formal Basic Education (1996) and Formal Secondary Education (1998) and the National Curriculum for Basic Education (2010)**

The Pilot Curriculum Guide for Formal Basic Education ran from 1996 to 1998. In 1996, the curriculum guide only covered Grade 1 to Grade 10. From 1998 onwards, the Ministry of Education introduced Grade 11 to Grade 12 as part of basic education in Namibia. The curriculum guide provided a framework on how subject syllabi and textbook resources for learning in various subjects were to be designed and implemented, as well as to identify areas of learning and subjects to be studied and how teaching and assessment were to be developed (NIED, 1996: 2). The above was achieved by ensuring that the goals, aims, competencies, core skills and key learning areas were identified in relation to a futuristic curriculum aiming to achieve Namibia's Vision 2030.

The Namibian National Curriculum for Basic Education was introduced in 2010; it improved the bedrock of primary and secondary education in Namibia aimed at standardising and improving basic education. It builds on the achievements of the antecedent curricula. It was developed as a response to changes, challenges and trends encountered by Namibian society, such as the challenges posed by globalisation and HIV/AIDS. The new Curricula for Basic Education are poised to produce learners who are able to deal with these contemporary challenges. The Curriculum for Basic Education (2010) is part of a wider national discourse aimed at accomplishing the country's development goals set out in National Development Programmes (1 & 2) and Namibia's Vision 2030, the policy framework for the country's long-term national development (NIED, 2009:1). It is the contention of this study that the National Curriculum for Basic Education should include contemporary challenges such as climate change and environmental education because climate change poses a threat to the economy and human day-to-day existence.

### **3.2.4 The Curriculum Reform for Basic Education effective from 2015 onwards**

The National Institute for Education Development (NIED, 2012: 1) explains that the proposal for the implementation of the New Curriculum Reform for Basic Education was motivated from the outcomes of the National Conference on Education of June 2011. The Minister of Education, Dr Abraham Iyambo, was of the opinion that in order for Namibia to improve its academic performances nationally for Grades 11 and 12, the current curriculum needed to undergo major transitions in order to strive towards quality education for all learners, including those with special needs. The Minister further stated that the transition had to focus on the acquisition of the necessary knowledge, skills, values and attitudes for a development-oriented and knowledgeable society.

Tjihenuna, (2014: 3) states that the purpose of the new revised education curriculum is to improve the current education system. Consequently, the review is underpinned by the aspirations of Vision 2030 to achieve the country's aims and is focused on a knowledge-based society where knowledge is constantly being acquired and renewed and used for innovation to improve the quality of life. Thus, the revised junior primary curriculum was implemented in January 2015, starting with the junior primary Grade 1-3 in 2015 and proceeding to the senior primary phase Grade 4-7 in 2016. The secondary school level began in 2017 with Grade 8, and will proceed grade by grade per year.

In conclusion, the new curriculum reform objective is to promote a competency-based curriculum which should continue to be reviewed every five years of each curriculum phase. The objective is to set learning standards that benefit every subject at each school phase, by defining relevant scope and sequence matrix to determine the width and depth of themes, topics and skills covered per subject, with a clear sense of progression and articulation. Each syllabus clearly shows an indication of key and subsidiary competencies so that teachers will be able to identify the essential learning outcomes of each grade (MEC, 2014:3). At senior secondary school level, the revised curriculum for Basic Education will be implemented in 2020 for Grade 11 and 2021 for Grade 12.

### **3.3 THE NATIONAL CURRICULUM FOR BASIC EDUCATION 2010 AS AN ENVIRONMENTAL LEARNING TOOL**

The National Curriculum for Basic Education identifies environmental learning as one of the key concepts that should be cultivated at the level of basic education (NIED, 2010:4). In

addition, it identifies several risks and challenges that affect Namibian society. Amongst them, the following relate to climate change and the environment: (i) the risks and challenges that arise from the misuse and neglect of natural resources and (ii) health risks and challenges caused by pollution, poor sanitation and waste (NIED, 2010:4). The Curriculum for Basic Education aims to create and promote an environmentally sustainable society (NIED, 2010:8) that is aware of the fragility of the environment. Consequently, human economic activity should be conducted in such a manner that it does not compromise the ecological balance of nature. The Curriculum for Basic Education further aims to develop learners who are innovative and possess scientific skills and expertise to mitigate the destruction of the environment in Namibia and globally. To incorporate environmental education, the Curriculum for Basic Education directs local schools to teach Natural Sciences as a compulsory subject. In Grades 1-4 it is called Environmental Studies, in Grades 5-7 it is called Natural Science and Health Education respectively and in Grades 8-12 it is called Physical Science, Biology, Life Science and Agriculture (NIED, 2010:13). The senior secondary Physical Science syllabus includes topics such as Environmental Chemistry (air pollution), Energy and Water and Chemical Industries and Radioactivity (NIED, 2009:20-32). Given the information above, it can therefore be stated that the Curriculum for Basic Education does not explicitly deal with the phenomenon of climate change (cf.2.4) Moreover, the challenges of climate change are increasingly gaining a lot of attention, and the informal teaching of environmental education in school makes it difficult for teachers, learners and society at large to understand aspects of climate change in a systematic approach (Imene, 2016:18).

The revised syllabi for Physical Science Grades 8-10 have been developed in such a way that they describe the intended learning outcomes and assessment practices for the Junior Secondary Phase within the Science mainstream (NIED, 2010:1). The learning experiences and subsequent outcomes in the Natural Science subjects are tailored towards promoting the learners' knowledge and understanding of the physical and biological world of which they are part (NIED, 2009:2). The Physical Science syllabi for the Junior Secondary Phase integrates natural science, social, economic, physical and mathematical and technological learning areas of the broad curriculum. The Physical Science syllabi were developed to convey the ethos of learner-centred education, which presupposes that teachers have a holistic view of the learner, valuing the learner's life experience as the focal point of learning and teaching (Current Science, 2016:1887). As such, teachers must select learning content and

methods on the basis of the needs of learners, the immediate environment and community. Learning experiences in the natural science area are focused upon promoting teaching and learning for understanding (Fien & Tilbury, 2002:10).

Namibia, like most African countries, is rich in natural resources. According to Namibia Environmental Education Network (1999:10), exploration of these resources requires scientific knowledge and relevant skills, the acquisition of which presents itself as a prerequisite for a progressive national economy and an improved standard of life for all Namibians. Therefore, it is important for learners to acquire knowledge and skills which will foster their understanding of the interaction between man and the environment in order to satisfy human needs.

Kanyimba (2009:15) believes there is need for transformative learning which is aligned to systematic thinking and progression of level of competences between the junior secondary Grade 8-10 and senior secondary phase Grades 11 and 12 in the Physical Science syllabus. There is lack of progression in topics, themes, objectives and basic competences of both the junior and secondary Physical Science syllabi because of a repetition in all syllabus key areas of learning (cf. 3.4). These gaps result in a poor focus on climate change and related issues in the Physical Science syllabus. As such, this study was premised on the need to include climate change more prominently in the syllabus. Hence, this hinders a developmental approach within the senior phase, since secondary learners prepare themselves for a critical approach to problem-solving of issues affecting communities, such as climate change.

### **3.4 PROGRESSION OF CLIMATE CHANGE WITHIN THE PHYSICAL SCIENCE SYLLABUS FROM JUNIOR SECONDARY (GRADE 8-10) TO SENIOR SECONDARY (GRADE 11-12).**

To promote a progressive and productive society, the Namibian National Curriculum Guidelines provide opportunities for developing essential skills in various fields of study. Basic skills development is not done in isolation; the goal is to harmonise the development of various skills under a comprehensive and flexible curriculum, taking into consideration the different fields of study. The Namibian National Curriculum Guidelines provides an insight into and understanding of crucial global matters that are pertinent in a non-static, dynamic and rapidly changing world. Examples of pertinent global matters include the AIDS pandemic, global warming, environmental degradation, the inequitable distribution of wealth, conflicts and strife, the technological explosion and increased connectivity (NIED, 2009:1).

Contrary to the above-mentioned global concepts, neither the Junior Secondary nor the Senior Secondary syllabi highlight the keywords of global warming or greenhouse gases as a topic, theme, objectives or basic competencies. This is besides emphasising that the National Curriculum for Basic Education (2010) is designed in such a way that learners are taught about topical and pertinent local and global concepts important to their educational development. The Junior Secondary Syllabi's Grade 8-10 and the Senior Secondary Syllabi's Grade 11-12 environmental topics are outlined as follows:

- Grade 8- Topic 3: The Gases of the air (Junior Secondary Curriculum Physical Science Syllabus) (NIED 2010:12).
- Grade 9- Topic 3: Acids and alkalis (Bases) (JSC Physical Science Syllabus) (NIED 2010:24).
- Grade 10-Topic 4: The air around us, pollution of the air, water and energy conservation (JSC Physical Science Syllabus) (NIED 2010:46, 47, 48).
- Grade 11and12- Physics Section: Topic 2.2.2 Measurement of temperature and Topic 5 Nuclear Physics (5.2 Radioactivity); Chemistry: Topic4.1 Production of energy, Topic 8 Industrial uses and application chemistry, Topic 10 Environmental Chemistry (NSSCO Physical Science Syllabus) (NIED 2009:37).

This research study's focus was on Grades 11-12 Physical Science, therefore, for the discussion on progression the researcher has only highlighted a few topics for Grade 8-10. The environmental topics found in Grade 11-12 in Physical Science that speak to climate change are discussed in more detail. There is no incremental approach in the teaching of Physical Science topics under the current syllabi. For instance, topics dealt with in Grade 8 and 9 are again taught in 10 and 11 without expanding on the contents of the topics. For example, the Grade 8 syllabus Topic 3 teaches about air, particularly the gases of the air, whereby learners are required to outline the uses of those gases, namely carbon dioxide. In Grade 9 Topic 3 focuses on the reactions of acids, alkalis with metals as an environmental topic without considering the environmental impacts of acids. The same topic continues to Grade 10 without considering any environmental impacts posed by such toxic acids to the atmosphere. Grade 10 learners are taught about the air around us, pollution of the air, water and energy conservation. However, this is mainly a repeat of Topic 3 for Grade 8 and Topic 3 for Grade 9 because the topic of environmental chemistry in Grade 10 does not progress to related environmental problems and solutions. It is important to underscore that Grade 10 Topic 4.6 focuses on air pollution and Topic 4.7 focuses on water and its availability in

Namibia. Furthermore, topics such as Nuclear Physics and industrial uses and application chemistry need to emphasise the dangers to the environment and possible solutions emanating from the use of such materials in order to educate for a sustainable future.

Evidence contained in the syllabi (NIED, 2009:37) shows that there is no systematic progression approach with regard to current global environmental issues, particularly those of climate change (global warming) as stated in the objectives of the National Policy on Climate Change for Namibia. The only progression taking place is that there is a repetition of basic competencies in all the syllabi from one level to another which mainly teaches more on the production and usefulness of such resources, but fails to balance such concepts with current problems and solutions in a critical thinking approach, especially in the senior secondary level Grade 11 and 12. In this regard, it can be stated that the Physical Science syllabus does not comprehensively focus on matters of global significance such as climate change and global warming.

### **3.5 CURRICULUM DEVELOPMENT FOR ENVIRONMENTAL LEARNING**

This section looks at ways through which the development of an environmental learning curriculum can be achieved in Namibia. In coming up with strategies of curriculum development, this section explores global initiatives that were introduced to develop a formal education curriculum that responds to the environmental needs of society. In education the term curriculum refers to a planned sequence of instruction, with a set of learning objectives that clearly articulate how and what should be taught to learners in the classroom teaching across all subject content grades. Thus, curriculums are based on a particular understanding of why a curriculum should be developed, what knowledge and skills should be included and how teaching should take place.

Alsubaie (2016:106) remarks that curriculum development is an ongoing process that should meet the current needs and demands of society through crafting educational programmes that are relevant to contemporary society, especially since education plays an important role in a changing society (Conde & Sanchez, 2010:477). Environmental education is important because environmental damage poses a serious threat to human life (Bakhitiar & Nugroho, 2016:20). In this regard, environmental education is one of the ways through which the deterioration of the environment can be addressed. The above-mentioned authors emphasise

that curriculum development for environmental learning in formal education systems will help in the fight against environmental damage.

With regard to environmental learning, curriculum development should be based on an open-ended process that engages learners because a curriculum must be viewed as an ongoing process rather than an absolute and finished product (Lobser, 2014:148). As such, a comprehensive curriculum development strategy for environmental learning should equip learners with the ability to organise, construct and structure knowledge by interacting with the society through a social constructivism approach (DoE, 2011:1).

Hungerford *et al.* (2010:42) underscore that environmental education has improved over the past decades, but that the development of the goals of curriculum developments is still lagging behind. One of the problems facing curriculum development in environmental learning is the “lack of principles of selection which could operate to validate curriculum items” (Hart, 1981:12). Apart from equipping learners with the requisite competencies, curriculum development also creates avenues for teachers to take part in determining the nature and content of environmental learning earmarked for learners. As such, curriculum development is a tool through which the skills of teachers can be constantly upgraded to meet prevailing trends (Loubser, 2014:149-151). The development of an environmental curriculum must take into account the existing knowledge embedded in society and also regional and international practices that have been implemented and that have produced positive outcomes (Bakhitiar & Nugroho, 2016:22). Thus, a national curriculum should be holistic and relate to the core values, attitudes and skills based on real life issues of globalisation which demand active involvement in finding solutions to contemporary global problems (Pandey& Kumar, 2018).

With the issue of globalisation in mind, schools need to take ownership of the basic and local curriculum to re-examine the purpose of the school curriculum and how it contributes towards addressing local, regional and global challenges. Therefore, learners should aspire, through global citizenship, to contribute towards global solutions. Global citizenship is based around a set of core competencies designed to effectively support learners as active global citizens by providing them with relevant engaging contexts which include their interests, experiences and opinions (Oxfam Education, 2012:2). Against this backdrop, the interpretivists approach (discussed in the next section) is significant to this study.

### **3.6 THEORETICAL FRAMEWORK OF THE STUDY**

According to Heidtman *et al.* (2000:17), a theory is a “major result of any type of scientific activity and research. It is the meaning and criteria set for its construction stand for the level of development of the discipline”. A theory is a set of “interrelated universal statements, some of which are definitions and some of which are relationships assumed to be true, together with a syntax, a set of rules for manipulating the statements to arrive at new statements” (Cohen, 1989:178). Furthermore, it can be understood as “a set of interrelated, general, universal and abstract statements which have an empirical import, supplemented by a set of scope conditions, which specify a theory's scope or domain of applicability” (Szmataka, 1997:91). A theoretical framework is a process of structuring a network of theories that have a bearing in a particular study (Kumar, 2014:385). Bruner’s theory of development is at the core of the theoretical foundation for curriculum development as it is dealt with in this study.

#### **3.6.1 Bruner’s theory of development**

Bruner’s theory states that education is a process of change negotiated between individuals and culture (Stenhouse, 1975:194). Hence, curriculum development should present useful knowledge, and visions of worthwhile life (Bruner, 1966:4). Bruner’s theory argues that educational reform should improve curriculum development and educational principles and practices. Bruner (1966:4) states that progressive experiential education motivates children to acquire daily experiences by expanding their perspectives beyond familiar ones. Therefore, the theory is focused on curriculum development that is determined by principles of intellectual excitement, creative interests in a subject through experimental explorations and constructed realities of contexts which are complementary rather than contradictory (Stenhouse, 1975:20-23). Stenhouse (2012) is preoccupied with ways of improving teachers’ practice by engaging learners in the curriculum process through explorative approaches to their communities. In this regard, teachers only act as facilitators in discovering new ideas and inviting learners to actively participate in the curriculum development process.

The theory is premised on an approach that seeks for a change in order to complement an ever-changing internal and external environment. Stenhouse (1975:4) pioneered this approach and he is of view that curriculum development should not be stagnant but it should be an on-going process that can accommodate for changes within latest developments. Thus, educational development needs to be in the form of principles that are open to change of

critical enquiry and should be capable of undergoing a translation that best suits to different contexts of practice (Stenhouse, 2012:2).

The theory is geared towards a process of change. The aspects of change coincide with the transformational perspectives underpinning this study. As stated earlier, this research study seeks to transform the nature and content of the current Physical Science syllabus in Namibia. In the succeeding chapters, the researcher motivates the need to transform the current syllabus in order to accommodate climate change education as a requisite subject in today's society that is continuously threatened by the effects of climate change. As such there is a need for curriculum change and transformation in learning achievable through the integration of climate change in the Namibian Physical Science syllabus for grade 11 and 12.

### **3.7 CONCLUSION**

This chapter dealt with the development of an environmental learning curriculum. It demonstrated that curriculum development should be an open-ended process that allows for reflection and regular reviews of the curriculum and should not be seen as fixed but as a process open to modern changes. This chapter discussed the antecedent stages and strategies of curriculum development in Namibia. The antecedent strategies and policies of curriculum development in Namibia show that curriculum development in Namibia is not static. On the contrary, it is an on-going exercise that seeks to develop and improve the national curricula.

It is against this backdrop that this research study advocates for the incorporation of climate change education as part of curriculum development in order to introduce a Physical Science syllabus that addresses local and regional challenges people face in their daily lives. This chapter provided an understanding of the phases and policies pertaining to the historical progression of Namibian educational curriculum development since the advent of independence in 1990 to date. The chapter discussed the phases of curriculum development focusing on strategies, achievements and shortfalls. Furthermore, this chapter dealt with the theories that support the study. Bruner's development theory provides the fundamental theoretical foundation of this study. The next chapter focuses on the research methodology and research design utilised in this study.

## **CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY**

### **4.1 INTRODUCTION**

The previous chapter dealt with curriculum development and the theory of this study. This chapter focuses on the research design and methodology used in this study. I used a case study design, relying on purposive sampling to select participants who were knowledgeable and experienced in senior secondary Physical Science and its curriculum development. Data was generated using semi-structured interviews, and inductive data analysis yielded broad generalizations from specific observations. Thus, the main purpose of this chapter is to discuss the methodology, research paradigm, sampling methods, the method of data generation and the methods of data analysis (Punch, 2006:45). As such, the various processes and undertakings utilised in the study will be discussed, as well as the methods and ways used to ensure that the findings of the study were credible and dependable, and can therefore be confirmed and transferred by other researchers in similar circumstances.

### **4.2 METHODOLOGY**

‘Research’ is the process of investigating beliefs about the nature of realities (ontology) or nature of knowledge (epistemology) in a systematic manner (Merriam & Tisdell, 2016:3). Lincoln and Guba (2005:2) state that it is an inquiry process systematically designed to collect, analyse, interpret and use data in order to understand, describe, predict or control an educational phenomenon and empower individuals in such contexts. This study adopted a qualitative research approach because it aimed to acquire a holistic picture of climate change education in Namibia in the Grade 11 and 12 Physical Science syllabus. The overall purpose of a qualitative research is to gain an understanding of how people make sense of their surroundings, delineate the process of meaning-making and describe how people interpret what they experience. In other words, qualitative researchers are mainly interested in understanding how people interpret their experiences, how they construct their worlds and what meaning they attribute to their experiences (Merriam & Tisdell, 2016:15). According to Braun and Clarke (2013: 3-4), a qualitative research approach only uses words as data generation and analysis in all sorts of ways rather than numbers, meaning that the descriptions of all findings within a qualitative research approach will be described and confirmed in words and not in statistical techniques. Berg (1998:56) points out that a qualitative approach is

viewed as best because it is suited for obtaining data on attitudes, perceptions, meanings and the description of social reality. A qualitative case study approach focuses on practice, intervention and interpretation with the aim of improving the situation. In the context of the limited understanding of climate change, schools, among other sectors of society, must help to foster innovative teaching of climate change and research (Fahey, 2012:703). Hence, by undertaking this research an opportunity was created to understand and improve effective measures of integrating climate change in the Namibian senior secondary Physical Science syllabus.

### **4.3 PHILOSOPHICAL ORIENTATION**

Creswell (2013:45) defines a research paradigm as a basic set of beliefs that guide actions. As such, researchers tend to have different beliefs and feelings about the world and how it should be studied and understood. There are certain rules that guide researchers' beliefs. These rules, according to Denzin and Lincoln (2011: 34), Creswell (2013:25) and Patton (2015:106), are referred to as paradigms, worldviews, theoretical perspectives, or philosophical assumptions. In research it is helpful to philosophically position qualitative research among other forms of research by exemplifying what one believes about the nature of reality (ontology) and the nature of knowledge (epistemology) in order to clearly understand people's beliefs as they engage in activities, experience or phenomenon of ongoing realities and constructed knowledge (Merriam & Tisdell, 2016:8).

The way researchers do their research is influenced by the purpose of their studies. Janse van Rensburg (2001:16) asserts that humans understand the world as it appears to them. Hence, research knowledge is constructed in the minds of the people who are active in the research process and understand the phenomena under inquiry. In simple terms, a paradigm is a way of looking at the world to guide and direct thinking of an action (Lincoln & Guba, 2005:7). As such, I interacted with the participants by listening and cooperating to the sharing of their experiences, therefore this research study was influenced by the interpretivist paradigm.

#### **4.3.1 Interpretivist paradigm**

Bertram and Christiansen (2014:26) point out that researchers grounded in the interpretivist paradigm "aim to understand how people make sense of their world. Likewise, that of the integration of climate change in the Namibian senior secondary Physical science syllabus.

Merriam and Tisdell, (2016:23) state that qualitative research is based on belief that knowledge is socially constructed by people in an ongoing fashion, as they engage in making meaning of an activity, experience or a phenomenon. The aforementioned views that interpretivist paradigm focuses on people's subjective experiences, how they construct their social world and how they interact with each other. Subjective in this case meaning that people's opinions can differ and change with time through a process of social interactions and experiential learning (Neil, 2006:1). The interpretivist paradigm stresses that people can be involved in 'making things happen' rather than have things happen to them. The above connotation means to say that "researchers do not find knowledge instead they construct it" through multiple realities or interpretations of a single events (Merriam & Tisdell, 2016:23). Neill (2006: 1) concurred that the interpretivist paradigm aims to understand the meanings that people give in their own social interactions as laid across by multiple realities which can differ in time and place. Consequently, an interpretivist worldview places people in their social contexts in order to present an opportunity and understanding of how they perceive their own activities (Maree, 2007:59).

Cohen *et al.* (2007:37) assert that "interpretivist researchers begin with individuals in order to understand their interpretations of the world". The goal of interpretivist paradigm is to gain some understanding of a particular situation or context. This means that, the interpretivist paradigm places primary emphasis on the process of understanding the situation in which the research is done. In other words, researchers become interested in the meaning that people make of phenomena by understanding and interpreting daily occurrence of social structure (Janse van Rensburg, 2001: 25). Henceforth, the researcher as an interpretivist social scientist using an interpretivist paradigm asks what kind of things people do, how they do them, what serves the purposes of activities and their significance to the participants (Bailey, 2007:2). Applying an interpretivist paradigm in this study indicates the interest of this researcher to gain contextual meaning-making, rather than generalized rules. In a nutshell Creswell, (2013:24-25) hinted that individuals seek to understand the world in which they live and work by developing subjective meaning of their experiences. Likewise, these subjective meaning are negotiated according to the norms of individuals' lives both socially, culturally and historically through interaction with others. In this regard the interpretivist perspective's purpose is to describe, understand and interpret the extent to which climate change can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education.

## **4.4 CASE STUDY APPROACH**

Yin (2014:16) states that a case study is “an empirical inquiry that explores a contemporary phenomenon in depth and within its real-world context”. A case study enabled me, the researcher, to understand real-world cases in practical terms, therefore they enhanced my understanding of important contextual conditions pertinent to the case being studied. Furthermore, a case study inquiry relies on multiple sources as evidence to converge the needed data in a triangulating fashion. Yin (2014:56) emphasises that a case study can contain either a single study or multiple studies. Yin (2014:184) further states that when a researcher chooses to do a multiple case study he/she should be able to analyse the data within each situation and also across different situations, unlike when a single case study is chosen. Moreover, a multiple case study design is of immense importance because the focus of the study is extensively on exploring and understanding rather than confirming and quantifying.

### **4.4.1 Multiple-case study design**

This study follows a qualitative approach with a multiple-case design made up of six Physical Science school teachers from the Kalahari cluster circuit, one Physical Science subject advisor and one National Institute for Educational Development (NIED) official. This multiple-case study design enabled me to collect vast and comprehensive data from the participants. Each case was selected with the understanding that it would either provide similar results and contrasting results, but for anticipated reasons (Yin, 2014:56, 57). Case studies are frequently used in the field of Social Sciences (Yazan, 2015:134; Starman, 2013:28). A case study research allows for an “in-depth review of new or unclear phenomena whilst retaining the holistic and meaningful characteristics of real-life events” (Phelan, 2011:221). A case study design would therefore enable me to obtain information from the above-mentioned identified participants, thereby gaining an in-depth understanding of the various concepts under investigation in the study. For example, I used a focus group interview with teachers from the Kalahari cluster circuit, and one-on-one interviews with the Physical Science subject adviser and the National Institute for Educational Development (NIED) officials for them to provide clear perspectives on the climate change integration in the syllabus. The design was confined to a specific subject through a flexible open-ended techniques of data generation and analysis.

The advantage of using a multiple case study design is that it enabled me to understand the differences and the similarities between the responses of the participants (six cases) and it allowed me to explore the research questions more widely (Gustafsson, 2017:3). It provided an overview of in-depth understanding of a case, process and interactional dynamics. It is against this backdrop that this study aimed to gain a holistic understanding of and explore the situation regarding the integration of the concept of climate change in the Namibian senior secondary Physical Science syllabus through environmental education. Through such a design the study provided as much information as possible by gathering information from different sources to understand it in its entirety. Therefore, the researcher spent sufficient time to build a rapport with the participants before collecting any data. Using multiple methods to collect data, such as obtaining information from documents and gathering data through a focus group interview and one-on-one interviews, was an important aspect of this case study (Kumar, 2014:156).

#### **4.5 SAMPLING METHODS AND PARTICIPANTS**

Sampling refers to the way a researcher selects a sample from the population under study (Kumar, 2014:382). It allowed me to choose research participants who would provide information that would be useful in investigating the research problem. A sample is a selection from a population drawn from a sample frame (Newby, 2014:699). Kothari (2004:152) states that sampling allows a researcher to obtain information about the whole sample frame by investigating part of it. In this study, purposive sampling was used to enable me to focus on a portion of the population, particularly participants from six senior secondary schools in the Kharas region of Namibia, as well as one Physical Science subject advisor and one National Institute for Education official who deals with the development of the Physical Science syllabi and resources to obtain the relevant data.

##### **4.5.1 Purposive sampling**

According to Patton (2015:53) and (Merriam & Tisdell, 2016:96), the logic and power of purposive sampling is to gain an in-depth understanding of a specific case through discovery, understanding and gaining inside information about issues of central importance to the purpose of the inquiry. In this case, I used purposive sampling to represent the case in its representative complexity and not the whole population of cases (Kumar, 2014:155). Thus I

selected all Physical Science teachers who teach Grades 11 and 12 in the six schools within the Kalahari circuit because of their vast knowledge of the subject and its syllabus. Tongco (2007:147) concurs that purposive sampling is a “deliberate choice of an informant due to the qualities the informant possesses”. The deliberate bias of purposive sampling promotes efficiency because a researcher knows exactly who should take part in the study. At the time of this research I was a teacher at a secondary school situated in the Kalahari circuit. As such, I possessed prior knowledge about the population of the study area and therefore knew which teachers could provide information that would be instrumental in solving the research problem. Using purposive sampling, I requested that all senior Physical Science teachers who taught Grade 11 and 12 in the six schools within the Kalahari circuit be selected for the research. The school where I taught had a locum teaching in my place and that locum participated in this study. The Physical Science subject advisor and the National Institute for Educational Development (NIED) official were also purposively included because of their vast knowledge pertaining to the development and planning of the Physical Science teaching content and materials.

#### **4.5.2 Sample population**

A population is the total possible number of participants who are likely to take part in the study. Through sampling, a researcher selects a portion of the total that can be included in the study. Sampling enabled me to get different views from a portion of the total population of participants (Grove *et al.*, 2012:44). In this study, six teachers were purposively selected to provide information that would be pertinent to the study. The Kharas region has a total of six Senior Secondary Schools which form part of the Kalahari cluster circuit. The Kalahari cluster circuit is an initiative programme which aims to empower subject teachers to meet once every school trimester to discuss and share information about their subject issues. Furthermore, the Kharas region has one Physical Science subject advisor who was also included in the sample of the study. In addition, a National Institute for Education and Development official who deals with the development of the Physical Science syllabi and resources within the Department of Natural Sciences was included in the sample. Both the subject advisor and official were part of the sample because of their vast knowledge and experience in curriculum development of Physical Science at regional and national level. The aforesaid sample population, both females and males, comprised a total of eight participants, thus, six teachers and two officials.

### 4.5.3 Focus of the study

According to Merriam and Tidell (2016:97), criteria-based selection should consider the area being studied as an important part of data generation process. In order to gain a deep understanding of the phenomenon under study, data was collected from a specific location, namely the Kharas region, situated in the southernmost part and the least densely populated out of the 14 regions of Namibia. The capital town of the Kharas region is Keetmanshoop, which hosts the bi-annual Kalahari cluster circuit. The six schools participating in this study are located within this circuit. Most schools have only two Physical Science teachers (one for Grade 11 and 12) and it is for that reason that only one teacher from each school was selected for the sample.



Figure 1 A map of the Kharas Region. (Source: Google Maps)

### 4.6 DATA GENERATION

In order to generate data from the research participants, I embarked on a data generation exercise. The process of collecting data from numerous methods using various sources is known as data generation (Hox & Boeije, 2005:593). Roberts (2007:4) postulates that data generation is the way in which researchers collect information from their sample. Different

methods, particularly exploring documents, focus group interviews and one-on-one interviews using open-ended questions were used to collect data in this study.

#### **4.6.1 Document research**

According to Bowen (2009:27), document analysis is a form of qualitative research in which documents are interpreted to give voice and meaning around a topic. Document analysis involves obtaining data from existing documents without having to question people through interviews, questionnaires or observing their behaviour. Thus, I discussed all the relevant documents within the literature review. In this study, focus was on the concept of climate change and environmental education in order to gather facts about the phenomenon. I studied Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD), the National Policy on Climate Change for Namibia, the National Curriculum for Basic Education, and the senior secondary Physical Science Syllabus Grade 11 and 12 for Namibia. The motivation for the relevant keywords used in the document analysis is found in Addendum A. An analysis of these documents was supplemented by the literature review that I undertook before conducting the semi-structured focus group interview and two one-on-one interviews. The documents provided me with in-depth knowledge about how the government of Namibia seeks to include and address climate change in the Curriculum for Namibia and in the Physical Science syllabus for Grade 11 and 12.

#### **4.6.2 Focus group interview**

A focus group interview is a rich method of gathering data and allowed me and the participants to have an open discussion about the phenomena under study. DiCicco and Crabtree (2006:315) state that focus group interviews allow a researcher to get a wider range of experience. I used a focus group to collect information about the integration of climate change in the senior secondary Physical Science syllabus from the six teachers.

Before undertaking the focus group interview, the researcher contacted the participants to seek their consent and to inform them about the venue and time of the focus group interview. Invitation letters were sent out in November 2017, prior to the bi-annual Physical Science circuit meeting (See Addendum E). The letter contained the objectives of the study and what was expected from the participants. The focus group interview was conducted in February

2018. A Physical Science circuit is a gathering of Physical Science teachers from a Region who meet biannually. The six teachers are located far apart, therefore, the researcher took advantage of the Physical Science bi-annual circuit to carry out a focus group interview. I used open-ended questions (See Addendum B) to conduct the focus group interview with the six teachers so that they could learn from each other's shared characteristics and marked differences of their Physical Science teaching experience with regard to how they include and address climate change. From the data collected the researcher consolidated the data that was relevant to the research questions. To qualify data, I utilised an academic research practice called member-checking. A detailed discussion of how member-checking was conducted in this study is contained in section 4.8.6.

#### **4.6.3 One-on-one interviews**

An interview is a conversation where questions are asked and answers are given. It is a one-on-one conversation with one person acting in the role of the interviewer and the other in the role of the interviewee (Steinar 1996:5). There are three types of interviews, namely structured interviews, semi-structured interviews and unstructured interviews (Bowen, 2009:28). DiCicco-Bloom and Crabtree (2006:315) state that semi-structured interviews are “organized around a set of predetermined open-ended questions, with other questions emerging from the dialogue between interviewer and interviewee”.

Before undertaking one-on-one interviews, the researcher contacted the two participants, namely the Kalahari circuit Physical Science subject advisor and the National Institute for Educational Development (NIED) official for Physical Science (See Addenda C & D) to seek their consent and to inform them about the venue and time of the interview. Invitation letters were sent out in November 2017 (See Addendum E). The letter contained the objectives of the study and what was expected from the participants. Using semi-structured interviews enabled me to ask questions and probe further in order to get a complete picture about how climate change is and can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education. A semi-structured interview combines the characteristics of a structured interview and an unstructured interview (Alsaawi, 2014:151). Thus, semi-structured interviews did not restrict me, the interviewer, to the pre-planned questions, but rather gave me an opportunity to follow up on what the participants will have said. Likewise, member-checking guidelines were maintained. A summary of the process of data generation is found in Table 2.

Table 2: A summary of the course of the data generation process

Data generation process	Dates
Approval to conduct research study from NWU Ethics Committee (See Addendum F)	21 September 2017
Permission requested to conduct study from Kharas Regional Council Directorate of Education, Art and Culture in Namibia (See Addendum G)	01 November 2017
Approval received to conduct research at schools located in the Kharas Region by the Kharas Regional Council Directorate of Education, Art and Culture in Namibia (See Addendum H)	19 December 2017
Participants were notified through invitation letters (See Addendum E)	8 January 2018
Data generation: Semi-structured one-on-one interviews and focus group interview were conducted (See Addenda B, C & D)	9, 16 and 22 February 2018

#### 4.7 METHODS OF DATA ANALYSIS

Data analysis structures, organises and give meaning to data collected by a researcher from the participants (Marshall & Rossman, 1999:150) and from documents. Data analysis was undertaken after I collected information from the documents researched and the research participants who I interviewed. Data analysis generates meaning and logical conclusions from information obtained (Schwandt, 2007:6). “Analysing and interpreting the data involves drawing conclusions about it, representing it in tables, figures, and pictures to summarize it and explain the conclusions in words to provide answers to the research questions” (Creswell, 2008:10). In this study, data collected from the documents researched was analysed using content analysis and the data collected from the participants was analysed using thematic analysis. According to Braun and Clarke (2006:79), thematic analysis is a qualitative analytic method for “identifying, analysing and reporting patterns (themes) within data”.

#### **4.7.1 Content analysis**

Merriam and Tisdell (2016:179) state that in a qualitative study, content analysis is used to analyse relevant documents. Content analysis is a technique that allows a researcher to analyse the symbolic qualities and expressive contents of unstructured data to give it meaning in relation to the objectives of the study (Krippendorff, 2013:49). Maree (2007:101) emphasises that content analysis is a “systematic approach to qualitative data analysis that identifies and summarizes message content”. In other words, content analysis assisted me to understand and interpret raw data by looking for similarities and differences in the documents pertinent to the study. Thus, it entails the analysis of relevant documents with the aim of gathering facts (Owen, 2014:10). Accordingly, I studied accessible documents about climate change and environmental education in Namibia.

These documents included government policy documents, namely Namibia’s Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD), the National Policy on Climate Change for Namibia, the National Curriculum for Basic Education and the Senior Secondary Physical Science Syllabus (Grade 11 and 12) for Namibia. The analysis of these documents enabled me to draw conclusions about the integration of climate change in the Namibian education system. More importantly, through content analysis I was able to foster comparisons and deductions on the Namibian government’s policy objectives and vision with regard to climate change. To this end, I was able to interpret the current developments in as far as climate change and environmental education are concerned in the Namibian education system. In this study the goal of content analysis was to assist me to arrive at well-informed and practical conclusions about the subject under study. As such, it was envisaged that data generated through content analysis would be instrumental in enabling me to come up with informed ways and strategies aimed at integrating climate change in the senior secondary Physical Science syllabus Grade 11-12.

Schneider (2013:173) remarks that analysing documents incorporates coding content into themes similar to how focus group or interview transcripts are analysed. Accordingly, this study utilised content analysis to analyse data from the policy documents discussed in this section (See Addendum A).

### **4.7.2 Thematic analysis**

Thematic analysis is a qualitative analytic method instrumental in “identifying, analysing and reporting patterns (themes) within data” (Braun & Clarke, 2006:79). It is widely used in qualitative research because it allows flexibility in a researchers’ choice of theoretical framework. The advantage of using thematic analysis is that it can be used in conjunction with the theory or theories that a researcher chooses in the study. The flexibility inherent in thematic analysis provides a rich and detailed description of complex data. In addition, it enables a researcher to compare participants’ opinions about different themes (Maree, 2007:101, 104). In this study, thematic analysis of interview data was instrumental in categorising certain phenomena of the curriculum. This study also confirms the notion by Braun and Clarke (2006:77) that it is appropriate to choose a method of analysis that is driven by both the research question and broader theoretical assumptions. In an effort to comprehensively analyse data using thematic analysis, I made use of the technological implements at my disposal. In this regard, I used a qualitative research analysis tool called ATLAS.ti™ 8 data analysis.

### **4.7.3 ATLAS.ti™ 8 software as a tool for organising empirical data**

ATLAS.ti™ 8 is a qualitative data analysis tool that can be used for audio, visual and text data (Smit, 2002:65; Wright & Bhatt, 2016:491). It assists a researcher to systematically and effectively analyse data in a qualitative study (Rambaree, 2014:1; Hwang, 2008:519). ATLAS.ti™ 8 does not analyse the data but is a tool for supporting the process of qualitative data analysis to make it easier to analyse data systematically (Classen, 2018:2). Petrova (2014:2) and Alvira-Hammond (2012:3-4) believe it is a qualitative data analysis tool which is used to code data. The software requires that text segments and coding schemes be defined before the data is entered, which contravenes the inductive categorisation strategy preferred by most qualitative researchers (Smith, 2002:68). With such software, unstructured textual material can be organised by attaching codes to certain text passages. The open-ended questions are analysed by means of coding, categorizing, and the identification of themes and incorporation as primary documents into one heuristic unit in ATLAS.ti™ 8. According to Rambaree (2014:12) and Smit (2002:65), the software allows a researcher to come up with codes of the main concepts in the study. The NCT (Noticing, Collecting and Thinking) model is used for data analysis (Friese 2012). Significant statements are noted, codes collected and thinking takes place when codes are conceptualized into categories and themes, and links are

made and described. These codes are subsequently read into the software. The software then organises the codes according to their frequency in the data. As such, the software enabled me to organise and present research findings in a legible manner. Classen (2018:2) believes that the software increases the validity of the research findings, especially in the conceptual stage of analysis because raw data is closely linked and there is transparency of the analytical process. In this study, after collecting data from the focus group interview and one-on-one interviews, I transcribed and coded the data before subjecting it to the ATLAS.ti™ 8 computer software. Using the coded data, the software organised the data into comprehensible and readily usage patterns. Figure 2 below is a flow chart that represents the process of data manipulation that was adopted in this study using the ATLAS.ti™ 8 software.

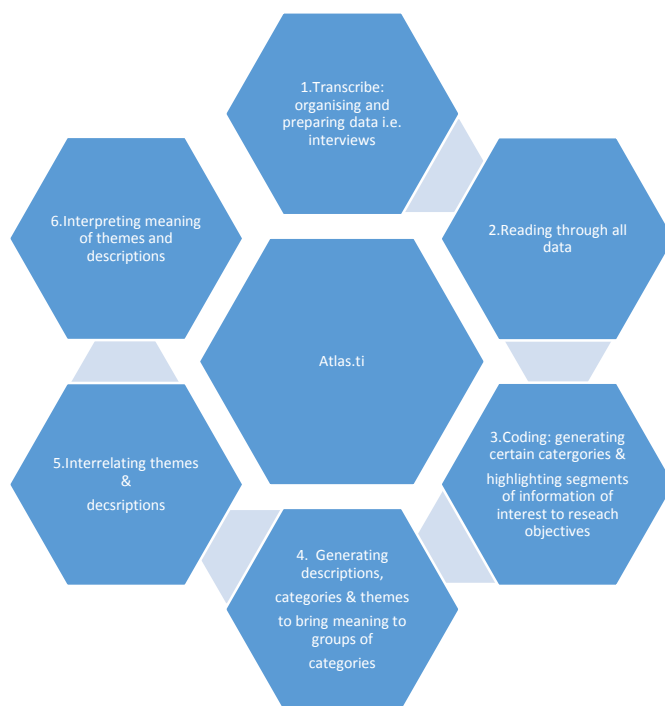


Figure 2 A flow chart representing the process of data manipulation in this research study using the ATLAS.ti™ 8 (Adopted from Creswell, J.W.2014. Research design: Qualitative, quantitative and mixed methods designs)

#### **4.8 THE ROLE OF THE RESEARCHER IN THE STUDY**

Denzin and Lincoln (2003:2) state that the researcher in a qualitative research is considered an instrument of data generation because the researcher plays a role in the collection of research information from the research participants. Accordingly, in this study, the researcher's role was to conduct semi-structured one-on-one interviews and a focus group interview. Thus, the researcher was a non-participatory observer who had the critical role of engaging with the

participants who were identified in this study. The overall aim of this exercise was to generate information pertinent towards addressing the research problem identified in the first chapter of this study. Punch (1998:5) believes that an effective qualitative researcher seeks to build a picture using ideas and theories from a wide variety of sources. Merriam (2009:52) describes how qualitative case studies are limited by the sensibility and integrity of the researcher, who is the principle investigator. Researchers often rely on their own instincts and reliabilities throughout the study. Bearing this in mind, in this study I was continuously guided by the various ethical considerations stipulated by the NWU Ethics Committee. Suffice it to say my ethical conduct was beyond reproach and always professional to ensure that the results emanating from the study were valid and reliable.

Therefore, the researcher had no influence on the nature of information provided by the research participants. The researcher was guided by the pre-prepared open-ended question schedule. As such, only questions relevant to the study were asked. The generation of empirical data was conducted in an objective and professional manner. In addition, the participants were informed of their rights and responsibilities in the study. If at any point they did not feel comfortable or unwilling to participate, they had the privilege to discontinue their participation. In essence, I did not in any way alter or add on to the information provided by the participants. Thus, the data generated from the study is legitimate, reliable and valid.

#### **4.9 QUALITY CRITERIA**

The criteria discussed below ensured that my bias and preferences did not interfere with the findings generated from the study. As stated in 3.7, I did not interfere with the participants' provision of knowledge because it would have interfered with the trustworthiness of the empirical data. This is important since Babbie and Mouton (2008:276) state that the key criterion of good qualitative research is found in its trustworthiness. Ultimately, the criteria discussed in this section seek to convince the reader about my impartiality and objectivity as researcher in the process of gathering and analysing data. Trustworthiness ensures that the results from a study are credible and authentic (reliable and valid) (Anney, 2014:272). Trustworthiness to the level of trust attached to the findings of the study. The concept of trustworthiness has further been divided into four aspects, namely credibility, dependability, transferability and conformability (Gunawan, 2015:10). According to Krefting (1991:321), qualitative research considers the issue of trustworthiness prior to deciding whether the findings of qualitative research have relevance to their day-to-day work. Trustworthiness is

the extent to which the findings of a study are an authentic reflection of the personal or lived experiences of the phenomenon under investigation. Trustworthiness is the way in which a researcher is able to persuade the readers that the findings in the study are worth paying attention to and that the research is of high quality (Maree, 2007:305). In other words, in research, trustworthiness refers to the degree of accuracy and dependability of any given study.

#### **4.9.1 Credibility (Truth value)**

To ensure the rigour of findings' trustworthiness, Farmer *et al.* (2006:377) state that there are several strategies through which researchers may ensure the trustworthiness of their research in accordance with truth value, applicability, consistency and neutrality criteria.

Trustworthiness is intertwined with credibility. Credibility refers to the assurance that a researcher's conclusions emanate from the data and should be presented and discussed in an accurate manner as obtained from the participants. Kumar (2014: 368) maintains that credibility refers to a situation where the results obtained by research through qualitative means are agreeable to the participants of the research study. To ensure that this study was credible, I first obtained ethical clearance from the North-West University's Ethics Committee (See Addendum F). While conducting the document research I made sure that the documents used were valid. I investigated their credibility to determine whether there was any form of bias. Furthermore, the Physical Science teacher's consent (See Addendum I), Physical Science subject advisor's consent (See Addendum J), and the National Institute for Education's official for Physical Science's consent (See Addendum K) were sought before the event of collecting data. The invitation letter (See Addendum E) and permission request letter (See Addendum G) state the objectives of the study and the rights and responsibilities of the participants. Therefore, in this study, I gathered and presented information from the participants in an ethical manner, without altering, falsifying or making any unauthorized additions. This is substantiated by the subsequent member-checking that was conducted to harmonise the results of the study and the data provided by the participants. Thus, on the whole, every effort was made to ensure that the results would be credible and beyond question.

#### **4.9.2 Transferability (Applicability)**

Applicability refers to the extent to which the findings can be transferred or have applicability to other settings and target populations (De Vos *et al.*, 2011:352; Stommel & Celia, 2004:289). In order to achieve transferability, I provided a thick description of the nature of the study participants and their reported experiences. I identified and described sufficient data and compiled the findings so that it became easier to evaluate the applicability of the data to other settings and contexts (Polit & Beck, 2008:539).

#### **4.9.3 Dependability (Consistency)**

Dependability is one of the criteria used to establish trustworthiness by performing an audit of the study's findings (Brink, 2006:125). Dependability therefore refers to the stability (reliability) of data over time, conditions and occasions (Polit & Beck, 2008:539). To achieve dependability, I submitted the collected data to two different researchers to examine it officially and they then compared the results to confirm its accuracy (Stommel & Will, 2004:288). In this study, member-checking was done to ensure that the findings were authentic, reliable and relevant.

#### **4.9.4 Confirmability (Neutrality)**

Confirmability refers to objectivity, which has the potential for congruence between two or more independent people about the data's accuracy, relevance, and how to interpret it (De Vos *et al.*, 2011:352; Polit & Beck, 2008:539; Stommel & Will, 2004:288). To achieve confirmability, I used audit trails in which the approaches to data generation, decisions about data to collect and about the interpretations of data were carefully documented so that another knowledgeable researcher could have arrived at the same conclusions about data as the primary researcher (Stommel & Will, 2004:288). I ensured that the findings reflected the participants' voices and the condition of inquiry, not my biases, motivations or perspectives (Polit & Beck, 2008:539). I also ensured that there was an internal agreement between my interpretation and the actual evidence (Brink, 2006:125). There was consensus between me, the participants and the supervisor (co-coder).

#### **4.9.5 Triangulation**

Triangulation is a research technique that seeks to ensure the credibility and reliability of the study information. It involves “the careful reviewing of data collected through different methods in order to achieve a more accurate and valid estimate of qualitative results for a particular construct” (Oliver-Hoyo & Allen, 2006:42). Krefting (1991:222) states that it is important to consider triangulation strategies and member-checking strategies between a researcher and the participants to determine how the research findings may impact on their practice. Thus, in this study, triangulation was employed to ensure that all the information in the study was consistent and dependable. Farmer *et al.* (2006:377) state that triangulation is better used to capture a holistic view of the phenomenon being studied, leading to a greater understanding of the phenomenon as each research strategy used contributes a different piece to the puzzle. Each strategy chosen offers another unique perspective on the phenomenon. Triangulation used for the purpose of completeness means divergent results can enrich the explanations for the phenomenon rather than leaving a researcher puzzled about what to do with results that do not converge (Redfern & Norman, 1994: 56). According to Lincoln and Guba (1985:305), triangulation refers to the use of multiple and different sources, methods, investigators and theories. In an effort to ensure the generation of credible, reliable and trustworthy data, this study selected a qualitative research strategy commonly known as triangulation. Triangulation was achieved through documents from the literature review, the focus group interview, and two one-on-one interviews. Triangulation is the cross-checking of multiple sources of data and data generation techniques to ensure that research findings are credible (Yeasmin & Rahman, 2012:154). The usage of several sources of information enabled this study to counter-balance and verify the credibility of data generated. For example, data obtained from the one-on-one interviews and the focus group interview can easily be collated with information contained in government policy documents and other resources, such as the senior secondary Physical Science syllabus and the Namibia National Curriculum for Basic Education.

#### **4.9.6 Member-checking**

Another strategy through which researchers may try to ensure the trustworthiness of their research is to conduct member-checking (Punch, 2005:237). This refers to the involvement of participants in the data analysis process, providing opportunities for them to read, comment on and contribute to the findings. I conducted member-checking upon the completion of the

data generation to ensure that the views of the participants were accurately captured. After the interviews, I discussed the interpretation of the research findings with the participants to find out whether they were accurate and gave them an opportunity to volunteer additional information. Member-checking requires a researcher to return to the participants who participated during the study and discuss the interpretation of the collected data (Creswell, 2007:202; Lincoln & Guba, 1985:314; Guba & Lincoln, 1989:47). One of the purposes of conducting member-checking is to give the participants the opportunity to correct errors and challenge interpretations. I made appointments with the teachers, the subject advisor and the official, where I gave the opportunity to go through the information they provided during field study to ensure that my interpretations were inline with their contributions. Member-checking also provides an opportunity to summarise the collected data, regarded as the first step towards data analysis. Member-checking is important because it guards against research bias by eliminating misrepresentation and misinterpretation of data. Furthermore, it afforded me an opportunity to gain clarity on misunderstandings and get additional information as well as to correct errors (Guba & Lincoln, 1989: 47).

#### **4.10 ETHICAL CONSIDERATIONS**

This study was approved by the Research Ethics Committee of the Faculty of Education Sciences (EduREC) at the North-West University (NWU). The ethical approval certificate (See Addendum F) gave me permission (Ethic number NWU-00701-17-S2) to conduct the research study in line with the ethical guidelines of the Education Research Ethics Committee. Ethical considerations play a major role during a research study such as the avoidance of plagiarism, honesty in reporting results as well as the confidentiality and anonymity of the participants (Welman *et al.*, 2012:181). In the same vein, Henning *et al.* (2004:73) state that ethical behaviour refers to the awareness that participants need to have their privacy and sensitivity and other rights protected.

##### **4.10.1 Permission letters**

The study was granted approval by the NWU's Research Ethics Committee in the Faculty of Education Sciences that allowed me to conduct a low-risk research study (See Addendum F). Additionally, I sent out a letter to the Namibian authorities (the Ministry of Education in Namibia) before the onset of data generation (See Addendum G) requesting permission to

collect information through a focus group interview and one-on-one interviews with the participants identified in section 4.4.2. Permission was granted (See Addendum H).

#### **4.10.2 Voluntary participation**

Participants in a research ought not to be coerced or tricked into taking part in the study. To this end, I ensured that research participants participated voluntarily and without coercion and/or undue influence, as was explained in the invitation letter sent to participants (See Addendum E). Accordingly, Neuman (2003:124) highlights that taking part in a research study should always be voluntary.

#### **4.10.3 Informed consent**

Consent to take part in a study should be informed. In other words, participants should be aware of the aspects of the study before they decide whether or not to participate. Kumar (2014:285) maintains that informed consent implies that participants are made aware of the type of information a researcher wants from them, why the information is being required, what purpose it will be put to, how they are expected to participate in the study and how it will affect them directly or indirectly. Consent should be voluntary and without pressure of any kind. A permission letter seeking consent clearly stipulating participants' voluntary participation was given to each participant (See Addenda I, J &K). To further cultivate the doctrine of informed consent, before the onset of each interaction with the participants, I underscored the need for informed consent. Thus, the consent letter was signed by both parties before the commencement of data generation.

#### **4.10.4 Privacy**

I assured the participants that I would respect their right to privacy. The right to privacy is a way of keeping the participants' information in a confidential manner (Kumar, 2014:286). Privacy ensures that the identity of participants in the study remains anonymous (Welman *et al.*, 2012:201). Therefore, particularsthat could identify participants, such as their names and schools, were not divulged. To further enhance participants' privacy, I replaced their names with letters and numbers. Furthermore, information of a personal nature that was not relevant to the study was avoided. Thus, only the name of the circuit in which the schools are found was made known. According to Kumar, (2014:286) the environment in which the participants

work should be free of any form of discomfort, such as anxiety and harassment. Participants should be given the assurance that they will be indemnified against any physical and emotional harm (Welman *et al.*, 2012:201). In addition, participants were informed that they could withdraw from the study at any stage without any fear of victimisation. Under the guidance of the supervisor, I ensured that all data was kept in a safe place as per the guidelines of the NWU.

#### **4.11 CONCLUSION**

This chapter focused on providing a detailed narrative of the research methodology and design utilised in this study. It was stated that the study employed a qualitative approach in gathering and analysing data from the participants selected for the study. In addition, the philosophical paradigm of the study was discussed. In this regard, it is important to note that an interpretivist paradigm underpinned this study. As such, using an interpretivist approach, I undertook to explore ways through which climate change can be incorporated in the Namibian Senior Physical Science Syllabus. This line of reasoning was influenced by the prominence of climate change and its related concepts in our contemporary societies. The chapter also dealt with the methods and techniques employed to collect and analyse qualitative data. Accordingly, a focus group interview and two one-on-one, semi-structured interviews were used to collect data from the participants in the study. Upon collecting data, thematic analysis using ATLAS.ti™ 8 software and content analysis of the documents researched were utilised to analyse data that was generated from the field. The trustworthiness of the data was also discussed, as well as the ethical considerations of the study.

## **CHAPTER 5: REPRESENTATION OF DATA FINDINGS AND INTERPRETATION**

### **5.1 INTRODUCTION**

The previous chapter dealt with the research methodology and research design utilised in this study. As such, Chapter 4 contained the methods and instruments used by the researcher to collect data from the participants that were identified in Chapter 1. This chapter is devoted to presenting the findings generated from data collected from the participants. As mentioned in section 4.5.1, the following documents, namely the National Policy on Climate Change (2011) for Namibia, the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) (2017), the National Curriculum for Basic Education (2010), and the senior secondary Physical Science syllabus (Grade 11-12) for Namibia were analysed by means of content analysis. Furthermore, in line with section 4.5.2, focus group interviews using open-ended questions were conducted with the aim of collecting information about the integration of climate change in the senior secondary Physical Science syllabus. The one-on-one interview using open-ended questions was conducted, which involved the Physical Science subject advisor and the National Institute for Educational Development (NIED) official for Physical Science for the data generation. Both the focus group interview and one-on-one interviews' results were analysed through thematic analysis using ATLAS.ti™ 8 software, as highlighted in section 4.6.2 and 4.6.3.

### **5.2 DOCUMENT RESEARCH**

As discussed in section 4.6.1, the official documents used in the study were analysed using content analysis. Content analysis enables a researcher to distil words into fewer content-related categories (Satu & Kyngus, 2007:107). Each document was discussed in Chapter 2. A brief review of each of the documents follows.

The National Policy on Climate Change for Namibia (NPCCN) is a policy document that encapsulates the current information about climate change in Namibia. The draft policy on Environmental Education (EE)/Education for Sustainable Development (ESD) discusses the findings obtained from the selected data generation tools, particularly with reference to Namibia. The Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) (EE/ESD) presents the national guiding principles and frameworks for mainstreaming environmental issues in the country. The National Curriculum

for Basic Education (NCBE) ensures continuity of the foundation principles of the Namibian education system. The goal, aims, competencies, core skills and key learning areas were identified in relation to Namibia Vision 2030 and are presented as a curriculum for the future. The senior secondary Physical Science syllabus (Grade 11-12) (PSS/Grade 11-12) is the document used by teachers for teaching and learning. It was developed in 2010 by the Ministry of Education in collaboration with the University of Cambridge International Examinations. The Physical Science syllabus is modelled around the Namibia National Curriculum Guidelines. The frequency of main key words and general key words motivated for in Addendum A are presented in Table 3 and Table 4 respectively.

Table 3: Content analysis of the main keywords identified in this study

Key words ✓ Present X notfound (Frequency in documents) One example is presented.	NCBE	PSS/ Grade 11-12	EEESD	NPCCN
Climate change	X(0)	X(0)	✓ (10) Promote objectives of UNFCCC and environmental issues through educational programmes centred on climate change (EE/ESD,2017: iv,vi,1,2,4,11&16)	✓ (283) An overview of climate change in Namibia (NPCCN,2011:i- 44)
Anthropogenic phenomenon / Human modification / human activity/ Human induced processes	X (0)	X(0)	X(0)	✓ (1) Made by people or resulting from human activities. Usually used in the context of emissions that is produced as a result of human activities (NPCCN,2010:38)

	NCBE	PSS/ Grade 11-12	EEESD	NPCCN
Industrialization /Industrial processes	X(0)	X(0)	<p>✓ (1) Bio-physical issues Population growth, urbanization and industrialization increases pollution and toxins into Namibia's urban environment: Education for sustainable urbanization ensures minimization of these effects (EEESD,2017:11)</p>	<p>✓ (1) Industrial processes as a result of principal anthropogenic greenhouse gas that affects the Earth's radiative balance (NPCCN,2010:38)</p>
Burning of Fossil fuels	X(0)	<p>✓ (1) state the source of sulphur dioxide from the combustion of fossil fuels which contain sulphur compounds (leading to 'acid rain') NSSCO Physical Science (Syllabus NIED, 2009:37)</p>	X(0)	<p>✓ (1) By-product of burning fossil fuels and biomass, as well as land-use changes(NPCC,2010:38)</p>
Natural Phenomenon	X(0)	X(0)	X(0)	X (0)
Natural climate variability	X(0)	X(0)	X(0)	<p>✓ (1) Refers to changes in patterns, such as precipitation patterns, in the weather and climate(NPCCN,2010:39)</p>

	NCBE	PSS/ Grade 11-12	EEESD	NPCCN
Global warming/increased in carbon dioxide in the atmosphere	X(0)	<p>✓ (1)</p> <p>The Namibia National Curriculum Guidelines: provide insight and understanding of crucial “global” issues in a rapidly changing world which affect quality of life: global warming, environmental degradation (NSSCO Physical Science (Syllabus NIED, 2009:1)</p>	X(0)	<p>✓ (8)</p> <p>Global warming is an average increase in the temperature of the atmosphere near the Earth’s surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, “global warming” often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. Preservation carbon offset projects which are in line with global warming solutions (NPCCN,2011:1, 16&amp;41)</p>
Infrared radiation	X(0)	X(0)	X(0)	<p>✓ (1)</p> <p>Greenhouse gases absorb infrared radiation in the atmosphere (NPCCN,2011:41)</p>
Carbon dioxide	X(0)	<p>✓ (5)</p> <p>State that photosynthesis leads to the production of glucose from carbon dioxide. Describe the use of the following tests to identify carbon dioxide. Describe the composition of</p>	X(0)	<p>✓ (4)</p> <p>Carbon Dioxide (CO<sub>2</sub>)A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. Greenhouse gases include carbon dioxide (CO<sub>2</sub>) etc. (NPCCN,2011:1)</p>

		clean air as carbon dioxide etc.NSSCO Physical Science Syllabus. (NIED 2009:27,29,34,51,52)		
	<b>NCBE</b>	<b>PSS/ Grade 11-12</b>	<b>EEESD</b>	<b>NPCCN</b>
Carbon dioxide emissions	<b>X(0)</b>	<b>X(0)</b>	<b>X(0)</b>	✓ <b>(2)</b> The release of a substance usually a gas when referring to the subject of climate change into the atmosphere. Greenhouse gases include carbon dioxide (CO <sub>2</sub> ) etc. (NPCCN,2011:40,1)
Ozone layer depletion	<b>X(0)</b>	<b>X(0)</b>	<b>X(0)</b>	✓ <b>(1)</b> Ozone Depleting Substance deplete stratospheric ozone (chlorofluorocarbons & hydro-chlorofluorocarbons). Greenhouse gases include, ozone (O <sub>3</sub> ) (NPCCN,2011:42)
Energy	✓ <b>(1)</b> They learn to manipulate and relate to the natural environment in the value-framework of the sustainable use of matter, energy (The National Curriculum for Basic Education,2010:13)	✓ <b>(51)</b> Show understanding of sources of energy and alternative sources of energy NSSCO Physical Science Syllabus (NIED, 2009:6-27)	✓ <b>(5)</b> Mines and Energy promote energy conservation, renewable energy, pollution control and promote intergenerational equity policy in sustainable use of renewable and non-renewable resources (EEESD,2017:16)	✓ <b>(30)</b> Namibia could adopt alternative energy sources such as solar, wind, and biomass (NPCCN,2011: i, iii,1,3,9,18).
	<b>NCBE</b>	<b>PSS/ Grade 11-12</b>	<b>EEESD</b>	<b>NPCCN</b>
Water scarcity or low rainfall	<b>X(0)</b>	<b>X(0)</b>	<b>X(0)</b>	✓ <b>(1)</b> Namibia is predicted to

(drought) Temperature changes/Increase in temperature changes				suffer complete water scarcity by 2020 (NIED,2011:4) ✓ (3) Increase in temperature and low precipitation result in drought, and poor nutrition and sanitation (NPCCN,2011:4&6).
Rising in sea levels (flooding)	X(0)	X(0)	X(0)	✓ (11) Climate change induced sea level rise is expected to cause increased coastal erosion and flooding (NIED,2011:17)
Greenhouse gases	X(0)	X(0)	X (0)	✓ (6) Gases that absorb infrared radiation in the atmosphere is called Greenhouse gases (NPCCN,2011:1,38 &41)
Acid rain (ocean acidification)	X(0)	✓ (1) Contain sulphur compounds (leading to 'acid rain') NSSCO Physical Science (Syllabus NIED, 2009:37)	X(0)	X(0)
Deforestation/ Desertification/ Natural resources depletion	X(0)	X(0)	✓ (5) Namibia, as a member of the UN, should mainstream EE/ESD to implement Resolution 57/254 of the UN General Assembly with emphasis on MEAs on climate change, desertification and biological diversity.	✓ (6) Biodiversity loss leads to low tourism revenues. Rainfall changes, intensified land use hasten desertification & land degradation (NPCCN,2011:15,25,31,39,40) ✓ (5) Promote sustainable management to avoid land degradation and deforestation (NPCCN, 2011:1, 15,39). ✓ (9) Human life and nature's capacity to support human needs will severely be

				affected by the impacts of climate change NPCCN,2011:3,7,11, 21,26,43).
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Based on the data analysed, the findings in Table 3 show how the National Curriculum for Basic Education only contains the main keyword “Energy” and no other main keyword is found in this document. The word “energy” has the highest frequency of fifty-one (51) in the Physical Science syllabus, five (5) in the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development and thirty (30) in the National Policy on Climate Change. It is evident that all four the documents analysed refer the most to the theme of *energy* and its related issues (High consumption of energy, energy budget). As mentioned previously, the National Curriculum for Basic Education is a broad official policy for teaching, learning and assessment. It guides schools on how to organise the teaching-learning process by providing a coherent framework to ensure that there is consistency in the delivery of the syllabi through the planning, organizing and implementing of teaching and learning. For such a policy to not directly contain most of the main key words creates a gap in knowledge whereby teachers do not address climate change directly in the Physical Science syllabus for Grade 11 and 12. As a result, learners will not have an opportunity to master key issues related to climate change because these issues are not adequately addressed in class through the curriculum.

Table 3 shows how the Physical Science Syllabus refers to the following keywords: burning of fossil fuels, global warming, carbon dioxide, energy and acid rain. In the Namibia Draft Policy on Environmental Education (EE)/Education for Sustainable Development (ESD) only the following key words are highlighted: climate change, industrialization, energy and desertification. I observed that although the word “energy” was mentioned several times in the documents, “high consumption of energy or energy budget” were not mentioned in any of the four documents despite their close link to energy.

“Climate change” is the most frequently used main key term in the documents under investigation. It appears two hundred and eighty-three times (283) in the National Policy on Climate Change for Namibia and ten times (10) in the Draft Policy on Environmental Education (EE)/Education for Sustainable Development (ESD) for Namibia. For example, the National Policy on Climate Change for Namibia states that “*Namibia is recognized as one of the countries most vulnerable to the impacts of climate change*”; “*Climate change is real and*

*our actions and behaviours need to be more climate-sensitive*”; *“This Policy presents an overview of climate change from Namibia perspective, vulnerability of Namibia to climate change per sector”*; *“Financial provisions under the United Nations Framework Convention on Climate Change (UNFCCC) such as the Clean Development Mechanism (CDM), Green Climate Change Fund, Special Climate Change Fund, Adaptation Fund etc., represent a great opportunity for us to leverage much-needed investments into these areas”* (NPonCCforNamibia,2010: iii-46). It is striking that “climate change” does not appear in the Senior Physical Science Syllabus or the National Curriculum for Basic Education. It is further evident that most of the main key words only appear in the National Policy on Climate Change for Namibia.

Despite the latter policy document having identified education as a key issue in dealing with climate change, it has not yet influenced the Namibia Draft Policy on Environmental Education (EE)/Education for Sustainable Development (ESD), the National Curriculum for Basic Education and the Physical Science Syllabus to include practical ways through which the people of Namibia can adapt and mitigate the effects of climate change through education. The words anthropogenic phenomenon, human modification, human activity, industrial processes, burning of fossil fuels, natural climate variability, global warming, increased in carbon dioxide in the atmosphere, carbon dioxide, energy, ozone layer depletion, carbon dioxide emission, flooding, water scarcity, rising in sea levels, greenhouse gases, deforestation, desertification, natural resource depletion and infrared radiation all appear in the National Policy on Climate Change for Namibia documents except for natural phenomenon and acid rain (ocean acidification). ‘Global warming’ appears once in the Physical Science syllabus and eight times (8) in the National Policy on Climate Change. ‘Burning of fossil fuels’ appears once in the Physical Science syllabus and once in the National Policy on Climate Change. ‘Carbon dioxide’ appears five times (5) in the Physical Science syllabus and four times (4) in the National Policy on Climate Change. Infrared radiation, water scarcity, emissions of carbon dioxide and ozone depletion each appear once in the National Policy on Climate Change. Rising sea levels, desertification, increase in temperature changes, natural resource depletion and deforestation appear in the National Policy on Climate Change at various frequencies, as shown in Table 3. Greenhouse gases appears six (6) times in the National Policy on Climate Change. Lastly, acid rain only appears once (1) in the Senior Physical Syllabus, as shown in Table 3. It is important to note the manner in which greenhouse gases does not feature in the Physical Science syllabus and only

in the National Policy on Climate Change. Acid rain only appears once in one document (Physical Science syllabus). It is evident that policy has not yet informed the curriculum and Physical Science syllabus.

Table 4 below represents the content analysis of the general keywords contained in the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD), the National Policy on Climate Change for Namibia, the Namibian National Curriculum for Basic Education (NCBE), and the Physical Science syllabus for Grade 11 and 12. The general words used in this study integrate the principles, values and practices of sustainable development in education and learning in order to address modern social, economic, cultural and environmental challenges.

Table 4: General keywords identified in this study

Keywords found verbatim ✓ Present X notfound (Frequency in documents) One example is presented	NCBE	PSS/Grade 11-12	EEESD	NPCCN
Education for Sustainable Development (ESD)	X(0)	X(0)	✓ (4) Education for Sustainable Development (ESD) policy is one of the means to mainstream environmental issues and promote MEAs into sectoral and sub-sectoral strategic plans(EEESD,2017:1).	X (0)
Environmental Education	X(0)	X(0)	✓ (26) coordinate EE activities (EEESD,2017:22)	X(0)
Sustainable development goals (SDG)	X(0)	X(0)	X(0)	X(0)
Environmental learning impacts	X(0)	✓ (1) Environmental impact (nuclear power stations)(NIED,2009:6)	X(0)	X(0)
Learning for sustainability	X(0)	X(0)	X(0)	X(0)
Sustainability	X(0)	X(0)	✓ (10) Learning process based on the ideals and principles underlying sustainability and concerned with all levels and types of learning to provide quality education and foster sustainable development.promote policy on sustainable use of resources (EEESD,2017:1,16)	✓ (3) Accessible technology, skills transfer and sustainability (NPCCN, 2011.

Based on the data analysed and presented in Table 4, the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) contains most of the general words except for Sustainable development goals (SDG), Environmental learning impacts and Learning for sustainability. On the other hand, the National Curriculum for Basic Education does not highlight any of the general words under investigation. Similarly, the National Policy on Climate Change for Namibia only refers to “sustainability”, which is highlighted three (3) times. “Sustainability” appears ten (10) times in the Draft Policy on Environmental Education(EE)/Education for Sustainable Development (ESD) for Namibia. Environmental education appears twenty-six (26) times in the Draft Policy on Environmental Education(EE)/Education for Sustainable Development (ESD) for Namibia, Education for Sustainable Development (ESD) appears four (4) times in the latter document, whilst “environmental learning impact” appears only once (1) in the Physical Science syllabus (Grade 11 and 12).

Based on the findings presented in Table 4 it is evident that the general terms used in this study do not appear frequently in the four documents under investigation. This is a cause for concern because global citizenship education is vital (cf. 3.5) to ensure that learners are equipped with knowledge, skills and values of the changing world and make sense of a world faced by environmental changes. The general words are important because they promote awareness of climate change to the wider world and instil values of diversity and sustainability globally. In the same vein, The Oxford Committee for Famine Relief (Oxfam, 2017:4) postulates that knowledge, skills and values should promote globalisation and interdependence, self-awareness and reflections, as well as concern for the environment and commitment towards sustainable development. Therefore, in order to develop learners who are able to adapt to societal changes, it is crucial to foster environmental stewardship that improves the quality of life by developing their creativity and innovation competencies that will benefit our contemporary society and our future generations.

### **5.3 ANALYSING THE FOCUS GROUP INTERVIEW**

The focus group interview results were thematically analysed using ATLAS.ti™ 8 software. As stated in section 4.5.2, I used open-ended questions to elicit responses from the six teachers who were each drawn from six schools within the Kalahari region. The group was made up of two males and four females. Teachers were assigned pseudonyms (T1, T2, T3, T4, T5, T6) for easy identification during the interview and to protect their privacy before

and after the interview. This was done in line with the declaration made by the researcher in section 4.10.4. Below, some background information of the participants that took part in this study is provided by highlighting their experience and expertise in the subject Physical Science.

Teacher T1 is a male teacher with four years' teaching experience. He holds a Basic Education Teacher Diploma (Namibia), Junior Secondary in Physical Science and an advanced certificate in learner support. He recently moved to the current school. Teacher T2 is a female teacher with three years' teaching experience. She holds a Bachelor's degree in Junior Secondary Physical Science qualification. Teacher T3 is a senior female teacher with six years' teaching experience in Junior Secondary Physical Science teaching and one year in the senior secondary phase. She holds a Bachelor's degree in Physical Science. Teacher T4 is a female teacher with one year's experience in the senior secondary phase at the current school. She holds a Bachelor's degree in Pure Science. Teacher T5 is senior teacher with 15 years' experience in both the junior and secondary phase at the current school. She holds a Basic Education Teacher Diploma (Namibia) in Physical Science, advanced certificate in curriculum studies and an Honours degree in Learner Support Education. Teacher T6 is a male senior teacher with eight years' experience in senior secondary Physical Science teaching. He holds a Basic Education Teacher Diploma (Namibia), Advanced certificate in Curriculum Studies and Honours degree in Leadership and Management, Laws and Systems in Education.

### **5.3.1 Aspects of teachers' understanding of climate change**

Figure 3 collates teachers' opinions with regard to their understanding of climate change. During the focus group interview, the teachers demonstrated sufficient knowledge about climate change. All six teachers optimally contributed to the discussion that required them to express their knowledge of climate change. As shown in Figure 3, the general consensus submitted that climate change is the noticeable change in the elements of weather. For example, T3 stated that "*climate change is a result of too much carbon dioxide in the atmosphere that blocks the heat when it is escaping from the earth*". T3's response relates to the literature sources in section 2.2.1. T5 was of the opinion that climate change results in "*changing experiences which increased to more drought and higher temperatures and less rainfall for the three years in Namibia as well as coastal sea levels constantly rising due to the melting of the arctic and the Antarctic circles*". It can be said that the participants

involved in the focus group interview sufficiently understand what climate change entails and corresponded with the literature reviewed in this study. Words used in this study, such as those identified in Table 4, i.e. *change in temperature globally, changes in rainfall, high carbon dioxide in the atmosphere, unusual behaviour of the environment, drought, higher temperatures, less rainfall, sustaining environmental resources, global warming, greenhouse effect, natural disasters, gases in the atmosphere, ozone layer, planting trees to increase oxygen, heating of the atmosphere, greenhouse gases, ozone depletion, atmospheric carbon dioxide concentration leads to acidification, CFC friendly chemicals, production of CO<sub>2</sub> and carbon monoxide, alternative methods of energy, air pollution, environmental friendly, burning issue, altitude levels rising in coastal towns, tree-planting day, protecting the environment and sustaining the available resources environmental preservation*, were mentioned by teachers during the interviews, thereby demonstrating great awareness on the subject.

It was noted that teachers referred to global warming and high carbon dioxide in the atmosphere which damages the ozone layer in most of their responses. It was further noted that the teachers' knowledge about climate change is related to the information reviewed in the literature sources consulted in this study. It is interesting to note how teachers refer to the main keywords in isolation since the syllabus does not directly emphasize the words for the learners to fully master what climate change entails. Teachers also expressed their dismay at the lack of detailed information regarding references to carbon dioxide, global warming, greenhouse gases and the green house effects in the Physical Science syllabus, which is supposed to help them emphasise matters of climate change in lessons. T5 stated that "*climate change is increasing more and more year after year. As it increases, our learners and teachers need to be more aware about it. They should find solutions to address the challenges of climate change. Thus, if included in the syllabus, learners will have knowledge of its causes and effects. In the long-run it will benefit the Namibia society and world at large*". Similarly, T1 stated that "*not much is expected from the learners about global warming. There is need to add more objectives. Learners need to go out and study and looks for factors happening out there*". T1 further stated "*although the topic of environmental chemistry in the syllabus is great to address global warming but the topic is not addressed in detail*". This information demonstrates that the integration of climate change with the senior Physical Science syllabus was identified by the teachers as a gap that needs to be filled. Its

integration in the syllabus will enrich both teachers and learners to find possible solutions to Namibia’s vulnerability to the effects of climate change.

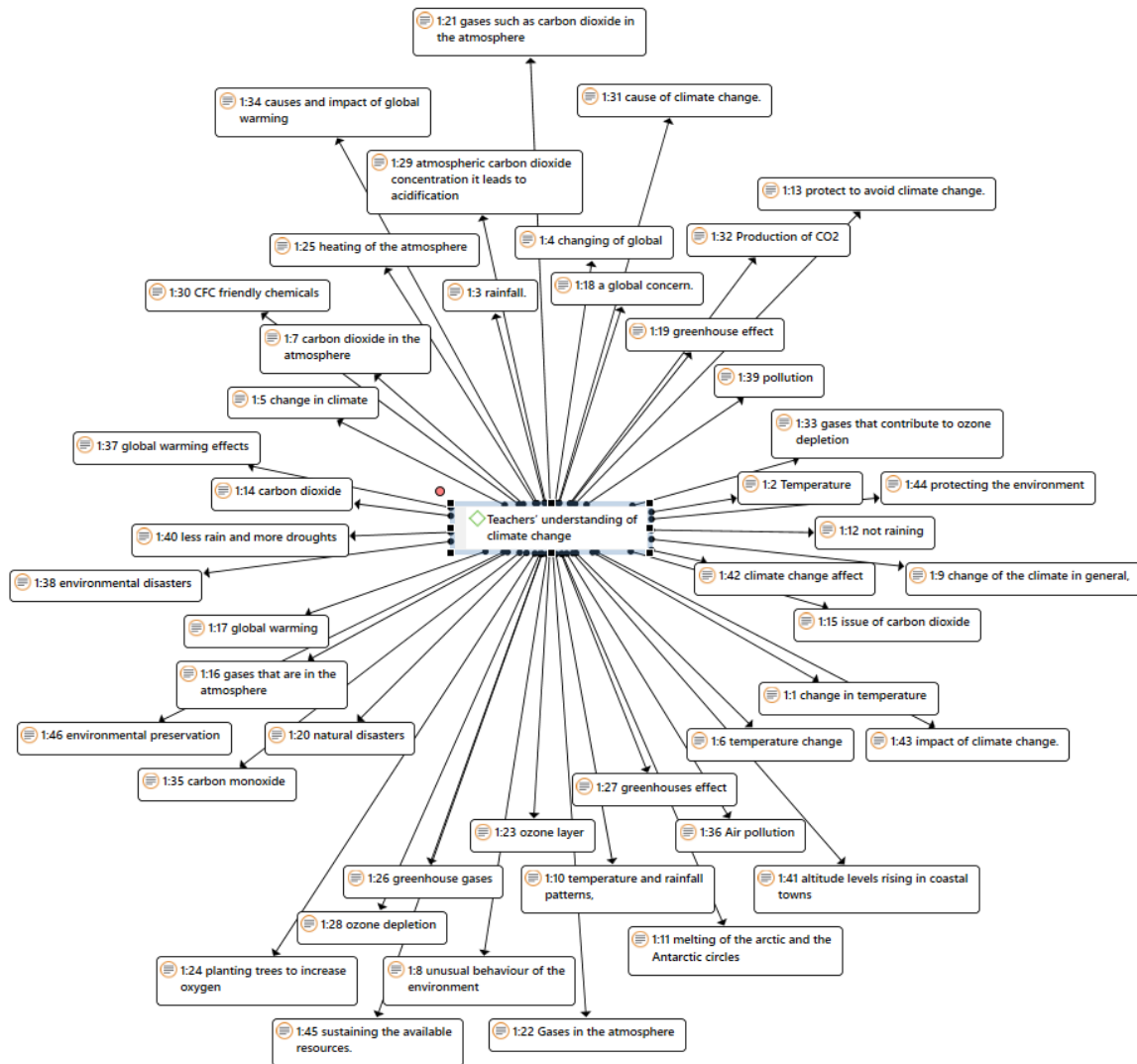


Figure 3 ATLAS.ti™ 8software’s depiction of teachers’ understanding of climate change

### 5.3.2 Teachers’ understanding of environmental education

The question about environmental education was posed because it is the vehicle through which climate change can be introduced. In Chapter 2, UNESCO (1977), Hedefalk *et al.* (2015) and Shallcross *et al.* (2006) dealt with the importance of environmental education. Based on the data analysed from the focus group interview, it is evident that teachers have knowledge of environmental education. The information contained in Figure 4 below relates to teachers’ understanding of environmental education with regard to the following

conceptsthememes that emerged from the analysis: “*awareness, educating, interaction and teaching*” about the environment to sustain resources.

Teacher T1 stated that environmental education means “*to be aware of the environment*”; Teacher T2: “*teaching learners about the environment*”; Teacher T3: “*educating people i.e. learners about the environment or environmental factors*”; Teacher T4: “*how people interact with the environment, protecting the environment to avoid climate change*”; Teacher T5: “*interaction of human being with the environment and how to sustain resources from the environment*” and Teacher T6: “*ways to sustain the environment*”.

I noted that the teachers’ responses are in line UNESCO (1977), which defines environmental education as “learning that enhances learners’ knowledge and awareness about the environment and environmental issues, and knowledge and awareness that develop the necessary values and skills to address issues and to make responsible and informed decisions”. In addition, Hedefalk *et al.* (2015) view “Education for Sustainable Development as education about the environment (knowledge about natural systems), education in the environment (direct experiences in nature), and education for the environment (solving environmental problems and making socially just and sustainable decisions)”. Therefore, environmental education and Education for Sustainable Development co-exist with one another, being the focus concern to educate learners, teachers and the society about the total environment by placing greater emphasis on the ecology curriculum, interdisciplinary and experiential learning. This viewpoint is echoed by Shallcross *et al.* (2006).

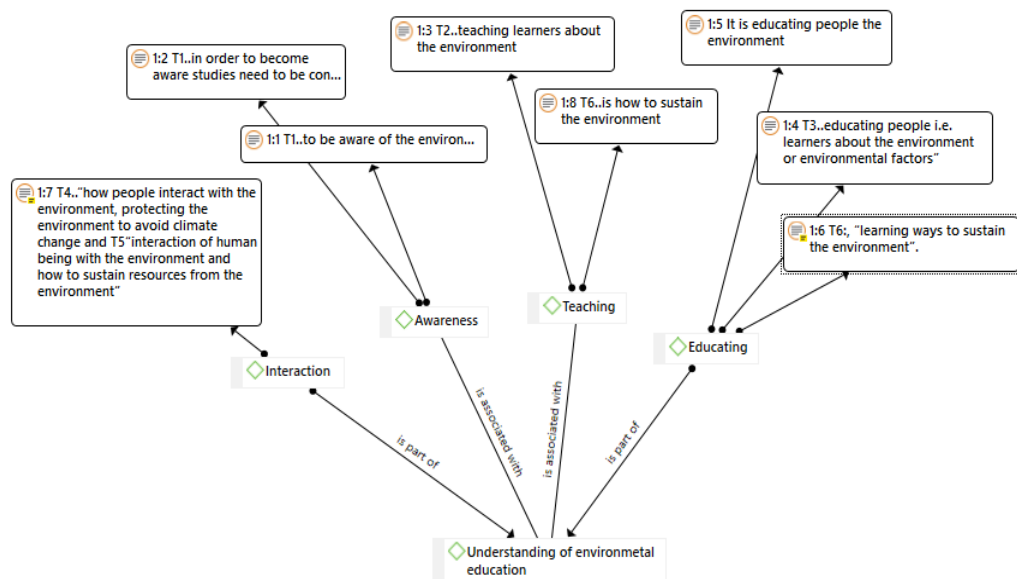


Figure 4 ATLAS.ti™ 8software’s depiction of teachers’ understanding of environmental education

### 5.3.3 Teachers' opinions of integrating climate change with the senior Physical Science syllabus through environmental education

The teachers expressed various opinions about climate change integration into the syllabus. All six teachers were keen on its integration and shared creative thinking about integrating climate change into the senior Physical Science syllabus. Teacher T1: *"Good idea, introduce as a separate topic i.e. learners should be aware at measure to limit climate change and carbon dioxide"*; Teacher T2: *"Agree climate change as a topic is not addressed in the physical science syllabus. Learners need to be educated about climate change"*; Teacher T6: *"it is important to address climate change in all subjects"*; Teacher T4: *"Agree climate change is not clearly addressed, i am only aware of CFC or growth of carbon people talk about"*. Teachers T5 and T3 were very specific in their responses and referred to interesting detail that should be included. Teacher T5: *"Agree both learners and teachers need to be aware about climate change particularly its definition, causes and effects. Climate change is a global concern"*. Teacher T3: *"Good idea, syllabus needs to elaborate more about issues of carbon dioxide, gases in the atmosphere, increased in carbon dioxide resulting to global warming."*

In line with the responses from the teachers, there should be a more direct focus on climate change in the syllabus, such as the increase in temperature and green energy sources for sustainable development. Hence, learners' competencies section in the syllabus should address climate change more clearly, together with the increase in temperature, global warming, burning fossil fuels, and energy (cf. Table 4). As emphasised in the literature sources (cf. 2.4.1), climate change is indirectly addressed in the syllabus. This is evident in the introductory summary chemistry section that talks about "The finite life of the world's resources and the need for recycling and conservation" (NIED, 2009:23).

Teacher T4 registers an opinion about the lack of dissemination of information about climate change by stating that *"so far what I know it's just a portion, it's not a big topic for now, all i know is just a CFC people talk about growth of carbon but then it's not really emphasised that much"*. This suggests that both the National Curriculum for Basic Education and the Physical Science syllabus should correspond and filter through with what the National Policy on Climate Change calls for in Objective 3: "To integrate climate change effectively into policies, institutional and development frameworks in recognition of the cross-cutting nature of climate change" (cf. 2.5). Figure 5 below shows that all the participants support the

integration of climate change into the senior Physical Science syllabus, most specifically making it a separate topic in the syllabus.

It is evident from the responses that due to a lack of synergy between policy documents, teachers have resorted to dealing with the concept of climate change in isolation. Therefore, teachers need to find references to the incorporation of the concept climate change in the learners' specific objectives section of the syllabus in a more detailed manner for learners to fully master issues about climate change for sustainable development.

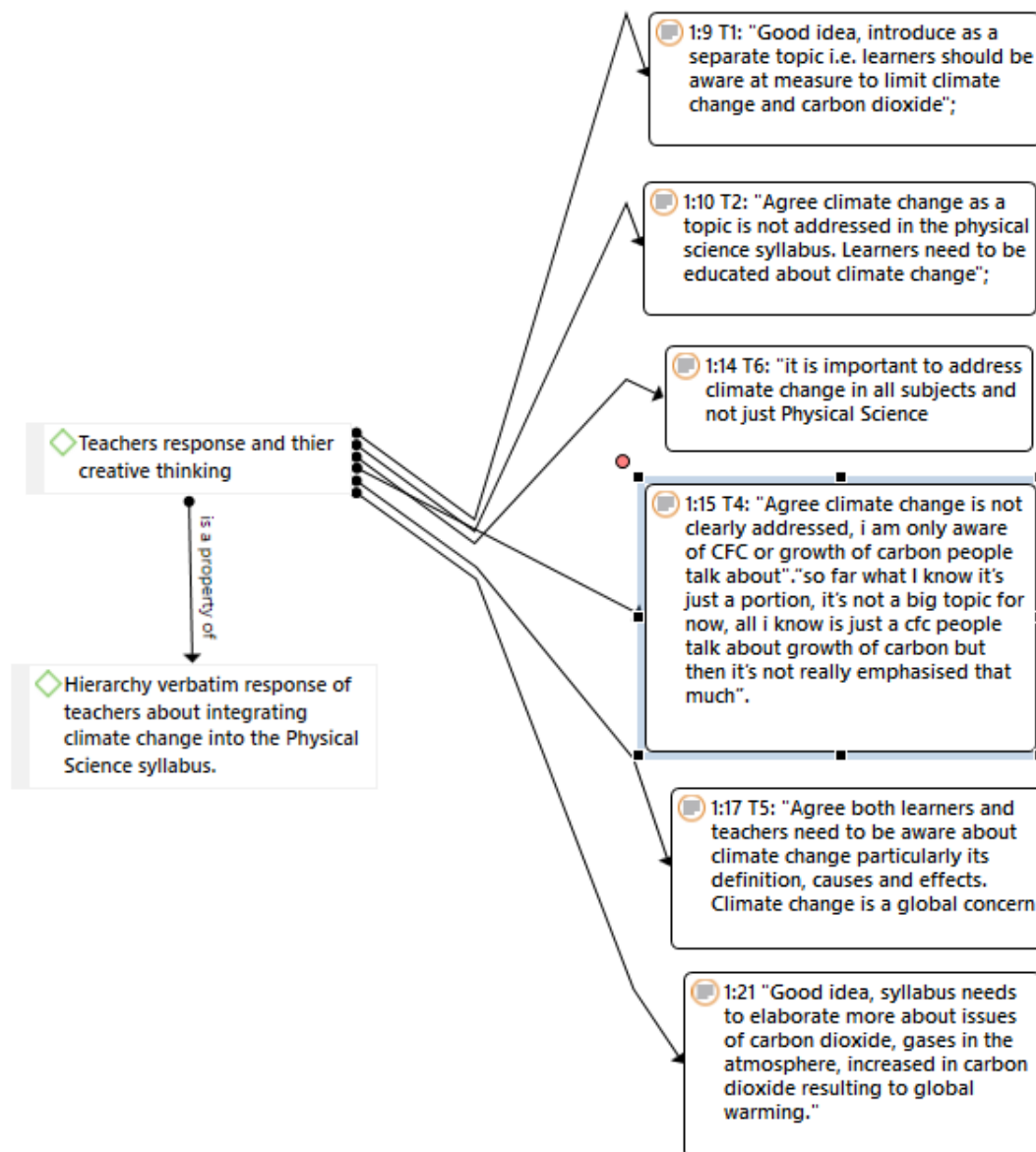


Figure 5 ATLAS.ti™ 8software's depiction of verbatim responses of teachers' opinions of integrating climate change with the senior Physical Science syllabus through environmental education

### **5.3.4 Participants responses regarding awareness of the objectives of the National Policy on Climate Change within the National Curriculum for Basic Education and the Physical Science syllabus**

Data generated (Figure 6) shows responses from all the participants in the focus group interview and the one-on-one interview with regard to their awareness of the objectives of the National Policy on Climate Change within the National Curriculum for Basic Education and the Physical Science syllabus. The participants were able to relate with key words such as *global warming, greenhouse effect, atmospheric carbon dioxide concentration it leads to acidification, ozone layer depleted, ozone layer, CFC friendly chemicals, heating of the atmosphere*. These key words relate to what Objective 3 (To integrate climate change effectively) calls for to be mastered in the National Policy on Climate change. Teacher T1 stated *“how global warming occurs, ozone depletion and greenhouse effect are some of the objectives stated in the syllabus are”*; Teacher T2: *“atmospheric carbon dioxide concentration it leads to acidification”*; Teacher T3: *“learners are supposed to know how is the ozone layer depleted and the importance of ozone layer”*; Teacher T4: *how to use CFC friendly chemicals that cannot deplete the ozone”* and Teacher T5: *“heating of the atmosphere and how the ozone layer is depleted, how does it affect our lives, global climate and global warming?”*. From the responses it is clear that an indirect mastering of the objective is present without an awareness of the objective.

It is apt to point out that some of the information the teachers provided is consistent with information provided in Table 4, relating basically to climate change and environmental education. It can be pointed out that the National Policy on Climate Change contains some key issues of climate change. Although the teachers could not understand the question properly they managed to point out keywords that address and that relate to objective 1 (To develop and implement appropriate ... actions that will lower the vulnerability of Namibians and various sectors to the impacts of climate change.) and objective 3 (To integrate climate change effectively into policies, institutional and development frameworks in recognition of the cross-cutting nature of climate change) of the National Policy on Climate change. It was noted that teachers have knowledge of main key concepts that relate to the effects of climate change as contained in the policy document. However, amongst the six participants, Teacher T6, the Subject Advisor, and the NIED official were the only ones who failed to provide a response to the question posed. Teacher T6: *“I’m not aware of the objectives.”*; Subject

advisor: “I am not aware of the objectives; may you show them to me”; NIED official: “I am not aware of the document.”

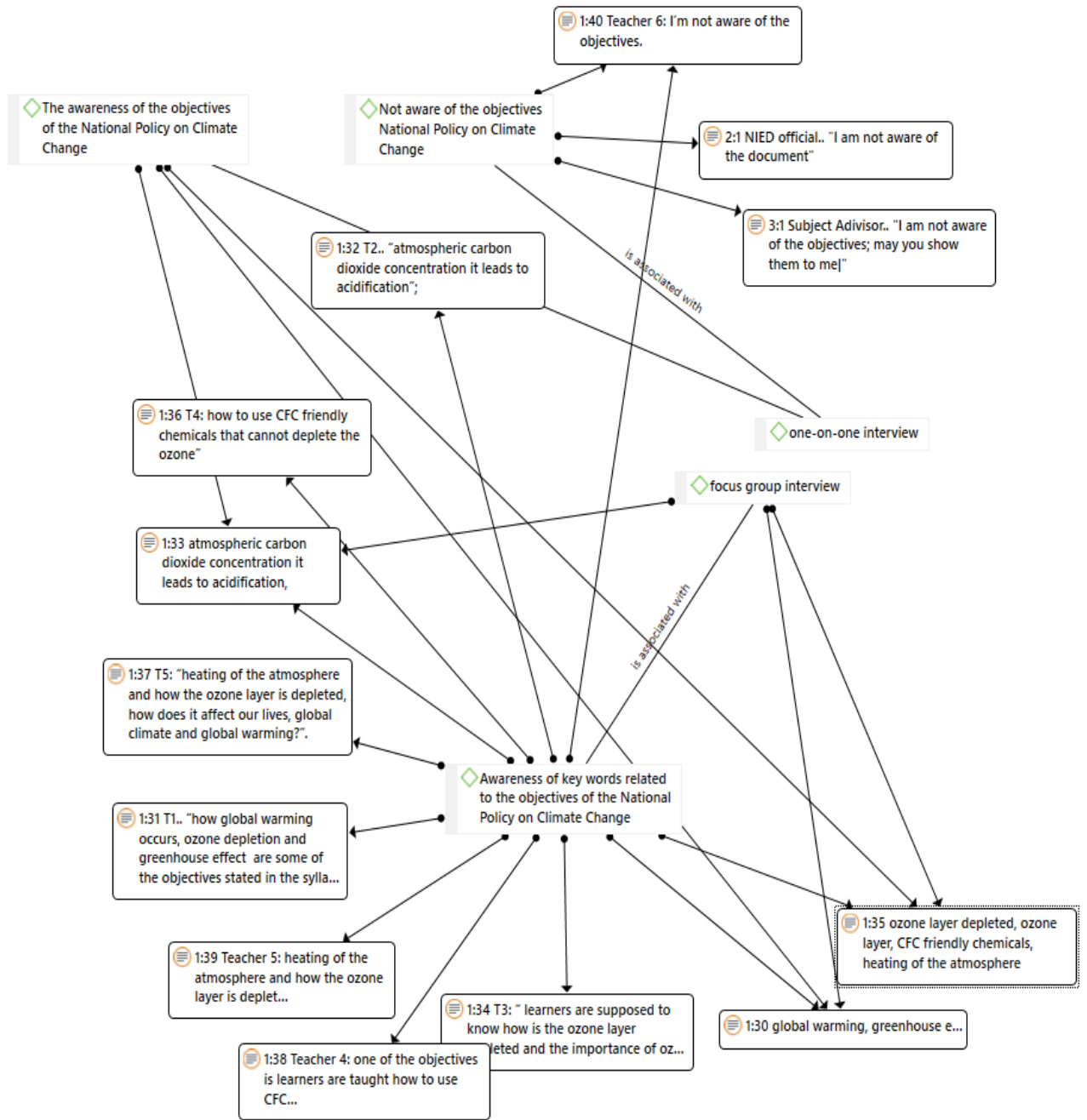


Figure 6 ATLAS.ti™ 8software’s depiction of the awareness of the objectives of the National Policy on Climate Change

### 5.3.5 Teachers' responses to climate change issues addressed in the Grade 11 and 12 Physical Science syllabus

All the participants referred to global warming as the climate issues addressed in the Grade 11 and 12 Physical Science syllabus, especially in Topic 10: Environmental chemistry of the syllabus. Teacher T1: *“Global warming but not much is expected from the learners”*; Teacher T2: *“... add more examples, about cause of climate change”*; Teacher T3: *“Global warming learners should know more about it in detail”*; Teacher T4: *“Production of CO<sub>2</sub>, this is the main gases that contribute to ozone depletion”*; Teacher T5: *“Global warming”* and Teacher T6: *“Global warming”*. The topic's general objectives for learners are to evaluate the economic advantages of industry with respect to ecological and social impact. The syllabus specific objectives only require learners to *“state the common pollutants in the air as being carbon monoxide, sulphur dioxide, oxides of nitrogen and lead compounds”* (NIED, 2009:37). All participants referred to “global warming” even though there is no reference to global warming, climate change, production of carbon dioxide, ozone depletion in the Physical Science syllabus.

The responses show that teachers have knowledge about climate change and its scope. The objective of this question was to gain insight into the extent to which climate change is addressed in the Grade 11 and 12 Physical Science syllabus. This question is important because it identifies areas and subjects under which climate change can be addressed in the Physical Science syllabus. As stated previously, climate change does not occur in isolation. There are numerous topics in the subject areas, frequently mentioned by the teachers, that are in the current Physical Science syllabus under which climate change can be taught. Teacher T1 pointed out *“environmental, chemistry (i.e. global warming, greenhouse effect, and the effects of natural disasters)”*, whilst Teacher T2 referred to *“Global warming, gases such as carbon dioxide in the atmosphere”*. Teacher T3 mentioned *“Gases in the atmosphere”*, whereas Teacher T4 believed that planting trees increases oxygen in the atmosphere. Lastly, Teachers T5 and T6 mentioned *“heating of the atmosphere, greenhouse gases”* and *“greenhouses effect”*. From these responses it is clear that teachers depicted *climate change issues which are or should be addressed in Grade 11 and 12 Physical Science syllabus*.

From a different perspective, it is evident that a number of related concepts of climate change are not dealt with directly within the Physical Science syllabus, as mentioned by the teachers in the above verbatim. It is further important to note that Teachers T1, T3, and T5 were of the opinion that it would be best if climate change was introduced under environmental

chemistry in order to address issues related to climate change in a more direct focus. Teacher T1 stated that *“environmental chemistry but currently it is a very short topic because it lacks detail”*. Teacher T3 was of the opinion that the climate change issue addressed in the syllabus is global warming but that it is not addressed in detail, and moreover that learners should be able to reduce the impact of climate change, such as protecting the environment and sustaining the available resources. Accordingly, Teacher T5 believed that *“we can look at environmental concerns like climate change in the syllabus”*. Teacher T2 and T4 felt that climate change should be dealt with together with the subject of wave and chemical energy. In this regard, Teacher T2 stated that *“waves or waste it’s not clear”* whilst T4 felt it should be addressed in the topic of chemical energy.

In concluding the discussion on this finding, it can be said that all the participants highlighted global warming as a climate change issue which they currently address in the Physical Science syllabus.

### **5.3.6 Teachers’ perspectives on how environmental education can be implemented in the senior Physical Science syllabus to address climate change**

The focus group interview generated several themes about how to implement environmental education in the senior Physical Science syllabus to address climate change. These themes, as demonstrated in figure 7, include; implementation guidelines, training of teachers, funding and resources. With regard to the first theme, implementation guidelines, teachers’ responses are as follows:

Teacher T1: *“learners become aware of global climate change matters i.e. environmental disasters and possible ways of reducing the impact of climate change i.e. protecting the environment and responsible usage of non-renewable resources. Emphasise the use of alternative energy sources such as solar and wind instead of fossil fuels. Encourage learners to watch news and search the internet for current news with regards to environmental disasters”*.

Teacher T2: *“Teach basic concepts of climate change, subsequently focus on the causes and ways to mitigate climate change. Furthermore, learners need to do practical activities related to the environmental education and the effects of climate change such as visiting arid and flooded areas.*

Teacher T4: *“This is a burning issue in our daily lives that should be taught from lower grades. Learners who have knowledge on how to avoid ozone depletion will have ideas on the causes and they will share the knowledge with their families who might not be aware of this”.*

Teacher T6: *“...when learners are taught about climate change and how to be environmental friendly they can take that information to their families and thus contribute towards environmental preservation, look at environmental concerns like climate change in the syllabus”.*

The responses highlight the participants' positive perceptions with regard to the implementation of environmental education in the Physical Science syllabus as a measure of addressing climate change. This is significant in the sense that it illustrates, to a certain extent, the feasibility and the merits of implementing an in-depth approach in teaching environmental education in the Physical Science syllabus to include a pertinent topic such as climate change. This postulation gains credence in light of the significance of environmental education in promoting education for sustainable economic development in countries vulnerable to climate change such as Namibia. Teacher T3 expressed the importance of integrating climate change within the Namibian National Curriculum and the senior Physical Science syllabus, citing that it plays a vital role in raising climate change awareness with teachers and learners. Most teachers felt that issues such as training, resources and funding need to interlink with the process of implementing guidelines for effective implementation into Physical Science. Teachers' opinion on this matter are as follows:

Funding: Teacher T1: *“I think government can support the schools with funds to take learners on field trips.”* Teacher T3 felt that *“the government can sponsor tours so that kids can go and explore and get some understanding of climate change.”* Similarly, Teacher T6 was of the opinion that *“government should put more money to enable learners to out and learn about climate change.”*

Training: Teacher T1 stressed on the need to adequately train teachers because if teachers are not sufficiently trained they will be unable to conduct their primary duty of imparting knowledge to the learners. In the same vein, Teacher T2 insisted that *“The ministry of education has to train teachers and equip them with their current knowledge”.*

Resources: Teacher T5 suggested that *“our main concern is resources, as such government should provide resources and do so in time. Resources like textbooks, CDs etc because main time we just have to rely on internet searches which is a disadvantage to rural-based schools”.* Teacher T6 was of the opinion that organisations in the private sector can assist by

providing schools with practical experiences and resources such as, rain gauges because learners need to do practical activities by visiting sites to witness pollution at first-hand. Teacher T5 underscored that “if learners had resources like rain gauges and thermometers and they do recordings annually they would know first-hand about the differences in rainfall and temperature”.

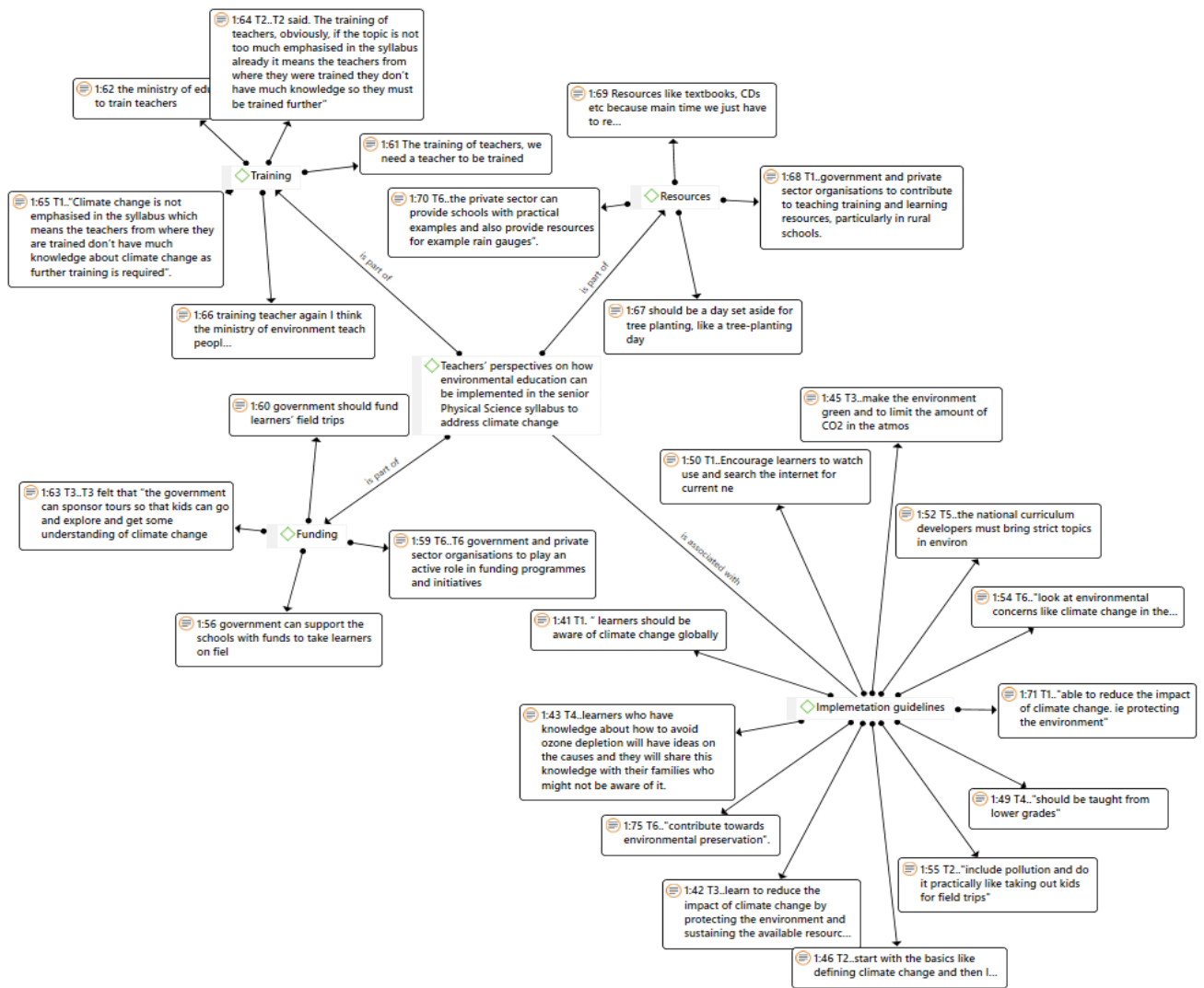


Figure 7 ATLAS.ti™ 8software's depiction of teachers' perspectives on how environmental education can be implemented in the senior Physical Science syllabus to address climate change

#### **5.4 ANALYSIS OF THE ONE-ON-ONE INTERVIEWS**

The one-on-one interviews were conducted separately with the National Institute for Educational and Development (NIED) official for the Kalahari circuit and the Subject Advisor for Physical Science Grade 11 and 12. This section used thematic analysis to analyse and present their responses in accordance with the aims of this study. These two participants were included in the sample because of their intimate knowledge of curriculum development and syllabus management in Namibian basic education schools. Subject advisors act as mentors to teachers who monitor and conduct workshops for teachers' skills development and training. As such, their understanding of day-to-day educational issues cannot be understated. Similarly, National Institute for Educational and Development officials are responsible for overseeing curriculum development by reviewing the syllabus throughout the process of curriculum reforms which takes place every five years and infuses trends of crucial global issues together with other stakeholders from other sectors for effective implementation of the syllabus. In accordance with the objectives of the study the interview probed both participants about their understanding of climate change and environmental education.

The Subject Advisor is a former teacher with eight years' experience in teaching and four years' experience in her current position in the Kalahari circuit of Kharas Region. She holds a Basic Education Teacher Diploma (Namibia) in the senior secondary Physical Science phase, the Advanced certificate in curriculum studies and an Honour's and Master's degree respectively in Physical Science education. Her role as a subject advisor is the monitoring and implementation of the syllabus, as well as working with teachers and conducting workshops by training them on how to implement the content of Physical Science.

The NIED official is a former teacher with seven years teaching experience in Physical Science education, as well as five years' experience in curriculum development and formulation at the National Institute for Educational Development at Okahandja. She is responsible for overseeing other subjects in the subdivision of Natural Sciences such as agricultural science, biology and maths. She holds a Basic Education Teacher Diploma (Namibia) in the senior secondary Physical Science phase, and an Honour's and Master's degree respectively in Physical Science.

#### **5.4.1 One-on-one interviews with the Subject Advisor and the National Institute for Educational and Development official for Physical Science**

Figure 8 discusses the main themes highlighted by the Physical Science subject advisor and Physical Science NIED official. These themes include: curriculum development and implementation, implementation guidelines, training, funding and resources, awareness of the objectives of the National Climate Change Policy for Namibia, a list of climate change issues addressed in the senior Physical Science syllabus, as well as an understanding of climate change and environmental education.

With regard to curriculum development, the subject advisor stated that she is “*not involved in the formulation of the syllabus but only involved in monitoring the implementation of the syllabus*”. On the other hand, the NIED official highlighted that she is directly involved in curriculum development. She shared aspects of curriculum development. For example, she underscored that in her capacity as a NIED official she is responsible for curriculum formulation of Physical Science. She also stressed that the Namibian curriculum is benchmarked against the Cambridge specifications and standards which are generally regarded as a global standard. The NIED official further highlighted that, as an aspect of curriculum development, the ministry conducts curriculum review every five years. In this regard, the NIED official’s role is to research global curricula with the aim of ensuring that the Namibian curriculum is up-to-date and consistent with African, particularly SADC, and global standards. She added that “*curriculum development is not a one size fits all because the world is changing and evolving and curriculum should be designed in a way that it is responsive to the needs of the country. As such, the curriculum should periodically undergo review to align it with contemporary developments*”. She emphasised that the ministry recently adopted a cross-curricular approach to basic education in Namibia. A cross-curricular approach endeavours to incorporate pertinent contemporary issues, subjects, topics and themes in basic education curricula and syllabi to ensure that learners are aware of current issues of global concern affecting or impacting on society such as globalisation, global warming, environmental issues and technology.

The NIED official further stressed that teachers play a significant role of implementing the products of curriculum development. The NIED official was in line with the views of Bruner’s development theory that advocates for curriculum as a process that should welcome changes and in this case the official welcomed climate change in the curriculum development of Physical Science as a global concern in Namibia and internationally. The subject advisor

urged the “*Ministry of Environment and tourism which is responsible with the formulation of the National Policy on Climate Change for Namibia to work timeously in collaboration with the ministry of education to train teachers intensively on how to effectively address climate change into educational policies and documents*”. The NIED official urged responsible stakeholders “*to provide with a list of climate change issues linked to the Physical Science subject in order for curriculum developers to implement it through curriculum reforms which takes place every after five (5) years*”. She concluded by supporting Bruner’s development theory, saying that “*curriculum development and implementation is a process that needs to undergo changes and not a once size fit all*” (cf. 3.6.2 & 3.6.3).

With regard to the role of government policies on issues such as global warming in curriculum development the NIED official stated that “*it is beyond my responsibility as an official because national document for curriculum development which is the national curriculum for basic education in Namibia is drawn up by the deputy director, the director and other persons in the ministry. I assume for them to come up with a curriculum they should be informed by some documents which I’m not 100% sure about*”. When asked about their awareness of the objectives of the National Policy on Climate Change for Namibia, both officials pointed out that they were not aware of the policy in question. The subject advisor responded by stating that “*I am not aware of the objectives; may you show them to me*”; the NIED official stated that “*I am not aware of the document*”. This research study deduces that the NIED official and the subject advisor are not aware of the objectives of the National Policy on Climate Change for Namibia.

Regarding training, funding and resources, the subject advisor proposed that “*educators need to be empowered to enable them to teach learners to be environmental sensitive and conscious about conserving the environment and to reduce pollution*”. The NIED official pointed out that the curriculum aims to include pertinent issues of global concern, hence the reviews conducted after every five years. These two participants were requested to list climate change issues being taught in the Physical Science syllabus. The subject advisor mentioned global warming, the increase of pollutants (pollutions), impact of human activities on the environment, and the reduction of deforestation. The NIED official mentioned renewable energy (clean sources of energy like solar), environmental chemistry, air pollution and global warming. The NIED official identified global warming as one of the climate change topics present in the current syllabus. Such evidence is contrary to what is presented in the Physical Science syllabus, since there is no direct focus on either global warming (only

mentioned in the guidelines) or climate change in the subject specific objectives, despite teachers also having vast knowledge of it (cf. 5.5). Of greater significance is that global warming only features once in the curriculum guidelines (cf. 2.4), but is remembered and focused on by the teachers even though it does not appear in the syllabus in the specific objectives of the learners (cf. 2.4.1).

The two participants were requested to share their opinions on the implementation of guidelines developed to address climate change in the senior Physical Science syllabus through environmental education. The subject advisor stated that *“the ministry of environmental and tourism should work in collaboration with the ministry of education because teachers need to be trained intensively on how to integrate it cross-curricular issues that in some cases fall under the portfolio of a particular ministry. In this case, in as much as climate change as an educational matter, it is also an area that the ministry of environment and tourism focuses on.”* Therefore, I am of the opinion that there should be flexibility in government ministries to enable cooperation and sharing of ideas across the board. She noted that *“although the policies and documents are there most teachers are struggling to integrate and teach environmental education in a way that is consistent with 21<sup>st</sup> century requirements because climate change is a global challenge, of which Namibia is not spared. We have been experiencing drought, as such, communities need to be educated about ways to mitigate climate change”*. This response highlights the lack of awareness of the objectives of the National Policy on Climate Change for Namibia displayed by the subject advisor and the NIED official.

The subject advisor emphasised that climate change needs to be addressed under the topic of environmental chemistry but currently there is no details of climate change in the syllabus although there are related concepts such as, deforestation, pollution, and global warming. The NIED official concurred that climate change issues are taught under the theme of energy in the physics section (renewable energy) and environmental chemistry. In this regard, she agrees with the document by stating that *“the word climate change is hardly mentioned especially in the objectives. I have not seen the word only the theme itself is environmental chemistry which cover air pollution and global warming”*. Thus, *“the degree to which issues of climate change should be addressed depends from one subject to another, for example, environmental education is more dominant in geography but it is also dealt with in physical science, biology and agriculture. However, it could be linked with other subjects such as, maths where it can be used for statistical information for graphs”*. She further highlighted

that curriculum development still has room for other cross-curricular issues like that of climate change.

Both the subject advisor and NIED official showed sufficient knowledge about the difference between climate change and environmental education. The subject advisor defined “*climate change as change in weather condition as a result of human activity which effect of ozone layer due to human activity, industry, burning fuels, increase of cars and increase of pollutants*”. She defined environmental education as being “*environmental sensitive or aware of how to conserve the environment or to reduce pollution within the environment*”. The NIED official defined climate change as “*something global, generally speaking, it is the changing in weather or climate resulting in change in rainfall patterns and it is increased by human activities. For example, cutting down of trees, deforestation due to communal farming, increase in population putting pressure on the environment*”. The NIED official stated that “*environmental education deals with issues pertaining to the earth such as sustaining natural resources, planting vegetation and preserve the environment so that future generation can benefit from the natural environment*”. Their responses were consistent with what the conceptual meaning of climate change and environmental education dealt with in Chapter 2 of this study. Their responses correspond with findings from the literature sources, especially those of the subject advisor who stated that climate change is the result of “*human activities*”. The word human activities are used by most authors in relation to anthropogenic phenomenon/human modification or human induced processes. It is striking how the two experts make clear references to such important concepts.

From the responses quoted above it is clear that climate change cannot be ignored because it is a global concern that continues to be felt in the society because of its adverse effects on people’s daily lives.

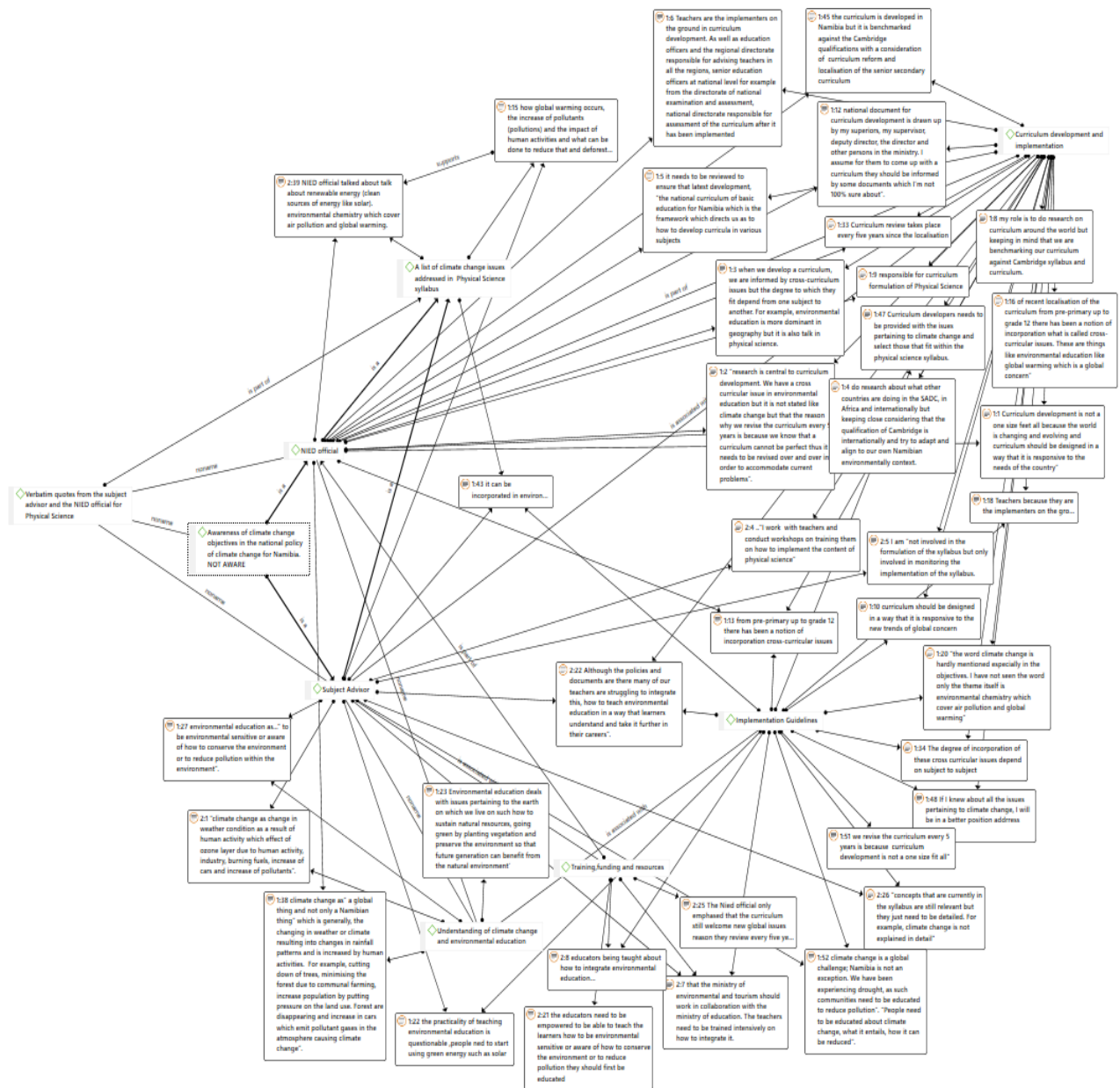


Figure 8 ATLAS.ti™ 8software’s depiction verbatim quotes from the subject advisor and the NIED official for Physical Science

The teachers’ perspectives on how environmental education can be implemented in the senior Physical Science syllabus to address climate change was a critical aspect of this research study. In addition, professional opinions in this regard will go a long way in constructing measures and strategies of integrating climate change in the Physical Science syllabus. The NIED official came up with various but complementary responses. She felt that there is a scarcity of information on climate change in the Namibian National Curriculum for Basic Education system. The official urged that “*the ministry of environmental and tourism should*

*work in collaboration with the ministry of education to train teachers intensively on how to integrate climate change in the syllabus. Although the policies and documents [National Policy on Climate Change] are there many of our teachers are struggling to integrate environmental learning such [as] how to teach environmental education in a way that learners understand and take it further in their careers".* From the response it is clear that there should be more resources channelled towards research on climate change, especially in the local context. The response also emphasises that the objectives of the National Policy on Climate Change are hardly stated in the syllabus and in the National Curriculum for Basic Education. This is a cause of concern which should be addressed promptly. The NIED official also highlighted that a curriculum is not static; as such, it is a good thing that this study has identified certain gaps that need to be attended to.

To summarise these findings: the integration of climate change should be taken seriously, through the process under which it can be initiated. As the subject advisor suggested, before the integration of climate change can be rolled out there is a need to first capacitate and equip the teachers with the knowledge about and skills pertaining to climate change. Her argument was that teachers are at the forefront of delivering information and expertise of the phenomenon, thus naturally, unless teachers acquire the necessary skills it is unthinkable how they can impart them to the learners. Thus, according to the subject advisor, the first step is to ensure that the teachers have all the necessary skills. She also felt that the concepts currently in the syllabus are still relevant to address climate change, but need to be detailed. In this regard she suggested that the government and the private sector should commit resources to teacher training and skills development. She stated that, although the concepts currently in the syllabus are still relevant, they need to be addressed in greater detail. For example, currently there is a lack of detailed explanation of climate change in the syllabus.

## **5.5 CONCLUSION**

This chapter was devoted to analysing and presenting data in a legible, sensible format. Data analysis and presentation are crucial in a research study because it ensures that the findings of the study are presented in line with the research question(s). The overarching objective of this chapter therefore was to fulfil the objectives of this research study as mentioned in Chapter 1. This was done because the objective of data analysis is to breakdown data and present in a way that is comprehensible and easy to consume. The objective of this chapter was to analyse the content of the four government documents as well as the data generated from the focus

group interview and the one-on-one interviews conducted during field study. Two methods of data analysis, namely thematic analysis and content analysis, were employed in this study. Content analysis was used to analyse the occurrence of key words pertinent to this study. In this chapter it was presented in the form of two tables. One table consisted of the main key words whilst the other consisted of general key words. Content analysis demonstrated the extent and frequency of occurrence of these words in the documents pertaining to climate change. On the other hand, thematic data analysis was conducted with the aid of ATLAS.ti™ 8 software, which enabled the researcher to analyse data findings in a presentable and organised manner using different figures to highlight the themes that emerged from the data. The next chapter summarises the study and offers some recommendations.

## **CHAPTER 6: SUMMARY OF RESEARCH STUDY, SIGNIFICANCE OF RESEARCH FINDINGS, RECOMMENDATIONS FOR FURTHER RESEARCH, LIMITATIONS AND CONCLUSION**

### **6.1 INTRODUCTION**

This chapter marks the end of the research study. As such, it summarises the findings in line with the objectives of the study as highlighted in Chapter 1. The primary aim of the research was to establish how climate change can be integrated into the Namibian senior secondary Physical Science syllabus (Gr11 and12), particularly through environmental education. The study addresses the research aim by reflecting on the resonance between the findings and the literature reviewed in the study. This chapter is guided by the research findings generated through collecting field data on climate change and environmental education in Namibian senior secondary schools. Finally, the chapter concludes by offering recommendations and highlighting areas for further research.

The main research question of the study sought to focus on climate change by asking: *How can climate change be integrated into the Namibian senior secondary Physical Science syllabus through environmental education?*

In addition to the main research question, the researcher developed secondary research questions which explored:

- Which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education?
- Which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus?
- What climate change issues are addressed by teachers in Grade 11 and 12 in Physical Science?
- How can environmental education be implemented in the senior secondary Physical Science syllabus to address climate change?

## 6.2 SUMMARY OF THE RESEARCH STUDY

The overview of the study provides a summary of each chapter.

**Chapter 1** provided an outline of the study by defining concepts such as climate change, curriculum, syllabus, physical science and environmental education. More importantly, the first chapter contained the aims and objectives of the research. In addition, Chapter 1 dealt with the problem statement of the study and identified various theories in line with the phenomenon under investigation. Chapter 1 also outlined the purpose and highlighted the significance of the study.

**Chapter 2** reviewed literature relevant to the study. The focus of the chapter was to conceptualise the phenomenon of climate change in Namibia by examining, amongst others, the Intergovernmental Panel on Climate Change's projections of climate change globally and in Namibia, the historical and modern perspectives on climate change, and climate change in Namibia and in Africa. In addition, I reviewed literature on the National Policy on Climate Change for Namibia, the Draft Environmental Education (EE)/Education for Sustainable Development (ESD) Policy for Namibia, the incorporation of climate change international perspectives, such as those of BRICS nations, as well as environmental education and Education for Sustainable Development. I concluded this chapter by stating that that climate change is a global concern affecting all nations around the globe and, more importantly, related concepts of climate change need to be addressed in the Physical Science syllabus.

**Chapter 3** placed the main focus on tracing the development of the Namibia Curriculum for Basic Education. Therefore, I focused on various government policies on education, such as the Education Transformation in Namibia, Bantu Education system (1990), Toward Education for All: A Development Brief (1993), Pilot Curriculum Guide for Formal Basic Education (1996), Formal Senior Secondary Education (1998), the National Curriculum for Basic Education (2010), the Curriculum Reform for Basic Education effective from 2015 onwards, the National Curriculum for Basic Education 2010 as an environmental learning tool, progression of climate change within the Physical Science syllabus from junior secondary (Grade 8-10) to senior secondary level (Grade 11-12), and curriculum development for environmental learning. This chapter dealt with the theory of development that informs this research study and I envisage active involvement of learners, both in and out of school in learning initiatives to acquire knowledge about climate change issues, by providing quality education through shared understanding and multi-disciplinary

approaches in meeting the developmental and environmental apprehension for a sustainable future.

**Chapter 4** dealt with the research methodology and design used in the study. As such, methods of data generation and data analysis employed in the study were discussed. The objective of this chapter was to identify participants who would provide data that would be instrumental in addressing the research question. Eight participants were identified as part of the purposive sampling.

**Chapter 5** dealt with the presentation and interpretation of field data. I used content analysis to analyse the government documents and analysed the data generated from the focus group interview with teachers and the one-on-one interviews with the education officials.

Lastly, **Chapter 6** contains the summary of the study. This chapter provides a brief summary of all the chapters contained in the study. In addition, I provide the research findings and recommendations, as well as the conclusion of the study.

### **6.3 SIGNIFICANCE OF THE RESEARCH FINDINGS**

The summary of the research findings is presented in relation to the objectives of the study.

#### **6.3.1 Objective 1: To identify which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.**

It is important to note that although the Namibian National Curriculum for Basic Education could not directly specify the climate change objectives of the National Policy on Climate Change in its policy document, it made indirect reference to educating learners about cross-curricular issues such as environmental learning. It is further important to note that the climate change objectives of the National Policy on Climate Change for Namibia (2011:18) enforce education, training and capacity-building for climate change to develop and strengthen individual skills, expertise and to increase the capacities of relevant institutions and organisations to reduce greenhouse gas emissions and reduce vulnerability to climate-related impacts (adaptation), as required by objective four and objective five. There is, however, no evidence of capacity building, awareness and dissemination of information about climate change amongst teachers (cf. 5.4.1).

It is evident that not all climate change objectives in the National Policy on Climate Change for Namibia are directly addressed in the Namibian National Curriculum for Basic Education. The motivation for this statement is that from the literature there is a lack of a systematic structure which should illustrate how aspects of environmental learning like climate change can be addressed directly in all Grade levels from Grade 0-12 (cf. 3.4). Furthermore, this research study has found that teachers are dealing with the concepts of climate change in isolation in Physical Science. As such the objectives of the National Policy on Climate Change for Namibia are not directly implemented in the Namibian National Curriculum for Basic Education, but some teachers in this research study are attending to it (cf. 5.3.3).

Of significance is that the Physical Science subject advisor and the National Institute for Education's official for Physical Science do not know of the objectives of the National Policy on Climate change. This implies that objective two and three of the National Policy on Climate Change for Namibia are not being met in the curriculum, especially since climate change is not integrated into the curriculum policy document. Teachers are teaching about climate change related key terms by taking action through Physical Science education to lower the impact of climate change. This means that objective one is partly addressed.

According to literatures sources (cf. 3.2.2) the curriculum is the official policy for teaching, learning, and assessment and gives direction to planning, organising and implementing teaching and learning. As such the curriculum structure of basic education should aim for learners in the senior grades to be taught in depth about global concerns through environmental learning which should be integrated across the curriculum. The National Curriculum for Basic Education links environmental learning to issues which deal with particular risks and challenges in the Namibian society, namely the challenges and risks we face if we do not care for and manage our natural resources. Of significance was the finding from the analysis that showed how main keywords linked to climate change are not directly listed in the Namibian National Curriculum for Basic Education except for energy (cf. 5.1). Therefore, the government and curriculum developers need to find effective approaches on how to "integrate climate change into the education curriculums in order to generate awareness and capacities at an early age with the objective of securing long-term capacity to deal with climate change" (NPCCN, 2011:10-11). Both the subject advisor and the NIED official for Physical Science agreed that teachers need to be trained on how to integrate climate change into teaching and learning (cf. 5.4.1).

### **6.3.2 Objective 2: To identify which climate change objectives from the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus**

The Namibian senior secondary Physical Science syllabus is modelled as a document to impart knowledge from the teacher to the learner according to the guidelines of the Namibia National Curriculum Guidelines (NIED, 2009:2). As such, the latter aim for the syllabi is to provide opportunities for developing essential skills across the various fields of study. Furthermore, the syllabi aim to fulfil the objectives of the said Guidelines (cf. 2.4 & 2.4.1), which are “to provide insight and understanding of crucial global” issues in a rapidly changing world which affect quality of life, these mainly being the AIDS pandemic, global warming, environmental degradation etc., because such skills cannot be developed in isolation and they may differ from context to context according to a field of study” (NIED 2009:1).

This study illustrates what is expected from the Namibian senior secondary Physical Science syllabus in terms of addressing the objectives of the National Policy on Climate Change for Namibia. It can be said that from the findings in the document research (cf. 5.1 Table 3&4), the syllabus could outline minimal keywords related to climate change, specifically, burning of fossil fuels, global warming, carbon dioxide, energy and acid rain. However, it also became evident that although such words were listed in the syllabus they were not detailed in the learners’ Physical Science specific objectives in order for them to master aspects related to the effects of climate change. In fact, keywords such as global warming was only once highlighted in the introductory summary of the chemistry section, which is only for the purpose of referring teachers to the “*finite life of resources like global warming*” and not directly addressing it in the learners’ specific objectives of the syllabus in order to systematically master factors influencing climate change and global warming. Hence, it was interesting to note how the Namibia National Curriculum Guidelines that are found in the syllabus remind the teacher of crucial global issues that should not be addressed in isolation. It also becomes evident from the participants’ responses that the syllabus might have outlined some of the keywords in its contents but lacks detailed information for both teachers and the learners to fully understand and master the concepts related to climate change.

Responses from the subject advisor, NIED official and Teacher T6 verify the lack of knowledge about the objectives of the National Policy on Climate Change for Namibia by stating that “*I am not aware of the objectives from the documents*” as well as that the

participants shared their worries about the lack of detailed information about such concepts, i.e. global warming, energy and burning of fossil fuels in the syllabus.

The senior secondary Physical Science syllabus in terms of addressing climate change is in contradiction to objective three of the National Policy on Climate Change for Namibia which *“promotes for the integration of climate change effectively into policies, institutional and development frameworks in recognition of the cross-cutting nature of climate change”*.

From a different perspective, although participants possessed the knowledge and understanding of climate change, it can be argued that they deal with the topic about climate change in isolation. The lack of synergies between documents makes it impossible to transmit such information to the learners in order to achieve objective four of the National Policy on Climate Change for Namibia which is geared towards enhancing capacities and synergies at local, regional and national levels and at individual, institutional and systemic levels to ensure successful implementation of climate change response activities.

To answer the objective of this section, it became evident that climate change objectives in the National Policy on Climate Change for Namibia, specifically objective one, which aims *“to develop and implement appropriate adaptation strategies and actions that will lower the vulnerability of Namibians and various sectors to the impacts of climate change”*, and objective two, which aims *“to develop action and strategies for climate change mitigation”* are indirectly addressed in the Namibian senior secondary Physical Science syllabus. It can also be said that although the syllabus highlights some of the keywords related to climate change there is a need for a more systematic direct focus with in-depth detail in the learners’ specific objectives to help them gain learning based on the knowledge and understanding of crucial global issues, such as that of main keywords in Table 3 and 4 and literature sources to be able to achieve the objective of this study.

In summary, the senior secondary Physical Science syllabus does not directly address aspects of climate change in the syllabus. Keywords such as global warming, fossil fuels, pollutants gases, carbon dioxide, energy and acid rain lack detailed descriptions for the learners to acquire knowledge and understanding in a systematic and critical thinking approach for global citizenship and sustainable development.

### **6.3.3 Objective 3: To establish what climate change issues are addressed by teachers in the Grade 11 and 12 Physical Science syllabus**

It was impressive to note the manner in which all the participants who took part in the data generation outlined the various climate change issues they think are addressed and should be addressed in the Grade 11 and 12 Physical Science syllabus. This section provides all the various keywords listed by each participant. It is further important to note that this objective was achieved based on how the participants understood the questions related to this objective in their own way. As such, not all the keywords mentioned by the participants are addressed in the syllabus because some participants understood the questions differently. The significant aspect of this objective was also to establish if the participants' responses had some similarities to that of the findings from the literature sources and the documents. Several keywords relating to climate change issues were listed by the participants as follows: the subject advisor outlined the effect of the ozone layer, human activities impacts, burning of fossil fuels from industries, increase of pollutants gases from cars, pollutions in the atmosphere, global warming, deforestation, green energy, i.e. solar energy, unsustainable use of natural resources, drought, flooding, reduction of pollution, environmental conservation, and to be environmental sensitive and awareness. The NIED official listed cross-curricular issues related to environmental education such as global warming, changes in rainfall patterns, i.e. low and heavy rainfall, floods, cutting down of trees, minimising forests, increase in population, pressure on land for land clearance, disappearing of forests, increase in cars emitting pollutants gases in the 21st century, sustainability of natural resources, environmental preservation by going green (i.e. planting), use of clean sources of energy, i.e. solar energy and renewable energy.

The focus group participants pointed out changes in temperature and rainfall patterns, increase in carbon dioxide in the atmosphere, higher temperatures, less rainfall, increase in drought, global warming, greenhouse effect, ozone depletion, ozone layer, greenhouse gases, natural disasters, acidification, CFC friendly chemicals, gases in the atmosphere, rise in sea level, melting of Arctic and Antarctic circles, environmental sustainability, carbon dioxide as main gas that contributes to ozone depletion, increase of carbon dioxide in the atmosphere, planting trees to increase oxygen, heating of the atmosphere, production of carbon dioxide and carbon monoxide, air pollution, environmental disasters, protection and sustaining natural resources in the environment. Global warming was listed high as the only climate change issue mostly addressed in the Senior Secondary Physical Science syllabus. However,

the participants felt that it is not addressed in detail. Most participants were of the view that climate change issues should be taught from lower grades to senior grades in a systematic way with critical approaches in all grades where applicable. Such views will surely honour the National Policy on Climate Change for Namibia, particularly objective one: *“To develop and implement appropriate adaptation strategies and actions that will lower the vulnerability of Namibians and various sectors to the impacts of climate change.”*

From the responses quoted above it is clear that the participants have a broad knowledge about climate change issues and are fully in support of the idea to integrate climate change issues into the senior Physical Science syllabus so that they can gain knowledge and understanding and further explore to find better solutions to combat Namibia’s vulnerability to climate change and improve its sustainable development.

In concluding this discussion, it can be said that climate change is a global concern and Namibia is no exception, hence serious measures need to be taken to ensure that issues related to climate change are directly addressed in the curriculum and its syllabi.

#### **6.3.4 Objective 4: To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.**

Climate change is a topical global issue that Namibia cannot afford to ignore. The guideline that this research study recommends is that the government should draft policies that actively seek to address climate change by engaging the relevant stakeholders in society. Measures to address climate change have to focus on sharing of new knowledge about climate change through environmental education teaching and learning. As such, this study recommends that at policy level, government should draft and implement policies that seek to disseminate climate change knowledge through environmental education. More importantly, there should be a deliberate education policy for syllabi to teach learners new skills to mitigate the effects of climate change.

This study found that the cross-ministry government policies, chiefly Namibia’s Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) and the National Policy on Climate Change for Namibia that seek to promote climate change and environmental education do not filter through to teaching and learning in Namibian schools. On the ground, not much is being done in the way of teaching learners about climate change.

To this end, this study recommends that the Ministry of Education should ensure that the content of existing policies should be reconstructed and expand themes related to climate change from basics to complex knowledge and understanding from lower grade to senior grade in order to have a systematic balance in topics and themes about crucial global issues. These would include environmental learning, i.e. climate change in a critical thinking approach within the Namibian National Curriculum for Basic Education and Namibian junior/senior secondary Physical Science syllabus. Furthermore, the Ministry of Education should coordinate and form synergies with other ministries, such as the Ministry of Environment and Tourism, to increase climate change awareness and knowledge in society through environmental learning. The Ministry of Education should also deploy resources towards equipping teachers through teacher training with current knowledge and skills pertaining to teaching about climate change in all subjects through environmental education to ensure their skills are up to date.

Lastly, the study recommends that support in the form of in-service training must be rendered to scholars and researchers so that they can revise syllabi to include a more tangible focus on climate change in each school subject in both the junior and secondary phases. This will enable Namibia to have a rich knowledge-base of the local trends in climate change and stop the country from relying on external bodies.

It can be concluded that if the integration of climate change in the Physical Science syllabus (Grade 11 and 12) is to be successful, the teachers of the subject should be well informed and educated on the phenomenon. This calls for teachers to pursue the subject matter intensively and be well aware of all the aspects of climate change. Continuous research and further training on the part of teachers are key to the success of implementing climate change education in schools. From a different perspective, most of the participants were of the view that climate change should be emphasised more in detail under environmental chemistry, and as an energy topic or addressing it as a separate topic in the syllabus. As such it became evident that climate change should feature and be more predominant in the Physical Science syllabus because a syllabus is a specific document that directly specifies what teachers are supposed to teach and what learners are supposed to learn (cf. 2.8.2). The suggestions on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change is that the integration of climate change in the syllabus must: be based using a holistic approach; examine major environmental issues from local, national, regional and international points of view; use Namibian situations so as to seek

solutions for local environmental problem-solving; plan for learners to have active roles in planning their learning experiences, that includes opportunities for making decisions and accepting their consequences; develop critical thinking and problem-solving skills; make use of indoor and outdoor learning environments for practical activities and first-hand experiences; and include different education approaches to teaching and learning about and from the environment.

#### **6.4 INNOVATIVE NAMIBIAN CURRICULUM REVIEW GUIDELINES ON HOW TO INTEGRATE CLIMATE CHANGE IN THE PHYSICAL SCIENCE SYLLABUS THROUGH ENVIRONMENTAL EDUCATION**

Boon (2010:5) attests that teaching about climate change improves learners' behaviours and attitudes towards the environment in a positive way. The aims of including climate change in the Physical Science Syllabus (Grade 11 and 12) go beyond merely imparting the knowledge to learners but rather it is to impart skills to address the effects of climate change. Thus, the knowledge should spread across society and involve the communities in mitigation. In line with this, the guideline recommended is that climate change should aim at empowering all learners through teaching and learning activities that will not only create awareness, but also provide problem-solving skills that are practical and effective in addressing the causes of climate change. For example, environmental education projects that require learners to create or plan for alternative sources of energy should be initiated, in line with objective two of the National Policy on Climate Change for Namibia: *The Namibian senior secondary Physical Science syllabus should develop action and strategies for climate change mitigation.* This might be achieved through the development and implementation of renewable energy and energy use efficiency, Clean Development Mechanisms (CDM) and enhanced carbon sinks. It is further important for the Ministry of Education and Ministry of Environment and Tourism to practically come up with innovative strategies to upgrade current policy documents, namely the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD) (2017), the National Curriculum for Basic Education (2010), and the senior secondary Physical Science syllabus (Grade 11-12) for Namibia, to help enhance synergies to ensure climate change and other issues are effectively, efficiently and cost-effectively addressed by relevant sectors and stakeholders. More importantly, education government departments in all spheres should work together on a cooperative basis to deal with climate change by harmonising of policies and laws to reflect an integrated

approach in planning, decision-making and implementation with respect to climate change. As far as possible, climate change is a global concern which should be mainstreamed into sectoral policies for sustainable development.

From the responses quoted during a one-on-one interview, the NIED official pointed out that the Namibian education curriculum is reviewed every five years. The official emphasised the need for researchers to provide current information, trends and statistics about climate change to provide curriculum developers with updated information concerning climate change. Such a contribution is crucial in the development of a curriculum that addresses issues and challenges relevant to the Namibian society. In line with this study, such information will be useful in integrating and incorporating current climate change concepts in the National Curriculum for Basic Education.

On the same note, the subject advisor pointed out that the current topics and themes in the syllabus are enough although they lack details about learning through environmental education, as well as learning for sustainable development and climate change. This assertion suggests that the current syllabus is shallow with regard to climate change and environmental education is concerned. To address this anomaly I am of the notion that these concepts and others highlighted in the study should be expanded and studied in depth. This line of reasoning opens the door for researchers to contribute to the Physical Science curriculum development, formulation and implementation by imparting new skills and approaches on how to address topics and themes about climate change and other environment-related issues which link to the Physical Science contents in the syllabus (Grade 11 and 12). Teachers are key stakeholders in curriculum development. They interact with learners on a day-to-day basis and are conveniently placed to know the contents (and deficiencies where they exist) of the Physical Science syllabus. As such, any measures to incorporate new subjects/themes into the curriculum need to take note of teachers' inputs.

In concluding this section, the table below is an illustration of a guideline on how climate change can be integrated in the Physical Science syllabus through environmental education.

Table 5: Curriculum Review on how to integrate climate change in the Physical Science syllabus (Grade 11 & 12) through environmental education

<b>Current syllabus sections for Grade 11&amp;12</b>	<b>Current Topics</b>	<b>Current Themes</b>	<b>Learners' specific objectives</b>	<b>Suggested guidelines topics or themes to address climate change</b>	<b>Suggested guidelines to address environmental education Grade 11-12</b>
General Science Section	2.Scientific Skills	2.1Recording data 2.2 Drawing graphs and tables	Use column headings of the table to be directly transferred to the axes of a constructed graph; draw the graph as the whole diagrammatic presentation.	Teachers should use temperature changes and rainfall patterns in Namibia to show how global warming is taking place over a long period of time.	The learner is an active participant: Taught the basics about climate change should be taught in the lower grades and then need to be expanded on with more themes pertaining to global warming issues and greenhouse gas issues in the higher grades so as to work through the higher cognitive levels whereby learners get to evaluate temperatures or rainfall patterns, and concentrate on the issues of climate change.
<b>Current syllabus sections for Grade 11&amp;12</b>	<b>Current Topics</b>	<b>Current Themes</b>	<b>Learners' specific objectives</b>	<b>Suggested guidelines topics or themes to address climate change</b>	<b>Suggested guidelines to address environmental education Grade 11-12</b>
Physics Section	2.Thermal Physics	2.2.2 Measurement of temperature 2.2.3 Melting and boiling	State and apply examples of how a physical property which varies with temperature may be used for the measurement of temperature. Understand the process of melting and boiling with reference to climate	Drought: causes of increase in temperature in the environment.  Water pollution domes  Water in Namibia sources, access, storage, pollution and quality. Reasons for water shortages - catchments and water management.	Learners should be taught about: the causes and effects of climate change, and focus placed on limiting the amount of carbon dioxide in the atmosphere; ways to reduce climate change; causes of climate change. Experiential learning about pollution by making environmental education relevant and involving learners in problem-solving activities where they

			change.		interact with the private sector to explore local environmental issues.
Chemistry Section	5. Nuclear Physics	5.2 Radioactivity	Describe radioactive isotopes, such as $^{235}_{92}\text{U}$ , as a source of energy (reference to isotopes).	Reduction of emissions and the role of different forms of ownership in sustainable use of natural resources, sustainable energy resources, exploitation of resources, and local environmental health problems, degradation and impact of humans on environment solution-based waste dumps, radiation, pollution.	Encourage learners to: plant trees as a sustainable practice; make the environment more sustainable by limiting the amount of carbon dioxide in the atmosphere; list the causes of climate change; explore how to reduce the effects of climate change at school. Experiential learning about pollution in the local community. All these activities work with an interdisciplinary approach.
<b>Current syllabus sections for Grade 11&amp;12</b>	<b>Current Topics</b>	<b>Current Themes</b>	<b>Learners' specific objectives</b>	<b>Suggested guidelines topics or themes to address climate change</b>	<b>Suggested guidelines to address environmental education Grade 11-12</b>
1.6 Energy	1.6.1 Major sources of energy and alternative sources of energy		Outline the advantages and disadvantages of the use of different sources of energy, including environmental considerations and the distinction between finite and renewable sources.	Biomes of Namibia, solar energy, sustainable energy, Renewable and non-renewable sources and lack of infrastructure, i.e. energy in rural areas, impact of contemporary socio-economic issues -unavailability of natural resources and exhaustion of natural resources.	Engage learners to actively implement renewable energy and use energy efficiency in their local environment by means of an audit task with reporting. Teach about Clean Development Mechanism (CDM) and enhanced carbon sinks. (These suggestions are strategies found in the Namibian National Policy Climate Change.)
	4. Chemical reactions	4.1 Production of energy	Describe the production of heat energy by burning fuels.	Energy, renewable, non-renewable, enviro impact and energy balance/ energy budget.  Burning of fossil fuels.	Increase learner awareness and knowledge about climate change, as well as to empower people to participate in the planning, development and implementation of appropriate responses to climate change by means of a project-

Current syllabus sections for Grade 11&12	Current Topics	Current Themes	Learners' specific objectives	Suggested guidelines topics or themes to address climate change	Suggested guidelines to address environmental education Grade 11-12
	8. Industrial uses and application chemistry	8.1 Metallurgical industrial plant 8.2 Chemical industrial plant	Name some of the uses of water in industry and in the home.  Describe the composition of clean air as being approximately 79% nitrogen, 20% oxygen and the remainder as being a mixture of noble gases, water vapour and carbon dioxide.	Impact on environment as a result of mining - acid drainage, dust pollution modern mining.  Overutilization of resources for productions.  Environmental changes caused by humans.  The environment - the problem, protecting, sustainability, global and local impact.	based assignment that reinforces decision making.  Ministry of Education has to train teachers and focus on environmental concerns like climate change in the syllabus. The national curriculum developers must include the topics related to climate change and promote environmental education. Government can support schools with funds to take learners on field trips. (These are all proposed suggestions from the participants that have been reformulated and taken into consideration for this research.)
	10. Environmental Chemistry		State the common pollutants in the air as being carbon monoxide, sulphur dioxide, oxides of nitrogen and lead compounds.  Explore the effects of dangerous chemicals on the environment	Climate change, greenhouse gases and greenhouse effects, global warming, sustainable development reduces, reuse, recycle, plastics, extraction and use of materials, including pollution, recycling scrap metals and design recycling scheme.	Start with the basics by defining climate change and global warming. Advocate for the sustainable and equitable use of natural resources by means of teaching activities that are based on indoor and outdoor investigations.

## **6.5 RECOMMENDATIONS FOR FURTHER RESEARCH**

This study focused on the main research question, namely how climate change can be integrated into the Namibian senior secondary Physical Science syllabus (Grade 11-12) through environmental education. Through the sub-research questions, the study established that a variety of key terms that unlock the understanding of how the climate change phenomenon should be included in key national documents. These documents include the National Curriculum for Basic Education and the senior secondary Physical Science syllabus (Grade 11-12) which are the direct policy documents geared towards delivering quality education for sustainable development, more particularly the curriculum which is the framework directing us on how to develop curricula in various subjects. Apart from introducing climate change to secondary school learners, in general the participants felt that the concept should in fact be introduced at primary school. The study revealed that while teachers were aware of some climate change objectives included in the senior secondary Physical Science syllabus, these were too few to address the demands of necessary knowledge and actions needed in combating challenges presented by climate change. Thus, the objectives need to be expanded into different components that make up climate change as a whole. Therefore, the recommendation that I make is that both the National Curriculum for Basic Education and the senior secondary Physical Science syllabus (Grade 11-12) should be reviewed and climate change be included across the syllabi for all subjects through environmental education, as suggested by a guideline example in Table 5. Research should be conducted so as to establish which subjects will best suit the integration of climate change.

## **6.6 LIMITATIONS OF THE STUDY**

The limitations of the study pertain to the aspects which have the potential to affect the results and findings generated in the study. In many cases the limitations were beyond the control of a researcher. The first limitations were time and resources at my disposal. I had limited time to complete this research and limited resources to undertake a much wider study. As a result, I could interview teachers from only six schools. Thus, the study was forced to make deductions from a small sample. During the data generation process, the study aimed at involving senior Physical Science teachers who have been teaching Grade 11 and 12 for a longer period (five and more years). Due to the migration and resignation of teachers from one school to another, most teachers who were involved were junior Physical Science teachers who have been either upgraded or who assist the senior Grades 11 and 12 as a result

of a shortage of staff in the schools. As such I was limited in obtaining accurate results from the intended senior educators.

## **6.7 CONCLUSION**

This marks the end of the study on climate change integration in the Namibian senior secondary Physical Science syllabus (Grade 11 and 12). The study discovered that matters of climate change are not being fully represented in relevant education documents and government policies. While teachers admit teaching some of the components of climate change, these were too few to make an impact as desired by global policies on climate change. On a positive note, there was general consensus on the need for climate change to be integrated in secondary education. The modalities of such integration should be a national issue involving all stakeholders.

The benefits of climate change cannot be over-emphasised. Equipping learners with the relevant knowledge and skills on the phenomenon will result in a positive attitude towards the environment in the long run. Furthermore, as learners gain knowledge on the phenomenon, they will join the world in embarking on scientific research on productions that seek to minimise the effects of climate change. To this end it became evident that Namibia and its education system need to seriously take measure of global concerns, particularly regarding environmental awareness, preservation and protection, climate change, environmental education and education for sustainable development in order to improve climate vulnerabilities facing the country so as to achieve sustainable development.

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## Addendum A: Document research

### The utilization of document analysis in this study

In my research study, document analysis was used to analyse the following documents:

- Namibia's Draft Policy for Environmental Education (EE)/Education for Sustainable Development (ESD)
- The National Policy on Climate Change for Namibia
- The National Curriculum for Basic Education
- The senior secondary Physical Science Syllabus Grade 11 and 12 for Namibia

The review of literature relevant to the study assisted me in identifying keywords relevant to the concept of climate change and they are listed below. In the process of conducting a literature review, I discovered that the phenomenon of climate change is not an isolated concept. As such, it does not occur in a vacuum because it is related to other concepts, themes and subjects. As such, the relevant keywords (sub-themes and sub-areas) are listed below. The list is related to climate change and was used for the content analysis. Some of the key words are found in the Physical Science syllabus (Grade 11 and 12) although they are not explained in detail in the syllabus, but are related to the concept of climate change, for example, energy, water and global warming.

Climate change	Infrared radiator	Global warming
Anthropogenic phenomenon	Emissions of carbon dioxide	Earth's energy budget
Human induced processes, Anthropogenic causes, human activities, human activities or human modification	Ozone layer depletion	Natural climate variability
Industrialization	Energy	Deforestation
Natural resources dependency	Water scarcity or low rainfall	Natural phenomenon
Burning fossil fuels	Rising sea levels	Natural resources depletion
Greenhouse gases emission	Greenhouse gases	Drought, and desertification
Increased carbon dioxide in the atmosphere	Acid rain (ocean acidification)	Increase in temperature changes
Heavy precipitation		

I also decided to include general keywords in the content analysis that are predominant words in this study and they may be found in the Namibian Draft Policy for Environmental Education (EE)/Education for Sustainable Development(ESD) and the National Policy on

Climate Change for Namibia. Both documents provide important perspectives on climate change and environmental education. The general keywords are listed below:

Education for Sustainable Development (ESD)	Climate change	Education for sustainability
Sustainable Development Goals (SDG)	Environmental education	Environmental teaching and learning
Environmental issues	Globalization	Sustainable development
Environmental sustainability		

## **Addendum B: Focus group questions**

1. Tell me about your understanding of climate change.
2. Tell me about your understanding of environmental education.
3. Share your opinion on climate change being taught in the Namibian Physical Science syllabus.
4. What themes of climate change can you identify that are included in the current senior Physical Science syllabus for Grade 11&12?
5. The National Policy on Climate Change for Namibia contains climate change objectives. If you are aware of these objectives, share which objectives are addressed in the Physical science syllabus that you know of.
6. Share which climate change issues you address in the grade 11&12 Physical Science syllabus. Let's begin with grade 11 and then grade 12.
7. In your opinion, under which syllabus themes can climate change issues be introduced in the senior Physical Science syllabus (Grade 11-12)?
8. From your experience, which climate change issues can be taught in the senior Physical Science syllabus to address climate change mitigation for sustainable development?
9. In your opinion, how can climate change be holistically integrated into the Namibian senior secondary Physical Science syllabus?
10. Share your opinions on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change issues.
11. What is your opinion regarding a suggestion to incorporate climate change with environmental education in the Namibian senior secondary Physical Science syllabus?
12. In your opinion, what form of support should government extend to Namibian schools to promote the teaching and learning of climate change issues?
13. In your opinion, what advantages if any, are there when teaching Namibian learners about climate change issues?

### **Addendum C: Subject advisor questions**

1. What is your understanding of climate change?
2. a) Are you aware of the climate change objectives contained in the National Policy on Climate Change for Namibia? If you are, please elaborate on the objectives. If you are not, please let me show you the document so that you can familiarize yourself with it. Then please share your views on the document with me.  
b) Tell me about your involvement in the formulation of the senior Physical Science syllabus.
3. Share your views on the extent to which the Physical Science syllabus reflects climate change issues contained in the objectives of the National Policy on Climate Change for Namibia.
4. In your opinion, how does the Physical Science syllabus address the climate change objectives contained in the National Policy on Climate Change for Namibia?
5. Following your answer to Question 4, what steps should be taken to adequately address climate change objectives contained in the National Policy on Climate Change for Namibia in the Physical Science syllabus?
6. a) In your opinion, is it advisable to integrate climate change issues in the senior Physical Science syllabus? If so, answer Question 6b.  
b) How should climate change education be integrated into the Namibian senior secondary Physical Science syllabus?
7. In your opinion, under which themes can climate change issues be introduced in the Physical Science syllabus?
8. In your opinion, what climate change issues can be taught in the senior Physical Science syllabus in order to address climate change mitigation and to educate for sustainable development?

## **Addendum D: NIED Official questions**

1. Tell me about the role that you play in the development of the Namibian senior secondary school curriculum.
2. How do you go about developing the curriculum?
3. How do you go about amending a curriculum?
4. Elaborate on the factors that influence the integration of current climate change issues in curriculum development.
5. Who are the relevant stakeholders in the curriculum development?
6. Tell me about the role of government policies and the constitution in curriculum development.
7. What is your understanding of climate change?
8. a) Are you aware of the climate change objectives contained in the National Policy on Climate Change for Namibia? If you are, please elaborate on the objectives. If you are not, please let me show you the document so that you can familiarize yourself with it. Then please share your views on the document.  
b) Tell me about your involvement in the formulation of the senior Physical Science syllabus.
9. In your opinion, does the senior Physical Science Syllabus adequately address the climate change objectives contained in the National Policy on Climate Change for Namibia?
10. Tell me about your understanding of environmental education.
11. Discuss whether you think that environmental education can be implemented in the senior Physical Science syllabus to address climate change issues?
12. In your opinion, under which themes can environmental issues on climate change be introduced in the Physical Science syllabus?
13. In your opinion, what climate change issues can be taught in the senior Physical Science syllabus in order to address climate change mitigation and to educate for sustainable development?

## Addendum E: Invitation letter to all the participants



### Faculty of Education

P. Bag X6001, Potchefstroom 2520  
Republic of South Africa  
School for Mathematics, Science and Technology for Education

Education

Department: Geography Education and Environmental

Tel: +27 18 2994727 or +27 83 4686726  
Email: Luiza.desousa@nwu.ac.za

### **Re: Invitation letter to contribute toward an academic study.**

**Title of the study:** *The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education.*

My name is Wilhelmine Ndapewa Ipinge (student no. 21996938), I am a full-time postgraduate student at North-West University in the Faculty of Education Sciences. The overall goal of this study is to find ways through which climate change can be integrated into the Namibian Physical Science syllabus. The study was necessitated by the absence of explicit climate change issues in the above-stated syllabus. I will collect information about climate change through focus group interviews with six senior Physical Science teachers from six schools of the Kharas region. In addition, one-on-one interviews will be conducted with the relevant official in the Ministry of Education. Owing to your extensive professional experience and knowledge of the phenomenon under study, I as the researcher am confident that you possess the required knowledge and information to contribute towards formulating ways to integrate climate change issues in the grade 11-12 Physical Science syllabus for Namibia.

Taking the above into consideration, you are cordially invited to participate in this study. Information gathered during the data collection phase of this study will be instrumental towards meeting the aims and objectives of the above-mentioned study.

**Aim of the study**

The aim of the study is to explore the extent to which climate change can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education.

**Objectives of the study**

- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.
- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus.
- To establish what climate change issues are addressed by teachers in grade 11 and 12 in the Physical Science syllabus.
- To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.

Your assistance and cooperation will be greatly appreciated

Wilhelmine Ndapewa Ipinge

.....

## Addendum F: NWU Ethics Approval Letter



1 October 2018

To Whom It May Concern

I hereby confirm that the ethics application, as stated below, was approved on the Edu-REC meeting of 30 November 2017.

**Ethics number: NWU-00701-17-A2**

**Project head: Dr LO de Sousa**

**Project team: WN lipinge**

**Title: The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education**

**Period: 1 September 2017 – 1 Desember 2018**

**Risk level: Low**

Should you have further enquiries in this regard, you are welcome to contact Prof Jako Olivier at 018 285 2078 or by email at [Jako.Olivier@nwu.ac.za](mailto:Jako.Olivier@nwu.ac.za) or Ms Erna Greyling at 018 299 4656 or by email at [Erna.Greyling@nwu.ac.za](mailto:Erna.Greyling@nwu.ac.za).

Yours sincerely

Prof J Olivier  
Chair Edu-REC

## Addendum G: Permission to conduct study in Kharas region



### Faculty of Education

P. Bag X6001, Potchefstroom 2520  
Republic of South Africa  
School for Mathematics, Science and Technology for Education

Education

Department: Geography Education and Environmental

Tel: +27 18 2994727 or +27 83 4686726  
Email: Luiza.desousa@nwu.ac.za

Kharas Regional Education Directorate

The Inspector: Mrs Wanternaar

Kalahari circuit

Kharas Region

### **RE: REQUEST FOR PERMISSION TO UNDERTAKE AN ACADEMIC RESEARCH STUDY AT SIX SECONDARY SCHOOLS IN THE KHARAS REGION**

Title of study:

The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education.

My name is Wilhelmine N Iiping, I am a full-time student (21996938) undertaking an academic research study with the abovementioned title. The study is in fulfilment of the academic requirements for a Master's degree under the Faculty of Education at the North West University. The researcher wishes to collect data on the integration of climate change in the Namibian senior secondary Physical Science syllabus. In a nutshell, the study examines how climate change can be integrated into the Physical Science syllabus. Furthermore, the study seeks to complement the current government drive aimed at creating a green economy and sustainable development in Namibia. Data collected in this regard will be instrumental towards attaining the objective of the study encapsulated in the research title.

Taking the above into consideration, this letter requests permission to allow the researcher to conduct focus group interviews with six senior Physical Science teachers from six secondary schools in the Kharas Region. In addition, the researcher intends to conduct one-on-one interviews with the Physical Science subject advisor in the Kharas region and the NIED Physical Science official. The researcher pledges to adhere to professional and ethical principles throughout this study, as such, privacy and confidentiality of the participants will be guaranteed. The researcher expects the outputs of this study to be beneficial to the Physical Science curriculum reform development. Upon completion, of the research study the findings will be made available to the Ministry of Education and other interested entities upon request. Furthermore, the researcher will publish the findings in an academic thesis, as well as academic journals.

Your assistance and cooperation is thankfully appreciated.

Wilhelmine Ndapewa Iipinge

.....

## Addendum H: Approved letter from the directorate of Education



**||KHARAS REGIONAL COUNCIL  
DIRECTORATE OF EDUCATION, ARTS and CULTURE**



Tel: (063) 227000  
Fax: (063) 223800

Private Bag 2160  
KEETMANSHOOP

Date: 19 December 2017  
File Ref. No.: 15/1

Mrs Wilhelmine Ndapewa Ipinge  
Private Bag X6001  
POTCHEFSTROOM 2520  
Republic of South Africa

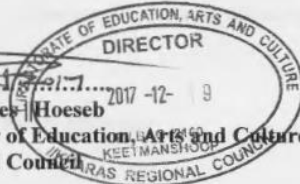
**SUBJECT: Approval to conduct research at schools located in ||Kharas Region**

Dear Mrs Wilhelmine Ndapewa Ipinge

- 1) Receipt of your request to be granted permission to undertake an academic research study at six secondary schools in the ||Kharas Region bear reference.
- 2) Permission is hereby granted to you to conduct research via **focus group interviews and one-on-one interviews** with **Physical Science teachers at six public secondary schools** in the ||Kharas Region which are resorting under the armpit of the Directorate of Education, Arts and Culture, as well as the **Senior Education Officer for Physical Science**, on the topic "*The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education*" on condition that and that the **anonymity of respondents (interviewees) and schools would be guaranteed.**
- 3) Please present this letter to the Principals of State schools, whenever you would visit a school and agree on the most suitable time-slot for research engagements.
- 4) Note must however be taken of the limitation that the engagement with the teachers at the respective schools is not supposed to lead to the disruption and or interruption of teaching and learning programmes and or processes, or the discontinuation of the teaching duties of teachers during normal school hours.
- 5) Lastly, the Regional Management Committee of the Directorate: Education, Arts and Culture in the ||Kharas Regional Council would like to request you to share your research findings with this directorate for insightful planning purposes.

Yours faithfully

.....  
Awebahe Johannes Hoeseb  
Regional Director of Education, Arts and Culture  
||Kharas Regional Council



## Addendum I: Consent form for teachers



### Faculty of Education

P. Bag X6001, Potchefstroom 2520  
Republic of South Africa  
School for Mathematics, Science and Technology for Education

Department: Geography Education & Environmental

Education

Tel: +27 18 2994727 or +27 83 4686726  
Email: Luiza.desousa@nwu.ac.za

21 January 2018

**TITLE OF THE RESEARCH STUDY:** The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education

**Project Supervisor:** DrLO de Sousa

**Address:** 11 Hoffman Street, Building C6-105 Potchefstroom, 2520

**Contact number:** +2718 299 4727

**Master Student:** Wilhelmine N. Ipinge

**Ethics Reference Number:** NWU-00701-17-S2

### **Informed Consent Letter to the Teachers in the Kalahari circuit**

You are invited to take part in a research study that forms part of my Master's degree programme. Please take some time to read the information presented here, which will explain the details of this study. Do not hesitate to ask any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied and that you clearly understand what this research is about and how you will be involved.

Your participation **is entirely voluntary** and you can withdraw to participate anytime. If you withdraw, this will not affect you negatively in any way whatsoever.

This study has been approved by the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) of the North-West University and will be conducted according to the ethical guidelines and principles of Ethics in Education Research:

Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study.

## **1.1 What is this study all about?**

### **Aim of the study**

The aim of the study is to explore the extent to which climate change can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education.

### **Objectives of the study**

- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.
- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus.
- To establish what climate change issues are addressed by teachers in grade 11 and 12 in the Physical Science syllabus.
- To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.

This study will be conducted in the Kharas region. The study explores the integration of climate change in Namibian schools, particularly grades 11-12. Eight participants will be involved in this study, namely six Physical Science teachers from the region, one Physical Science subject advisor and one Namibian Ministry of Education official.

I, the researcher, intend to conduct interviews with the abovementioned participants to gather information about climate change in Namibian senior secondary schools.

## **1.2 Why have you been invited to participate?**

You have been invited to take part because you are a teacher responsible for the Physical Science syllabus in your school. Hence your contribution will be beneficial to this study.

### **What will be expected of you?**

As a participant in this study, you will be expected to cooperate, within the limits of your discretion, with the requirements of this study. The researcher intends to conduct a focusgroup interview with you that will dwell on climate change in Physical Science and any other related areas that are pertinent to this study. However, at no point in the interviews will the researcher request information that is beyond your scope or expertise.

### **1.3 Will you gain anything from taking part in this research?**

No direct, personal benefits will be accrued by you in this study. However, the basic education fraternity and society at large will benefit from this study.

### **1.4 Are there risks involved in you taking part in this research and what will be done to prevent them?**

At this point, it can be stated with considerable confidence that the study does not pose any discernible risks to you.

### **1.5 How will your confidentiality be protected?**

Information gathered from this study will only be used for academic purposes. Your personal contribution will not be divulged or made public. All the participants' contributions will be pooled together to avoid any individual being personally identified with the information he/she provides. Your privacy will be respected by ensuring that the information provided will only be used for this study's purpose and access will be limited only to the study leader (supervisor) and the Master student (researcher). Only the researcher and the study supervisor will be able to look at your contribution. Findings will be kept safe by locking hard copies in locked cupboards in the study supervisor's office and for electronic data it will be password-protected. Data will be stored for five (5) years as required by the North-West University.

### **1.7 What will happen to the findings or samples?**

The findings of this study will only be used for academic purposes. The results will be presented in the form of a master's degree dissertation. Together with my supervisor I will publish findings of this study in an academic journal. Thus, as stated above, the information sought in this study is for academic purposes and it will be shared with the

Namibian Ministry of Education to promote change in the Namibian Physical Science Syllabus. Under no circumstances will the information be used for commercial purposes.

### **1.8 How will you know about the results of this research?**

The results will be made available when the researcher has completed the study. It is envisaged that the study will be completed before 31 December 2018. The researcher pledges to inform the participants about the findings that will be derived from this study by means of a summary and presentation at a circuit meeting in 2019.

### **1.9 Is there anything that you need to know or say?**

You can contact the researcher, Wilhelmine Ndapewa Iiping, on the contact details provided above if you have any further questions or have any problems. You can also contact my supervisor, Dr Luiza de Sousa, at [Luiza.desousa@nwu.ac.za](mailto:Luiza.desousa@nwu.ac.za) or +2718 299 4727.

You can also contact the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) via Miss Jessica Mabaso at 018 299 4707 or [Ethics-EMHS@nwu.ac.za](mailto:Ethics-EMHS@nwu.ac.za) if you have any concerns that were not answered about the research or if you have complaints about the research.

### **1.10 Declaration by the participant**

By signing below, I ..... agree to take part in the research study titled “The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education”.

#### **I declare that:**

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.

- I may choose to leave the study at any time and will not be treated in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (place)..... on  
 (date)..... 20.....

.....  
**Signature of participant** **Signature of witness**

**1.9.1 Declaration by person obtaining consent**

I (name).....declare that:

- I clearly and in detail explained the information in this document to .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above.
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....  
**Signature of person obtaining consent** **Signature of witness**

**1.9.2 Declaration by researcher**

I (name)..... declare that:

- I explained the information in this document to ..... or had it explained by..... who I trained for this purpose.
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them or I was available should he/she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....

**Signature of researcher**

**Signature of witness**

## Addendum J: Consent form for subject advisor



### Faculty of Education

P. Bag X6001, Potchefstroom 2520  
Republic of South Africa  
School for Mathematics, Science and Technology for Education

Department: Geography Education and Environmental

Education

Tel: +27 18 2994727 or +27 83 4686726

Email: [Luiza.desousa@nwu.ac.za](mailto:Luiza.desousa@nwu.ac.za)

21 January 2018

**TITLE OF THE RESEARCH STUDY:** The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education

**Project Supervisor:** DrLO de Sousa

**Address:** 11 Hoffman Street, Building C6-105 Potchefstroom, 2520

**Contact number:** +2718 299 4727

**Master Student:** Wilhelmine N. Ipinge

**Ethics Reference Number:** NWU-00701-17-S2

### **Informed Consent Letter for the Physical Science subject advisor.**

You are invited to take part in a research study that forms part of my Master's degree programme. Please take some time to read the information presented here, which will explain the details of this study. Do not hesitate to ask any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied and that you clearly understand what this research is about and how you will be involved.

Your participation is **entirely voluntary** and you may withdraw from the project anytime. If you withdraw, this will not affect you negatively in any way whatsoever.

This study has been approved by the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) of the North-West University and will be conducted according to the ethical guidelines and principles of Ethics in Education Research:

Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study.

## **1.6 What is this study all about?**

### **Aim of the study**

The aim of the study is to explore the extent to which climate change can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education.

### **Objectives of the study**

- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.
- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus.
- To establish what climate change issues are addressed by teachers in grade 11 and 12 in the Physical Science syllabus.
- To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.

This study will be conducted in the Kharas region. The study explores the integration of climate change in the Namibian schools, particularly grades 11-12. Eight participants will be involved in this study, namely six Physical Science teachers from the region, one Physical Science subject advisor and one Namibian Ministry of Education official.

I, the researcher, intend to conduct interviews with the above-mentioned participants to gather information about climate change in Namibian senior secondary schools.

## **1.7 Why have you been invited to participate?**

You have been invited to take part in this study due to your extensive knowledge and experience about the teaching of senior secondary Physical Science by Namibia educators. As such your contribution to this study will be beneficial to the research.

## **1.8 What will be expected of you?**

As a participant in this study, you will be expected to cooperate, within the limits of your discretion, with the requirements of this study. The researcher intends to conduct a one-on-one interview with you that will dwell on climate change in Physical Science and other related areas that are pertinent to this study. However, at no point in the interviews will the researcher request information that is beyond your scope or expertise.

### **1.9 Will you gain anything from taking part in this research?**

No direct, personal benefits will be accrued by you in this study. However, the basic education fraternity and society at large will benefit from this study.

### **1.10 Are there risks involved in you taking part in this research and what will be done to prevent them?**

At this point, it can be stated with considerable confidence that the study does not pose any discernible risks to you.

### **1.11 How will we protect your confidentiality?**

Information gathered from this study will only be used for academic purposes. Your personal contribution will not be divulged and made public. All the participants' contributions will be pooled together to avoid any individual being personally identified with the information he/she provides. Your privacy will be respected by ensuring that the information provided will only be used for this study's purpose and access will be limited only to the study leader (supervisor) and the Master student (researcher). Only the researcher and the study supervisor will be able to look at your contribution. Findings will be kept safe by locking hard copies in locked cupboards in the study supervisor's office and for electronic data it will be password protected. Data will be stored for five (5) years as required by the North-West University.

### **1.7 What will happen to the findings or samples?**

The findings of this study will only be used for academic purposes. The results will be presented in the form of a master's degree dissertation. Together with my supervisor I will publish findings of this study in an academic journal. Thus, as stated above, the information sought in this study is for academic purposes and it will be shared with the

Namibian Ministry of Education to promote change in the Namibian Physical Science Syllabus. Under no circumstances will the information be used for commercial purposes.

### **1.8 How will you know about the results of this research?**

The results will be made available when the researcher has completed the study. It is envisaged that the study will be completed before 31 December 2018. The researcher pledges to inform the participants about the findings that will be derived from this study by means of a summary and presentation at a circuit meeting in 2019.

### **1.9 Is there anything that you need to know or say?**

You can contact the researcher, Wilhelmine Ndapewa Iipinga, on the contact details provided above if you have any further questions or have any problems. You can also contact my supervisor, Dr Luiza de Sousa, at [Luiza.desousa@nwu.ac.za](mailto:Luiza.desousa@nwu.ac.za) or +2718 299 4727.

You can also contact the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) via Miss Jessica Mabaso at 018 299 4707 or [Ethics-EMHS@nwu.ac.za](mailto:Ethics-EMHS@nwu.ac.za) if you have any concerns that were not answered about the research or if you have complaints about the research.

### **1.10 Declaration by the participant**

By signing below, I ..... agree to take part in the research study titled The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education.

#### **I declare that:**

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.

- I may choose to leave the study at any time and will not be treated in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (place).....on (date).....20.....

.....

**Signature of participant**

**Signature of witness**

**1.9.1 Declaration by person obtaining consent**

I (name).....declare that:

- I clearly and in detail explained the information in this document to .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above.
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....

**Signature of person obtaining consent**

**Signature of witness**

**1.9.2 Declaration by researcher**

I (name)..... declare that:

- I explained the information in this document to .....  
or has it explained by..... who I trained for this purpose.
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them or I was available should he/she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....

**Signature of researcher**

**Signature of witness**

## Addendum K: Consent form for NIED Official



### Faculty of Education

P. Bag X6001, Potchefstroom 2520  
Republic of South Africa  
School for Mathematics, Science and Technology for Education

**Department: Geography Education and Environmental**

**Education**

Tel: +27 18 2994727 or +27 83 4686726  
Email: Luiza.desousa@nwu.ac.za

21 January 2018

**TITLE OF THE RESEARCH STUDY:** The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education.

**Project Supervisor:** DrLO de Sousa

**Address:** 11 Hoffman Street, Building C6-105 Potchefstroom, 2520

**Contact number:** +2718 299 4727

**Master Student:** Wilhelmine N. Ipinge

**Ethics Reference Number:** NWU-00701-17-S2

### **Informed Consent Letter to the NIED official**

You are invited to take part in a research study that forms part of my Master's degree programme. Please take some time to read the information presented here, which will explain the details of this study. Do not hesitate to ask any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied and that you clearly understand what this research is about and how you will be involved.

Your participation **is entirely voluntary** and you can withdraw to participate anytime. If you withdraw, this will not affect you negatively in any way whatsoever.

This study has been approved by the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) of the North-West University and will be conducted according to the ethical guidelines and principles of Ethics in Education Research: Principles, Processes and Structures (DoH, 2015) and other international ethical guidelines applicable to this study.

## **1.12 What is this study all about?**

### **Aim of the study**

The aim of the study is to explore the extent to which climate change can be integrated into the Namibian senior secondary Physical Science syllabus through environmental education.

### **Objectives of the study**

- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian National Curriculum for Basic Education.
- To identify which climate change objectives contained in the National Policy on Climate Change for Namibia are addressed in the Namibian senior secondary Physical Science syllabus.
- To establish what climate change issues are addressed by teachers in grade 11 and 12 in Physical Science syllabus.
- To suggest guidelines on how environmental education can be implemented in the senior secondary Physical Science syllabus to address climate change.

This study will be conducted in the Kharas region. The study explores the integration of climate change in the Namibian schools, particularly grades 11-12. Eight participants will be involved in this study, namely six Physical Science teachers from the region, one Physical Science subject advisor and one Namibian Ministry of Education official.

I, the researcher, intend to conduct interviews with the abovementioned participants to gather information about climate change in Namibian senior secondary schools.

## **1.13 Why have you been invited to participate?**

You have been invited to take part because you are an official for the National Institute for Educational Development (NIED), responsible for the Physical Science curriculum development as well as the implementation of the Physical Science syllabi. Hence your contribution will be beneficial to this study.

## **1.14 What will be expected of you?**

As a participant in this study, you will be expected to cooperate, within the limits of your discretion, with the requirements of this study. The researcher intends to conduct a one-

on-one interview with you that will dwell on climate change in Physical Science and any other related areas that are pertinent to this study. However, at no point in the interviews will the researcher request information that is beyond your scope or expertise.

**1.15 Will you gain anything from taking part in this research?**

No direct, personal benefits will be accrued by you in this study. However, the basic education fraternity and society at large will benefit from this study.

**1.16 Are there risks involved in you taking part in this research and what will be done to prevent them?**

At this point, it can be stated with considerable confidence that the study does not pose any discernible risks to you.

**1.17 How will your confidentiality be protected?**

Information gathered from this study will only be used for academic purposes. Your personal contribution will not be divulged and made public. All the participants' contributions will be pooled together to avoid any individual being personally identified with the information he/she provides. Your privacy will be respected by ensuring that the information provided will only be used for this study's purpose and access will be limited only to the study leader (supervisor) and the Master student (researcher). Only the researcher and the study supervisor will be able to look at your contribution. Findings will be kept safe by locking hard copies in locked cupboards in the study supervisor's office and for electronic data it will be password protected. Data will be stored for five (5) years as required by the North-West University.

**1.7 What will happen to the findings or samples?**

The findings of this study will only be used for academic purposes. The results will be presented in the form of a master's degree dissertation. Together with my supervisor I will publish findings of this study in an academic journal. Thus, as stated above, the information sought in this study is for academic purposes and it will be shared with the Namibian Ministry of Education to promote change in the Namibian Physical Science Syllabus. Under no circumstances will the information be used for commercial purposes.

**1.11 How will you know about the results of this research?**

The results will be made available when the researcher has completed the study. It is envisaged that the study will be completed before December 2018. The researcher pledges to inform the participants about the findings that will be derived from this study by means of a summary and presentation at a circuit meeting in 2019.

**1.12 Is there anything that you need to know or say?**

You can contact the researcher, Wilhelmine Ndapewa Iiping, on the contact details provided above if you have any further questions or have any problems. You can also contact my supervisor, Dr Luiza de Sousa, at [Luiza.desousa@nwu.ac.za](mailto:Luiza.desousa@nwu.ac.za) or +2718 299 4727.

You can also contact the Education, Management, Humanities and Social Sciences Research Ethics Committee (EMHS-REC) via Miss Jessica Mabaso at 018 299 4707 or [Ethics-EMHS@nwu.ac.za](mailto:Ethics-EMHS@nwu.ac.za) if you have any concerns that were not answered about the research or if you have complaints about the research.

**1.13 Declaration by the participant**

By signing below, I ..... agree to take part in the research study titled The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education.

**I declare that:**

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be treated in a negative way if I do so.

- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (place)..... On  
 (date)..... 20.....

.....  
**Signature of participant**

**Signature of witness**

**1.9.1 Declaration by person obtaining consent**

I (name).....declare that:

- I clearly and in detail explained the information in this document to .....
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above.
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....  
**Signature of person obtaining consent**

**Signature of witness**

**1.9.2 Declaration by researcher**

I (name)..... declare that:

- I explained the information in this document to .....  
or has it explained by..... who I trained for this  
purpose.
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them or I was  
available should he/she want to ask any further questions.
- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as  
described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (place).....on (date).....20.....

.....

**Signature of researcher**

**Signature of witness**

Addendum L: Language editor

*Rita van Wyk*

*Language Practitioner*

*Afrikaans – English / English – Afrikaans*

084 5484177

*rieviera@mweb.co.za*



## DECLARATION

12 November 2018

I herewith declare that I was responsible for the language editing of the M.Ed dissertation:

The integration of climate change in the Namibian senior secondary Physical Science syllabus through environmental education, by Ms WN Ipinge.

*M J VAN WYK*

BA (Unisa)  
Advanced Dipl in Translation and Interpreting Cum Laude (UFS)  
Accredited member of the SA Translators' Institute

